Application: A.25-12-019
Exhibit No.: _____
Witness: Jennifer L. Walker, David M. Mercer, Amy D. Vulin, Linden S. Olah

(PUBLIC)

PREPARED SUPPLEMENTAL TESTIMONY OF JENNIFER L. WALKER, DAVID M. MERCER, AMY D. VULIN, AND LINDEN S. OLAH ON BEHALF OF SOUTHERN CALIFORNIA GAS COMPANY

(CHAPTER VI)

October 5, 2026

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PREPARED SUPPLEMENTAL TESTIMONY OF JENNIFER L. WALKER, DAVID M. MERCER, AMY D. VULIN, AND LINDEN S. OLAH

I. INTRODUCTION

Pursuant to the Assigned Commissioner's Scoping Memo and Ruling (Scoping Memo), dated August 20, 2026, Southern California Gas Company (SoCalGas) submits this supplemental testimony regarding Application A.25-12-019 (Application). The Application seeks authorization to implement a revenue requirement for the Advanced Meter Infrastructure Replacement (AMIR) Project—a planned, systemwide replacement of SoCalGas's Advanced Meter Infrastructure (AMI) system. The replacement is necessitated by the legacy system's expected end-of-life, including the manufacturer's discontinuation of support and projected significant module battery failures beginning in 2030.

The AMI system is the backbone of SoCalGas's meter-to-cash process, enabling accurate usage measurement and billing for more than six million customer meters. Without AMI, usage would need to be collected manually, increasing costs significantly and increasing the risk of delayed billing, estimated bills, and billing exceptions. AMI also supports SoCalGas's ability to provide safe, reliable, and affordable service, including operational visibility, demand forecasting, core balancing, customer conservation, and emergency response, while reducing field exposure and vehicle miles traveled. The AMIR Project represents the most prudent and cost-effective path to maintaining these essential capabilities and avoiding a costly and inefficient return to manual meter reading or a reactive system replacement.

In this supplemental testimony, SoCalGas provides responses to the questions set forth in the Scoping Memo, further explaining the need for timely, coordinated replacement of the legacy AMI system; the projected module failures and alternatives considered; the costs and operational impacts of manual meter reading; and the technology, cybersecurity, communications, and workforce considerations associated with implementation.

II. SUPPLEMENTAL TESTIMONY ADDRESSING SCOPING MEMO QUESTIONS

A. Responses to Scoping Memo Questions

1.1 Please provide the meter communication module end of life analysis supporting this expectation that significant battery failures will begin in 2030.

In April 2025, SoCalGas engaged Exponent to refresh the module end of life analysis and validate findings previously performed by Bridgewater Consulting Group (Bridgewater) in 2021. As indicated in SoCalGas's direct testimony,[1] the Exponent end of life analysis (Exponent Analysis), provided in Attachment A, confirmed the critical failure timeline identified in the Bridgewater end of life analysis (Bridgewater Analysis), provided in Attachments B and C, and indicated a slightly earlier acceleration in the failure rate. The Exponent Analysis was informed by historical module failure data collected by SoCalGas and confirmed that failure rates are increasing to levels that are unsustainable for SoCalGas's existing workforce to remediate without leading to major impacts to SoCalGas's billing and meter-to-cash functions and its ability to maintain safe, reliable, and affordable service beyond year 2030.

The Exponent Analysis, which supports the Application, evaluated AMI module design, historical failure data, physical failure analyses of returned field units, enclosure material performance, and battery reliability modeling. Exponent assessed the condition and expected lifespan of critical components such as batteries and enclosures, analyzed trends across the installed meter population, and developed forecasts of future AMI module failures. Exponent delivered a report that summarizes the study's scope, methodologies, key findings, and conclusions, as well as a statistical reliability model used to forecast future AMI module and projected failure rates.

1.2 Provide documentation from vendors that supporting components will become obsolete or must be replaced to maintain compatibility and support evolving cybersecurity.

a) Obsolescence

(1) Hardware Obsolescence

Pursuant to Schedule C, Section 2.1.1 (c) of the current contract between SoCalGas and Aclara, referred to as the Third Amended and Restated AMI Equipment, Software and Services

[1] Prepared Direct Testimony of David M. Mercer, Chapter II – Business Case, on behalf of SoCalGas (December 30, 2025) (SoCalGas Chapter II) at DMM-2.

Agreement, provided in Attachment D, legacy AMI modules will not be available from the current AMI vendor (Aclara) after mid-2031, beyond that required to fulfill warranty obligations. The contract states that Aclara agrees to provide equipment for a period of twenty years following the Effective Date, defined as June 1, 2011. In addition, a communication from the vendor in March 2026, provided in Attachment E, demonstrates that Aclara plans to transition its customer base from legacy modules (the Series 3000 modules) to its newer generation products over the next five years, targeting end of life for Series 3000 by mid-2031.

(2) Systems Obsolescence

Pursuant to Section 2, Commencement and Completion of Services, of the Third Amended and Restated AMI Equipment, Software and Services Agreement, provided in Attachment F, legacy AMI services, including warranty support for modules, the HeadEnd system,[2] and Meter Data Management (MDM) system,[3] ends on February 11, 2039, which results in 2038 as the final full calendar year of support. Within the active contract, SoCalGas works with the current vendor to resolve defects and cybersecurity vulnerabilities. Should the current contract expire before complete AMI system replacement is achieved, SoCalGas would be vulnerable to security risks and operational impacts from a lack of software support and equipment availability.

b) Compatibility

The vendor's System Capabilities summary, provided in Attachment G, indicates the current HeadEnd system is not forward compatible with the vendor's next generation modules or ultrasonic meters.[4] Additionally, the existing MDM platform utilizes a tightly integrated, proprietary architecture designed specifically for the current HeadEnd system. As a result, implementation of a new HeadEnd System would also require replacement of the MDM platform.

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[2] The HeadEnd system (or "system brain") manages the Endpoints and Communication Network. Its primary functions include encrypting and decrypting data, collecting and processing endpoint data, handling usage requests, and managing field assets (e.g., performing firmware updates).

[3] The Meter Data Management system (or "system storage") functions as the official system of record for AMI metering data, receiving usage information from the HeadEnd system. It performs validations, identifies missing reads and estimates usage, and supports billing.

[4] Note "NCC" is the vendor terminology for the current HeadEnd system and "DCU II/II+" indicates the current NCDs.

The System Capabilities summary also states the existing Network Control Devices (NCDs) can provide connectivity to the vendor's next-generation modules. However, as shown, this support is subject to network capacity constraints and does not provide robust two-way communication capabilities. The capacity limitations would prevent increasing the meter data collection frequency across the full customer base, limiting both customers' access to more timely hourly usage information and SoCalGas's ability to identify potential service outages or usage abnormalities more quickly. The lack of reliable two-way communication prevents the implementation of on-demand readings, remote firmware updates, over-the-air configuration changes, and the future capability to initiate remote valve control for ultrasonic meters.

c) Cybersecurity

The System Capabilities summary also indicates that neither the current HeadEnd system nor the existing NCDs support modern cybersecurity standards. As a result, SoCalGas would be unable to implement several industry-standard security enhancements. These enhancements include strengthened encryption capabilities to protect against malicious interception of transmissions as computing power continues to advance over the devices' expected 20-year service life. Another cybersecurity enhancement is bi-directional message authentication, which verifies the identity of communicating devices and confirms that messages have not been modified in transit. Further details regarding these cybersecurity enhancements are provided in the response to Question 1.4.

1.3 Provide the warranties relating to any module elements that are now expected to fail prior to their expected 20 year life, along with an analysis of how vendors will be held responsible for replacement of those elements.

SoCalGas's existing AMI modules are covered by a contractual warranty with Aclara, the module manufacturer.[5] Schedule K – Warranties, is provided in Attachment H. AMI Series 3000 modules represent the overwhelming majority of modules in service,[6] and their warranty provides a Parts Credit (i.e., the cost required to replace a failed module) and Labor Reimbursement (i.e., the labor cost required to replace a failed module) for qualifying module

[5] Refer to Attachment H.

[6] Note that, of the 6.3 million modules, only 3,200 are Series 4000. Series 4000 modules are used on commercial meters' EVCs and pipeline pressure monitoring EPMs.

failures during the warranty period. The following describes the applicable warranty terms, SoCalGas's warranty coverage by Installation Class, and how failures are addressed under the Aclara agreement.

a) Applicable Warranty Coverage

Existing AMI modules are eligible for warranty coverage if they meet applicable Warranty Failure criteria as described in Schedule K, Section 1(a)(vii). Warranty coverage is dependent on whether the module meets the contractual requirements specified at the time it is removed from service.

AMI Series 3000 modules were purchased with a 20-year warranty.[7] Within the 20-year Warranty Period, the remedies include a Parts Credit and/or a Labor Reimbursement. Specifically, as shown in Table 1, during the initial Warranty Period (years 1-15, "Standard Warranty Period"), coverage is 100% for Parts Credit, with 100% Labor Reimbursement available for qualifying Warranty Failures. In years 16 through 20 ("Additional Coverage Period"), coverage declines over time, with reduced Parts Credit and no Labor Reimbursement, as shown in Table 1 below, as well as in Schedule K, Section 2.1(f)(iii).

Table 1 – Parts Credit and Labor Reimbursement for Series 3000 MTUs by Module Age

Module Age	Parts Credit	Labor Reimbursement
Years 1-15	Standard Warranty	Standard Warranty
Year 16	25% of Standard Warranty	N/A
Year 17	20% of Standard Warranty	N/A
Year 18	15% of Standard Warranty	N/A
Year 19	10% of Standard Warranty	N/A
Year 20	5% of Standard Warranty	N/A

Per Schedule K, Section 2.1(f), SoCalGas may elect to extend the duration of the Standard Warranty Period, beginning in year 16 onwards, of full recovery of both Parts Credits and Labor Reimbursements (Extended Warranty Coverage). Based on the findings of the Bridgewater Analysis,[8] SoCalGas purchased Extended Warranty Coverage for Installation Classes 2012, 2013, and 2014 due to increasing failure rates forecasted in the later years of module life. Extended Warranty Coverage was determined to be the most prudent approach to

[7] *Id.* (Schedule K, Section 2.1(b)).

[8] Refer to Attachment B and Attachment C.

manage expected failures and associated costs at the time those decisions were made, given that the AMIR Project had not yet been developed.

SoCalGas has not purchased Extended Warranty Coverage for Installation Class 2015, 2016, 2017, and 2018. Based on the planned AMIR Project deployment schedule to replace modules prior to module end of life or obsolescence, a significant component of the system (HeadEnd) will be in place in 2029, at which point failed modules will be replaced with AMIR modules rather than legacy modules. Accordingly, SoCalGas determined that incurring additional warranty costs for those installation classes was not prudent.

Table 2 below provides a forward-looking estimate of the existing AMI modules that may remain under applicable warranty coverage by year. Because the estimate depends on current deployment assumptions, projected failure timing, and applicable warranty terms, actual warranty eligibility will be determined at the time each module is removed from service and evaluated under the contract. As described below, SoCalGas will continue to administer a robust warranty management process to pursue available remedies for qualifying legacy warranty failures.

Table 2 – Exponent Projected Failures Count with and without Warranty from 2026-2040

Installation Class	PROJECTED FAILURES														
	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
2012	184	204	300	655	1,548	3,013	4,382	4,630	3,555	914					
2013	8,358	8,673	10,295	17,480	40,268	89,445	157,086	204,876	193,162	125,625	10,250				
2014	17,864	18,058	18,807	22,686	38,615	85,012	176,663	290,386	344,927	291,722	164,842	4,914			
2015	15,872	15,995	16,174	16,822	20,180	34,224	75,964	160,263	267,862	324,296	282,622	157,598	5,743		
2016	14,714	14,801	14,888	15,033	15,667	18,973	32,184	69,244	139,142	220,489	236,506	189,038	82,662	549	
2017	3,388	3,402	3,414	3,427	3,454	3,595	4,320	7,042	14,178	26,718	40,096	33,475	25,997	10,536	67
2018	2,568	2,579	2,588	2,596	2,603	2,616	2,690	3,087	4,653	8,969	16,961	25,982	21,234	14,691	6,590
2019	2,169	2,179	2,188	2,195	2,200	2,206	2,218	2,286	2,648	4,035	7,730	14,320	20,978	14,361	10,555
2020	2,983	2,997	3,008	3,016	3,022	3,026	3,028	3,039	3,123	3,568	5,223	9,425	16,449	21,910	6,845
2021	3,231	3,250	3,265	3,277	3,285	3,290	3,293	3,295	3,306	3,395	3,869	5,610	9,961	17,083	20,809
2022	3,351	3,377	3,398	3,414	3,425	3,434	3,439	3,442	3,444	3,456	3,551	4,059	5,902	10,464	17,838
2023	3,773	3,812	3,842	3,866	3,884	3,897	3,907	3,913	3,917	3,919	3,932	4,040	4,615	6,709	11,898
2024	3,693	3,742	3,781	3,811	3,835	3,853	3,866	3,876	3,883	3,886	3,889	3,903	4,016	4,608	6,743
Total	82,148	83,069	85,948	98,278	141,986	256,584	473,040	759,379	987,800	1,020,992	779,471	452,364	197,557	100,911	81,345
Under Warranty	82,148	83,069	85,948	98,278	121,806	110,929	22,441	19,851	17,673	14,656	11,372	7,943	4,016	-	-
Not Covered	-	-	-	-	20,180	145,655	450,599	739,528	970,127	1,006,336	768,099	444,421	193,541	100,911	81,345

= entire year under warranty

b) Warranty Administration and Vendor Recovery

SoCalGas follows a contractually defined warranty recovery process, provided in Attachment I,[9] that identifies eligible warranty failures and submits them to Aclara for the

[9] Attachment I provides additional details on the failure processing procedures between SoCalGas and Aclara.

applicable contractual remedies. Both Aclara and SoCalGas follow an end-to-end warranty administration process for modules removed from the field. That process tracks each module by serial number, records the applicable error or Return Material Authorization (RMA) code, and uses the supporting removal information to determine whether the module satisfies the contractual criteria for a warranty failure. Qualifying failures are then processed and submitted to Aclara for the applicable contractual remedy, including parts credit and labor reimbursement where available. Through this process, the manufacturer is responsible for eligible module failures. In accordance with SoCalGas's Core Fixed Cost Account (CFCA) tariff,[10] SoCalGas records to the CFCA any Labor Reimbursements received from the vendor in order to refund these amounts directly back to core customers.

During the warranty period, warranty coverage helps offset costs associated with qualifying failures; however, it does not provide a substitute for a planned systemwide replacement. The warranty process applies only after modules are removed from service and determined to meet contractual Warranty Failure criteria; it does not avoid the operational impacts of increasing failures, nor does it provide the new HeadEnd, MDM integration, cybersecurity, and future endpoint capabilities addressed by the AMIR Project.

1.4 Please provide studies supporting this statement that the AMIR Project will provide enhanced cybersecurity, more frequent meter data collection, and integration of ultrasonic meters (USMs) with remote valve control and residential methane detectors.

The AMIR Project is currently in an open solicitation process to select a new AMI vendor. As part of this solicitation, SoCalGas is seeking solutions from the marketplace that implement modern cybersecurity protocols, transmit meter data more frequently, and support compatibility with future endpoint technologies. The AMI Vendor request for proposal (RFP) includes detailed requirements to confirm those capabilities are supported by the selected vendor. Vendors in the RFP process meet these requirements. The relevant RFP requirements and associated capabilities are provided in Attachment J and summarized below.

[10] SoCalGas Preliminary Statement - Part V - Balancing Accounts Core Fixed Cost Account (CFCA) (Effective August 1, 2024), *available at:* https://tariffsprd.socalgas.com/view/tariff/?utilId=SCG&bookId=GAS&tarfKey=329.

a) Cybersecurity Enhancements[11]

AMIR modules will provide extended and enhanced encryption as well as device message authentication capabilities. Encryption will be improved from AES-128[12] to AES-256 to protect module transmissions against malicious interceptions facilitated by advances in computing power throughout the device's expected 20-year service life. The substantial increase in key size enabled by AES-256 provides a greater security margin against advances in quantum computing. In addition, encryption will be extended to all module communications including alarms and over-the-air commands. This comprehensive protection helps prevent unauthorized parties from monitoring network traffic, analyzing communication patterns, or attempting to reverse engineer operational commands over time.

Although not available in the legacy system, the AMIR system will support bi-directional device message authentication, which verifies the identity of communicating devices and confirms that messages have not been modified in transit. It also provides protection against replay attacks by preventing previously transmitted messages from being reused by unauthorized parties.

The new NCDs will further strengthen security through expanded use of encryption and improved physical access controls. All communications originating from an NCD, including transmissions to modules and other NCDs, will be encrypted. This helps protect network management functions and time synchronization communications from interception, tampering, or unauthorized access. Physical security will be strengthened through the implementation of role-based authentication across all NCDs, while retaining the hardened enclosures and door alarm protections currently in place.

b) More Frequent Meter Data Collection[13]

AMIR modules will transmit data more frequently than the current standard of four times per day. This increased transmission frequency provides meaningful benefits to both customers

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[11] Refer to Attachment J, Sections 3.5, 4.17, 4.18, and 4.20, for the RFP requirements and associated capabilities related to cybersecurity enhancements.

[12] AES (Advanced Encryption Standard) is a widely used encryption algorithm designed to protect digital data. AES was adopted as a U.S. federal standard by the National Institute of Standards and Technology (NIST) and is now used globally to secure data.

[13] Refer to Attachment J, Sections 1.1, 3.18, 4.1, and 5.1, for the RFP requirements and associated capabilities related to more frequent meter data collection.

and SoCalGas. Customers can gain more timely access to hourly usage information through the customer portal, enabling them to identify abnormal consumption trends and take corrective action sooner. SoCalGas will also leverage this enhanced visibility to more quickly detect potential service outages and verify service restoration.

c) Future Endpoint Technologies[14,15]

While the AMIR Project does not include deployment of ultrasonic meters (USMs), the solution will support the ability to integrate those devices. USMs, which are installed downstream of the customers' regulator, have the ability to transmit meter data, gas pressure and temperature, alarms, and device health over the AMIR network and will include the ability to perform remote valve shut-off through over-the-air command. SoCalGas is currently conducting a USM field pilot at selected locations to evaluate the technology and its operational capabilities. Additional information on SoCalGas's field pilot of USMs is provided in the response to Question 1.6.

The AMIR Project also enables the future deployment of residential methane detectors (RMDs). These devices have the ability to leverage the AMIR communications network to transmit methane readings and alarm notifications, supporting enhanced safety monitoring capabilities, as described in Attachment K which provides an overview of RMD capabilities. Additional information on the SoCalGas RMD field pilot is provided in the response to Question 1.5.

1.5 Provide studies of the ability of USMs to detect methane leaks, and whether they are able to detect where the methane leak is located, i.e., within or outside the residence.

The replacement HeadEnd system will provide support for new endpoint technologies such as ultrasonic meters with remote valve control and residential methane detectors.[16]

USMs do not independently detect methane emissions through chemical sensing. USMs provide operational data including hourly usage, pressure, temperature, flow, meter health,

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[14] Refer to Attachment J, Sections 3.9, 3.13, 4.1, 5.1, 5.3, and 10.2, for the relevant RFP requirements and associated capabilities related to the residential USM future endpoint technology.

[15] Refer to Attachment J, Sections 3.9, 4.1, and 10.2, for the relevant RFP requirements and associated capabilities related to the RMD future endpoint technology.

[16] Revised Prepared Direct Testimony of Amy D. Vulin, Chapter III – Technology, on behalf of SoCalGas (July 2, 2026) (SoCalGas Chapter III) at ADV-5.

communication health, and alarms that can identify abnormal flow conditions potentially indicating a leak. USMs also incorporate meter valve control capability, enabling SoCalGas to remotely shut off gas flow to a residence without dispatching a field technician. SoCalGas is currently conducting a field pilot of residential USMs. The focus of that pilot is meter accuracy, data communications, and integration with SoCalGas systems. That effort is further described in the response to Question 1.6.

SoCalGas also executed an RMD field pilot with the objective of identifying leaks in air-flow-constricted areas. Traditional leak detection largely relies on customer reporting, routine inspections, or field observations. Certain meter locations, such as basements, closet cabinets, garages, and porches and decks can limit natural airflow and potentially allow methane to accumulate before a leak is detected. The RMD field pilot explored whether permanently installed methane sensors could provide continuous monitoring of these environments and automatically notify SoCalGas when elevated methane levels were detected.

The RMD field pilot partnered with a third-party company specializing in gas detection and air quality products, to develop methane sensors for a small-scale evaluation. The solution for the pilot used:

- Methane sensors installed near residential meters
- Bluetooth Low Energy (BLE) communications between the methane sensor and communication devices
- The cloud-hosted platform to receive and process sensor data
- Automated interfaces into SoCalGas systems to generate investigation work orders when methane thresholds were exceeded

The pilot alarm threshold was established at 10% of the Lower Explosive Limit (LEL), approximately 4,500 parts per million (ppm) methane. This setting enabled methane detection at levels significantly below combustible concentrations and below levels detectable by smell. The RMD pilot demonstrated the technology's ability to detect methane and trigger alarms in its installed sites.

1.6 Is SoCalGas conducting any pilot studies of USMs, and if so, in which area(s) of its service territory?

a) USM Pilot

As explained in the response to Question 1.5, SoCalGas is currently conducting a field pilot of residential USMs,[17] at select residential and company facility locations. The scope of the pilot is limited to "size 1" meters which generally support flow rates up to 250 Cubic Feet per Hour (CFH). The meters provide hourly usage and operational data including pressure, temperature, flow, device health, communication health, and alarms. The data is collected via cellular network and stored in a third-party HeadEnd system. The meter data received from this pilot is successfully being integrated into the existing MDM system, used to generate customer bills, and is available for review in the customer portal and data warehouse systems.[18]

b) Areas of Service Territory

Ultrasonic meters installed under the pilot program were installed at four residences within the Downey field district and at branch offices in Huntington Park, Glendale, and East Hollywood.

1.7 How many temporary regional warehouses will be established and where will they be located?

The AMIR warehouse schedule, shown in Table 3, was developed using the original AMI deployment sequence, warehouse locations, and warehouse operating schedules as key planning inputs. Because AMIR deployment activities are intended to prioritize replacement of the oldest communication modules first, which are also expected to have the highest probability of battery failure, the geographic progression and timing of warehouse activation generally follow the original AMI deployment pattern. This approach enables the availability of installation resources to support replacement activities in areas where module failures are expected to occur earliest. As a result, the timing of warehouse activation and deactivation, as well as the duration each warehouse remains operational, closely mirrors the original AMI deployment warehouse schedule, with only minor adjustments made to reflect current deployment planning assumptions.

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[17] Refer to Attachment L which provides an overview of USM capabilities and benefits.

[18] This limited pilot did not leverage the AMI communications network or the current HeadEnd system. A large-scale deployment would require the USM integration capabilities proposed by the AMIR Project.

Table 3 – AMIR Warehouses (Location & Estimated Cost)

Warehouse Location	Start	End	2029	2030	2031	2032	2033	2034	Estimated Cost (in $000s)
South Gate	Oct-29	Sep-33							1,759.69
El Centro	Feb-30	May-30							112.32
Irwindale	Mar-30	Oct-31							711.36
Sun Valley	Apr-30	Aug-32							1,048.33
Bakersfield	Apr-30	Nov-31							673.92
Indio	May-30	Nov-30							224.64
Northridge	Jun-30	Sep-32							1,010.89
Valencia	Aug-30	Jun-32							823.69
Visalia	Nov-30	Jul-31							299.52
Hemet	Dec-30	Aug-31							299.52
Perris	Dec-30	Feb-32							524.16
Los Angeles	Jan-31	Jan-34							1,347.85
Anaheim	Feb-31	Jan-34							1,310.41
Mission Viejo	Sep-31	Jun-32							336.96
Chino	Nov-31	Aug-32							336.96
Oxnard	Jul-32	Feb-33							262.08
San Bernardino	Sep-32	Apr-33							262.08
Santa Monica	Oct-32	Jun-33							299.52
Santa Barbara	Mar-33	Aug-33							224.64
Nipomo	Mar-33	Sep-33							262.08

a) Warehouse Count

For planning purposes, the program has forecasted the use of approximately 20 warehouse locations across the SoCalGas service territory over the course of the AMIR Project deployment.

b) Warehouse Location

The cities identified in the warehouse schedule represent approximate geographic locations intended to illustrate the planned coverage areas and deployment sequence. These locations should not be interpreted as final facility selections, and actual warehouse sites may ultimately be located in nearby cities or alternative locations that best meet operational, logistical, and real estate requirements.

1.8 What is the cost of each warehouse?

The estimated cost of each warehouse is expected to vary based on several factors, including geographic location, facility size, local market lease rates, and the duration for which the warehouse remains operational. Warehouses supporting larger deployment regions or areas with higher real estate and operating costs may require higher investment levels than facilities in other portions of the service territory. In addition, warehouse durations differ based on the deployment sequence and the length of time required to support field activities within a given region, which further contributes to cost variability between locations.

The warehouse costs shown in Table 3 (see the response to Question 1.7) were developed by applying an estimated average monthly warehouse cost to the planned operating duration of each facility. The estimated monthly cost includes facility lease expenses as well as associated operating costs such as permitting, utilities, janitorial services, and other routine facility-related expenses necessary to maintain warehouse operations. Total warehouse cost for each location is calculated by multiplying the estimated monthly cost by the number of months the warehouse is expected to remain active in support of AMIR Project deployment activities. Accordingly, warehouse locations with longer operating durations or larger facility requirements generally result in higher total costs than locations that are active for shorter periods of time.

The warehouse cost estimates are intended for planning and forecasting purposes and represent estimates based on currently available assumptions. Actual warehouse costs may vary depending on final site selection, prevailing market conditions, lease negotiations, permitting requirements, and operational needs at the time each facility is established.

1.9.1 Please provide information as to when and where the current AMI system has identified leaks and localized pressure points and has supported emergency response.

a) Abnormal Gas Consumption Process – Advanced Meter Detection (AMD)

An operational use of AMI data is to identify abnormal gas consumption that may warrant additional review. An AMD indication is not, by itself, confirmation of a gas leak or unsafe condition. The process applies established screening and response criteria to determine whether customer outreach, further evaluation, or field investigation is appropriate. Through SoCalGas's AMD process, interval consumption data is analyzed to identify conditions warranting potential customer outreach or field investigation, examples of situations found are:

- Gas leaks on customer-owned piping and equipment
- Appliances unintentionally left operating
- Hot water leaks causing continuous water heater operation
- Excessive registration conditions
- Continuous gas usage at vacant facilities
- Open valves, vandalism, or other abnormal situations

When such conditions are identified by AMD, SoCalGas may conduct customer outreach or initiate field investigations. The customer outreach process includes direct customer contact

to investigate hot water leaks, appliances unintentionally left operating, or other abnormal usage conditions. When safety concerns or other operational factors warrant field verification, AMD investigations may be initiated to determine the cause of the abnormal consumption and take appropriate corrective action.

From January 2018 to July 2026, SoCalGas issued nearly 74,000 orders to investigate abnormal consumption through the AMD field process across the service territory. See Table 4 for the approximate number of year-over-year quantities of abnormal gas consumption orders identified through the AMD program, and Table 5 for the number of orders by SoCalGas District. Table 6 provides a summary of orders to investigate abnormal gas consumption in July 2026.

Table 4 – Approximate Number of Orders to Investigate Abnormal Gas Consumption from 2018 through July 2026

Year	# of Orders
2018	4,952
2019	5,797
2020	3,652
2021	7,792
2022	10,582
2023	12,266
2024	12,429
2025	11,605
2026*	4,715
Grand Total	**73,790**

*2026 count is for January – July 2026

Table 5 – Approximate Number of Orders to Investigate Abnormal Gas Consumption from January to July 2026 by SoCalGas District

SoCalGas District	Count of Orders
Alhambra	74
Anaheim	70
Antelope Valley	191
Azusa	87
Bakersfield	100
Beaumont	42
Belvedere	60
Blythe	2
Branford	103
Canoga	188
Chino	136
Compton	109
Corona	127
Crenshaw	71
Downey	57
El Centro	23
Fontana	80
Garden Grove	131
Glendale	84
Hanford	48
Hollywood	199
Huntington Park	67
Industry	77
Juanita	71
La Jolla	84
Mission Viejo	215
Murrieta	128
Palm Desert	212
Pasadena	77
Porterville	33
Ramona	116
Redondo Beach	78
Rim Forest	87
Riverside	72
San Bernardino	121
San Luis	23
San Pedro	84
Santa Ana	164
Santa Barbara	51
Santa Maria	43
Santa Monica	223
Saticoy	150
Simi	127
Templeton	12
Valencia	51
Ventura	63
Visalia	102
Whittier	66
Wrightwood	9
Yucca Valley	16
Yukon	111
Grand Total	**4,715**

Table 6 – July 2026 AMDs by Category[19]

Orders	Category	Customer Services Field Operations – Findings / Results
13	**A1 Orders**	• (7) Yardline leak • (2) Houseline leak • (1) Outdoor appliance left on • (1) Spa heater in use • (1) Consumption returned to normal prior to employee arrival • (1) Consumption returned to normal after restore
334	**Gas Leak**	• (127) Yardline leak • (126) Houseline leak • (27) BBQ left on • (23) Appliance/connector leaking • (22) Fireplace left on • (7) Outdoor appliance left on • (1) MSA leak • (1) Range top burners left on
157	**Hot Water Leak**	• (157) Suspected hot water leaks
82	**Customer Corrected**	• (35) Field employee did not determine the cause of high continuous consumption, but obtained a good registration/clock test • (25) Field employee found excessive registration and meter left off; consumption returned to normal after restore • (22) Consumption returned to normal prior to CSF employee arrival
130	**Appliance Left On or In Use**	• (90) BBQ in use • (16) Forced air unit malfunction • (6) Circulating pump in use • (4) Fireplace in use • (4) Generator in use • (2) Heater in use • (2) Multiple pilots on appliances • (2) Gas lamps in use • (1) Boiler in use • (1) Pool heater in use • (1) Outdoor appliances in use • (1) Spa heater in use
29	**Excessive Registration**	• (29) Meter was closed due to excessive registration; meter remains off
51	**Vacant Facilities**	• (51) Orders completed at vacant facilities where high continuous consumption was stopped
1	**Meter Closed for Diversion**	• (1) Facility was off for non-payment, bills had not been paid, gas was turned back on by the customer, and abnormal constant usage occurred for a minimum of 24 consecutive hours
Total: 797 (July 2026 Data)		

b) Localized Pressure Points

Electronic Pressure Monitors (EPMs) are critical field devices used to monitor pressure conditions across the natural gas distribution system. These devices are installed throughout the service territory at key pipeline locations, regulator stations, supply points, and pressure district

[19] Total excludes orders that required follow-up, such as those involving access issues.

boundaries to provide operational visibility into the distribution network. Each EPM is directly connected to a natural gas pipeline and measures system pressure. The vast majority of EPMs communicate through SoCalGas's AMI communication network.

Pressure readings and alarm notifications are transmitted from the field through the communication network to the HeadEnd system, where the data is processed, monitored, and made available to operational personnel. This architecture enables centralized monitoring of pressure conditions across the gas distribution system.

When an EPM detects an abnormal pressure condition, such as an over-pressure or under-pressure event, the device generates an alarm that is communicated through the AMI network to system operators. During the event, the EPM continues to transmit updated pressure measurements, providing visibility into changing field conditions and supporting operational assessment and response.

In addition to supporting routine system operations, EPMs play an important role in emergency response activities. Near real-time alarm notifications and pressure data provide operators with rapid awareness of abnormal pipeline conditions, allowing personnel to identify affected areas, assess the severity of an event, and prioritize field response activities. The ability to monitor pressure conditions remotely through the AMI network enhances coordination between gas control, gas engineering, and field operations personnel during emergency situations and supports responses to potential threats to system integrity and public safety.

The current AMI system has identified thousands of localized pressure events through its EPM network. Since 2017, approximately 30,000 alarms have been generated and processed through EPM infrastructure across more than 2,000 locations (as of 2026) within SoCalGas's service territory, as shown in Table 7. These alarm counts include operational alarms, troubleshooting and diagnostic activities, as well as annual inspection and validation events that confirm EPM equipment, communications systems, and associated network infrastructure are functioning as designed.

Table 7 – Location of Localized Pressure Points by Measurement & Regulation (M&R) District (As of 2026)

SoCalGas M&R District	Count of Localized Pressure Points
Anaheim	284
Azusa	63
Bakersfield	124
Compton	178
El Centro	39
Fontana	248
Glendale	62
Industry	86
Juanita	130
Lancaster	106
Oxnard	99
Palm Desert	121
Ramona	142
Saticoy	137
Santa Barbara	22
San Luis Obispo	98
Santa Monica	76
Visalia	246
Grand Total	**2,261**

c) Emergency Response

AMI data supports emergency response and incident management. Emergency incidents may include, for example, mudslides, extreme snow events, pressure situations, water intrusion incidents, land movement events, and other situations impacting gas service. During emergency incidents, AMI data can allow SoCalGas to remotely determine whether gas is flowing to customers in affected areas and monitor how usage changes. This situational awareness helps support emergency response, including local emergency responders (e.g., fire and police personnel), and assist restoration once conditions stabilize.

For example, the 2023 Rim Forest incident was an extreme snow event that buried and damaged gas equipment. AMI data helped identify facilities with sustained abnormal gas usage, indicating open lines or other hazardous conditions, enabling personnel to prioritize response efforts. As another example, the 2024 Rancho Palos Verdes incident was a land movement event that caused homes to separate from stationary utilities. During this event, AMD consumption

monitoring was used for facilities impacted by land movement, using gas-usage to identify potential concerns and to support targeted field follow-up.

1.10.1 Provide information showing that the replacement of the HeadEnd System will enable on-demand meter reads outside the regular collections schedule.

The AMIR Project is currently in an open solicitation process to select an AMI vendor. As part of the AMI Vendor request for information (RFI), SoCalGas determined on-demand meter read capability is commonly available within the marketplace. Therefore, the AMI Vendor RFP includes requirements to confirm those capabilities are supported by the selected vendor and subsequently implemented by the AMIR Project, as listed in Attachment J[20] and summarized below.

Those requirements address the end-to-end success of read collection outside the standard data transmission cycle. The HeadEnd application will support collection of on-demand reads initiated through over-the-air commands. Modules will provide a minimum threshold of on-demand reads annually without impacting long-term battery life while also confirming the reads have a greater than 99% success rate. In addition, the tools used by field technicians will be able to collect on-demand reads.

1.9.2 Please explain if it's the communication system's upgrade or the modules themselves that will enable the enhanced cybersecurity features.

As part of the current open solicitation to select a new AMI vendor, SoCalGas is seeking solutions from the marketplace that improve cybersecurity features in both the module and communication network.

For information on cybersecurity enhancements for the module and communication network, see the responses to Question 1.4 and Question 1.10.2.

1.10.2 What parts of the AMI system will they protect?

Each of the cybersecurity features protects the AMI system components in a distinctive manner.

[20] Refer to Attachment J, Sections 4.1, 8.1, and 10.2, for the relevant RFP requirements and associated capabilities related to on-demand meter reads.

- The upgrade to AES-256 encryption safeguards all aspects of the AMI system by providing a greater security margin against malicious interceptions facilitated by advances in computing power.
- The extension of encryption to alarms, over-the-air commands, and NCD-initiated communications prevents these transmissions from being monitored, analyzed, or reverse engineered by unauthorized parties. This protects communication exchanges between modules, NCDs, and the HeadEnd system.
- Device message authentication similarly protects multiple AMI components by ensuring messages between the modules, NCDs, and the HeadEnd system cannot be forged, altered, or replayed.
- New access control enhancements improve local security at NCDs to reduce the risk of unauthorized on-site access.

1.11 Has SoCalGas received any cybersecurity threats to its AMI system? If so, please describe.

SoCalGas defines a cybersecurity threat as a circumstance, event, or actor with the potential to adversely impact a system, asset, or operation. Given that definition, SoCalGas has not experienced any cybersecurity threats to its AMI system. While the cybersecurity protections in place for the existing AMI system have been effective in protecting the system to date, the absence of a cybersecurity threat does not mean that those protections will remain sufficient over the expected 20-year life of the AMIR system. Cybersecurity risks continue to evolve as computing capabilities advance and malicious actors develop more sophisticated methods, including through the use of artificial intelligence. The proposed cybersecurity enhancements align with evolving security practices and provide enhanced long-term protection for the AMIR system.

1.12 How has the use of estimated actual AMI data improved reliability since 2020 as opposed to SoCalGas' Acquisition's previous practice of scheduling and balancing using demand forecasts?

The availability of estimated actual AMI data has improved this process by enabling the Gas Acquisition Department to schedule and balance with greater precision. The reduction in forecast error achieved through the use of estimated actual AMI data directly benefits system

reliability. Reducing forecast error confers system-wide benefits. For example, on days when the system is oversupplied (high operational flow order (OFO) days), a more accurate forecast helps reduce the potential for excess deliveries. Conversely, on days when the system is undersupplied (low OFO days), a more accurate forecast helps confirm that the Gas Acquisition Department's deliveries more closely align with actual demand, reducing the magnitude of any imbalance.

1.13 Please provide any studies that show the amount of natural gas savings per household and annum that SoCalGas' initial AMI deployment has saved, including how the attribution of savings to the program was derived, controlling for other influences such as weather and cost of gas.

SoCalGas's Advanced Meter Semi-Annual Reports,[21] provided in Attachments M and N, describe a series of "Test and Learn" residential conservation campaigns conducted in conjunction with the initial Advanced Meter deployment.

The campaigns used AMI data to provide participating households with treatments, which are specific interventions to encourage energy-saving behavior. Examples of treatments include Home Energy Reports, Seasonal Energy Updates, personalized usage comparisons, projected charges, and energy-saving recommendations. The final campaign began in late November 2016 and continued through March 2017.

The principal study relevant here is the evaluation included as Appendix C to the August 31, 2017, SoCalGas Advanced Meter Semi-Annual Report.[22] The report states that all 11 new residential treatments tested in the 2016-2017 campaign produced statistically significant natural gas savings.[23] The new treatments produced average savings of 1.74 percent during the fall/winter treatment period (see Table 8). Continuing treatments first introduced in prior campaigns produced savings of 1.42 percent for the 2015-2016 treatments and 1.31 percent for the continuing 2014-2015 treatment. Across the new and continuing treatments, the reported overall reduction was 1.60 percent for the November 2016 through March 2017 period. One

[21] Refer to Attachment M and Attachment N for the August 2016 and August 2017 Semi-Annual Reports, respectively.

[22] Attachment N at Appendix C (Evaluation of Southern California Gas Company's 2016-2017 Conservation Campaign, August 31, 2017).

[23] *Id.* at 24.

treatment, the SoCalGas-developed Seasonal Energy Update, achieved a reported savings rate of 3.43 percent, the highest rate among the treatments evaluated during the four campaign years.

The report also provides an aggregate estimate of 2,314,756 therms saved among 503,494 treated residential customers during the November 2016 through March 2017 period (see Table 9). Dividing those reported values produces approximately 4.6 therms per treated customer over the five-month campaign period. This is a calculation from the reported aggregate results, not a separately reported annual-per-household estimate.

a) Attribution and Control for Outside Influence

The Conservation Campaign was structured as a randomized controlled trial (RCT). This resulted in a "Test and Learn" evaluation in which designated customer groups received specific conservation communications and their usage was evaluated relative to similar customers who did not receive the corresponding treatment (a control group). Because treatment and control customers were observed over the same time period, both groups were exposed to common external conditions, including weather and prevailing natural gas prices. The estimated treatment effect therefore reflects the net difference in usage attributable to receiving the conservation treatment, rather than the overall change in usage experienced by all customers during the heating season.

This RCT design is the principal means by which common influences such as warmer or colder weather and changes in natural gas prices were controlled. Weather or gas prices could affect overall consumption in both groups but would not ordinarily explain a statistically significant difference between otherwise comparable treatment and control groups during the same period. The report identifies the resulting treatment savings as statistically significant and reports the percentage reduction and aggregate therm savings by treatment. Specifically, the study supports attribution of the measured savings to the AMI-enabled conservation treatments, including usage reports, comparative feedback, and personalized information.

Table 8 – Percent Reduction in Fall/Winter 2016-2017 Gas Usage f or Residential Conservation Treatments[24]

Treatment	Percentage Reduction
11 New Treatments	1.74%
9 2015-2016 Treatments	1.42%
1 2014-2015 Treatment	1.31%
Overall % Reduction	**1.60%**

Table 9 – Estimated Gas Savings for the 2016–2017 SoCalGas Conservation Campaign

Initial Treatment Year	Treatment	Group	Number of Treatment Customers	% Reduction	Aggregate Therms Saved (Nov-Mar)
2016-2017	BTA w/Tips + Paper & Email Opower HER	T-31	38,700	2.21%	255,322
2016-2017	BTA w/o Tips	T-36	30,906	0.77%	70,435
2016-2017	BTA w/ Tips	T-37	30,649	0.88%	83,103
2016-2017	Paper-only Opower HER	T-32	51,508	1.37%	209,944
2016-2017	Paper Aclara Home Energy Update Report (HEU)	T-40	31,772	1.47%	143,375
2016-2017	Paper In-House HER	T-39	13,414	1.25%	53,596
2016-2017	Paper SEU	T-34	19,612	3.18%	211,926
2016-2017	Paper SEU (Weatherize)	T-35	19,625	3.43%	223,203
2016-2017	Paper & Email Opower HER - CARE	T-30	49,995	1.78%	236,316
2016-2017	Paper SEU - CARE	T-33	18,364	2.24%	123,932
2016-2017	Paper Bi-lingual HER	T-41	3,453	0.60%	12,616
Overall for 2016-2017 treatments (fall/winter)			**317,997**	**1.74%**	**1,623,768**
2015-2016	Opower Email HER	T-16	12,008	1.12%	38,447
2015-2016	Opower Email Thermostat HER	T-19	11,950	1.58%	56,261
2015-2016	Old BTA, w/materials	T-26	17,452	1.04%	51,561
2015-2016	New BTA, w/materials	T-28	17,392	1.46%	72,103
2015-2016	New BTA, w/o materials	T-29	17,465	1.18%	59,103
2015-2016	Opower Paper-only HER	T-17	12,609	1.02%	35,966
2015-2016	Opower Paper-only Thermostat HER	T-20	12,580	1.57%	56,434
2015-2016	Opower Paper & Email HER	T-15	11,987	1.01%	30,326
2015-2016	Opower Thermostat Email HER ESA & Non-ESA	T-18	24,146	1.84%	117,747
Overall for 2015-2016 treatments (fall/winter)			**137,588**	**1.42%**	**517,947**
2014-2015	Opower Paper-only HER	T-13	47,910	1.31%	173,041
Overall for 2014-2015 treatments (fall/winter)			**47,910**	**1.31%**	**173,041**
Overall for December 2016-March 2017			**503,494**	**1.60%**	**2,314,756**
2015-2016	Opower Email HER	T-16	12,024	0.80%	21,887
2015-2016	Opower Email Thermostat HER	T-19	11,980	0.87%	23,602
2015-2016	Old BTA, w/materials	T-26	17,500	0.81%	30,076
2015-2016	Old BTA, w/o materials	T-27	17,499	0.85%	31,829
2015-2016	Opower Paper & Email HER	T-15	12,028	0.62%	29,866
2015-2016	Opower Paper & Email Thermostat HER (ESA & Non-ESA)	T-18	24,209	1.09%	62,632
Overall for 2015-2016 treatments (spring / summer)			**95,241**	**0.94%**	**199,893**
2014-2015	Opower Paper & Email HER	T-10	11,658	1.43%	40,022
2014-2015	Opower Paper-only HER	T-13	46,764	1.15%	119,788
Overall for 2014-2015 treatments (spring / summer)			**35,000**	**1.21%**	**159,809**
Overall for April 2016-November 2016			**130,240**	**1.04%**	**359,702**
Overall for April 2016-March 2017			**657,698**	**1.49%**	**2,674,458**

[24] Refer to the August 2017 Semi-Annual Report, attached as Attachment N.

1.14 Has SoCalGas done any studies that compared the gas consumption of households that received motivational materials such as "Ways to Save" vs. of those that did not receive such materials, controlling for climate zones, size and type of residence, etc? If so, please provide. If not, why were these controlled impact studies of the effect of the project's outreach not done?

Yes, the Advanced Meter program included a series of controlled residential conservation studies that compared gas consumption for customers who received AMI-enabled outreach and motivational materials against customers who did not receive those treatments.

As described in the August 31, 2017 Advanced Meter Semi-Annual Report,[25] SoCalGas conducted four consecutive residential "Test and Learn" conservation campaigns designed to evaluate the effectiveness of AMI-enabled customer engagement tools. These treatments included Home Energy Reports, Seasonal Energy Updates, personalized usage comparisons, energy-saving tips, projected bill information, and other customer-facing communications made possible by Advanced Meter data. The campaigns were specifically designed to measure conservation impacts and track savings attributable to the outreach efforts. The August 2017 report states that all eleven new residential treatments tested during the 2016-2017 campaign produced statistically significant gas savings, with average savings of 1.74% during the fall/winter treatment period. In addition, treatment groups from prior years continued to demonstrate measurable savings, resulting in an overall reduction of 1.60% across new and continuing treatments.

With respect to controlling for external factors, the evaluation used an RCT design that included treatment and comparison (control) groups that were observed during the same period. This design controls for common influences affecting all customers during the study period, such as weather conditions and natural gas prices, because both the treatment and control groups are exposed to those same external conditions. The reported savings therefore represent the incremental effect associated with receiving the AMI-enabled conservation treatment rather than overall changes in consumption experienced by all customers.

Additional evaluation reports developed for SoCalGas's Behavioral Outreach Program indicate that these outreach efforts were structured as RCTs, in which eligible customers were

[25] Refer to Attachment N.

randomly assigned to treatment groups that received Home Energy Reports and other behavioral communications, or to control groups that did not receive those communications. These reports specifically note that the earliest treatment waves originated in the 2015-2016 and 2016-2017 AMI Conservation Campaigns, demonstrating that controlled impact evaluations continued beyond the initial Advanced Meter deployment and were designed to establish a causal relationship between outreach activities and energy savings.

The documentation reviewed also indicates that customers were subject to eligibility screening and segmentation prior to assignment into treatment and control groups. Eligibility criteria included factors such as energy usage levels, California Alternate Rates for Energy (CARE) participation, and MyAccount enrollment status. The RCT implicitly controls for climate zone, housing size, and type of residence and the random assignment to treatment and control is validated via statistical tests. The AMI Conservation Campaign continued to evolve and is now implemented as a Behavioral Program as part of SoCalGas's energy efficiency portfolio. By 2024, approximately 1.62 million randomly selected treatment customers were receiving Home Energy Reports (HERs), resulting in nearly 10 million therms saved and an average savings of 6.1 therms per customer.[26] In 2025, the program expanded to more than 1.87 million treatment customers, delivering approximately 10.5 million therms in savings with an average of 5.6 therms saved per customer.[27] The program continues to generate significant energy savings through targeted customer outreach while increasing customer awareness and understanding of their energy usage. By providing personalized energy insights and recommendations, Home Energy Reports encourage customers to adopt energy-efficient behaviors that deliver measurable and lasting conservation benefits.

[26] Refer to Attachment O.

[27] Refer to Attachment P.

1.15.1 Please describe how the August 22, 2017 Semi-Annual Report (prepared by Nexus Consultants) attributed the average natural gas savings of 1.6 percent by residential customers to the program and excluded other motivational factors such as weather and the price of gas.

The August 2017 Advanced Meter Semi-Annual Report[28] attributed the reported 1.6% average residential natural gas savings to the conservation program through a randomized controlled trial (RCT), which excluded the effects of external factors such as weather and natural gas prices and found that the natural gas savings were statistically significant.

a) Research Design

The conservation campaigns were conducted as RCTs. Eligible residential customers were randomly assigned either to treatment groups that received the Advanced Meter-enabled communications or to control groups that did not. Random assignment is the strongest available basis for causal attribution, because it produces treatment and control groups that are statistically equivalent in expectation on every characteristic, observed and unobserved, including climate zone, home size and type, occupancy, income, and prior usage. The control group therefore measures directly what treated customers would have consumed had they not received the communications.

b) Exclusion of Weather, Gas Prices and Other Common Influences

Treatment and control customers were served in the same territory over the same months, so both groups experienced the same weather conditions and the same gas prices. Those factors move usage in both groups together and cannot by themselves produce a difference between the groups. Because the savings estimate is the difference between two contemporaneous groups rather than a change in usage over time, common external influences are excluded by construction.

c) Estimation Model

Savings were estimated using a lagged dependent variable panel regression covering December 2016 through March 2017, with December 2015 through March 2016 as the pretreatment period. Monthly time effects absorb any factor common to treatment and control

[28] Refer to Attachment N.

customers within a given month, which is where month-specific weather and gas price conditions are captured. The lagged term, each customer's own average daily usage in the same month of the prior year, controls for persistent differences among individual customers such as home size, building envelope, climate zone and household habits. Standard errors were clustered at the customer level. The estimated treatment coefficient is the basis for the reported percent reductions, all of which were statistically significant. Because the analysis relied on contemporaneous treatment and control groups created through random assignment, the reported 1.6 percent reduction represents the incremental effect of the program's AMI-enabled behavioral interventions, not the effect of external influences affecting all customers.

1.15.2 Please describe what additional environmental benefits will result from which of the proposed advanced capabilities of the proposed AMI Replacement system.

The AMIR system's integration with next-generation endpoint technologies is expected to extend the environmental benefits of the current AMI system—including eliminating millions of vehicle-based meter reads, identifying unusual consumption patterns that may indicate leaks or malfunctioning equipment, and enabling customer-driven conservation through usage information—by providing customers with more timely and frequent access to energy usage information. Enhanced data as a result of the AMIR Project will provide SoCalGas customers with greater awareness of consumption patterns and provide them with more control over their energy usage.

2.1 Please provide the referenced third-party analyses (Bridgewater and Exponent) of projected module and End of Life failures showing that module failures begin to accelerate in the 18th year, or around year 2030, for modules installed in 2013.

As described in the response to Question 1.1, both the Exponent Analysis[29] and the Bridgewater Analysis[30] support the expectation that significant battery failure will begin in 2030.

Figure 10 of the Exponent Analysis,[31] excerpted below as Figure 1, shows an annual failure rate of 2.03% in 2030 of all modules installed, which is unsustainable for SoCalGas's existing workforce to remediate without leading to major impacts to SoCalGas's billing and

[29] Refer to Attachment A.

[30] Refer to Attachment B and Attachment C.

[31] Refer to Attachment A.

meter-to-cash functions, and its ability to maintain safe, reliable, and affordable service beyond year 2030. For Installation Class 2013, the failure rate is 3.63% in Year 18 (see Table 17).

Figure 1 – Summary of Exponent Statistical End of Life Analysis

Calendar Year	Observed or Expected Failures from Exponent's Model	Cumulative # Failures	Total Meters Installed By Calendar Year	Active Meters By Calendar Year (Not Failed or Not Removed)	Rate (% of Meters Installed By Calendar Year)	Cumulative Failure Rate (% of Meters Installed By Calendar Year)	Cumulative Failure Rate (% of Active Meters)
2012	53	53	23,035	23,035	0.23%	0.23%	0.23%
2013	8,105	8,158	1,131,025	1,130,919	0.72%	0.72%	0.72%
2014	27,291	35,449	2,922,084	2,909,986	0.93%	1.21%	1.22%
2015	36,002	71,451	4,641,673	4,574,147	0.78%	1.54%	1.56%
2016	59,029	130,480	5,964,959	5,839,536	0.99%	2.19%	2.23%
2017	68,093	198,573	6,187,750	5,952,689	1.10%	3.21%	3.34%
2018	68,684	267,257	6,348,671	5,980,093	1.08%	4.21%	4.47%
2019	70,357	337,614	6,475,956	5,993,578	1.09%	5.21%	5.63%
2020	62,792	400,406	6,598,477	5,994,288	0.95%	6.07%	6.68%
2021	67,693	468,099	6,713,650	6,000,161	1.01%	6.97%	7.80%
2022	75,646	543,745	6,825,266	5,992,117	1.11%	7.97%	9.07%
2023	93,519	637,264	6,953,372	5,997,772	1.34%	9.16%	10.63%
2024	84,394	721,658	7,082,326	5,992,819	1.19%	10.19%	12.04%
2025	83,271	804,929	7,082,326	5,807,020	1.18%	11.37%	13.86%
2026	83,983	888,912	7,082,326	5,807,020	1.19%	12.55%	15.31%
2027	84,936	973,848	7,082,326	5,807,020	1.20%	13.75%	16.77%
2028	87,839	1,061,687	7,082,326	5,807,020	1.24%	14.99%	18.28%
2029	100,184	1,161,871	7,082,326	5,807,020	1.41%	16.41%	20.01%
2030	143,909	1,305,780	7,082,326	5,807,020	2.03%	18.44%	22.49%
2031	258,517	1,564,297	7,082,326	5,807,020	3.65%	22.09%	26.94%
2032	474,982	2,039,279	7,082,326	5,807,020	6.71%	28.79%	35.12%
2033	761,329	2,800,608	7,082,326	5,807,020	10.75%	39.54%	48.23%
2034	989,753	3,790,361	7,082,326	5,807,020	13.97%	53.52%	65.27%
2035	1,022,948	4,813,309	7,082,326	5,807,020	14.44%	67.96%	82.89%
2036	781,429	5,594,738	7,082,326	5,807,020	11.03%	79.00%	96.34%
2037	454,325	6,049,063	7,082,326	5,807,020	6.41%	85.41%	100.00%
2038	199,528	6,248,591	7,082,326	5,807,020	2.82%	88.23%	100.00%
2039	102,960	6,351,551	7,082,326	5,807,020	1.45%	89.68%	100.00%
2040	83,786	6,435,337	7,082,326	5,807,020	1.18%	90.86%	100.00%

2.2 Provide the number of modules installed each year from 2013-2018.

Please see Table 10 for the number of modules installed each year from 2013-2018, including module replacements. Modules are replaced as needed for a number of reasons, including meter replacement, meter failure, and module failure.

Table 10 – Module Installations (Including Replacements) by Year

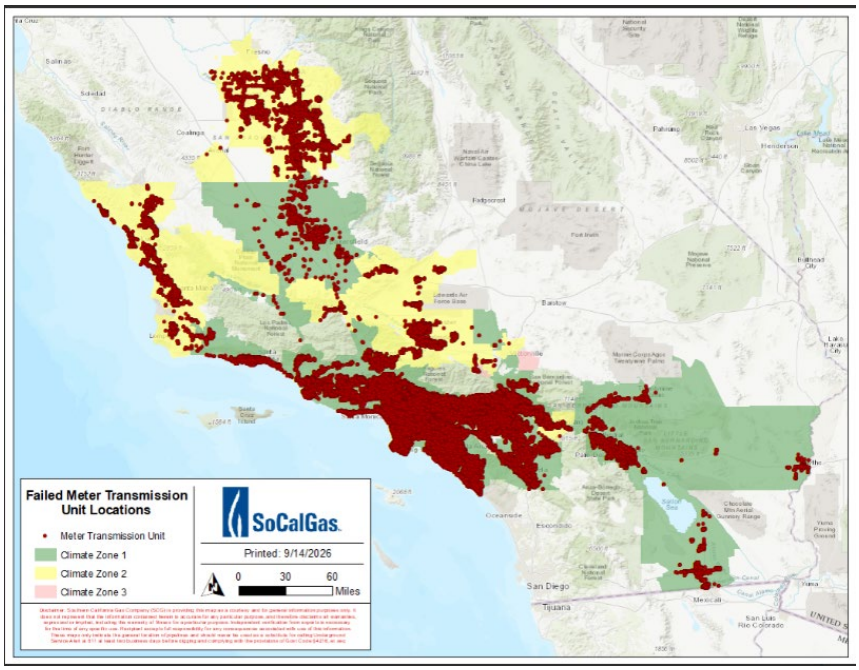
Year	Module Installation Count (Including Replacements)
2013	1,107,991
2014	1,791,059
2015	1,719,590
2016	1,323,385
2017	223,665
2018	162,033
TOTAL	6,327,723

2.3 Provide a map showing the locations, installation year and climate zones of any modules that have already failed.

Figure 2 shows the locations and climate zones of the approximately 927,000 failed modules from 2012 through September 9, 2026. SoCalGas is separated into three zones based upon geographic areas and annual heating degree days.[32]

Please see Table 11 below for the count of module failures to date by installation year and climate zone.

Figure 2 – Map of Failed Modules and Climate Zones



[32] The baseline allowance for Zone 1, 2, and 3 is in therms per day and is 1.69, 1.823, and 2.950 for these zones, respectively. The non-baseline residential rate is an additional $0.26/therm.

Table 11 – Module Failures by Climate Zone by Installation Class

Installation Year	Climate Zone 1	2	3	Total
2012	1,993	6	0	1,999
2013	160,510	8,967	249	169,726
2014	172,593	20,276	77	192,946
2015	199,346	12,128	54	211,528
2016	147,814	12,150	3,179	163,143
2017	23,137	1,214	97	24,448
2018	32,735	1,995	81	34,811
2019	27,088	1,426	36	28,550
2020	24,559	1,402	80	26,041
2021	18,420	1,289	39	19,748
2022	12,594	1,319	41	13,954
2023	13,191	1,506	43	14,740
2024	11,268	1,294	28	12,590
2025	8,335	900	43	9,278
2026	3,323	404	18	3,745
Total	**856,906**	**66,276**	**4,065**	**927,247**

2.4 Provide studies of alternatives to systemwide deployment.

As described in SoCalGas's direct testimony,[33] SoCalGas evaluated two alternatives to the planned systemwide replacement of its existing advanced meter infrastructure system. The two alternatives are a failure-based replacement (Scenario 2) and a return to manual meter reading (Scenario 3). For purposes of the alternatives analysis, the planned systemwide deployment is designated as "Scenario 1" and serves as the baseline against which the two alternatives were evaluated. Descriptions of the three scenarios and results are as follows:

- **Proposed Solution: Planned Systemwide Replacement ("Scenario 1"):** The most cost-efficient approach for ratepayers is the planned systemwide AMI replacement, as proposed in the Application, with all endpoints to be installed by 2034. Scenario 1 is an extension of the Application in that it is extended to 2050 and includes all relevant costs. The present value for the total loaded and escalated costs is $1.569 billion (See Table 12; row 6, col. c) and revenue requirement is $1.823 billion (See Table 12; row 7,

[33] Prepared Direct Testimony of David M. Mercer, Chapter II – Business Case, on behalf of SoCalGas (December 30, 2025) (SoCalGas Chapter II) at DMM-5 through DMM-10.

col. c).

The proposed deployment would consolidate module replacement activities within a defined period and utilize dedicated field resources, warehousing, fleet, training, quality assurance, and other deployment support functions. By coordinating replacement activities at scale and concentrating installation activities within a shorter deployment period, the proposed approach allows SoCalGas to capture deployment efficiencies and economies of scale, while limiting customer and operational disruption and avoiding higher costs.

- **Failure-Based Replacement ("Scenario 2"):** This alternative is a failure-based replacement, with endpoints replaced as modules fail and all legacy modules replaced by 2040. The present value for the total loaded and escalated costs is $2.125 billion (See Table 12; row 6, col. d) and revenue requirement is $2.432 billion (See Table 12; row 7, col. d). In this scenario, the deployment costs are significantly higher because module installations occur over a longer period (through 2040) and are not optimized geographically. As a result, crews complete fewer installations per day due to increased travel and routing inefficiencies, causing increased labor costs on a per-installation basis. The extended deployment period also has higher deployment costs and reduced efficiencies as it requires field, logistics, and support resources to remain in place for a longer period of time (approximately 6 years).
- **Manual Meter Reading ("Scenario 3"):** This alternative is the least cost-effective approach for ratepayers. This scenario includes the decommissioning of the current AMI system beginning in 2030 and the decommissioning of all existing AMI equipment by 2034, with a return to manual meter-reading operations beginning in 2029 and fully implemented by 2031. The present value for the total loaded and escalated costs is $3.262 billion (See Table 12; row 6, col. e) and revenue requirement is $3.461 billion (See Table 12; row 7, col. e). In this scenario, SoCalGas personnel must visit each meter on a recurring basis to

obtain and record each meter read, rather than relying on AMI-enabled technology to remotely collect reads and other relevant data. This scenario requires SoCalGas to rebuild and sustain a large meter reading workforce, including vehicles, field support, and facilities dispersed across a large geography. Additionally, this scenario assumes full removal of the current Advanced Meter technology, assets, and systems as well as loss of benefits associated with the implementation of the current AMI system.

Table 12 – Total Forecasted Costs and Present Value[34]

	AMIR Cost Summary (in $ millions)	Planned Systemwide Deployment (Scenario 1)	Failure-Based Replacement (Scenario 2)	Manual Meter Reading (Scenario 3)	Scenario 2 compared to Scenario 1	Scenario 3 compared to Scenario 1
	Column (b)	(c)	(d)	(e)	(f)	(g)
1	**Forecast Costs**					
2	Direct Cost (1)	1,913	2,633	3,995	138%	209%
3	Total Costs Loaded and Escalated (2)	3,025	4,698	8,524	155%	282%
4	Revenue Requirement (3)	4,837	7,348	9,582	152%	198%
5	**Present Value**					
6	Total Costs Loaded and Escalated (2)	1,569	2,125	3,262	135%	208%
7	Revenue Requirement (3)	1,823	2,432	3,461	133%	190%

(1) Direct costs are presented in unescalated and unloaded dollars, including the base cost of labor, materials, and contracts, before the application of escalation and overheads. Cost forecast from 2025-2050.

(2) Does not include AFUDC and capitalized property tax. Cost forecast from 2025-2050.

(3) Revenue Requirement for Scenario 1 and Scenario 3 are recovered between 2025 to 2071; and Scenario 2 will be recovered between 2025 to 2050.

a) Comparison Methodology

The present value of the revenue requirement for all three scenarios was the financial metric utilized to evaluate the three scenarios. This approach allowed alternatives to be compared on both an underlying resource-cost basis and an estimated customer-recovery basis.

To develop the present value for each scenario, direct costs were forecasted in 2025 dollars from 2025 through 2050 to standardize the scenarios for comparability, then escalated and loaded before calculating the revenue requirement. The present value of the total costs and the revenue requirement were calculated using the scenario's expenditure and recovery profiles. All future year costs were discounted to 2025 using a discount rate of 7.52 percent, which is SoCalGas's current authorized rate of return. Applying a common base year and discount rate

[34] Refer to Attachment Q for detailed cost information and assumptions for all three scenarios described in Table 12.

places future cost and revenue requirement streams on a comparable present value basis and accounts for the time value of money. Taken together, these measures provide a consistent basis for comparing the three scenarios from both cost and ratepayer impact perspectives.

b) Comparison Timeline

To compare the three scenarios, the costs from 2025 to 2050 capture the near-term planning and implementation timeline and the ongoing operating and support costs associated with each scenario. The timeline ending in 2050 was utilized to represent the estimated asset life of the modules, assumed to be installed beginning in 2030. Evaluating all three scenarios over the same time period prevents the results from being influenced by differences in timing or duration and provides a consistent basis for comparing the total cost impacts of each alternative.

2.5 Will the new HeadEnd and MDM system support the legacy modules as well as the new replacement modules?

As described in SoCalGas's direct testimony,[35] the implementation of new HeadEnd and MDM systems is required to support the deployment of new modules. The AMIR Project is currently in an open solicitation for the selection of a new AMI vendor. The level of backward compatibility with existing systems will depend on the vendor ultimately selected.

If the incumbent AMI vendor is selected, the new HeadEnd system would support most of the existing communication modules. However, customization would be required to enable support for EPMs and electronic volume correctors (EVCs). The new MDM system would be capable of consuming data from the existing modules, but integrations with downstream systems that depend on MDM consumption data would need to be re-established.

If the incumbent AMI vendor is not selected, its HeadEnd system would not be compatible with the incumbent vendor's communication modules. In this scenario, the existing HeadEnd would remain operational in parallel with the new HeadEnd until all legacy modules have been replaced. Concurrent operation of two MDM platforms is not anticipated. Instead, the new MDM system would require custom integration capabilities to consume data from both the legacy and new module populations.

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[35] Revised Prepared Direct Testimony of Amy D. Vulin, Chapter III – Technology, on behalf of SoCalGas (July 2, 2026) (SoCalGas Chapter III) at ADV-5.

2.6 What was the actual failure rate of modules installed in 2013 in 2025?

The actual failure rate of modules installed in 2013 in 2025 is 1.67%. Tables 13 to 16 include both module failure rates and module failure counts for each installation class 2012 through 2018, for calendar years 2012 through 2040. Failures identified from 2012-2025 are represented by actual failure counts observed by SoCalGas whereas failures identified from 2026 through 2040 are projections from the Exponent end of life analysis.

a) Module Failure Rates

Table 13 – SoCalGas Actual Failure Rates from 2012-2025 by Installation Class[36]

	ACTUAL FAILURE RATES													
Installation Class	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
2012	0.28%	0.85%	0.75%	0.66%	0.50%	0.60%	0.66%	0.54%	0.50%	0.59%	0.53%	0.53%	0.47%	0.62%
2013		0.81%	1.37%	0.99%	1.12%	1.15%	1.01%	1.06%	1.01%	1.08%	1.11%	1.31%	0.92%	1.67%
2014			0.84%	0.81%	0.80%	0.84%	0.82%	0.89%	0.79%	0.87%	0.89%	1.00%	0.74%	0.94%
2015				0.83%	1.26%	1.21%	1.08%	1.24%	1.07%	0.98%	1.02%	1.11%	0.92%	0.99%
2016					1.20%	1.46%	1.11%	1.30%	1.16%	1.07%	1.08%	1.21%	0.99%	1.17%
2017						1.68%	1.52%	1.21%	1.07%	1.02%	0.95%	1.02%	0.82%	1.07%
2018							1.70%	1.84%	1.63%	2.56%	3.12%	3.25%	3.15%	2.58%

Table 14 – Exponent Projected Failure Rates from 2026-2040

	PROJECTED FAILURE RATES														
Installation Class	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
2012	0.80%	0.89%	1.30%	2.84%	6.72%	13.08%	19.02%	20.10%	15.43%	3.97%					
2013	0.75%	0.78%	0.93%	1.58%	3.63%	8.07%	14.18%	18.49%	17.43%	11.34%	0.93%				
2014	1.00%	1.01%	1.05%	1.27%	2.16%	4.75%	9.86%	16.21%	19.26%	16.29%	9.20%	0.27%			
2015	0.92%	0.93%	0.94%	0.98%	1.17%	1.99%	4.42%	9.32%	15.58%	18.86%	16.44%	9.16%	0.33%		
2016	1.11%	1.12%	1.13%	1.14%	1.18%	1.43%	2.43%	5.23%	10.51%	16.66%	17.87%	14.29%	6.25%	0.04%	
2017	1.52%	1.53%	1.53%	1.54%	1.55%	1.61%	1.94%	3.16%	6.36%	11.99%	18.00%	15.03%	11.67%	4.73%	0.03%
2018	1.60%	1.60%	1.61%	1.61%	1.62%	1.63%	1.67%	1.92%	2.89%	5.57%	10.54%	16.15%	13.20%	9.13%	4.10%

b) Module Failure Counts

Table 15 – SoCalGas Actual Failures Count from 2012-2025 by Installation Class

	ACTUAL FAILURES													
Installation Class	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
2012	64	196	173	152	115	138	152	124	115	136	122	122	108	143
2013		8,975	15,179	10,969	12,409	12,742	11,191	11,745	11,191	11,966	12,299	14,515	10,194	18,503
2014			15,045	14,508	14,328	15,045	14,687	15,940	14,149	15,582	15,940	17,911	13,254	16,836
2015				14,273	21,667	20,807	18,572	21,323	18,400	16,852	17,540	19,087	15,820	17,024
2016					15,879	19,320	14,688	17,203	15,350	14,159	14,291	16,012	13,101	15,482
2017						3,743	3,386	2,696	2,384	2,272	2,117	2,272	1,827	2,384
2018							2,736	2,961	2,623	4,120	5,021	5,230	5,069	4,152

[36] The failure rates presented in Tables 13 and 17 of this supplemental testimony are derived from SoCalGas's actual historical module failure data. These rates may differ slightly from the rates shown in Figure II-1 of Prepared Direct Testimony of David M. Mercer, Chapter II – Business Case, on behalf of SoCalGas (December 30, 2025) (SoCalGas Chapter II) at DMM-3, which was based on Exponent's analysis.

Table 16 – Exponent Projected Failures Count from 2026-2040

	PROJECTED FAILURES														
Installation Class	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
2012	184	204	300	655	1,548	3,013	4,382	4,630	3,555	914					
2013	8,358	8,673	10,295	17,480	40,268	89,445	157,086	204,876	193,162	125,625	10,250				
2014	17,864	18,058	18,807	22,686	38,615	85,012	176,663	290,386	344,927	291,722	164,842	4,914			
2015	15,872	15,995	16,174	16,822	20,180	34,224	75,964	160,263	267,862	324,296	282,622	157,598	5,743		
2016	14,714	14,801	14,888	15,033	15,667	18,973	32,184	69,244	139,142	220,489	236,506	189,038	82,662	549	
2017	3,388	3,402	3,414	3,427	3,454	3,595	4,320	7,042	14,178	26,718	40,096	33,475	25,997	10,536	67
2018	2,568	2,579	2,588	2,596	2,603	2,616	2,690	3,087	4,653	8,969	16,961	25,982	21,234	14,691	6,590

2.7 What is the actual failure rate of modules installed in 2013 in 2026 through June 1, 2026?

The actual failure rate of modules installed in 2013 in 2026 as of June 1, 2026 is approximately 0.4%.

2.8 What is the actual failure rate of modules installed in 2014 as of 2025?

See Table 13 for the 2014 failure rate and additional annual failure rates by installation class. The actual failure rate of modules installed in 2014 as of 2025 is 0.94%.

2.9 Was the failure rate of 2013 modules used to project the failure rates of modules installed through 2018, as shown in Figure II-2 and Figure II-3?

No, the failure rate of modules installed in 2013 was not used to project failure rates for any other installation year. Each year's projected failure rate was calculated separately for the study. Both Tables 14 and 16 above and Figures II-2 and II-3 in direct testimony[37] reflect projected failure rates from the Exponent Analysis.[38]

2.10 Given that the failure rate of modules installed in 2013 in 2030 (year 17) is projected to be only 1.58% (Table 10, p. 3), and projected to be only 14.18% in year 20, how does SoCalGas propose to account for the stranded investment constituted by removal of 86% of the modules projected to still be working?

SoCalGas treats 2030 as Year 18 for modules installed in 2013 ("Installation Class 2013"). This is because the installation year is counted as the module's first year of operation, regardless of whether the module was installed in January or December 2013. Under this convention, 2013 is Year 1, 2014 is Year 2, and 2030 is Year 18. While in Year 20, 2032, the projected failure rate for that year is 14.18%, the cumulative failure

[37] SoCalGas Chapter II (Mercer) at DMM-3 to DMM-4, Figure II-2 "Projected Failure Rates for Classes 2012 through 2018" and Figure II-3 "Projected Aggregate Failure Rate for Classes 2012 through 2018".

[38] Refer to Attachment A.

rate for that year is 44.53%. For Installation Class 2013's module age, projected failure rates, and cumulative failure rates, see Table 17 below.

Table 17 – Installation Class 2013 Failure Rate (FR), Years 2013-2036[39,40]

Installation Class 2013				
Module Age	**Historical FR**	**Projected FR**	**Cumulative FR**	**Calendar Year**
Year 1	0.81%		0.81%	2013
Year 2	1.37%		2.18%	2014
Year 3	0.99%		3.17%	2015
Year 4	1.12%		4.29%	2016
Year 5	1.15%		5.44%	2017
Year 6	1.01%		6.45%	2018
Year 7	1.06%		7.51%	2019
Year 8	1.01%		8.52%	2020
Year 9	1.08%		9.60%	2021
Year 10	1.11%		10.71%	2022
Year 11	1.31%		12.02%	2023
Year 12	0.92%		12.94%	2024
Year 13	1.67%		14.61%	2025
Year 14		0.75%	15.36%	2026
Year 15		0.78%	16.14%	2027
Year 16		0.93%	17.07%	2028
Year 17		1.58%	18.65%	2029
Year 18		3.63%	22.28%	2030
Year 19		8.07%	30.35%	2031
Year 20		14.18%	44.53%	2032
Year 21		18.49%	63.02%	2033
Year 22		17.43%	80.45%	2034
Year 23		11.34%	91.79%	2035
Year 24		0.93%	92.72%	2036

The projected failure rates demonstrate that module failures do not remain static; they accelerate materially as installation classes reach later years of operation. SoCalGas's AMIR Project would proactively replace the AMI infrastructure at an

[39] The cumulative failure rate column in Table 17 does not total 100% because it includes only modules that have failed. Modules removed from service for other reasons—such as planned or routine meter changes, service abandonments, and other non-failure-related events—are excluded from the calculation.

[40] The failure rates presented in Tables 13 and 17 of this supplemental testimony are derived from SoCalGas's actual historical module failure data. These rates may differ slightly from the rates shown in Figure II-1 of Prepared Direct Testimony of David M. Mercer, Chapter II – Business Case, on behalf of SoCalGas (December 30, 2025) (SoCalGas Chapter II) at DMM-3, which was based on Exponent's analysis.

appropriate point in its lifecycle, before the assets experience costly and increasingly widespread failures, thereby avoiding reactive replacement costs and service disruptions that would ultimately impact ratepayers.

SoCalGas will account for the replacement of existing AMI assets in accordance with the established regulatory accounting requirements for retired mass assets as prescribed by the Code of Federal Regulations (CFR).[41] Per the CFR, the book cost of retired mass assets is credited to plant and debited to accumulated depreciation, which is the standard and accepted treatment for recognizing retirements of mass property. Consistent with established utility accounting practice, the remaining net book value of the retired AMI assets will continue to be recovered through the authorized depreciation framework and will remain in rate base until fully recovered.

This treatment is appropriate because SoCalGas's planned systemwide AMI replacement proposal is intended to benefit customers over the long term. As demonstrated above in the response to Question 2.4, SoCalGas can avoid significantly higher costs, operational inefficiencies, and customer impacts that would result from the Failure-Based Replacement Approach. SoCalGas's proposed approach is a prudent infrastructure replacement strategy designed to manage lifecycle risk, preserve meter-reading capabilities, and reduce avoidable ratepayer costs.

2.11.1 Why has SoCalGas not addressed in this application the question of its responsibility for the stranded investment in its proposed removal of modules before the end of their useful life or developed a proposed amount of stranded investment to credit to ratepayers?

SoCalGas did not develop a separate stranded-investment credit in the Application because the planned retirement of the existing AMI modules would be addressed through standard utility accounting practices applicable to retired mass utility property. The proposed replacement does not reflect an unexpected abandonment of the existing AMI assets; rather, it reflects a planned transition from aging infrastructure to replacement technology needed to continue providing safe, reliable, and efficient meter reading functionality. Moreover, the planned replacement approach would minimize overall ratepayer costs relative to failure-based replacement.

[41] 18 C.F.R. § 201 (Gas Plant Instructions: 10. Additions and Retirements of Gas Plant).

2.11.2 Why was the original deployment not conducted in a more stratified fashion?

The initial AMI deployment was not executed in a scattershot or territory-wide manner. Rather than attempting to install modules simultaneously across the entire service territory, deployment activities began within specific geographic regions as supporting warehouse locations were activated and then progressed systematically to other areas of the service territory. This is depicted in Figure 3, which is an illustrative rendering of the actual deployment strategy utilized for the initial AMI deployment in comparison to a scattershot deployment. As shown in Table 18 below, warehouses were activated in a deliberate, phased approach as installation activities began within each geographic region before expanding to additional locations.

Within each targeted geographic area, installers generally moved through neighborhoods in a systematic, linear fashion, progressing from one customer to adjacent customers rather than traveling between installations. This deployment methodology minimized drive time, reduced non-productive labor hours, and maximized the number of installations that could be completed each day. By clustering work geographically and advancing through neighborhoods in an organized sequence, the program achieved greater field productivity, improved workforce utilization, and reduced overall deployment costs compared to a dispersed installation strategy.

Table 18 – Warehouse Schedule

AMI 1.0 Warehouse Location	Start	End	2012 2013 2014 2015 2016
South Gate	Oct-12	Sep-16	
El Centro	Feb-13	May-13	
Irwindale	Mar-13	Oct-14	
Sun Valley	Apr-13	May-15	
Bakersfield	Apr-13	Nov-13	
Indio	May-13	Nov-13	
Northridge	Jul-13	Sep-15	
Hemet	Oct-13	Aug-14	
Visalia	Oct-13	Dec-14	
Perris	Nov-13	Feb-15	
Anaheim	Dec-13	Dec-16	
Los Angeles	Jan-14	Dec-16	
Valencia	Jul-14	Dec-15	
Mission Viejo	Sep-14	Jun-15	
Westchester (Los Angeles)	Oct-14	Sep-16	
Rancho Cucamonga	Nov-14	Oct-16	
Oxnard	Jul-15	Feb-16	
Nipomo	Mar-16	Sep-16	
Santa Barbara	Mar-16	Aug-16	

Figure 3 – Original AMI Deployment Strategy: Targeted vs. Non-Stratified Installation



Although the initial AMI deployment was conducted in a targeted and stratified manner, and SoCalGas expects the probability of module battery failures to increase over time in geographic areas that generally mirror the sequencing of the original deployment, SoCalGas does not expect those failures to occur in a predictable, linear fashion. Rather, individual module failures are expected to occur sporadically across customer locations within those broader deployment areas. As a result, as discussed in the responses to Questions 2.4 and 2.10, a failure-based replacement strategy would create a dispersed and reactive work environment, requiring installers to travel from one customer location to the next to address individual failures. Even when failures occur within the same neighborhood, installers may need to travel across multiple streets, neighborhoods, or towns between replacement activities. This travel reduces workforce productivity and increases overall deployment costs compared to a planned, geographically sequenced replacement strategy, where installers can systematically move from customer to neighboring customer and complete replacements in a continuous, efficient manner as

demonstrated in Figure 4 below. Figure 4 is intended to be an illustrative example of a planned systemwide replacement installation sequence compared to a failure-based replacement strategy installation sequence.

Figure 4 – AMIR Planned Systemwide Replacement and Failure-Based Replacement



2.12 If modules of the same vintage are dispersed throughout the service territory, why would a systemwide replacement deployment be any less scattershot than the original deployment?

SoCalGas does not intend to deploy replacement modules across the entire service territory simultaneously. As described in the responses to Questions 1.7 and 2.11.2, the initial AMI deployment was conducted in a targeted and stratified manner, with installation activities beginning in specific geographic regions before progressively expanding to other areas of the service territory. Because the AMIR Project is designed to prioritize replacement of the oldest communication modules first, which are also expected to have the highest probability of battery failure, SoCalGas expects the AMIR deployment sequence will generally follow a similar geographic progression as the

original AMI deployment. Accordingly, replacement activities will be concentrated in selected geographic areas and will advance through the service territory in a planned and orderly manner rather than occurring simultaneously across all regions.

2.13 Please provide the module manufacturer's warranty and describe its obligations to replace or repair modules that fail before the end of their useful life.

The manufacturer's warranty and an overview of Aclara's warranty obligations are provided in the response to Question 1.3.

2.14 Identify the component of the modules that is the most frequent cause of failure.

Pursuant to Schedule K-1 of the Aclara contract,[42] SoCalGas identifies modules as warranty failures based on insufficient communication performance or malfunction. To date, the exact component responsible for the majority of all failures has not been identified. In the future, beginning in 2030, module failures are projected to be overwhelmingly due to battery failure. A discussion of module issues encountered since early deployment follows.

Several module design issues were identified and addressed during the deployment period. Around 2013, the radio design of the Aclara module used with the slant-face Sprague meter was found to impair communication performance, resulting in the implementation of a temporary collar solution followed by a redesign of the above ground module for the Sprague meter. In addition, Aclara's Dresser Z-Series above ground module design was modified during the early years of deployment to mitigate water intrusion concerns.

In 2016, insufficient potting material in curb modules was identified as a primary cause of water intrusion and false tamper alarms. This finding led to a redesign of the Aclara Itron curb module, which was completed in late 2017 or early 2018.

Separately, the Exponent Analysis[43] included an examination of a limited sample of modules with cracked casings and identified instances of residue and corrosion on printed circuit boards. In a broader assessment of module failures, Exponent concluded

[42] Refer to Attachment I.

[43] Refer to Attachment A.

that environmental moisture ingress into the module enclosure was the primary driver of approximately 200 additional module failures. It should be noted that these samples were not designed to be representative of all modules, and Exponent did not observe significant plastic degradation or fracture patterns indicative of gradual age-related deterioration of the plastic enclosure.

2.15 Have there been any improvements in the design or application of the sealant of the battery casing to prevent moisture seeping in, over the course of the 2012-2018 deployment?

Significant design modifications have been implemented to two of Aclara's module designs – Dresser-Z above ground module design and Itron curb module design – to address water intrusion vulnerability. The Dresser-Z above ground module design was modified in the early years of deployment to prevent water intrusion. The Itron curb module design was modified from 2016-2017 to increase the effectiveness of potting material and thereby prevent water intrusion.

2.16 Please provide a breakdown of the expense and capital costs that would result if the Commission were to order a return to manual meter reading, as well as the assumptions used for that forecast.

Table 19 – Total Loaded and Escalated Costs without AFUDC 2025-2050

Total Loaded and Escalated Costs without AFUDC ($ in millions)			
	Capital	**O&M**	**Total**
2025	3.8	0.6	4.4
2026	6.9	3	9.8
2027	10.4	3.2	13.7
2028	443	138.5	581.5
2029	13.6	196.5	210.1
2030	42.3	296.8	339.1
2031	44.3	411.2	455.5
2032	37	415.3	452.3
2033	35.9	399.5	435.4
2034	7.3	389.2	396.5
2035-2050	53.1	5,573.1	5,626.2
Total	697.5	7,827.0	8,524.5

The costs associated with returning to manual meter reading (see Table 19 above) were developed based on the Manual Meter Reading (Scenario 3) alternative to the planned systemwide replacement of SoCalGas's AMI system, as summarized in the response to Question 2.4. Manual Meter Reading was found to be the costliest approach for ratepayers, as SoCalGas personnel would need to visit each meter on a recurring basis to obtain and record each meter read, while requiring the company to rebuild and sustain a large meter reading workforce.

This scenario was developed under the assumption that neither the AMIR Project nor a failure-based replacement option would be implemented. Under this scenario, SoCalGas would cancel pending legacy module orders, continue module remediation activities through the end of 2028 with a focus on non-communicating modules, and then begin ramp-up of both manual meter reading staff and supporting infrastructure as module failures increase and the existing AMI assets reach end of life.

The estimated total loaded and escalated cost of returning to manual meter reading is approximately $8.524 billion, consisting of approximately $697.5 million in capital costs and approximately $7.827 billion in O&M costs. The annual forecast shows that costs initially increase during the transition period, with the largest early-year cost occurring in 2028 at approximately $581.5 million as transition-related costs are incurred and then continue at elevated annual levels once a manual meter reading department is established. Beginning in 2031, annual total costs remain generally between $280.9 million and $455.5 million through 2050, driven primarily by the ongoing O&M costs required to support manual meter reading over the long term.

The expense forecast is primarily driven by the labor and operational resource costs required to re-establish and sustain manual meter reading. To develop the meter reading workforce estimates, SoCalGas relied on average workforce figures from the original AMI Application.[44] Those workforce figures were then scaled to reflect the current meter population and applied to the assumed module failure profile from the Exponent Analysis.[45] Table 20 below provides the sum of the expected workforce needs

[44] *See* Application (A.) 08-09-023, Errata to Direct Testimony of Mark L. Serrano, Chapter III – AMI Deployment Plan, Costs and Operational Benefits, on behalf of SoCalGas (March 6, 2009).

[45] Refer to Attachment A.

across part-time and full-time meter readers, non-management employees, and management employees. Additional personnel costs would include vehicles required for field operations.

Table 20 – Estimated Number of Resources Required for Manual Meter Reading by Year

Year	Part-time Readers	Full-time Readers	Non-Mgmt	Management
2029	412	55	36	32
2030	547	58	38	34
2031-2050	959	113	75	64

The forecast also reflects the loss of operational efficiencies or benefits gained during the original AMI implementation. Compared to manual meter reading, the AMI system provides more frequent meter reads and advanced meter data, which has led to cost savings across multiple departments. If SoCalGas were required to return to manual meter reading, these efficiencies would be eliminated, resulting in costs relative to the savings previously achieved. The lost benefits were calculated using the Customer Services Field, Customer Billing, Other O&M, Working Cash, Other Capital, and Theft categories from SoCalGas's original AMI Application.[46] Those amounts were scaled to reflect the current meter population and annualized over 25 years (2025 to 2050).

Beyond cost and operational burdens, returning to manual meter reading would erode the core safety, reliability, affordability, and environmental benefits provided by the AMI system. It would require a substantially larger field workforce and more travel to customer sites, increasing employee exposure to driving-related incidents, adverse weather, difficult terrain, animals, and site-specific hazards that remote meter data collection helps avoid. It would also eliminate the efficiency and reliability benefits of automated data collection, increase recurring labor, vehicle, facility, and technology costs, and expand the environmental footprint associated with additional field activity. Accordingly, returning to manual meter reading would not only be the most expensive option but would also sacrifice the broader operational and customer benefits enabled by an AMI system.

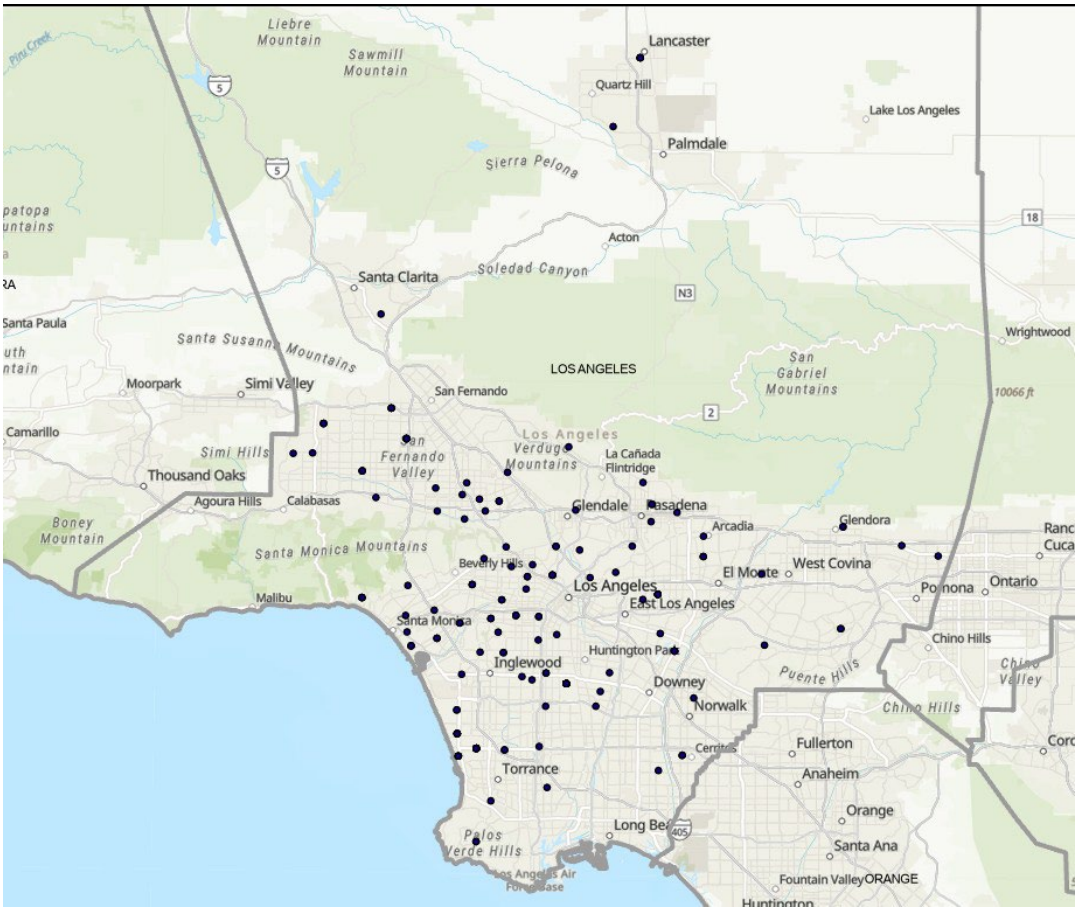
[46] Refer to A.08-09-023, Errata to Direct Testimony of Mark L. Serrano, Chapter III – AMI Deployment Plan, Costs and Operational Benefits, on behalf of SoCalGas (March 6, 2009).

The capital forecast is primarily driven by the facility-related costs necessary to support a manual meter reading workforce. Based on a comparison of SoCalGas's 2007 meter reading base capacity to its current base capacity, SoCalGas identified 32 locations that would not have sufficient capacity to support a meter reading workforce; therefore, SoCalGas assumes 32 new facilities would be needed. The capital forecast also includes costs associated with setting up the meter reading systems and related infrastructure necessary to support manual meter reading, including databases, routing functionality, workstations, parking, and other facility-related needs. Together, these assumptions support the conclusion that returning to manual meter reading would result in substantial incremental expense and capital costs, as well as increased operational and field safety risks.

2.17 Provide a map of Los Angeles that shows where decarbonization and electrification efforts have led to a decrease in demand for natural gas services, such as in areas hard-hit by wildfires in Pacific Palisades and Altadena, and how this has been factored into SoCalGas' systemwide forecasts of the need for over six million gas module replacements.

SoCalGas interprets "Los Angeles" to mean Los Angeles County. Figure 5 below represents the approximate location of the 199 meter removals from 2020 through 2025 for which SoCalGas's records include a Meter Change Reason code as due to electrification. Due to scale, some black dots represent several multifamily units at a single address or addresses in close proximity.

Figure 5 – Los Angeles County Meter Removals Identified as Due to Electrification



SoCalGas factored in electrification and building decarbonization policy through its forecast of new gas service connections, which feeds the projected count of approximately 6.3 million meter modules. In the Application, SoCalGas proposed a revenue requirement with a balancing account. Therefore, when module replacement under the AMIR Project begins, if there are customers that have had their service abandoned including through zonal electrification efforts, SoCalGas would no longer be servicing that address with a new module, resulting in a reduction to project costs recorded to the balancing account.

3.1 If USMs are chosen to replace some meter modules in the future, would the EPM, EVS and EC features become redundant?

SoCalGas interprets EVS to mean Electronic Volume Corrector (EVC), and has responded accordingly.

EPMs are designed to monitor and report district pressure conditions (i.e., pressure upstream of the customer's residential regulator). Because residential meters are typically placed downstream of the customer's regulator, USMs do not provide the same capabilities as EPMs.

ECs and EVCs are used for large commercial and industrial customers. They generate both corrected and uncorrected meter reads, which are required for accurate billing and operational purposes. In gas measurement, an uncorrected read reflects the raw metered gas volume, while a corrected read adjusts that volume for measurement conditions such as pressure and temperature so it can be used for accurate billing and operational analysis.

Residential USMs are designed for residential metering applications and provide neither the district pressure monitoring of the EPM nor the typical non-residential volume correction capabilities of the ECs and EVCs. Therefore, even if USMs are deployed to replace certain meters and modules in the future, EPMs, ECs, and EVCs will still be required to support their respective pressure monitoring and commercial and/or industrial metering functions.

3.2 What is the cost comparison between adding the new modules with the additional features of EPM, EVS and EC vs. the cost of USMs, per unit?

SoCalGas interprets EVS to mean EVCs, and has responded accordingly.

The new modules being installed will not replace the advanced instrumentation present at EPM, EVC, or EC sites. The modules integrate with the instruments to collect and transmit their measurements, derived calculations, and alarms over the communication network.

As identified in the response to Question 3.1, residential USMs serve a different metering application and do not provide the same functionality as EPMs, EVCs, or ECs. As a result, any cost comparison between these devices should not be viewed as a direct per-unit replacement comparison. Notwithstanding this distinction, the device pricing included in the Application is provided in Table 21 below. USM pricing was not requested as part of the AMI Vendor RFP.

Table 21 – EPM, EVC and EC Pricing

Unit	Cost
EPM module	$835
EVC module	$835
EC and module	$2,456 (corrector) $118 (module)

SoCalGas has not conducted a competitive evaluation of residential USM pricing. For reference only, prevailing market prices for residential USMs are generally estimated to range from approximately $200 to $600 per meter, depending on factors such as the communications technology employed, remote shut-off valve capabilities, and the type and sophistication of diagnostic functions provided by the device.

3.3.1 When was the module RFP issued and to whom?

a) Module RFP Issue Date

The module RFP was issued on June 19, 2025.

b) <u>Module RFP Recipients</u>

The module RFP was issued to Aclara, Honeywell, Itron, Sensus, and Landis+Gyr (L&G).

3.4.1 Which recipients responded to the RFP?

The recipients that responded to the RFP were Aclara, Honeywell, Itron, Sensus, and L&G.

3.5.1 Who reviewed the RFP?

The RFP responses were reviewed by the SoCalGas AMIR Project team in coordination with the appropriate technical, operational, supply management, and subject matter expert stakeholders.

3.6.1 Was a vendor selected? Which one?

A final AMIR technology vendor has not yet been selected. SoCalGas is in a vendor evaluation process, which includes vendor proposal evaluations, clarification activities, commercial reviews, and any required internal approvals. SoCalGas is targeting AMIR technology vendor selection by Q2 2027.

3.7.1 What import tariffs were forecast, and from which country?

a) Forecasted Import Tariffs

For equipment expected to be imported into the United States for the AMIR Project, a tariff has been incorporated into the cost forecast. This allowance reflects the potential impact of United States trade policy on imported goods and is intended to provide a conservative and reasonable estimate of future import costs.

Given the uncertainty associated with future tariff rates and the difficulty of precisely forecasting product-specific duties several years in advance, an aggregated and simplified approach was adopted. Based on the range of tariffs observed across relevant categories, a conservative 10 percent tariff allowance has been applied to specific Endpoint (modules and above ground meters) and Network Communication (NCDs, Solar Panels, and equipment to support NCD Construction and Maintenance) costs forecasted to be imported into the United States.

The tariff factor was not derived from a single tariff schedule, product-specific classification, or specific country. Instead, it was developed through a review of publicly available sources, including information published by the United States International Trade Commission, as well as news and policy analyses discussing current and proposed tariff regimes affecting imported equipment.[47,48] These sources indicate that tariff levels vary significantly by product classification, country of origin, and future trade policy developments.

b) Import Tariff Relevant Countries

The substantial majority of the forecasted tariff-related costs are associated with modules. As part of the ongoing RFP process, SoCalGas is evaluating vendors whose proposed equipment includes components manufactured outside the United States. For purposes of developing the forecast, SoCalGas has assumed these imported components will be subject to applicable United States tariffs in effect at the time of procurement.

3.3.2 What are examples of safety-critical messages that will be prioritized with the new communication system and how will they be accessed by safety personnel?

a) Safety Critical Message Examples

SoCalGas interprets "NDC" to mean Network Communication Device (NCD) and has responded accordingly.

Safety-critical messages are generated by a network of more than 2,000 EPMs that communicate over the current AMI system. These devices monitor pressure at pipeline locations

[47] U.S. International Trade Commission, *available at:* https://www.usitc.gov.

[48] CNN, *Trump's Historic New Tariffs Are Now in Effect. Here's What You Need to Know* (August 6, 2025), *available at:* https://www.cnn.com/2025/08/06/business/trump-tariffs-in-effect.

and regulator stations throughout the gas distribution network. When an EPM detects an abnormal pressure condition, it transmits a real-time alarm (safety message) through its associated AMI communication module. For the duration of the alarm event, the device continues to send near real-time pressure measurements, enabling operators to monitor changing conditions as they occur.

The AMIR system will enable end-to-end prioritization of both alarm notifications and associated pressure telemetry. This capability helps confirm that abnormal operating conditions are delivered to monitoring organizations with minimal latency, regardless of the volume of non-safety-critical traffic being processed by the network. This capability is especially important during emergency situations when timely situational awareness is critical to supporting rapid response and the mitigation of potential risks.

b) Safety Critical Message Access by Safety Personnel

Upon receipt by the HeadEnd system, pressure alarms and associated measurements are immediately forwarded to applications used by the Distribution Engineering and Dispatch organizations within Distribution operations. Distribution Engineering uses the Aveva PI data historian platform to continuously assess alarm conditions, evaluate their severity, and determine the appropriate field response. Dispatch uses TopView, an alarm management platform, to track alarm acknowledgment and initiate notifications.

3.4.2 What are the cybersecurity standards in SoCalGas' current communication network and what new standards will be incorporated?

a) Current Cybersecurity Standards

The current communication network includes several types of cybersecurity standards. Upon module activation, a secure relationship is established between the module and the HeadEnd that ensures only SoCalGas-approved devices can communicate with the HeadEnd system. Additionally, all transmissions from endpoints, except for alarms, are encoded using the AES-128 encryption algorithm. NCDs are installed in hardened outdoor enclosures that include door-access alarms and require a common password to enable console access. The password can only be updated via remote command to prevent unauthorized manipulation locally.

b) New Cybersecurity Standards

The AMIR Project intends to improve these standards in several ways. The secure relationship between modules and the HeadEnd system will remain in place and will be augmented with bi-directional message authentication. This addition will ensure transmissions are sent by a trusted source and are not altered in transit. The encryption protocol will be enhanced to AES-256 to protect communications against advances in computing power over the life of the system. Additionally, encryption will be extended to alarms, over-the-air commands, and all NCD-initiated messages. Lastly, NCDs will use role-based authentication to further augment on-site protection.

3.5.2 If these three "Core" systems are replaced, will they be able to continue to communicate with and manage legacy modules, and if so, for how long?

a) Core Systems and Legacy Module Continued Communication

The AMIR Project is currently in open solicitation to select a new AMI vendor. The ability of the new HeadEnd and MDM systems to support and manage legacy communication modules will depend on the vendor selected.

For an explanation of how the incumbent vendor and a new vendor would address backward compatibility differently, please see the response to Question 2.5. The incumbent vendor will provide the described support for HeadEnd and MDM systems through 2038.

b) Timeline for Core Systems and Legacy Module Continued Communication

Conversely, the ability of the new Network Exception Management and Operations (NEMO) solution to support the legacy modules is not dependent on the selected vendor. In both scenarios, the new system will be dedicated to monitoring the health and performance of new modules and network infrastructure. The existing NEMO application will continue monitoring legacy modules until they are fully replaced.

3.6.2 If a different deployment strategy is chosen, for example one that targets certain geographic areas for module replacement instead of a systemwide deployment, could the number of additional field technicians be reduced?

As discussed in the response to Question 1.7 and depicted in Figure 4, SoCalGas expects the AMIR deployment strategy to generally follow a geographic progression similar to the deployment sequence used during the original AMI deployment. SoCalGas does not intend to deploy replacement modules across the entire service territory simultaneously. Rather, deployment activities are expected to commence within specific geographic regions as supporting warehouse locations are activated and then progress systematically to other areas of the service territory.

This approach is intended to prioritize replacement activity in areas containing the oldest communication modules, where battery failures are forecasted to occur at higher rates first. By aligning deployment activities with projected battery failure patterns, SoCalGas can proactively replace modules before failures occur while maintaining an efficient, region-by-region deployment strategy. Since the deployment strategy SoCalGas intends to leverage for the AMIR Project does target specific geographic areas with required progression through the service territory to account for anticipated upticks in module failure rates, the estimated resource forecast in support of this deployment strategy is also aligned with this approach.

A deployment strategy focused on a specific geographic area without progressing into other areas of the service territory would not be expected to reduce overall field technician resource requirements, as it would ultimately contribute to a failure-based replacement. Communication module battery failures are anticipated to continue occurring outside of the targeted deployment area and are expected to increase over time as the current AMI system population ages. As a result, limiting deployment activities to a smaller portion of the service territory without progressing into other areas would require SoCalGas to address failures occurring elsewhere through a reactive failure-based approach (as described in Scenario 2 in the response to Question 2.4), in which field personnel are dispatched to individual customer locations after module failures occur. SoCalGas expects this approach to be less efficient and more costly than the planned targeted mass deployment strategy and would likely increase, rather than reduce, overall resource needs.

Under the planned AMIR deployment strategy, field technicians can be assigned to concentrated geographic areas and perform installations in a systematic manner, moving efficiently from neighborhood to neighborhood and from customer premise to customer premise. This allows travel time to be minimized, productivity to be maximized, and installation resources to be utilized efficiently. In contrast, a failure-based strategy requires technicians to respond to failures as they occur, contributing to increased travel time between individual service locations as the technician may be required to drive across a neighborhood or city. This reactive approach increases drive time, reduces the number of installations that can be completed per day, and results in higher labor and transportation costs. For these reasons, SoCalGas expects a proactive, geographically focused mass deployment strategy to be more operationally efficient and cost-effective than addressing module failures solely through individual failure response activities.

3.7.2 How many field technicians are in the current work force?

SoCalGas currently maintains a workforce of approximately 889 employees who routinely perform activities that may include communication module replacement. However, module replacement work represents only a small portion of these employees' overall responsibilities. These individuals support a broad range of customer service, field operations, meter maintenance, meter exchange, safety, compliance, and other operational activities that are essential to the day-to-day operation of the gas system. As a result, the existing workforce is not dedicated solely to module replacement activities and cannot be viewed as a workforce that is fully available to support a large-scale AMIR Project deployment.

While the current workforce manages the existing level of routine module replacement work under today's break-fix operating model, module replacement activities are generally performed alongside many other assigned duties. The AMIR Project is expected to require the replacement of more than six million communication modules over a relatively compressed deployment period, representing a substantially different scale of work than current operations. Consequently, although 889 employees routinely perform module-related work, only a portion of their available work hours are currently devoted to module replacement activities, as their primary responsibilities must continue to support ongoing operational and customer service requirements.

3.8 If the number of forecast field technicians were reduced to the current work force, would the Connected Deployment Systems enhancements be necessary, or could the current CDS manage the workforce logistics? If not, why not?

The existing technician workforce is sized to support the current volume of field operations. There is no realistic scenario in which this workforce could absorb the replacement of 6.3 million modules, even over an extended deployment period, without significant impacts to customer billing or requiring the stand-up of a large-scale manual meter reading operation. All realistic scenarios require Connected Deployment System (CDS) enhancements because of the need for management of increased headcount, field efficiencies, and minimization of customer service impacts.

III. CONCLUSION

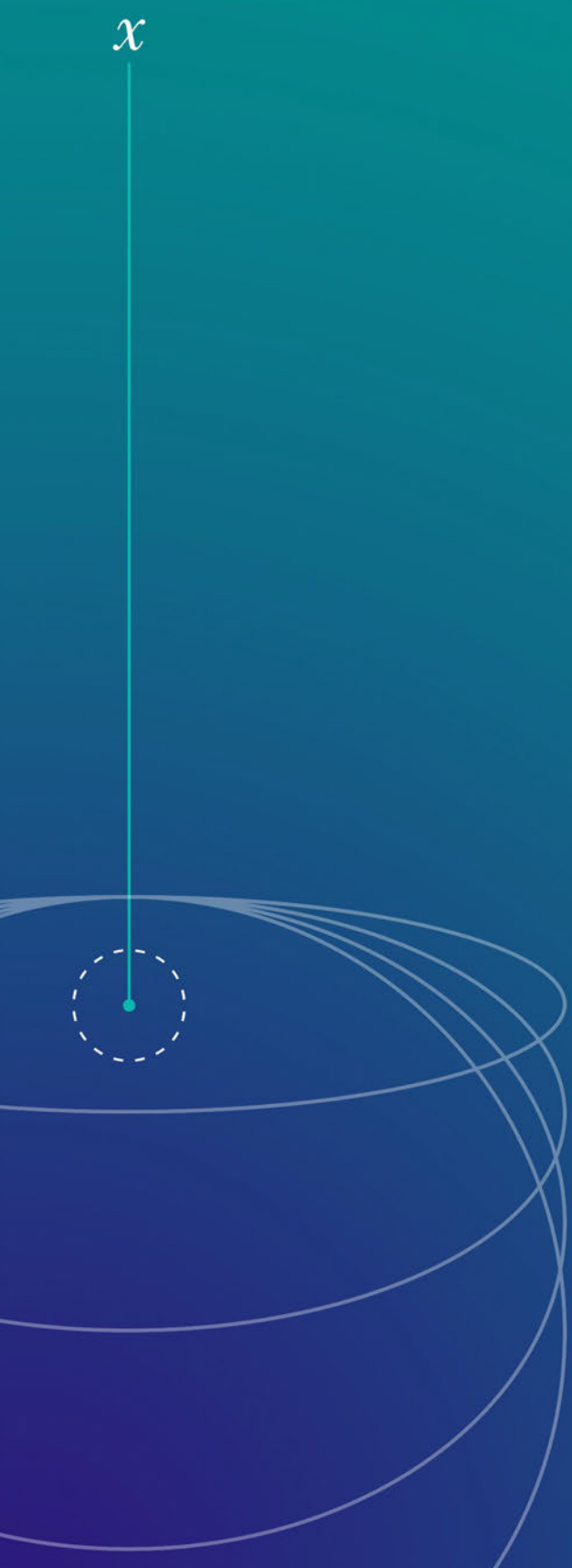
This concludes our prepared supplemental testimony.

Attachment A

Exponent's Advanced Meter MTU EOL Analysis

Confidential

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SoCal Gas Advanced Meter
MTU EOL Analysis

SoCal Gas Advanced Meter MTU EOL Analysis

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Limitations

At the request of SoCal Gas, Exponent conducted an end-of-life analysis of gas meter transmission units. Exponent investigated specific issues relevant to this analysis as requested by client. The scope of services performed during this analysis may not adequately address the needs of other users of this report, and any re-use of this report or its findings, conclusions, or recommendations presented herein are at the sole risk of the user. The opinions and comments formulated during this analysis are based on observations and information available at the time of the investigation. No guarantee or warranty as to future life or performance of any reviewed condition is expressed or implied.

The findings presented herein are made to a reasonable degree of engineering and scientific certainty. We have made every effort to accurately and completely investigate all areas of concern identified during our analysis. If new data becomes available or there are perceived omissions or misstatements in this report regarding any aspect of those conditions, we ask that they be brought to our attention as soon as possible so that we have the opportunity to fully address them.

Executive Summary

Exponent was retained by SoCalGas (SCG) to perform an End-Of-Life (EOL) analysis of its field population of meter transmission unit (MTU) modules. Specifically, Exponent was tasked to project future annual MTU failure quantities in support of SCG long-term budgetary planning including the transition to the next generation of Advanced Metering Infrastructure (AMI 2.0).

To perform this analysis, Exponent engaged in the following activities:

A. MTU Design Analysis: Exponent reviewed the SCG MTU design using publicly available information as well as several sample exemplar units. From this, Exponent identified key subsystems that are subject to failure and identified which subsystems should be given particular attention in subsequent failure and statistical analyses.

B. MTU RMA Analysis: SCG provided Exponent with its dataset and supporting documentation of field units including Return Merchandise Authorization (RMA) units that failed in the field. From this data Exponent identified major failure modes and the role key MTU subsystems may play in the failure. This informed subsequent failure and statistical analyses.

C. MTU Failure Analysis: Exponent received 200 sample RMA field units from SCG (100 Standard Range, 100 Extended Range) for examination and failure analysis (FA). Exponent developed a FA protocol, and identified trends across the 200 units as well as trends associated with specific RMA return codes.

D. MTU Plastic Enclosure Analysis: Exponent received eight RMA field units from SCG that were suspected to have a breach in the outer plastic housing. Exponent selected four of these units for x-ray computed tomography (CT), microscopic examination of the fracture surfaces, and oxidation onset time (OOT) testing.

E. MTU EOL Statistical Analysis: Using the SCG RMA dataset as well as the results of previous tasks, Exponent developed a reliability model that projects the number of MTU failures by year. This model utilizes both a battery EOL model and an analysis of historical MTU failures.

Based on the work performed and our knowledge and experience, our projection of annual MTU failures is summarized in the table figure below:

Calendar Year	Observed or Expected Failures from Exponent's Model	Cumulative # Failures	Total Meters Installed By Calendar Year	Active Meters By Calendar Year (Not Failed or Not Removed)	Rate (% of Meters Installed By Calendar Year)	Cumulative Failure Rate (% of Meters Installed By Calendar Year)	Cumulative Failure Rate (% of Active Meters)
2012	53	53	23,035	23,035	0.23%	0.23%	0.23%
2013	8,105	8,158	1,131,025	1,130,919	0.72%	0.72%	0.72%
2014	27,291	35,449	2,922,084	2,909,986	0.93%	1.21%	1.22%
2015	36,002	71,451	4,641,673	4,574,147	0.78%	1.54%	1.56%
2016	59,029	130,480	5,964,959	5,839,536	0.99%	2.19%	2.23%
2017	68,093	198,573	6,187,750	5,952,689	1.10%	3.21%	3.34%
2018	68,684	267,257	6,348,671	5,980,093	1.08%	4.21%	4.47%
2019	70,357	337,614	6,475,956	5,993,578	1.09%	5.21%	5.63%
2020	62,792	400,406	6,598,477	5,994,288	0.95%	6.07%	6.68%
2021	67,693	468,099	6,713,650	6,000,161	1.01%	6.97%	7.80%
2022	75,646	543,745	6,825,266	5,992,117	1.11%	7.97%	9.07%
2023	93,519	637,264	6,953,372	5,997,772	1.34%	9.16%	10.63%
2024	84,394	721,658	7,082,326	5,992,819	1.19%	10.19%	12.04%
2025	83,271	804,929	7,082,326	5,807,020	1.18%	11.37%	13.86%
2026	83,983	888,912	7,082,326	5,807,020	1.19%	12.55%	15.31%
2027	84,936	973,848	7,082,326	5,807,020	1.20%	13.75%	16.77%
2028	87,839	1,061,687	7,082,326	5,807,020	1.24%	14.99%	18.28%
2029	100,184	1,161,871	7,082,326	5,807,020	1.41%	16.41%	20.01%
2030	143,909	1,305,780	7,082,326	5,807,020	2.03%	18.44%	22.49%
2031	258,517	1,564,297	7,082,326	5,807,020	3.65%	22.09%	26.94%
2032	474,982	2,039,279	7,082,326	5,807,020	6.71%	28.79%	35.12%
2033	761,329	2,800,608	7,082,326	5,807,020	10.75%	39.54%	48.23%
2034	989,753	3,790,361	7,082,326	5,807,020	13.97%	53.52%	65.27%
2035	1,022,948	4,813,309	7,082,326	5,807,020	14.44%	67.96%	82.89%
2036	781,429	5,594,738	7,082,326	5,807,020	11.03%	79.00%	96.34%
2037	454,325	6,049,063	7,082,326	5,807,020	6.41%	85.41%	100.00%
2038	199,528	6,248,591	7,082,326	5,807,020	2.82%	88.23%	100.00%
2039	102,960	6,351,551	7,082,326	5,807,020	1.45%	89.68%	100.00%
2040	83,786	6,435,337	7,082,326	5,807,020	1.18%	90.86%	100.00%

Figure 1. Summary results of statistical analysis, listing projected failure quantities and rates by calendar year.

Our analysis predicts that annual failures will increase significantly from their current rate beginning around 2029 and will peak at more than one million failures in calendar year 2035. In addition to this analysis, we can make the following observations:

- The primary driver for the bulk of MTU failures is battery EOL. We employed a battery EOL model, developed previously by Exponent, that estimates energy depletion in MTU batteries over their normal use lifespans for both Standard Range and Extended Range models.
- The major driver for MTU failures to date is ingress of environmental moisture into the MTU enclosures. Nearly all of the 200 MTUs examined during our failure analysis showed signs of moisture ingress, with some still containing water. Most of the units showed damage arising from the moisture ingress, from direct corrosion of the batteries and printed circuit boards (PCBs), to what appeared to be moisture-mediated electromigration of solder from exposed solder joints. Many of these units had partially or fully depleted batteries as well,

although not all of the failures could be attributed solely to a depleted battery but instead were likely due to damage or faults elsewhere on the PCB.

- An examination of MTUs with fractures, i.e., clear entry points for moisture ingress, revealed that the root cause of failure of the outer plastic housing was stress overload at geometric stress concentrations from impact-type events. Some signs of outer surface oxidation were detected with the OOT data, but a consistent trend throughout the units was not observed. We did not observe significant plastic degradation or fracture patterns consistent with a gradual aging of the plastic.
- The failures to date show an average annual failure rate of approximately 1-2%, with Extended Range units showing a higher failure rate. The annual failure rate has not increased significantly since these MTUs began to be installed in the field in 2012.
- With the evidence that water ingress failures do not appear to be due to a universal aging of the enclosure but instead random external events, combined with the relatively flat failure rate to date, we do not believe that current observed failure modes will increase dramatically in the future and that battery EOL will remain the dominant mode of failure of the bulk of the MTUs.

It is noted that the Executive Summary cannot summarize all of Exponent's technical evaluation, analysis, conclusions, and recommendations. Hence, the main part of this report is at all times the controlling document.

Introduction & Background

Exponent was retained by SoCalGas (SCG) to perform a statistical End-Of-Life (EOL) analysis of its field population of Aclara SmartMeter meter transmission unit (MTU) modules. These modules remotely record and wirelessly transmit customer gas usage data. The MTUs are powered by non-removable batteries that have a finite lifespan; Aclara states a 20-year battery life for normal operation[1]. As the bulk of SCG's SmartMeters were installed in the years 2013-2016, it is expected that the bulk of MTUs will fail in the next 10-15 years. Exponent was tasked to project the annual number of MTU failures through the population's lifetime and to estimate when the bulk of units will fail. The aim of the projection was to support SCG long-term project planning as these MTUs fail and get replaced by the next generation of SmartMeters, i.e., Advanced Metering Infrastructure 2.0 (AMI 2.0).

Previously in 2021, Bridgewater Consulting Group performed an EOL Analysis for SCG[2] based on a battery failure model provided to them by Aclara, as well as a Weibull statistical analysis of MTU failures up to the date of 4/30/2021. The scope of the Bridgewater work did not include failure analysis (FA) of field return MTUs.

One goal of the Exponent work was to perform an EOL analysis with updated data past 2021. In addition, Exponent's scope included a FA of field return units to examine the root causes of historical SmartMeter failures, in particular failures caused by ingress of environmental moisture into the MTU enclosure. A material analysis was also performed on MTU enclosures to understand the nature of failures in the plastic (e.g., cracks or fractures) that could allow environmental moisture into the MTU. Exponent's scope of work was organized around 5 technical Tasks; this report reflects that organization with sections for Task A, Task B, etc. The Tasks are as follows:

A. MTU Design Analysis: Exponent reviewed the SCG MTU design using publicly available information; SCG also provided Exponent with 6 exemplar MTUs which Exponent disassembled and examined. Exponent identified a set of key subsystems that are subject to failure and identified which subsystems should be given particular attention in subsequent failure and statistical analyses.

B. MTU RMA Analysis: SCG provided Exponent with its dataset and supporting documentation of field units including Return Merchandise Authorization (RMA) units that failed in the field. From the dataset and information learned in Task A, Exponent identified potential failure modes and the roles key MTU subsystems may play in unit failure. This informed subsequent failure and statistical analyses.

[1] 'Series 3000 Direct Mount Gas MTU Spec Sheet.pdf'.

[2] The report is titled "AM MTU EOL Analysis" and was provided by SCG as the file 'SCG AM MTU EOL Final Report 20210926.pdf'

C. MTU Failure Analysis: Exponent received 200 RMA field units from SCG (100 Standard Range, 100 Extended Range) for examination and failure analysis. Exponent developed a FA protocol that evaluated the exterior and interior conditions of the MTUs including the printed circuit boards (PCBs) and batteries. and identified trends across the 200 units as well as trends associated with particular RMA return codes.

D. MTU Plastic Enclosure Analysis: Exponent received eight RMA field units from SCG that were suspected to have a breach in the outer plastic housing. Exponent selected four of these units for x-ray computed tomography (CT), microscopic examination of the fracture surfaces, and oxidation onset time (OOT) testing. Based on this testing, Exponent determined the root cause of failure of the outer plastic housing was stress overload at geometric stress concentrations. Some signs of outer surface oxidation were detected with the OOT data, but a consistent trend throughout the units was not observed.

E. MTU EOL Statistical Analysis: Aclara declined to provide materials for Exponent's EOL analysis and so Aclara's battery EOL model was not used. Instead, Exponent used a previously-developed model for battery wear-out that takes into account MTU usage patterns, including the differences between the Standard Range MTUs and the higher-power Extended Range MTUs. Exponent combined this model with a multipronged statistical analysis of the MTU failures to date. The combined analysis predicts failure numbers from 2025 to 2040, when nearly all currently-installed MTUs will have failed due to battery EOL or other reasons.

Summary reports for each of these Tasks have been previously provided to SCG[3]. This report is not intended to be an exhaustive recapitulation of the Task reports; instead, what follows is a summary of the major findings from each Task, and a Discussion section that summarizes Exponent's current understanding of failure in SCG MTUs and points at possible next steps.

[3] Task A: 'SoCalGas MTU EOL Task A Design Analysis May 16 2025.pdf". Task B: 'SoCalGas MTU EOL Task B RMA Analysis 23 May 2025.pdf'. Task C: 'SoCalGas MTU EOL Task C Failure Analysis 20 Jun 2025.pdf'. Task D: 'SoCalGas MTU EOL Task D Polymer Analysis.pdf'. Task E: 'SoCalGas MTU EOL Task E Statistical Analysis.pdf'.

Task A: MTU Design Analysis

A critical input to the MTU EOL analysis is an understanding of the MTU design itself, including the design of components and subsystems and their potential contributions to failure at all unit life stages. Exponent did not receive any non-public design information from SCG or the device vendor Aclara, such as diagrams, manufacturing documentation, circuit schematics, bills of materials, etc. Exponent based its analysis on public documentation of the MTUs, primarily a datasheet of the Aclara Series 3000 MTU[1]. In addition, Exponent received several exemplar MTU units, which were examined and disassembled to understand their subsystems and components. The Task A report[4] was provided on May 16, 2025.

Summary of Task A Findings

Table 1 shows basic information for the 6 exemplar MTUs received by Exponent. All units had been manufactured within the previous six months of receipt except for Ex3, which displayed a manufacture date of 12/17/2013 and showed signs of use such as dirt and scuff marks. All 6 were listed as Extended Range units. Exemplars Ex1-Ex3 were also "Remote" units, in which a second enclosure containing the communication subsystem was connected to the metering enclosure via a cable. As-received images of the 6 units are shown in Figure 2.

Table 1. Details of 6 exemplar MTUs received by Exponent.

Meter #	MTU ID	Model	Manufacturer Info	Manufacture Date
Ex1	109622616	3221-039-RBS2W-SCG	ITRON/Curb/Remote/Extended	4/4/2025
Ex2	109544363	3221-010-RBS2W-SCG	AMERICAN/ELSTER /Residential/Remote/Extended	10/23/2024
Ex3	100264762	3221-022-RBS2W-SCG	ROCKWELL/SENSUS 18-TOOTH/Commercial/Remote/ Extended	12/17/2013
Ex4	109582276	3141-021-RBS2W-SCG	ROCKWELL/SENSUS 11-TOOTH/Residential/Direct/ Extended	1/15/2025
Ex5	109633384	3151-031-RBS2W-SCG2	SPRAGUE/ITRON SLANT FACE/Residential/Direct/ Extended (V2.0 XR)	3/24/2025
Ex6	109576931	3131-010-RBS2W-SCG	AMERICAN/ELSTER/ Residential/Direct/Extended	1/13/2025

[4] 'SoCalGas MTU EOL Task A Design Analysis May 16 2025.pdf'.

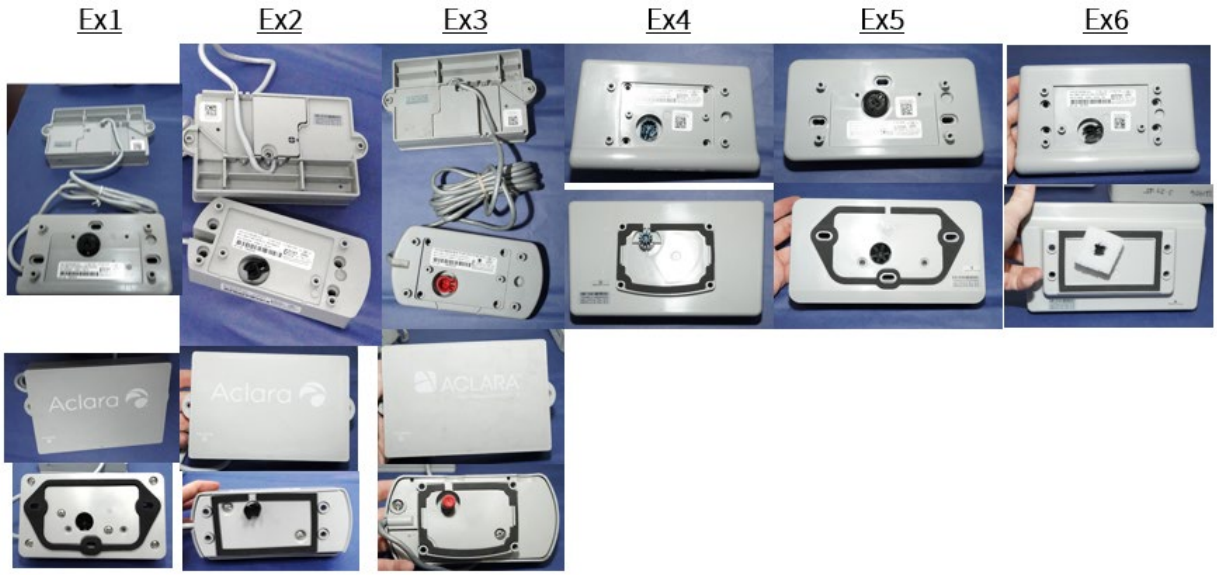


Figure 2. Exemplar MTUs as received. Ex1-Ex3 have a second remote antenna as a part of their design.

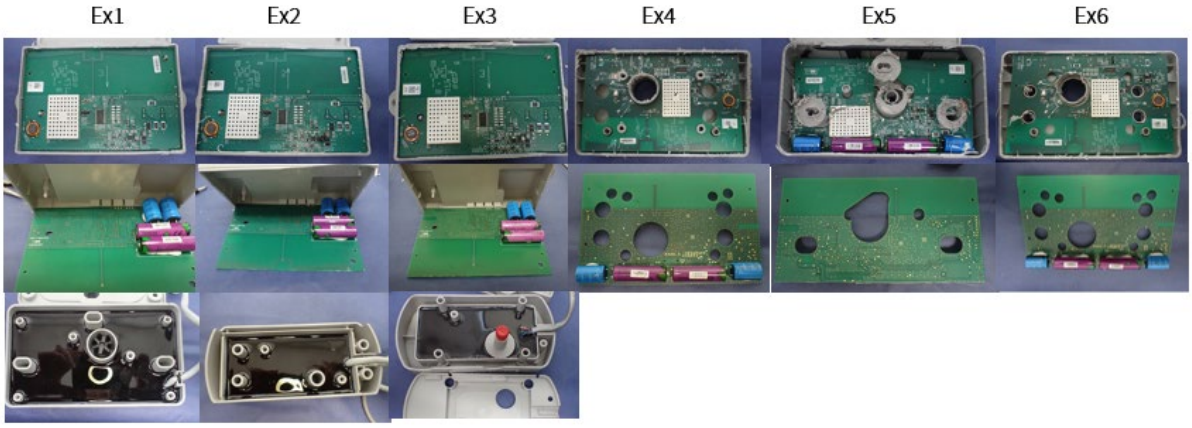


Figure 3. Exemplar MTUs after opening the enclosures. The metering unit circuit boards in Ex1-Ex3 are encased in a hard potting material and were not examined visually.

Each unit was visually examined and photodocumented, x-rayed, and opened to inspect the interior printed circuit boards (PCBs). The units with PCBs exposed are shown in Figure 3. Exponent identified the unit's key functional subsystems that were then used as the basis for the Task B RMA analysis. These subsystems included the following:

- **Communication and Control:** RF transceiver[5] and front-end module[6] ICs are used for communication, with the RF antenna embedded in the PCB. The RF circuit components are enclosed in a radiation shield. A microcontroller unit (MCU)[7] IC is used for board logic and memory.
- **Sensors:** There are several magnetic reed switches[8] used for metering and for generating alarms such as tampering alarms mounted on the PCB. A tilt switch[9] is also present to detect if the MTU is removed or moved from its mounted vertical position.
- **Battery and Power:** The MTU is powered by two 3.6 V primary lithium batteries[10] that are welded to tabs soldered onto the PCB. The batteries are labeled BT1 and BT2. The batteries are accompanied by two electrolytic capacitors[11] used for transient charge storage while powering the RF circuit for communication. The batteries are not in series and appear to be used in different ways, with BT2 mostly providing power for the RF circuit and BT1 supporting lower-power functions such as quiescent power for the MCU and sensor components.

[5] Analog Devices ADF7021. Datasheet can be found at https://www.analog.com/media/en/technical-documentation/data-sheets/ADF7021.pdf

[6] Skyworks SKY65342-11. Datasheet can be found at https://media.digikey.com/pdf/Data%20Sheets/Skyworks%20PDFs/SKY65342-11.pdf

[7] Texas Instruments MSP430F22. Datasheet can be found at https://www.ti.com/product/MSP430F2274

[8] The manufacturer and model of the reed sensors could not be identified.

[9] The tilt switch appears to be manufactured by Comus, but the exact model could not be identified. More information on these switches can be found at https://comus-intl.com/product-category/tilt-switches-motion-sensors/tilt-tip-over-switches/

[10] Tadiran TL-4903. Datasheet can be found at https://tadiranbat.com/wp-content/uploads/2022/03/tl-4903.pdf

[11] Lelon electrolytic capacitors are used throughout, but the model number varies by manufacturer.

Task B: MTU RMA Analysis

Using the outputs of the design analysis in Task A, this Task considered what roles these subsystems and components might play in MTU failures in the field. In support of this Task, SCG provided Exponent with a dataset[12] of its MTU SmartMeters that includes failures dating back to approximately 2012. SCG also provided a document[13] summarizing SCG's Return Merchandise Authorization (RMA) process and how different types of MTU failures are defined. A high-level review of the dataset was performed as a part of this Task, but discussion of the dataset will be reserved for the more thorough statistical analysis summarized later in this report. The Task B report[14] was provided on May 23, 2025.

Summary of Task B Findings

Figure 4 shows a table from SCG's RMA process write-up summarizing the RMA Meter Removal Reason Codes assigned to MTUs when they fail in the field. These codes represent determinations made by SCG based on specific MTU behavior or performance metrics and are not simply error codes generated by the MTU itself. Several categories of codes are highlighted with different colored boxes in Figure 4. These highlighted categories are as follows:

- **Communication failures** (blue boxes) such as ZCM (non-comm), ICH and ICL, where the MTU fails to communicate consistently or does not communicate at all.
- **Alarm failures** (red boxes) such as 630, AGA, XAC, and GAP, where the MTU communicates a defined number of false alarms over a defined period of time. The "three strikes" error code 3ST is no longer used by SCG and was ignored.
- **Other MTU errors**, including Negative Usage Spike (NUS) failures (green box), which occur when a MTU communicates a large positive or negative usage spike that does not correspond to actual gas usage. The NUS failure is highlighted separately from these other MTU error codes due to its unique characteristics and its relevance for the 200-MTU sample failure analysis in Task C. All failure codes listed here were considered as a part of the statistical analysis of Task D.

Based on a study of RMA code definitions and our understanding of MTU design derived from Task A, we developed initial hypotheses on the sources of different RMA failure types; this helped guide the structure and areas of focus in the MTU failure analysis (FA) work of Task C.

[12] 'Exponent Export 2.txt'.

[13] 'MTU Analysis Process Write-Up.docx'.

[14] 'SoCalGas MTU EOL Task B RMA Analysis 23 May 2025.pdf'.

Meter Removal Reason Code	Failure Category	Failure Name	Failure Description
3ST	MTU Alarms	Three Strikes	alarming module with suspected read gap
630	MTU Alarms	6 in 30	6 hours of alarm duration in 30 days - curb only (includes Magnetic & Reverse Flow alarms)
AGA	MTU Alarms	Above Ground Alarming	6 hours of alarm duration in 30 days - above ground only (includes all 5 MTU Tamper alarms)
GAP	MTU Alarms	Gap	verified read gap
ICH	Communication	Intermittent Communication - High	performance 75% to 90%
ICL	Communication	Intermittent Communication - Low	performance above 0%, below 75%
MDF	MTU Errors	Manufacturing Defect	unique defect in manufacturing, used for special cases only
NUS	MTU Errors	Negative Usage/Usage Spike	extreme downward (negative) or upward spike in consumption
OTH	MTU Errors	Other	miscellaneous failure
RNR	MTU Errors	Remediation, No Reimbursement	replaced for some reason other than module failure
SV1	MTU Errors	Sprague V1	an early module type deemed defective but only replaced when it fails
WIL	MTU Errors	Wrong Interval Length	interval other than 60 minutes reported
WIT	MTU Errors	Water Intrusion	primarily for specific Dresser Z modules with identified manufacturing defect
WWB	MTU Alarms	Wireless Wire Break	wire break alarm for direct mount modules, i.e. modules with no tether to break
XAC	MTU Alarms	Excessive Alarm Count	10 tamper alarms in 365 days (includes all 5 types of MTU Tamper alarms)
ZCM	Communication	Zero Communication	module not communicating

Figure 4. RMA failure codes provided by SCG. Certain classes of failures are highlighted, including communication failures (blue boxes), alarm failures (red boxes), and negative usage spike (NUS) failures (green box).

For **communication errors**, a primary driver is loss of battery energy. If the battery cannot supply sufficient power to drive the RF circuit, communication will cease (ZCM). As batteries approach end of life and their voltages drop, there may be conditions under which communication is only intermittently successful (ICH, ICL). Faults in the RF ICs themselves or the MCU could also lead to a sudden loss of communication and appear as a ZCM error. While all batteries will eventually reach EOL during normal operation, there are additional factors that could lead to premature loss of energy, the most significant of which is environmental moisture ingress & contamination. Such contamination can reduce energy available to the communication subsystem in a number of ways, such as corroding the batteries directly, damaging components needed for communication to operate, or generating current leakage paths that prematurely drain the battery before its expected end of life.

For **alarm errors**, sensor malfunctions are a key potential contributor, but from our understanding of the MTU circuit, we expect battery & power-related failures to also generate alarms. The reed and tilt switches are binary sensors that are used to switch between a high and low voltage signal when triggered. As this voltage ultimately depends on the battery voltages, any disruption in the battery voltage could potentially alter the high or low signals and generate a false signal to the MCU that is interpreted as an alarm. As such, ingress of moisture & contamination could potentially lead to alarm errors, although, without a full understanding of the MTU circuit, we cannot identify the exact mechanism.

Other MTU errors arise for a variety of reasons and cannot be traced to a single failure mode. Of these error codes, the **negative usage spike (NUS)** error is of particular interest due to its impact on gas billing. As usage is metered using magnetic reed sensors, it is less clear how moisture ingress & contamination could generate this particular error. The characteristics of MTUs with NUS errors is considered in more detail in Task C, where a set of these units underwent failure analysis.

Task C: Failure Analysis of 200 MTU RMA Units

Physical failure analysis (FA) of RMA return MTUs is an essential technique for determining the root cause(s) of MTU RMA failures. SCG provided Exponent with a sample of 200 MTUs that had failed in the field, were assigned RMA codes, and were removed. Based upon the analyses of Tasks A and B, Exponent developed a FA protocol to perform on the 200 units. After FA had been performed on each unit, Exponent analyzed the results, comparing them with each MTU's identifying information and history, including the RMA category to which they were assigned. The Task C report[15] was provided on June 25, 2025. A spreadsheet[16] summarizing the FA findings on the 200 units is provided separately.

Summary of Task C Findings

Sample MTUs

Figure 5 shows the distribution of the 200 units according to their assigned RMA code. This code is taken from the "1ST_RMA" column in the RMA dataset, and is the code assigned to the unit when it first begins to fail. Of the 16 codes listed in Figure 4, only 5 are represented in the sample of 200 units. Of these, the predominant codes are the communication code ZCM, the alarm code AGA, and the NUS code. 6 units have the XAC alarm codes, and a single unit has the ICL communication code. The codes ICL & ZCM are grouped in Figure 5 as "Comm" codes, AGA & XAC are grouped as "Alarm" codes, and NUS is grouped on its own. We note that this distribution is not representative of the full RMA population as documented in the RMA dataset and any extrapolation of Task C results to the full population should be made with care.

[15] 'SoCalGas MTU EOL Task C Failure Analysis 20 Jun 2025.pdf'.

[16] '200 MTU FA Data.xlsx'.

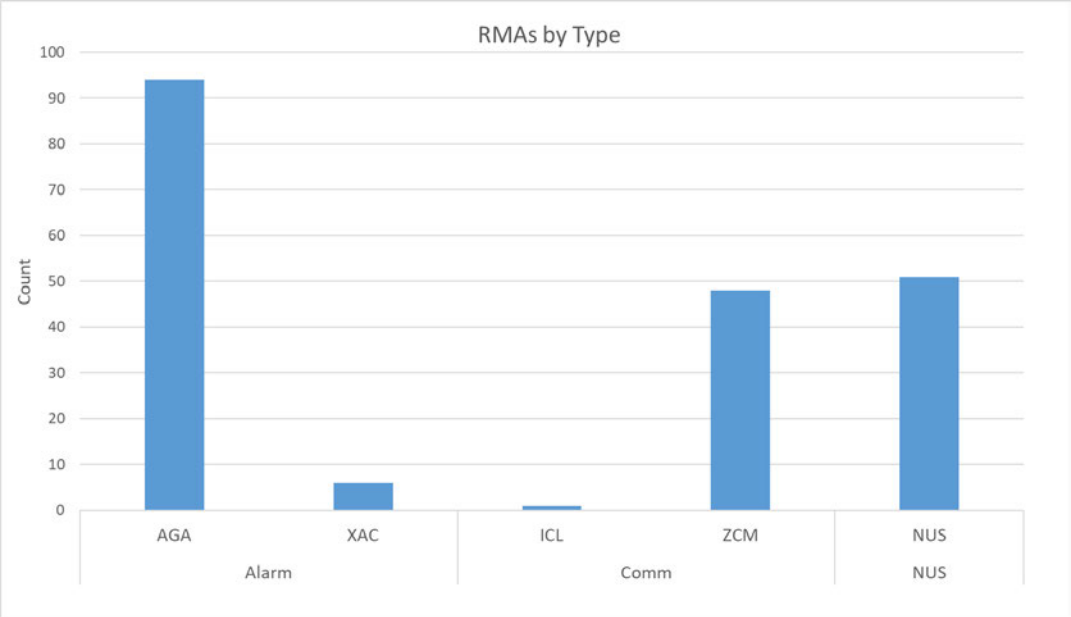


Figure 5. Distribution of sample units by RMA code, as listed in the "1ST_RMA" column in the SCG RMA dataset.

Figure 6 shows the distribution of units according to the Time to Failure in years. The time to failure is calculated by subtracting the column "FAILURE_YEAR" from the column "INSTALL_CLASS". The bars are color-coded according to the failure group types Alarm, Comm, & NUS. As can be seen, most of the units with Comm codes failed 9-12 years after installation, while most units with NUS codes failed within the first couple years after installation. The units with Alarm codes have a wider distribution of ages. These trends are present in the larger RMA population, although in different proportions.

We note that, although 100 Standard Range and 100 Extended Range units were provided, nearly all of the recent MTU installations have been of Extended Range units, which makes quantitative comparisons between Standard and Extended Range units difficult. from Figure 6, nearly all units with NUS failures (which are mostly early life failures) are Extended Range. Figure 7 shows the distribution of Time to Failure by Range model; as can be seen, most of the early year failures in the MTU sample are Extended Range, while most of the older failures are Standard Range.

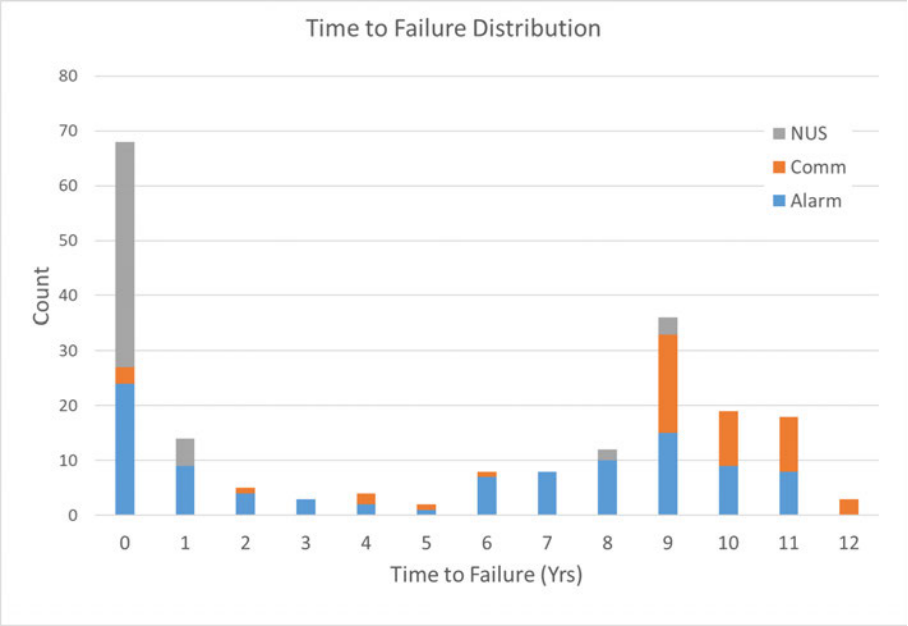


Figure 6. Distribution of sample units by years to failure, i.e. the difference between the "FAILURE_YEAR" and "INSTALL_CLASS" columns in the RMA dataset. The bars are colored according to the Comm/Alarm/NUS RMA code grouping.

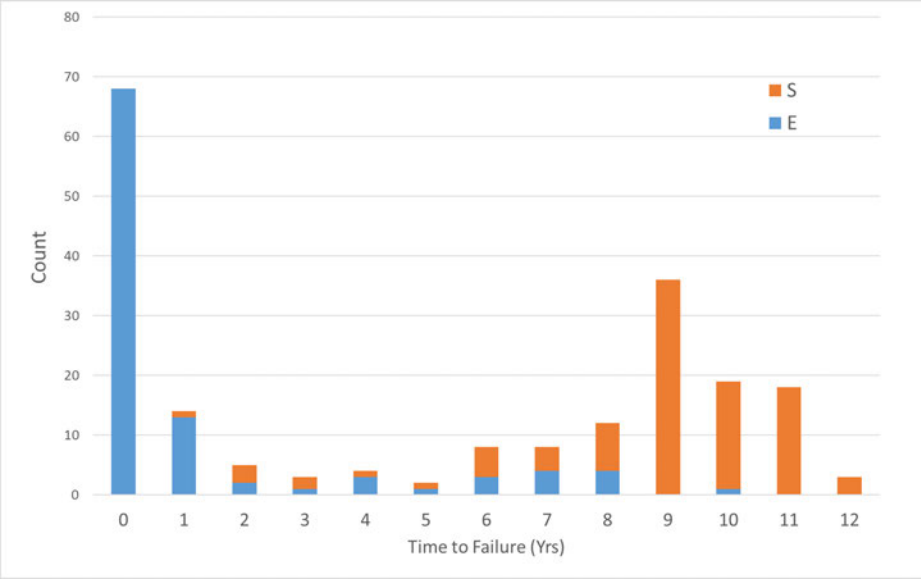


Figure 7. Distribution of sample units by years to failure, i.e. the difference between the "FAILURE_YEAR" and "INSTALL_CLASS" columns in the RMA dataset. The bars are colored according to Range model (S = Standard, E = Extended).

FA Protocol

Based on our analysis of the MTU design and the categories of RMA failure codes, we developed a FA test protocol to be applied to all 200 sample units. This protocol allowed us to categorize each MTU across several quantitative and qualitative metrics and identify trends or correlations with the RMA code categories. The FA protocol consisted of the following steps:

1. Visual inspection and photodocumentation of the exterior of the unit, noting its condition and any visible damage.
2. Opening of the unit enclosure[17].
3. Visual inspection and photodocumentation of the interior of the enclosure and the PCB, noting its condition and any visible damage. This includes identifying damage specific to any key subsystem or component.
4. Voltage testing of the MTU batteries BT1 and BT2[18].
5. Testing the basic functionality of the tilt and magnetic reed sensors[19, 20].
6. Additional microscopy and SEM-EDS on a subset of the units with features of note.

Unit Intake and Initial Visual Inspection

Each of the 200 units were photodocumented upon receipt and identifying information such as MTU ID and model was recorded. For simplicity, a shorthand naming convention was used according to how they were delivered (shipping box and position within the box)[21]. A spreadsheet[16] showing the MTU IDs and other information corresponding to each shorthand name is provided separately. The enclosures showed varying levels of dirt and wear-and-tear, but only one unit (B2-M7) showed a clear crack in the enclosure (Figure 8). No clear breaks along the weld seals of the other units could be seen, although we cannot rule out the presence of very thin cracks being present.

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[17] The construction of the enclosure involves nominally water-tight plastic weld seals around the perimeter as well as around several through-holes that pass through the interior PCB. Opening the unit without damaging the PCB thus requires specialty machining tools and precision cutting. Exponent developed a reliable and repeatable method for opening the 200 units that is not detailed in this report.

[18] The voltage measurements were taking using a digital multimeter with 2 probes. The measurements were taken under three conditions: 1) *in situ*, i.e., still connected to the board; 2) after removed from the board with an open load; and 3) after removed from the board with a 1 kΩ load connected to the battery terminals. Measuring voltages under a finite load gives more information about the remaining energy capacity of the battery, as the battery voltages reported by the MTU themselves draw very little current and would not detect a battery that failed to provide the larger currents needed for RF communication.

[19] For the tilt sensor, the resistance across the terminals was measured and the board was repeatedly rotated from a vertical position with the antenna board edge facing up, to a horizontal position. The sensor was designated "OK" if the sensor presented a high ~100's kΩ resistance with the board vertical and abruptly switched to a short as the board tilted and if this behavior was repeatable over several rotations. Similarly, the magnetic read sensor resistance was measured as a permanent magnet was brought near it. An "OK" reed sensor switched from a high resistance to a short when the magnet was nearby in a repeatable manner.

[20] None of the reed or tilt sensors showed signs of defect or damage in our testing.

[21] The 200 units were delivered in 10 boxes of 20 units each; the Standard Range units were in 5 boxes labeled 1, 2, …, 5, and the Extended Range units were in 5 boxes labeled A, B, … , E. The shorthand notation took the form B(box# or letter)-M(position in box), e.g., B3-M13.

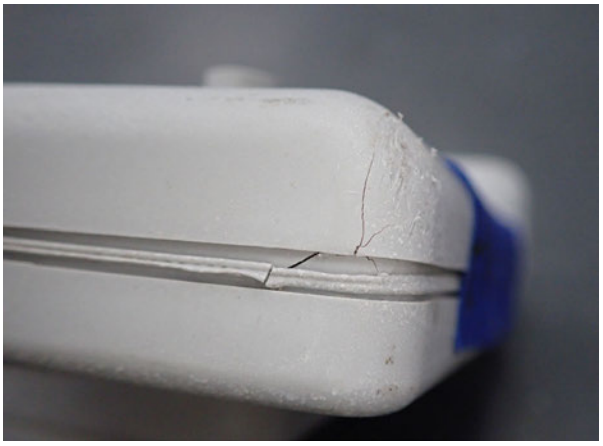
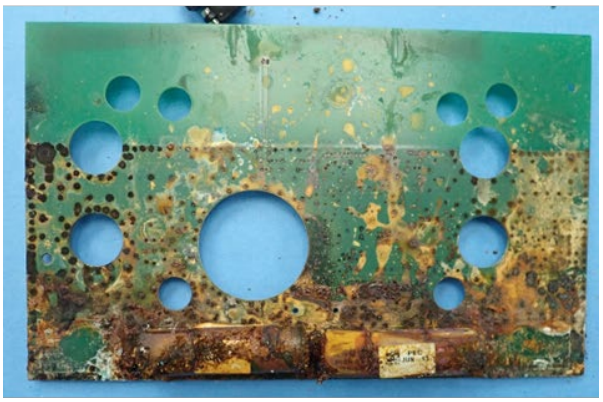


Figure 8. Unit B2-M7 showing cracks in enclosure.

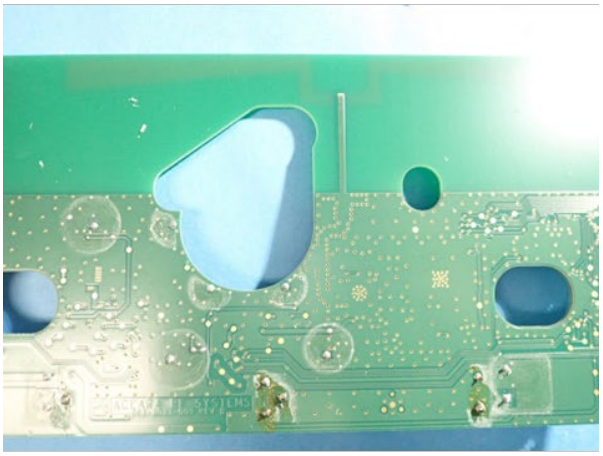
MTU Teardown and PCB Examination

After visual examination of the exteriors, the MTUs were opened and the interiors and PCBs were examined. Nearly all MTU PCBs showed some level of residue or contamination, regardless of RMA code. On the extreme end, some MTUs contained liquid water and the board and batteries were heavily rusted. Many units did not show corrosion or visible liquid but had significant board residue. We developed a scale of PCB contamination level based on visual evaluation of the board's condition, with Level 3 assigned to PCBs with clear signs of corrosion and/or rusting, Level 2 assigned to boards with significant residue that is not clearly corrosion or rusting, and Level 1 assigned to boards with minimal to no residue or contamination. Figure 9 shows examples of each contamination level found in the MTUs. Figure 10 shows the populations of each contamination level, with the different colors showing each level's makeup by RMA failure category. There were 16 units at Level 3 with heavy corrosion or contamination, 109 units at Level 2, and 75 units at Level 1. No NUS units had Level 3 contamination, while Alarm and Comm failures were represented at all 3 contamination levels.

Level 3 (B3-M3)



Level 2 (B5-M16)



Level 1 (BB-M9)

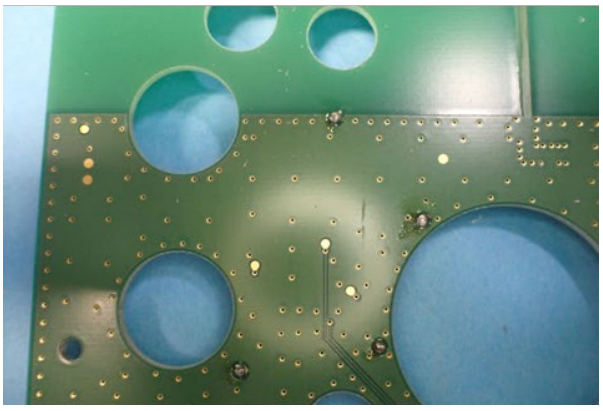


Figure 9. Examples of MTU PCBs assigned contamination levels of 3 (high, top image), 2 (medium, middle image), and 1 (low, bottom image).

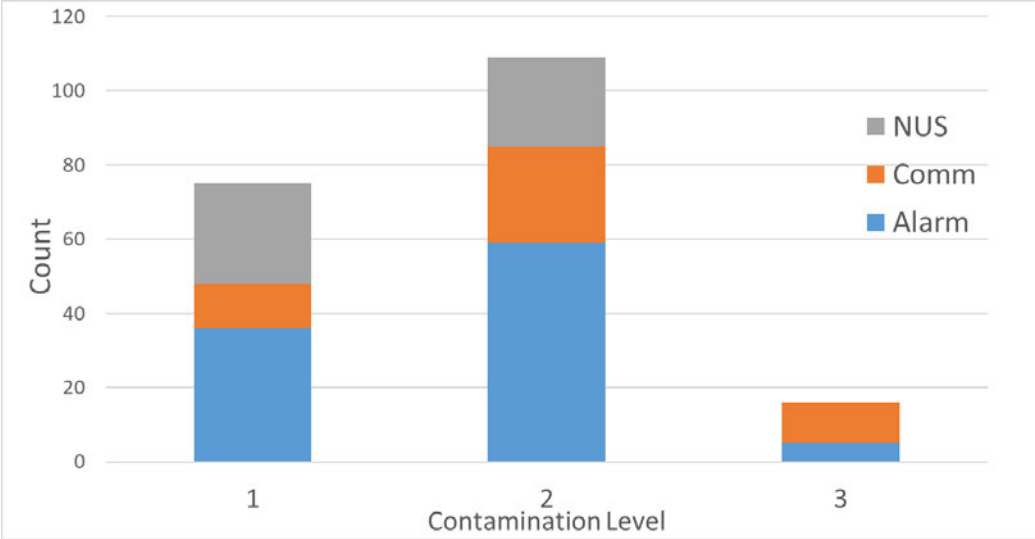


Figure 10. PCB contamination level populations, showing each population's makeup by RMA failure category.

Chemical Analysis of Residue

While the corrosion observed on Level 3 PCBs visually appeared consistent with the oxidation of board materials by moisture contamination, the residue seen on Level 2 PCBs had a different visual appearance. This residue often appeared in geometric patterns around manual solder locations, such as where components such as sensors, capacitor terminals, and battery weld tabs were soldered. This residue appeared crystalline in nature and had distinct tracking patterns, tending to follow paths between solder joints at different voltages (e.g., a grounded solder joint and a joint at the battery potential of 3.6 V); see Figure 11. Exponent performed Scanning Electron Microscopy-Energy Dispersive Spectroscopy (SEM-EDS) to identify the composition of the corrosion and residue found on the MTU PCBs. The testing indicated the presence of tin and lead in the residue, with certain residue crystals being mostly tin and others being mostly lead.

The observed residue patterns and chemical makeup are consistent with a process of electromigration of the solder used at the manual solder joints, with metallic ions in the solder (which likely is a tin-lead alloy) being driven to other locations via an electric potential gradient[22]. This process typically requires a liquid medium into which the ions dissolve; moisture ingress could provide this medium. Although the patterns have the characteristics of an electromigration process, further testing is needed to confirm this hypothesis.

Direct shorts caused by the residue were not found during the FA, as liquid was no longer present and the metal ions had crystallized into electrically isolated chunks. However, the

[22] See, e.g., https://www.tokimeku.com/blogs/news/how-do-dendrites-grow-on-electronic-assemblies

electromigration process requires a flow of charge and thus a leakage current was present while the ions traveled. Although we cannot quantify the size and duration of such leakage currents after the fact, it is reasonable to conclude that electromigration provided leakage currents that reduced the energy of the batteries and may have altered or inhibited circuit function.

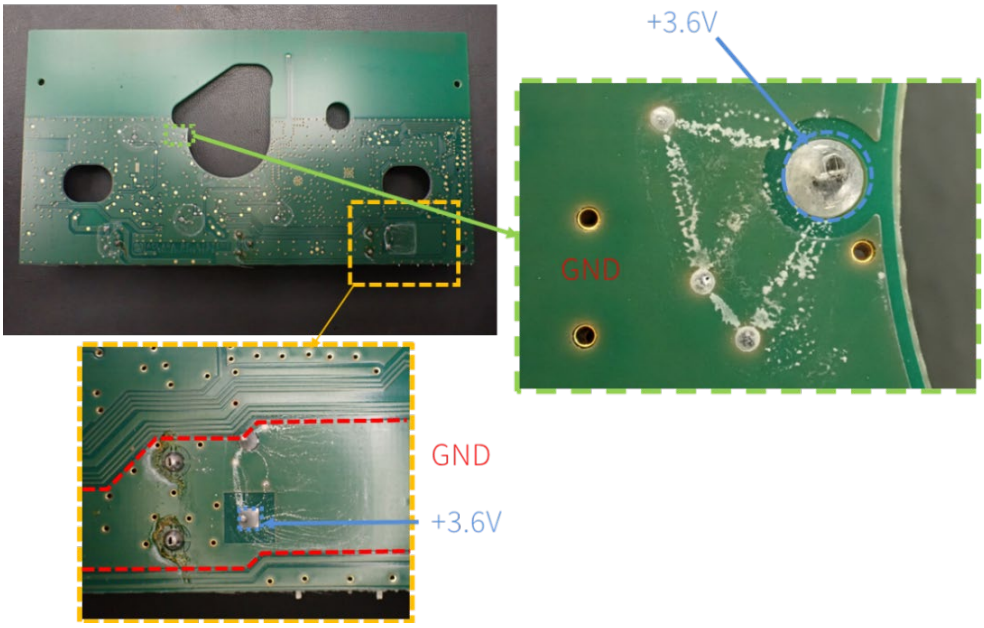


Figure 11. PCB from unit B3-M2, showing residue tracks between solder joints at different potentials.

Battery Testing

For each of the 200 units, the two batteries BT1 and BT2 were tested under 3 different load conditions: *in situ*, under an open load after removal, and under a 1 kΩ load after removal. Figure 12 shows the BT1 and BT2 voltages for each MTU *in situ* (blue dots and lines) and under a 1 kΩ load (red dots and lines). Most batteries appear healthy *in situ*, with voltages at or above 3.6 V. A larger number of BT2 batteries show low or zero voltage *in situ*. Under the 1 kΩ load, all batteries show a lower voltage but most are still in the 3.5 V range. Again, more BT2 batteries show low or zero voltage under the load than BT1 batteries.

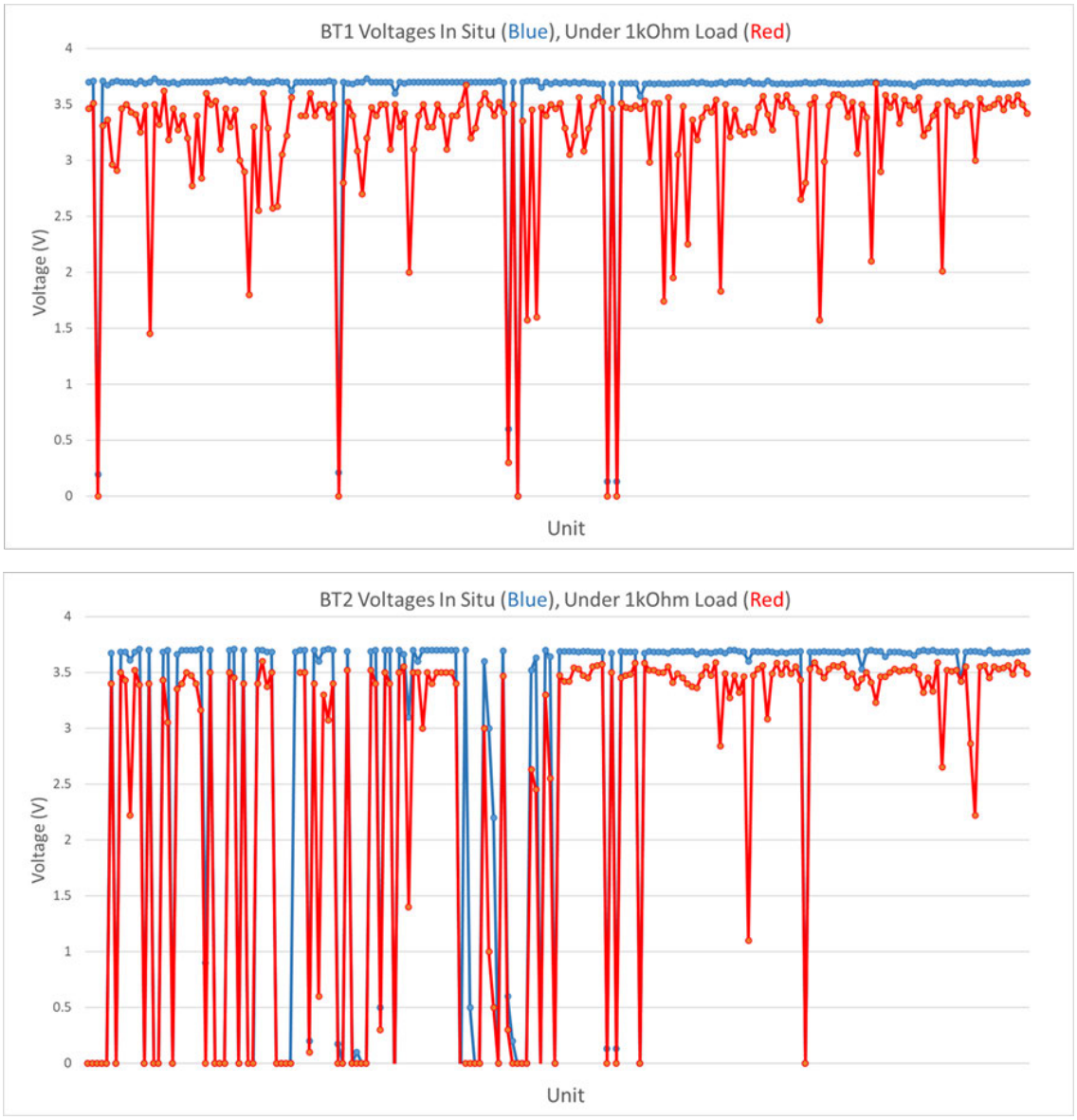


Figure 12. Voltages from each MTU for battery BT1 (top graph) and BT2 (bottom graph) under 2 conditions: *in situ* (blue dots and lines), and under a 1 kΩ load (red dots and lines).

Data Analysis

Exponent analyzed the FA data and compared it to the corresponding data for each MTU in the RMA dataset. Figure 13 shows the average BT1 and BT2 voltages for each of the test conditions, grouped by RMA failure code class (Comm, Alarm, NUS). MTUs with Comm failures show the lowest average BT1 and BT2 voltages, with the average BT2 voltage showing significant depletion, approximately 2 V below the average BT1 voltage. MTUs with Alarm failures also

show lower BT2 voltages than BT1 voltages, but with a smaller voltage difference. For NUS failures, both BT1 and BT2 have batteries that largely do not appear depleted.

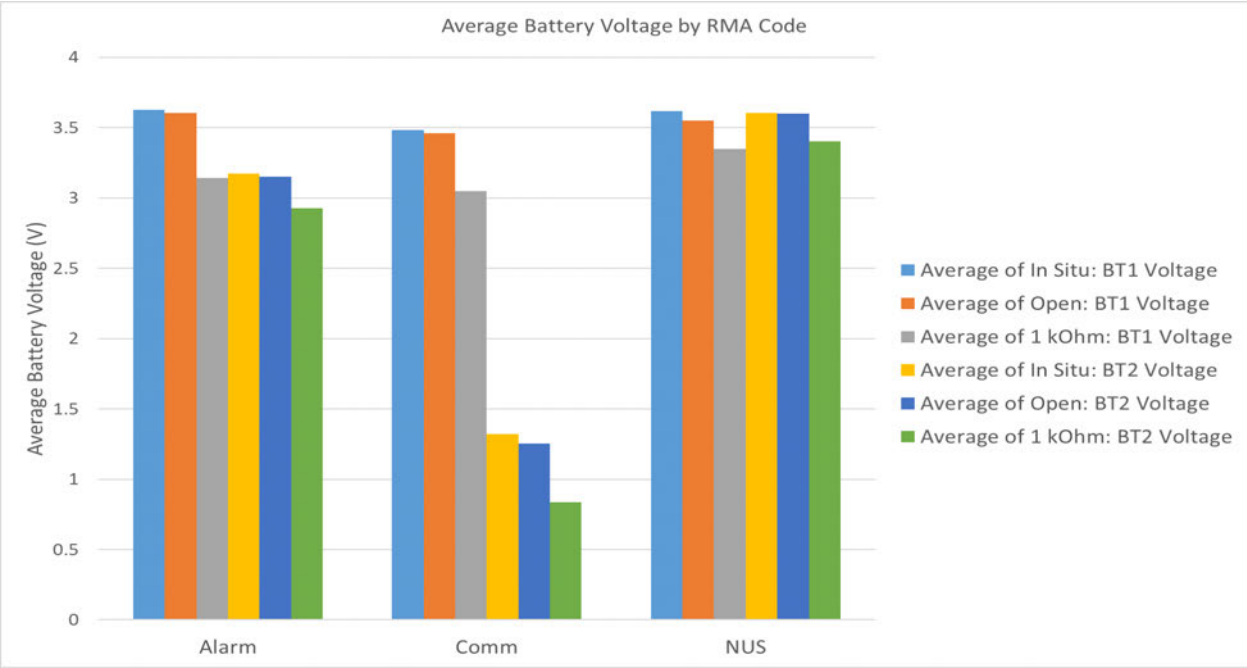


Figure 13. Average voltage for batteries BT1 and BT2 under different load conditions, grouped by RMA failure category.

The average battery voltages and the PCB condition also show some correlation. Figure 14 displays the average voltages of batteries BT1 and BT2 for each of the test conditions, grouped by PCB contamination level (3 = clear corrosion, 2 = no clear corrosion but significant residue, 1 = little to no residue). For the heavily corroded Level 3 PCBs, BT2 is almost fully depleted on average. For the Level 2 PCBs with significant residue, BT2 on average is lower than BT1 but still retains some energy. The Level 1 PCBs have average voltage levels similar to Level 2 PCBs.

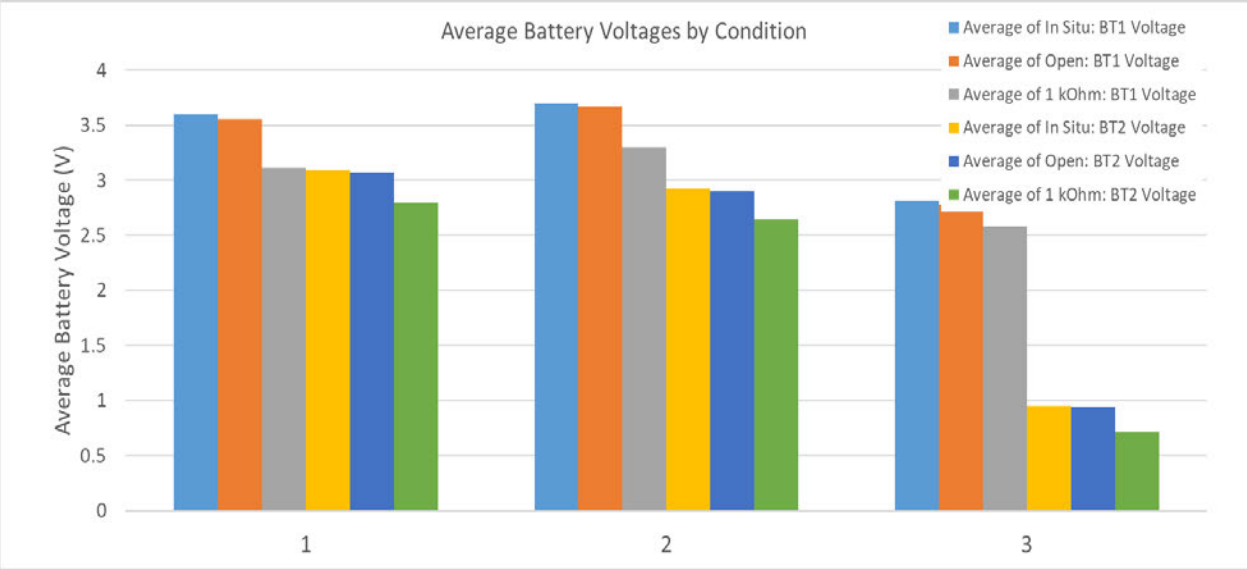


Figure 14. Average voltage for batteries BT1 and BT2 under different load conditions, grouped by PCB contamination level (3 = clear corrosion, 2 = no clear corrosion but significant residue, 1 = little to no residue).

Discussion

PCBs that have clear signs of water ingress show corrosion and depleted batteries consistent with either current leakage or battery damage that leads to loss of MTU function. As BT2 voltages were found to be consistently lower than BT1 voltages, battery depletion is likely caused by current leakage in the circuit rather than direct battery damage that would have affected both batteries equally on average. BT2 appears to drive higher power functions of the MTU such as RF communication, so a loss of BT2 energy is likely to trigger a Comm error. The Alarm errors also show some battery depletion, but it is less severe than for the Comm failures. This may indicate that, as discussed in Task B, a partially depleted battery results in lower voltages that could lead to ambiguous sensor signals and thus false alarms.

The presence of residue is common to most of the MTU PCBs. If this is due to a moisture ingress-driven electromigration process as appears probable, the impact on MTU performance could vary widely, from direct shorting and rapid battery depletion, to higher-resistance current leakage paths that change over time. As the reed sensor solder joints are common locations for this residue, the residue may have an outsized impact on the signals generated by the sensors and may lead to alarm failures without significant depletion of the batteries themselves.

Of the MTUs in the provided sample, those with NUS failures have on average the least internal contamination and the highest average battery voltages. They also largely failed within the first 2 years after installation, as seen in Figure 6. This would suggest a weak dependance of NUS failures on water ingress, although many NUS units showed some level of internal contamination

or residue. Further testing including possible failure recreation is required to elucidate the root cause of NUS failures.

The sample provided does not clearly display trends between Standard Range and Extended Range units, as the distributions in time to failure and RMA code are significantly different and likely mask any trends in Range model alone. For failures that arise from depleted batteries, we would expect Extended Range models to fail sooner as more battery energy is used over time for normal operation; our statistical analysis in Task E is consistent with this expectation.

The prevalence of contamination-related failures in the sample MTUs show a failure in the water resistance of the plastic enclosures. In Task D, we take a closer look at the nature of these plastic failures.

Task D: MTU Enclosure Material Analysis

Damage to the MTU enclosures or other failures of the unit body may impact the vapor and gas permeability of the MTU, enabling ingress of moisture into the enclosure that may affect the electronics. Additionally, long-term exposure to UV rays from direct sunlight and high temperatures creates conditions that could potentially result in oxidative degradation of the MTU polymer enclosures, which could lead to a decrease in long-term mechanical integrity of the units. In this task, Exponent conducted a failure analysis on four MTU units in service for at least 10 years to assess both the mode of polymer failures and likely contributing root causes. The fracture locations of the four MTUs were determined using X-ray computed tomography (CT); fracture surfaces were subsequently manually exposed and a fractographic analysis was conducted to study the fracture morphology. Exponent utilized this fractographic information to determine potential fracture initiation locations in combination with oxidation onset temperature (OOT) analysis of the inner and outside surface of the enclosure polymer to determine likely failure modes. The Task D report[23] was provided on June 23, 2025.

Summary of Task D Findings

MTU Selection and Visual Examination

Exponent received eight MTUs that had been returned from the field due to communications errors. Table 2 shows details of the four MTUs that were selected for further investigation by CT and fractographic analysis. These four units were selected to provide a sampling of manufacturing dates and unit types.

Table 2. Details of four MTUs selected for CT and fractographic analysis by Exponent.

MTU ID	Model	Manufacture Date	Likely Root Cause of Fracture
107649081	3151-031-RBS2-SCG	7/28/2015	Initial stress overload with continued propagation over time
103062938	3141-021-RBS2-SCG	2/20/2014	Stress overload event
102499007	3131-010-RBS2-SCG	10/9/2013	Stress overload event
104177412	3221-021-RBS2W-SCG	10/29/2014	Stress overload event

Each of the four units was visually examined and photodocumented to assess the extent of visible damage and/or weathering to the exterior of the unit. Additionally, two of the four examined MTUs displayed bowing or localized displacement of the casing near these fractures, suggesting the occurrence of a possible external loading event. Representative images of

[23] 'SoCalGas MTU EOL Task D Polymer Analysis.pdf'.

mechanical damage for MTU unit 102499007, which include a visible fracture near the weld, are shown in Figure 15.

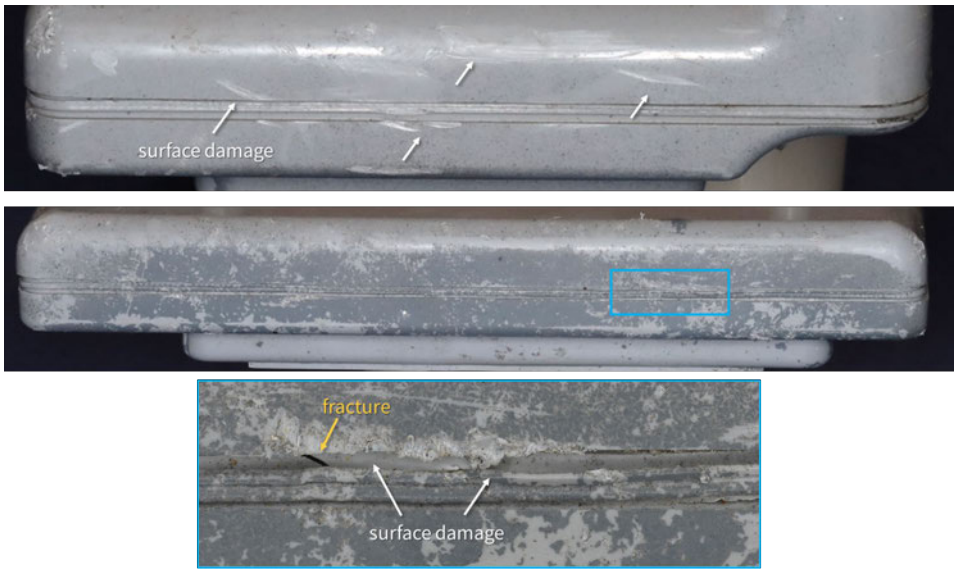


Figure 15. Exterior surface of two sides from MTU 102499007 displaying surface damage (white arrows) and a visible fracture near the weld line (yellow arrow).

Additional fractures were observed at the base of the screw posts located on the top face of two other devices (MTU 107649081 and MTU 103062938). Representative examples of these fractures are shown in Figure 16. These screw post fractures displayed stress whitening, a visual indication of ductility remaining in the housing material despite extended time in the field and elemental exposure.[24]



Figure 16. Fractures observed at the base of screw posts from MTU 107649081 displaying stress whitening (white arrows).

[24] Moll, J., and Lee, C. (2024). Fractography of Polymers. In *ASM Handbook Volume 12*: *Fractography*. ASM International, pp. 463-480.

CT Imaging and Analysis

Each of the devices was then scanned using CT to characterize and document observed cracks and to identify other non-visually detected cracks present on the external housing of the MTUs. Certain fractures on all units appeared to extend through the thickness of the housing wall (i.e., from the outside to the inside surface), providing a potential avenue for water ingress. The housing fractures at the weld lines appear to have initiated at a stress concentration point formed by a corner geometry at the thinnest portion of the housing wall near the weld (Figure 17). The crack path appeared to curve and extend at an angle through the housing rather than running straight across through the material. Similarly, fractures observed at the screw post bases appeared to originate along a stress concentration point near the interface of the enclosure body and the post and extended through the thickness of the housing.

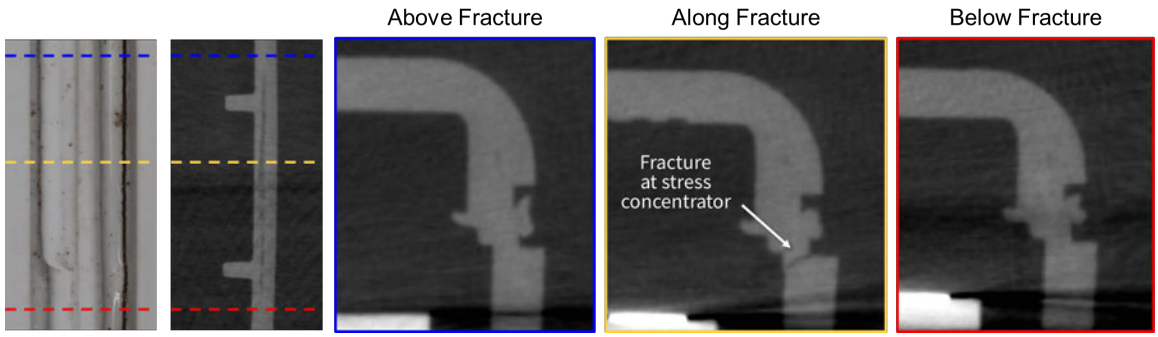


Figure 17. CT images along weld on MTU 103062938 showing through wall crack originating at stress concentration point formed by corner geometry.

CT imaging revealed localized displacement (i.e., bowing and/or misalignment) of the housing body along the fracture(s) of two MTUs (MTU 104177412 and MTU 102499007). For MTU 102499007, comparison of the CT images to optical microscopy of the units indicated that this localized housing displacement was co-located with observed surface damage shown in Figure 18, suggesting that the housing may have undergone a stress overload event (i.e., impact event) that initiated the fracture near the weld and resulted in the observed surface misalignment.

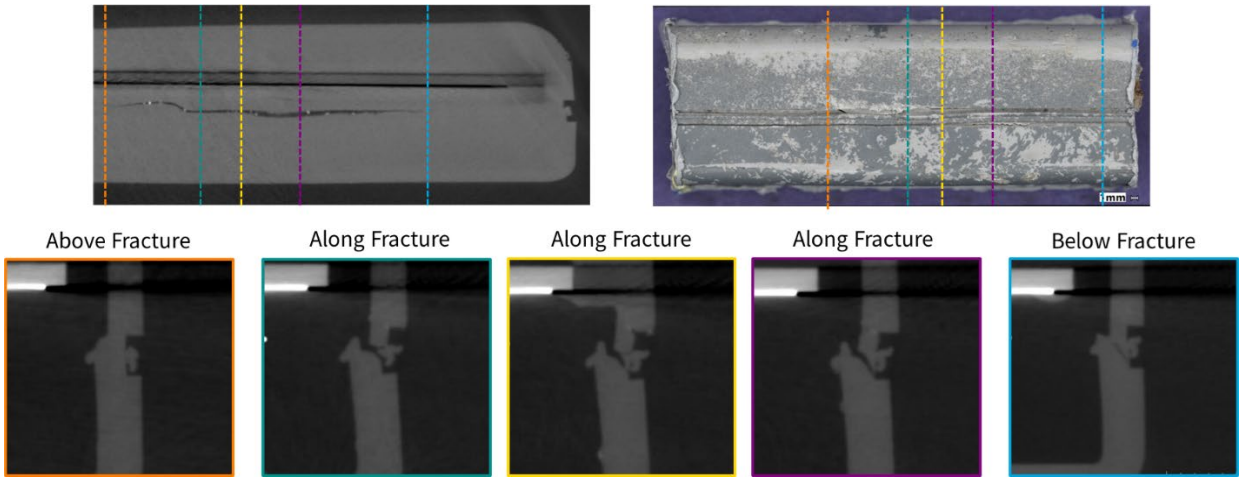


Figure 18. CT images of MTU 102499007 showing vertical misalignment of housing geometry along the length of a fracture observed in the weld (teal, yellow, and purple) compared to housing above (orange) and below (blue) the fracture.

Fractographic Analysis

After visual inspection and CT imaging, the MTUs were disassembled to excise through-wall fractures for further fractographic and thermal analysis. Visual inspection of the interior surface of the housings close to the fracture was also conducted. In MTU 102499007, a witness mark was observed close to the fracture, suggesting potential contact between the edge of the PCB and the inner housing surface due to an impact event causing the housing to deflect inward and make contact with the PCB. Samples of the housing material adjacent to the fracture were also isolated for oxidation onset temperature (OOT) measurements.

The fractures were then manually opened to expose the fracture surfaces. During manual opening, the housing material was qualitatively tough and ductile, making it difficult to manually advance the cracks. Stress whitening, a sign of microductility,[25] was observed in the laboratory fractured regions of the fracture surface for all of the analyzed MTUs due to the slower rate during manual crack propagation. The observed ductility in each of the four MTUs suggests that the polymer has retained some degree of bulk toughness and that extensive embrittlement as a result of oxidative degradation has not occurred in these regions.

The fracture surfaces were examined using optical microscopy and scanning electron microscopy (SEM) to identify fracture features indicative of fracture initiation and directionality of crack propagation. For all samples, the observed fracture surface features were consistent with crack propagation initiating at the outside surface of the housing at a geometric discontinuity and moving inwards towards the inside surface of the housing (i.e., outside to inside crack growth). A representative MTU fracture surface is shown in Figure 19.

[25] Moll, J., and Lee, C. (2024). Fractography of Polymers. In *ASM Handbook Volume 12*: *Fractography*. ASM International, pp. 463-480.

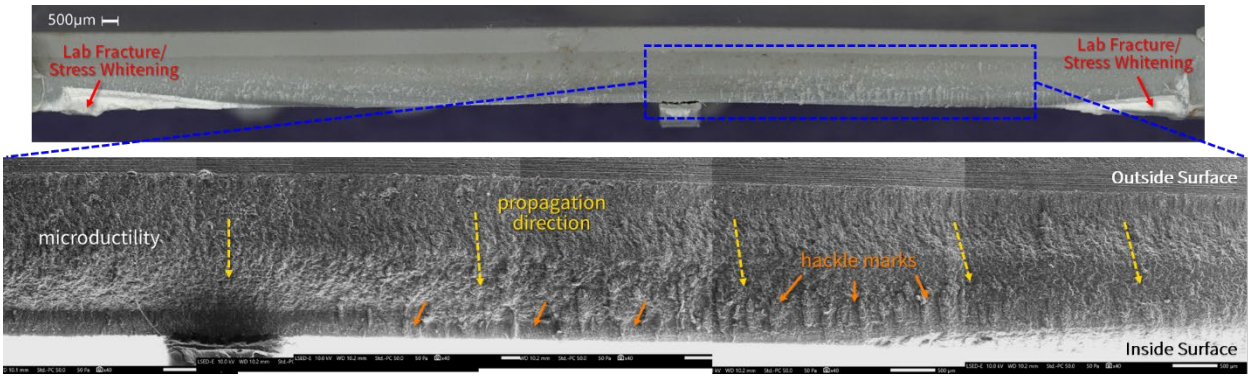


Figure 19. Optical micrograph (OM) and SEM images of fracture surface on user back of MTU 104177412 with lab fractured regions with stress whitening (red), fracture features (i.e., microductility and hackle marks), and crack propagation direction (yellow arrow) noted.

Some of the fracture surfaces displayed fracture features consistent with fast-fracture, such as hackle marks, at the inner surface edge of the fractures. Additionally, microductility and fibrillation were observed on all of the fracture surfaces, further suggesting that the housing material has retained some degree of bulk ductility and that extensive oxidative degradation and resulting embrittlement has not occurred.

For all samples, the fracture appears to originate at the outside surface of the housing at a geometric discontinuity and propagate through the wall towards the inner surface. Based on the observed fracture surface features, the root cause of the fractures is likely due to a stress overload event (i.e., impact, etc.).

Oxidation Onset Temperature Analysis

Oxidation onset temperature (OOT) measurements were conducted to complement the fractographic analysis and assess relative changes to the oxidative stability of the outer and inner surfaces of the housing material near the fracture locations following environmental exposure during time in service. Due to its comparative nature, OOT can be particularly helpful in assessing degradation of the outside surface of a polymer due to ultraviolet (UV) exposure, which primarily affects the outer surface. This analysis does not detect changes to the material over time that would affect the outside and inside surface of the MTU uniformly (e.g., temperature exposure). Higher OOT values generally correspond to greater oxidative stability in a material. OOT values are a relative measurement of oxidative stability and can be used as a comparative analysis; however, they are not an absolute measurement of stability against oxidative degradation. Exponent sectioned the housing material from the four MTUs into inner, middle, and outer layers to compare OOT values across the thickness of the MTU housing. A decrease in oxidative stability of the housing material due to oxidative degradation from UV exposure in the field would likely result in a significantly lower OOT value for the outer surface of the housing as compared to the interior surface of the device.

Overall, a consistent trend in OOT behavior across the four samples was not observed. OOT measurements on sectioned layers for two of the four MTU units (MTU 103062938 and MTU 102499007) did not show evidence of higher levels oxidative degradation of the outer surface housing material while for the remaining two MTU units (MTU 104177412 and MTU 107649081), the OOT values for the outer cross section layer were lower than those measured for the inner or middle layers. This suggests a potential localized decrease in oxidative stability of the exterior surface for some units, but not consistently across the samples analyzed. However, these results are from a small sample set of only one location on the MTU housing. Additional analysis using replicate samples as well as samples both close to and away from the fractures is necessary to confirm if this trend in OOT values is consistent.

Additionally, exemplar units were not examined as a control for comparison with the subject units. A control could help reveal uniform bulk changes in OOT values over time in the field rather than through the thickness of the housing (i.e., outside vs inside). Overall tracking degradation of the polymeric housing material as a result of continued exposure to elevated temperatures or other environmental conditions over time would require comparison to an exemplar sample (i.e., a t=0 timepoint, or non-exposed control).

Summary

Overall, four MTU units with through-housing cracks were analyzed to determine the mode of failure. In each case, the cracks initiated on the exterior of the housing at geometric discontinuities and were consistent with stress overload, likely from a rapid impact-type event. Although OOT testing did not identify a consistent trend throughout the four units tested, some degree of surface oxidation was detected on two of the four units. Despite this finding, qualitative indications of material ductility such as stress whitening were observed on each lab fracture, suggesting the bulk material has retained some degree of ductility and toughness, despite its time in the field.

Task E: MTU Reliability Analysis and Predictions of Future Failure Trends

In support of this task, Exponent utilized SCG's dataset of the MTU smart meter population[26] that includes failures and removals dating back to 2012 and was analyzed at a high level in Task B. The MTU population was explored and analyzed to investigate the number of installations, active meters, removed meters, and failed meters in the population by installation class, meter type (Standard Range MTU or Extended Range MTU), and RMA code, either through the first RMA listed or the RMA listed at remediation. Classifying the RMA codes by failure definition (i.e. MTU Alarms, Communications, MTU Errors) and separately for each RMA, Exponent examined the time in the field, time to failure and used non-parametric and parametric reliability models to examine the failure rate over time. With this information, Exponent combined an internal model for battery wear-out with the multipronged statistical analysis of the MTU failures to date to predict the number of failures from 2025 to 2040. Furthermore, Exponent incorporated uncertainty in the predictive models compared to the known failures in the 2022-2025 population to estimate uncertainty in the number of failures each future year, accounting for increasing uncertainty the farther out the predictions proceed. Exponent also explored the relationship of temperature and precipitation with failure rates by zip code over the study period. The Task E report[27] was presented on July 24th, 2025.

Summary of Task E Findings

MTU Population

The provided Return Merchandise Authorization dataset of MTUs going back to 2012 contained information on a base meter population of 7.55M meters, of which 410K have not been installed, 1M have been removed, 365K have been remediated, and 763K have failed as indicated with a date in the 'FAILURE_YEAR' column. The majority of MTUs are from the vendor American (47%), Sprague (27%), and Rockwell (19%). 77% of MTUs are Standard Range and 23% are Extended Range, with the most common firmware version of 41 at 67% and 42 at 26%.

Figure 20 provides the number of installations, active meters, removals, and failures by year for Standard and Extended range units. Active meters are ones in the field in that calendar year. 1.1M to 1.8M units were installed each year from 2013 to 2016, most of which being Standard Range. Since 2017, an average of 140K units are installed each year and since 2019, most installations are Extended Range. Almost 6M units were active in the field by 2016 and on average, 99K units were removed annually from 2016 to 2024. 763K have failed, peaking in

[26] 'Exponent Export 2.txt'.

[27] 'SoCalGas MTU EOL Task E Statistical Analysis.pdf'.

2023 with over 90K failures. The increase in 2023 is mostly attributed to Tropical Storm Hillary in Palm Springs in August 2023, but also due to inclement weather early in that year.

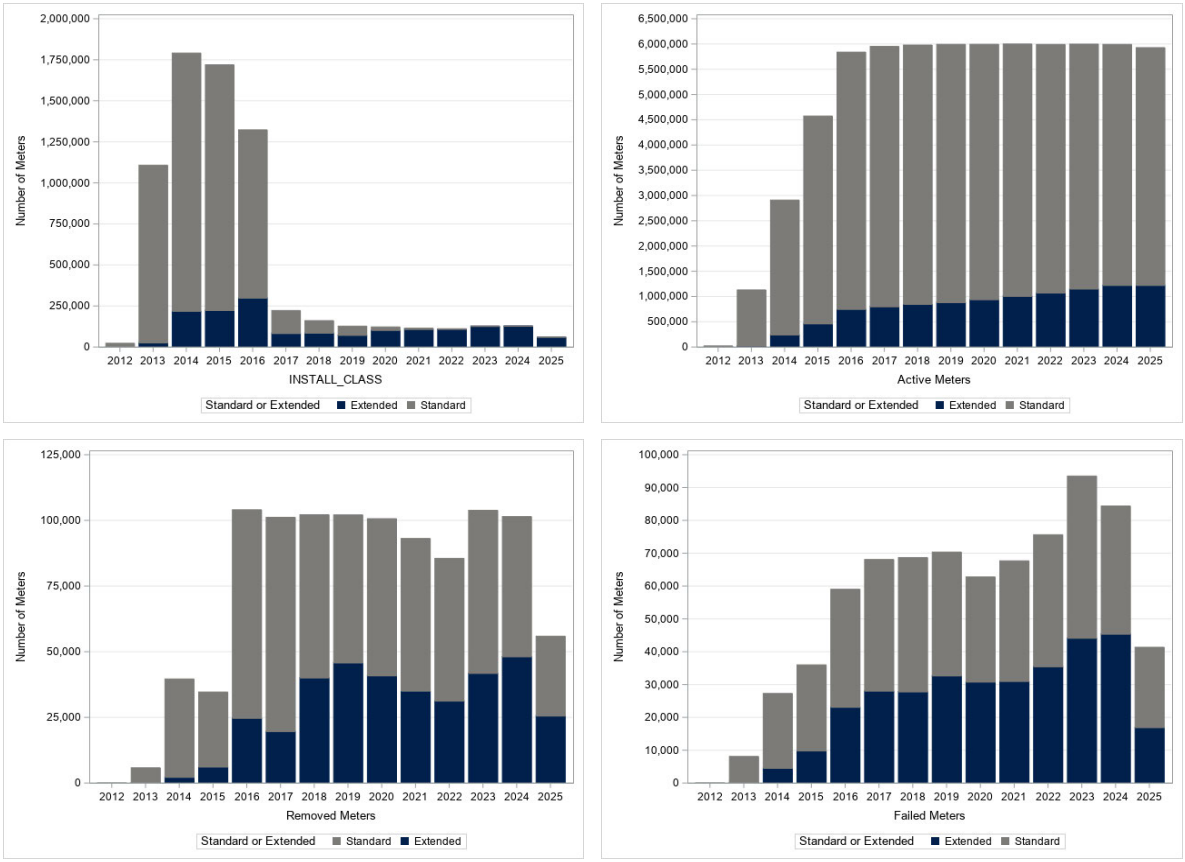


Figure 20. MTU Population by Installation year (upper left), Active year (upper right), Removal year (bottom left), and Failure year (bottom right). Standard range counts in grey and Extended range counts in blue.

Figure 21 provides the annualized failure rate overall and by type. The overall failure rate was less than 2% each year, yet Standard Range units tended to be below 1%, whereas Extended Range units were in the 3%-4% range.

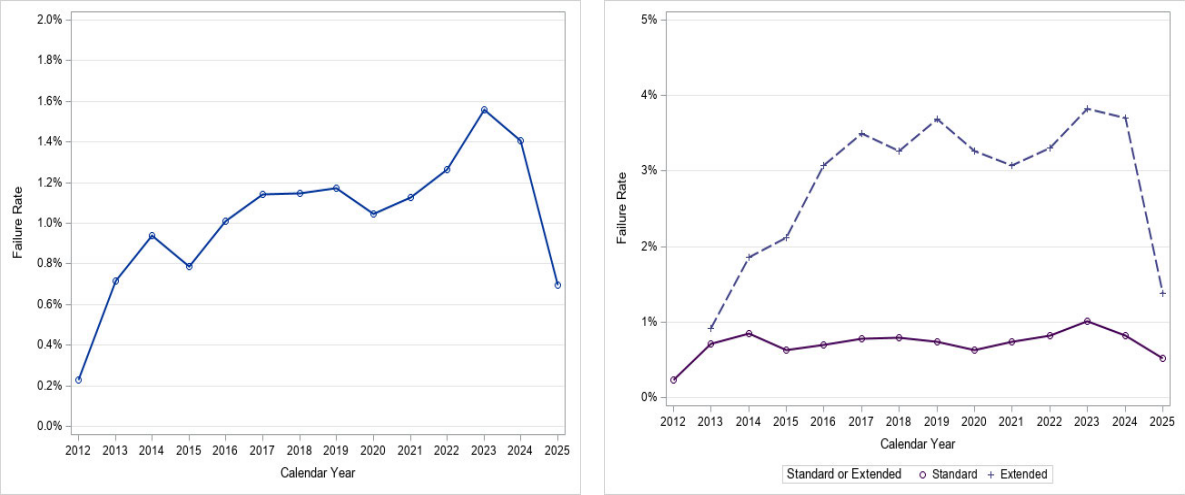


Figure 21. Annualized failure rate by Calendar Year. Overall (left) and by range type (right).

RMA Trends for Failures

Of the failed MTUs, the majority of failures were due to alarming, communication, or other errors (Figure 22). Failures were defined as in Figure 4. To note, the proportion of AGA for 1st RMA is higher than in the remediation codes. Furthermore, alarming codes are a smaller proportion of failures in older units (Figure 23).

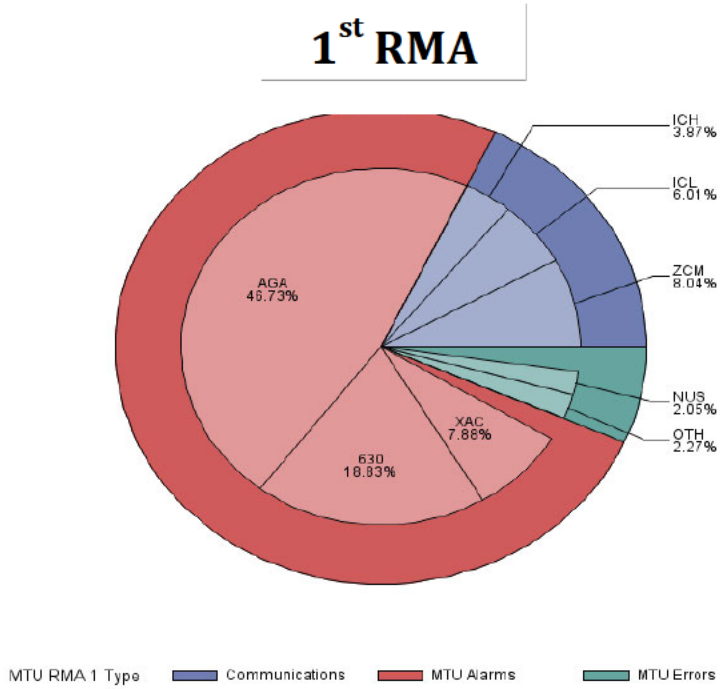


Figure 22. Proportion of MTU failures broken out by RMA class and individual error code.

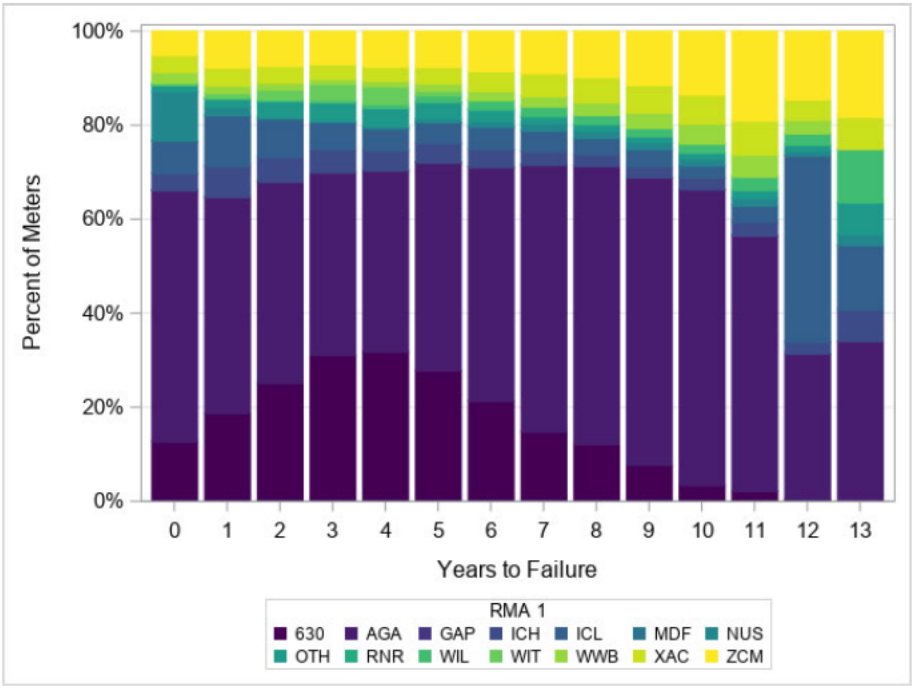


Figure 23. Distribution of RMA error codes for MTU failures by time to failure.

NUS failures, i.e. negative or positive usage spikes, are a small overall proportion of failures in the population but have been steadily increasing with more recent installation classes and are failing earlier in install classes 2021 and later. Table 3 below has the proportion by installation class of NUS failures.

Table 3. NUS failures by Installation Year.

Install Class	NUS RMA (%)
2012	4 (0.0%)
2013	1,032 (0.1%)
2014	1,350 (0.1%)
2015	1,342 (0.1%)
2016	1,007 (0.1%)
2017	208 (0.1%)
2018	66 (0.0%)
2019	140 (0.1%)
2020	138 (0.1%)
2021	673 (0.6%)
2022	1,379 (1.2%)
2023	3,173 (2.5%)
2024	3,835 (3.0%)
2025	1,594 (2.6%)

Survival Modeling

For the survival analysis, MTU units time in the field was defined by the time to failure, time to removal if not failed, or time to current date (June 2025). Exploratory analysis was performed using the Kaplan-Meier (KM) method and then parametric models were fit to the data to identify suitable parameters for estimating future failures.

The Kaplan-Meier method is a non-parametric (distribution free) method to estimate the survival function from lifetime data. It provides a robust focus on the entire curve of failures with increasing field time instead of looking at rates at fixed intervals. The KM curves provide the conditional probability that a meter survives at least X years in the field before failing.

Kaplan Meier Results

For the MTU population, the overall survival of meters is greater than 80% at 12 years. Extended units have a shorter survival and 70% survive by 12 years compared to 90% at 12 years for Standard units (Figure 24). The overall failure rate is steadily decreasing and given the current time in the field, MTUs do not appear to be close to end of life. The survival curves suggest the failure rate is constant and no new failure modes as of now are starting to appear in the population.

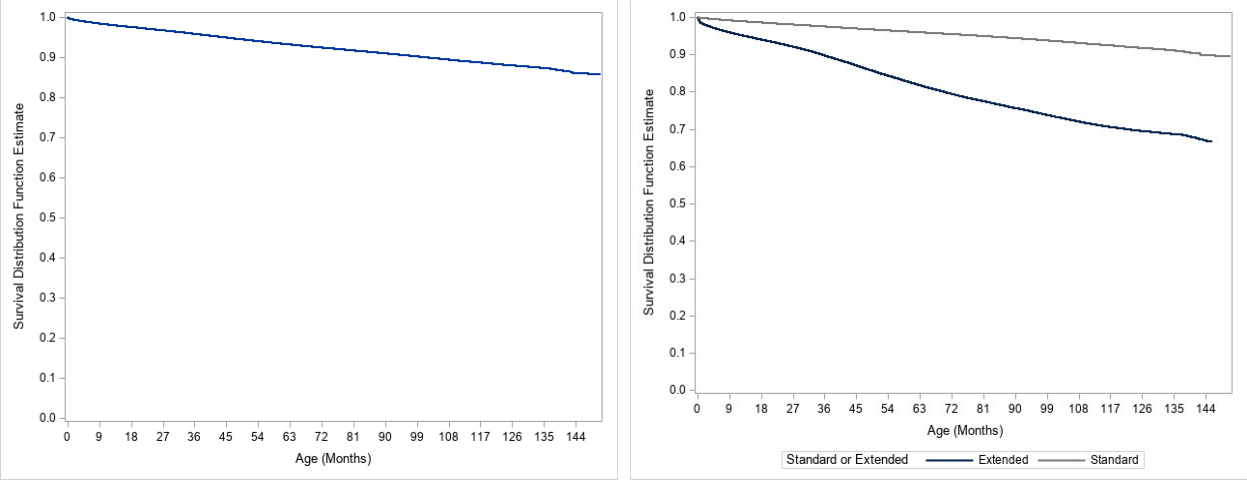


Figure 24. Kaplan-Meier Survival Curves overall (left) and by range type (right).

Weibull Model Estimates

For modeling future failures, the Weibull distribution is commonly used to model survival times (e.g., time to meter failure). Weibull distributions allow failure rates to decelerate, remain constant, or accelerate as devices age. The shape parameter, β, defines the failure rate trend over time.

- $\beta < 1$ early infant failures
- $\beta = 1$ random constant failures
- $\beta > 1$ wear-out failures

The resulting Weibull plots by Standard range and Extended range appear to fit well overall and the varying shape parameters demonstrate the difference failure trends for each RMA. There is curvature in failures against the probability due to early failures, but the trend line in older units is consistent with the Weibull model estimate. Exponent used the Weibull model parameters to estimate the number of future failures. For Standard units, RMAs 630, AGA, NUS, OTH, RNR, WIL, WWB, XAC, and ZCM exhibit wear-out failures. For Extended units, RMAs 630, RNR, WIL, XAC, and ZCM exhibit wear-out failures

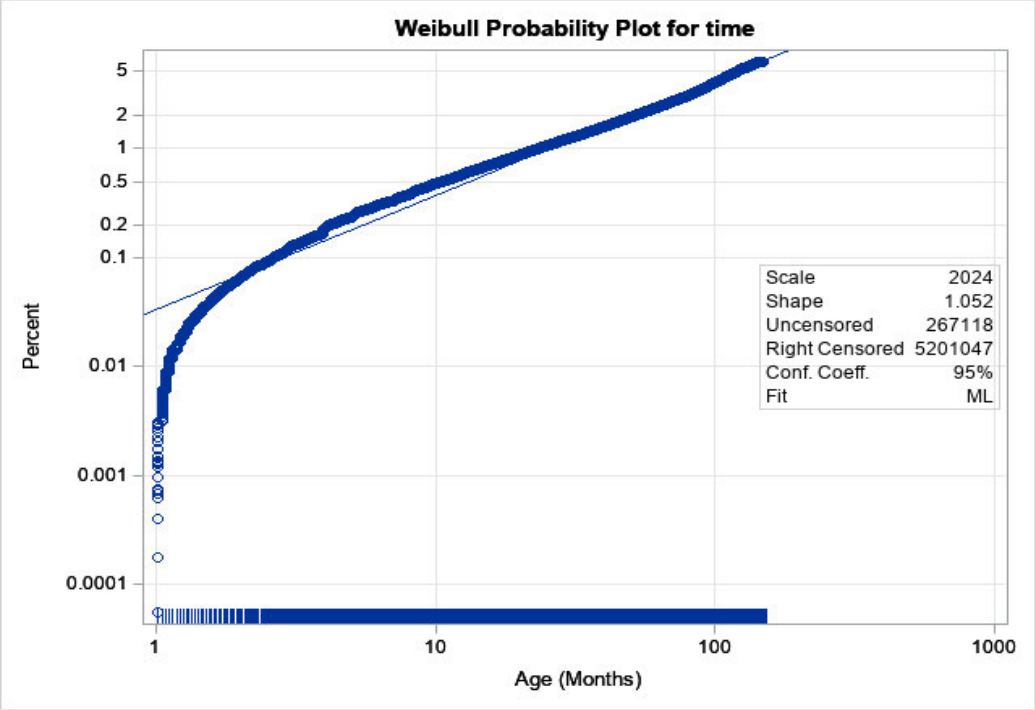


Figure 25. Example Weibull model fit to Standard range units for AGA failures.

Battery End of Life

Exponent used an internally-developed model for battery wear-out that takes into account variations in normal usage, including the differences between the Standard Range MTUs and the higher-power Extended Range MTUs. The average battery end of life is around 20 years with most of the population wearing out by 25 years (see Figure 26.

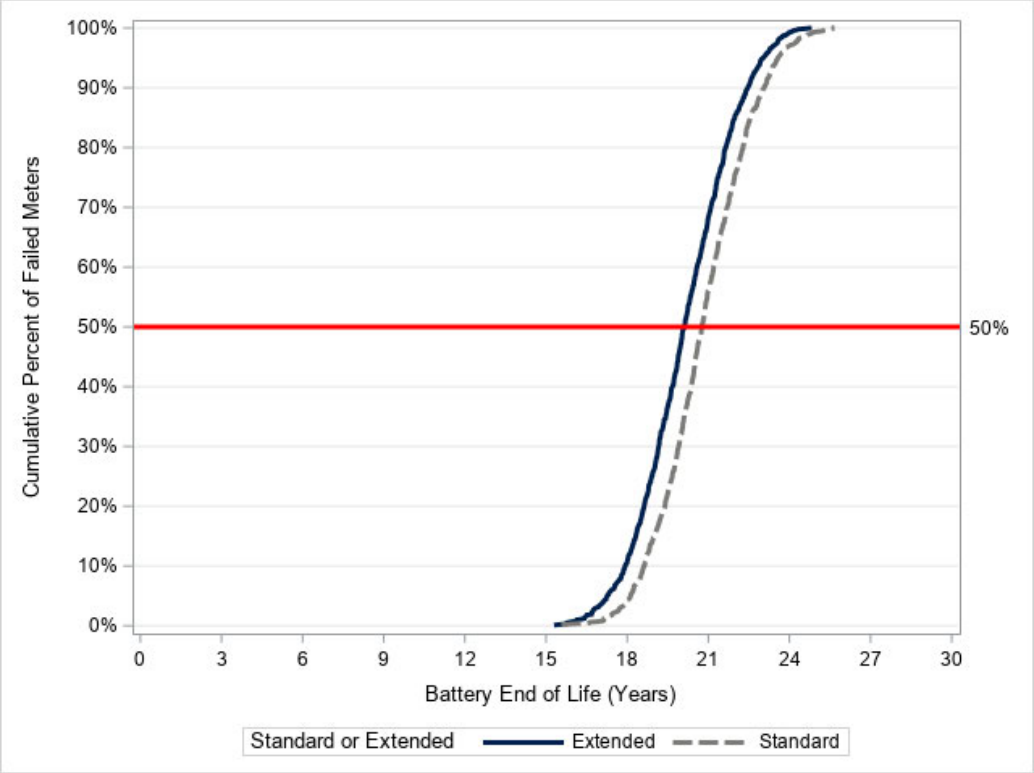


Figure 26. Battery End of Life Distribution.

Model Uncertainty and Validation

Confidence intervals provide a range of values within which the true estimate falls. Exponent calculated the 95% confidence limits initially based on the number of failures using a 95% Poisson confidence interval for the predicted number of failures. A limitation for this analysis is that this method is based solely on numbers and uncertainty decreases with higher estimates, even as they may be years in the future.

Exponent performed several sensitivity analyses to understand sensitivity to the assumed Weibull distribution, and how well the models predict over time. The predictions are based on a Weibull distribution, yet other parametric distributions were considered such as the Lognormal. The Lognormal models were adequate fits, and the estimated number of future failures was similar to estimates using the Weibull model and had the same trend, with increasing number of failures in 2029 and a peak in 2035.

To evaluate the performance of the Weibull models, Exponent ran models on 2012-2021 MTU data to predict the number of failures in 2022-2024, and compared it to the true number of failures in those years. The estimated number of failures was within 2-4% of the true failures, with an increasing error rate. Incorporating that percent difference as error and the rate of increase over time provided a margin of error around the estimated number of failures, ranging from almost ± 4.5% in 2025 to ± 28.4% in 2040.

Failure Projections

Figure 27 summarizes MTU failures estimated by Exponent through 2040; this table is also shown in Figure 1. By 2040, almost 6M meters are projected to fail due to RMA codes and battery end of life. An estimated 1.1M will fail due to RMA codes and 4.6M due to battery end of life. Meter failures start ramping up in 2029 with a peak over 1M in 2035 (Figure 28). As more recent installations are Extended Ranges, depletion in 2040 suggests more of those are affected, as most the Standard Range units will have already reached end of life (Figure 29).

Calendar Year	Observed or Expected Failures from Exponent's Model	Cumulative # Failures	Total Meters Installed By Calendar Year	Active Meters By Calendar Year (Not Failed or Not Removed)	Rate (% of Meters Installed By Calendar Year)	Cumulative Failure Rate (% of Meters Installed By Calendar Year)	Cumulative Failure Rate (% of Active Meters)
2012	53	53	23,035	23,035	0.23%	0.23%	0.23%
2013	8,105	8,158	1,131,025	1,130,919	0.72%	0.72%	0.72%
2014	27,291	35,449	2,922,084	2,909,986	0.93%	1.21%	1.22%
2015	36,002	71,451	4,641,673	4,574,147	0.78%	1.54%	1.56%
2016	59,029	130,480	5,964,959	5,839,536	0.99%	2.19%	2.23%
2017	68,093	198,573	6,187,750	5,952,689	1.10%	3.21%	3.34%
2018	68,684	267,257	6,348,671	5,980,093	1.08%	4.21%	4.47%
2019	70,357	337,614	6,475,956	5,993,578	1.09%	5.21%	5.63%
2020	62,792	400,406	6,598,477	5,994,288	0.95%	6.07%	6.68%
2021	67,693	468,099	6,713,650	6,000,161	1.01%	6.97%	7.80%
2022	75,646	543,745	6,825,266	5,992,117	1.11%	7.97%	9.07%
2023	93,519	637,264	6,953,372	5,997,772	1.34%	9.16%	10.63%
2024	84,394	721,658	7,082,326	5,992,819	1.19%	10.19%	12.04%
2025	83,271	804,929	7,082,326	5,807,020	1.18%	11.37%	13.86%
2026	83,983	888,912	7,082,326	5,807,020	1.19%	12.55%	15.31%
2027	84,936	973,848	7,082,326	5,807,020	1.20%	13.75%	16.77%
2028	87,839	1,061,687	7,082,326	5,807,020	1.24%	14.99%	18.28%
2029	100,184	1,161,871	7,082,326	5,807,020	1.41%	16.41%	20.01%
2030	143,909	1,305,780	7,082,326	5,807,020	2.03%	18.44%	22.49%
2031	258,517	1,564,297	7,082,326	5,807,020	3.65%	22.09%	26.94%
2032	474,982	2,039,279	7,082,326	5,807,020	6.71%	28.79%	35.12%
2033	761,329	2,800,608	7,082,326	5,807,020	10.75%	39.54%	48.23%
2034	989,753	3,790,361	7,082,326	5,807,020	13.97%	53.52%	65.27%
2035	1,022,948	4,813,309	7,082,326	5,807,020	14.44%	67.96%	82.89%
2036	781,429	5,594,738	7,082,326	5,807,020	11.03%	79.00%	96.34%
2037	454,325	6,049,063	7,082,326	5,807,020	6.41%	85.41%	100.00%
2038	199,528	6,248,591	7,082,326	5,807,020	2.82%	88.23%	100.00%
2039	102,960	6,351,551	7,082,326	5,807,020	1.45%	89.68%	100.00%
2040	83,786	6,435,337	7,082,326	5,807,020	1.18%	90.86%	100.00%

Figure 27. Summary of Exponent's estimated annual MTU failures through 2040. This table is also shown in Figure 1.

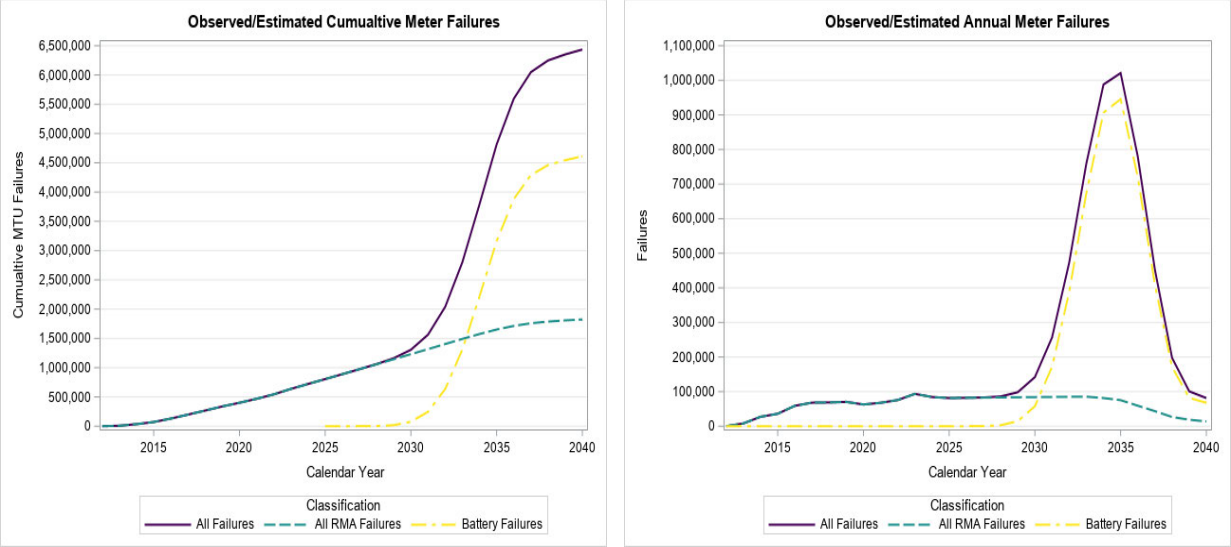


Figure 28. Cumulative Observed/Estimated Failure Projections through 2040 (left). Annual Observed/Estimated Failures through 2040 (right).

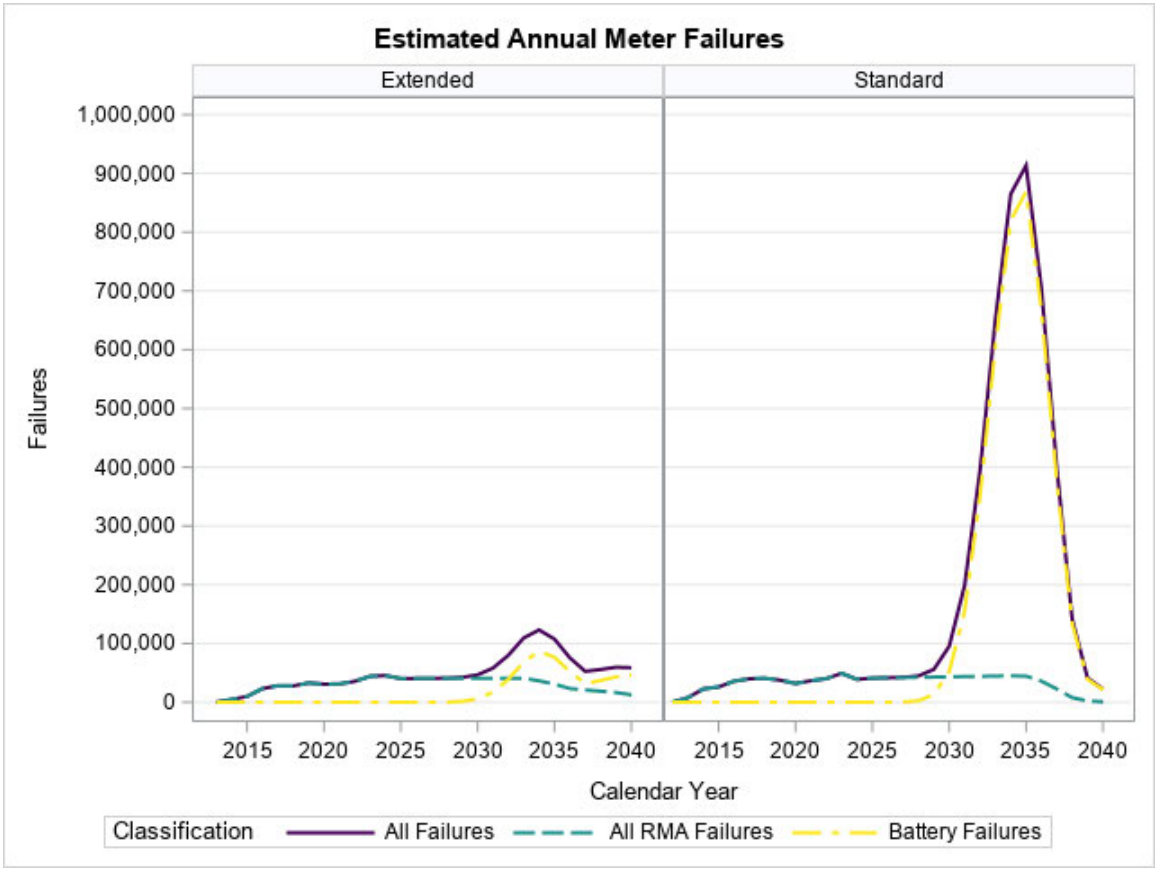


Figure 29. Observed/Estimated MTU Failures by Range.

Weather

Exponent linked latitude/longitude to zip code and then linked zip code to tabulation areas set by the US Census Bureau to relate geography and weather to meter failure rates (Figure 30). ZCTAs with high average temperatures tend to have slightly elevated failure rates and ZCTAs with average temperatures greater than 70ºF have failure rates greater than 10%. Approximately 300K (4%) of the 7.1M meters installed are in locations with average temperatures greater than 70ºF.

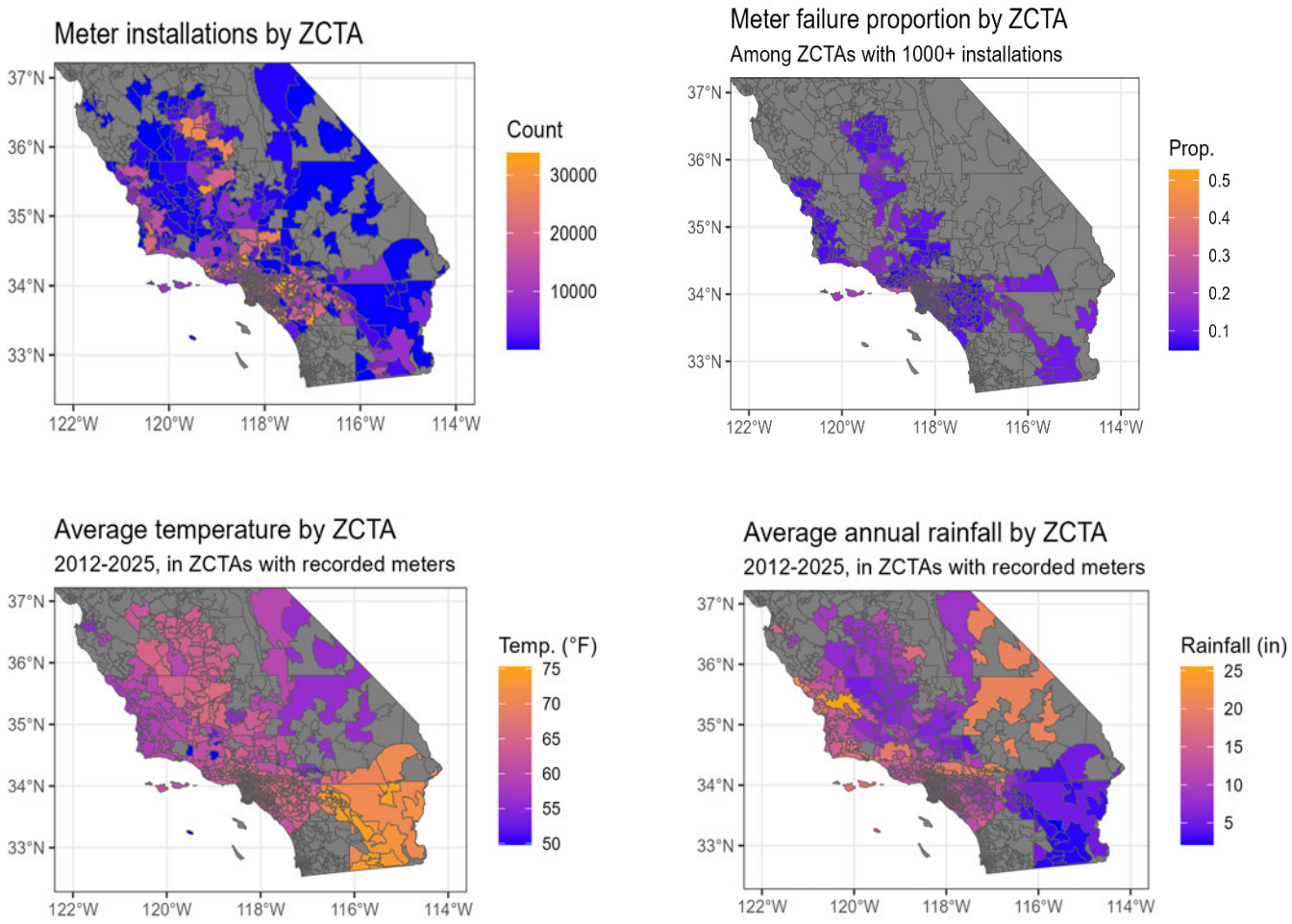


Figure 30. Number of Meters installed (top left), Proportion of failures (top right), Average Temperature (bottom left), and Average annual rainfall (bottom right) by ZCTA.

Observing peaks in higher rates by time, temperature, and rainfall, Exponent was able to identify case studies of increased meter failures within a ZCTA (Figure 31). For example, over 1,000 meters failed in the Palisades fire and several thousand during Tropical Storm Hillary. Failures

tend to increase in the winter months as the MTUs are more at risk of moisture ingress due to potentially more rainfall. Observed spikes in meter failure align with extreme rainfall months[28].

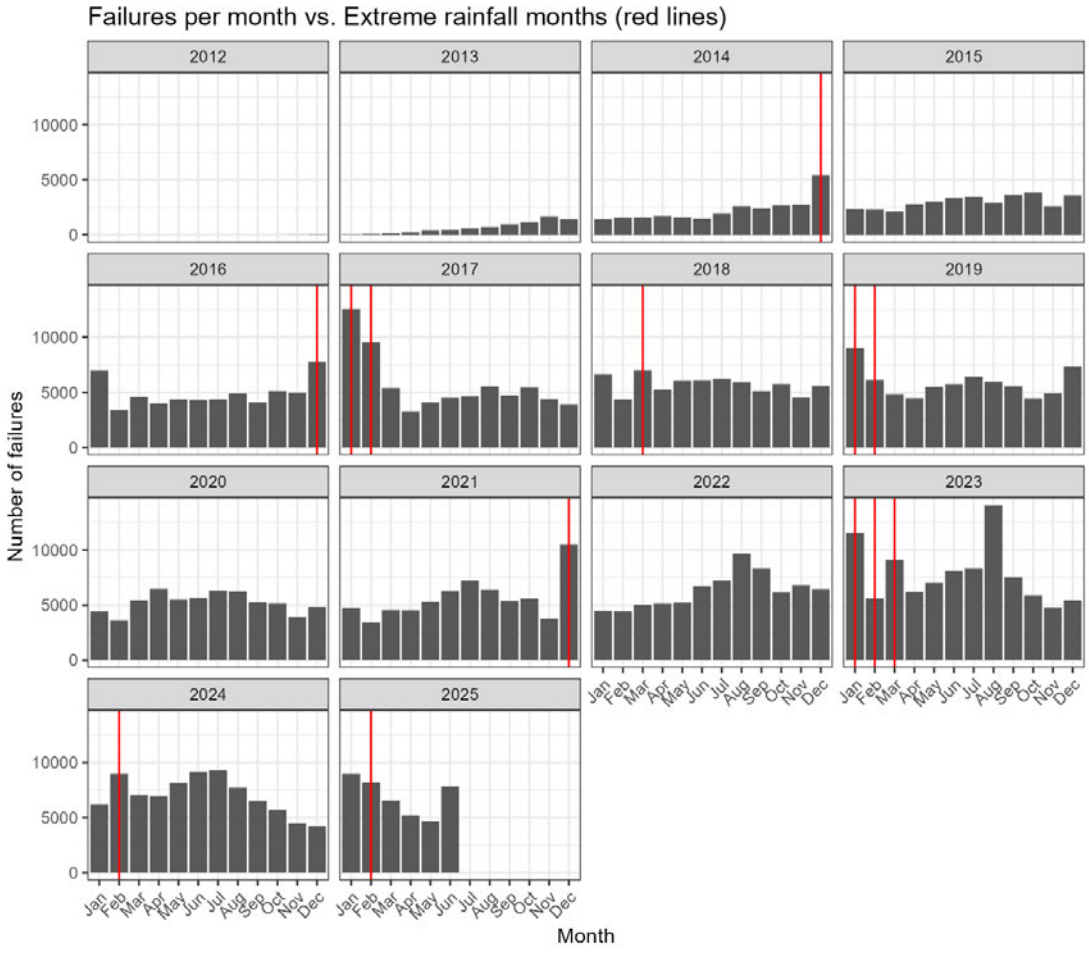


Figure 31. Number of failures by Month/Year vs Extreme rainfall months (red vertical lines).

[28] "Extreme rainfall" is defined as a month where at least 10,000 meters experience over 9 inches of precipitation, an average of almost 1 hour per day of heavy rain. American Meteorological Society defines heavy rain as 0.3 inches of rainfall in an hour. https://glossary.ametsoc.org/wiki/Rain

Discussion and Potential Next Steps

To rigorously develop a quantitative projection for SoCal Gas' MTU future failures, it is necessary to consider all possible failure modes. Battery EOL is the most obvious mechanism for failure, as normal MTU operation will eventually deplete the energy (wear-out) of every MTU battery. However, it is not the only mechanism for MTU failure, and one of the goals of this work was to gain a deeper understanding of failure modes currently being observed in the field, so as to better predict each mode's contribution to the future annual failure rate.

With the oldest MTUs in use approximately 13 years old, our model suggests that very few failures so far are due to battery wear-out, which is consistent with the expected MTU lifetime of approximately 20 years. Instead, our analysis indicates that a primary driver of current MTU failures is a failure in the plastic enclosure that allows environmental moisture to enter the MTU. During our FA of failed MTUs, nearly every unit demonstrated signs of moisture ingress. We observed instances of corrosion damage to the PCB and batteries, with some MTU enclosures still containing water. Other MTUs did not show clear corrosion or the presence of water, but contained board residue whose patterns and makeup are consistent with moisture-assisted electromigration of solder between board locations at different electrical voltages. Also, the batteries in the FA units were measured and many instances of low or even zero voltage batteries were found.

Corrosion or the spread of conductive solder across the PCB can have multiple negative effects, from direct damage or energy depletion of the battery through leakage current paths, to the creation of unwanted electrical connections in other parts of the circuit that could affect its operation. We believe that many of the communication and alarm failures of the MTUs in the FA sample are the result of water ingress damaging the PCB circuit, leading either to the unit not having sufficient power to communicate, or false alarms being generated by the degradation of the voltage signals used for alarm detection. The connection between Negative Usage Spike (NUS) failures and water ingress is less clear, but we cannot entirely rule it out.

The makeup of the sample of 200 MTUs examined for the FA did not allow us to clearly distinguish between failures in Standard Range units and Extended Range units. However, our statistical analysis has shown that MTU failures to date have followed a trend where the Extended Range units have a higher annual failure rate than the Standard Range units. This is consistent with the idea that battery energy losses are key to current failures, as Extended Range units require higher power operation than Standard Rate units and so would be vulnerable to depleted batteries sooner.

The presence of moisture inside of a MTU means that the enclosure has failed at preventing environmental ingress. Although failures from water ingress have not occurred for most MTUs to date, for predictive purposes it is critical to understand how the MTU enclosures are failing. If, for example, the plastic enclosures are fatiguing (embrittling) over time due to thermal cycling or mechanical installation stresses, then it is possible that eventually all or most MTUs will develop

leaks since all are subject to these stresses. This would put most of the MTU population at risk of failure due to water ingress, possibly rivaling battery EOL as a major driver of failure in the future and decreasing the overall mean time to failure.

However, our materials analysis of the MTU enclosures do not show significant embrittlement of older enclosures. Where enclosure failures (cracks/fractures) appear, they are consistent with impact-type events rather than a gradual fatiguing or aging of the plastic over time. The plastic in older MTU enclosures (>10 years) still appear fairly ductile and strong.

While we cannot pinpoint the exact cause or causes of the enclosure failures, our materials analysis points away from a failure mode whose frequency of occurrence increases significantly over time (such as from plastic aging), and towards a failure mode arising from random impact events, which would likely have a less variable failure rate over time. Our statistical analysis of the RMA dataset also supports the notion that the RMA failure rate has not, and will not, increase dramatically over time. It is thus our expectation that water ingress, although a main driver of failures to date and important for quantitative predictions, will not be the main cause of failure for the MTUs over the next 10-15 years. Instead, loss of energy due to battery depletion/wear-out remains the most important failure mode when considering how and at what rate most MTUs will fail.

Potential Next Steps

The results of this project suggest potential future avenues of investigation. For example, additional work could provide deeper insight into water ingress-based failure modes. Although our analysis predicts that most MTUs will not experience this failure mode, it is based primarily on units that have already failed. A test protocol analogous to our FA protocol, performed on a random sampling of in-service units that have not warranted RMA codes, would provide data on the condition of units that have not yet failed and may reveal characteristics that are precursors to failure.

The root cause of Negative Usage Spike (NUS) failures is also not yet fully understood. It does not appear strongly correlated with PCB or battery condition, unlike Alarm and Communication failures. The failure mechanism may involve a more complex interplay between the metering hardware and the MCU firmware that quantitates gas flow. A separate failure analysis focusing only on NUS failures with activities outside the scope of this work could yield insights. A NUS FA would include deeper analysis and testing of the MTU circuit and MCU logic, including failure recreation testing.

Attachment B

Bridgewater's Advanced Meter MTU EOL Analysis

Bridgewater Consulting Group, Inc.

Final Report for

SoCalGas

“AM MTU EOL Analysis”

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Introduction

SoCalGas (SCG) has engaged Bridgewater Consulting Group (BCG) to perform an Advanced Meter (AM) Meter Transmission Unit (MTU) End-of-Life (EOL) analysis. The scope of the engagement includes:

1. Identification of dominant failure code
2. Calculation and forecast of failure rate
3. Develop a warranty analysis model
4. Recommendation of warranty extension

This document serves as a final report and details the assumptions, data inputs, technologies, methodologies, results, and recommendations.

Approach

The approach leveraged the available field and simulation data from SCG and Aclara to determine the dominant failure code(s), forecast the time to failure based, quantity of failure over time, and warranty economics based on statistical analysis. Minimal assumptions were made to allow the data to "speak for itself". The raw data files were prepared to resolve data inconsistencies ambiguous values, and to remove unnecessary data. The cleaning process organized the data and correlated and combined the MTU data with the reharvest data. Details of this process is discussed in the following sections. After completion of the data preparation, it was imported into a reliability-specific statistical analysis tool called JMP, to generate the reliability results with the consideration of a simulated battery life model. The battery life simulation was conducted based on the alarm data to establish a probability of battery failure independent of the MTU field failure and reharvest logs.

Assumptions

1. Failure analysis of either field returns or test MTUs was not conducted as part of this engagement. This data analysis is strictly based on the field and battery life simulation model data provided by SCG and Aclara.
1. MTU serial numbers are unique and consistently label the same MTU.
2. Currently, the most prevalent MTU failure modes are 630 and XAC, and the qualification dates for these FMs (when available) determine the time of failure.
3. The failure threshold criteria for 630 & XAC are the same as used by SCG to decide whether & when to replace the MTU. Note, failure criteria have changed over time, likely becoming more stringent, i.e. lower threshold.
4. MTUs in use through the cut-off date of 04/30/2021 are not-yet-failed and are considered censor units.
5. Other failure causes, e.g. DCU, external (EXT) & NTF, are independent of the MTU failure mode and can be treated as censors, for the purposes of the reliability model.
6. The number of MTU failures with external cause, e.g. lightning, fire, flood, is insignificant.
7. For reharvested MTUs (reused from SGC's PMC pgm), there are no hardware changes, and the total in-use time is the sum of each install period.

8. If there is a single reharvest period with install date later than 04/30, the MTU install period (if available) is used to determine the use time.
9. RMA MTUs are rarely reused and these can be excluded as a factor. There were very few occasions when MTUs were taken from SCG's RMA bonepile and returned to the field.
10. A detailed assumptions & methodology document has been reviewed with SCG.
11. SCG can only extend the MTU warranty during the 10th anniversary year.
12. SCG has the option to renew the warranty extension for up to an addition 5 years.

Technology

This section outlines the technologies used during the process of data cleanup and analysis. The tools used for the analysis include Python, SAS JMP, and Octave. Python was used for harmonizing the data input files (MTU Installs and MTU Reharvests from SCG) for the analysis. SAS JMP is the statistical application used to develop the reliability model and analyze the failure codes. Octave was the software application used to model the battery life simulation.

The following are descriptions of each of the applications:

1. **Python**: Widely-used, open-source industry standard language used for data cleanup, correlation, and statistical analysis.
2. **SAS JMP**: Industry leading statistical discovery & reliability modelling toolbox that is visual, interactive, comprehensive and extensible. This was used to perform he reliability analysis. The model used was the "Time to Failure Reliability Model".
3. **Octave**: Powerful mathematics-oriented syntax with built-in 2D/3D plotting and visualization tools. The Octave syntax is largely compatible with Matlab. The Octave interpreter can be run in GUI mode, as a console, or invoked as part of a shell script.

Methodology

In summary, the methodology used to perform the reliability and warranty cost analysis included identification of minimum data requirements, clean-up and categorization of the MTU failure codes based on field data, development of the reliability model involving training and validation data subsets, combining the field model with the EOL battery model, and performing reliability life predictions and warranty cost analyses for various scenarios.

Data Inputs

Both field and simulation data were used during the analysis; adequate test data was not provided. The following are descriptions of the data inputs used to perform the reliability analysis.

Field Data (cutoff date of 4/30/2021)

1. **MTU Install Data File**: Historical record of MTU installations including installation dates, failure dates, and failure codes.
2. **MTU Reharvest Data File**: Historical record of MTU reharvests including installation dates, failure dates, and failure codes.
3. **Alarm log data for a subset of meters**

Other Data

1. **Aclara Battery Life Simulation Model (Aclara Model)**: Allows for battery life simulation based on temperature and transmission rate variables
2. **Weather Data for Los Angeles County**: Used as an input into the battery life simulation model. The weather data used in the battery model included a daily temperature (minimum and maximum) profile for 5 years.
3. **Warranty Information (SCG File: AM MTU EOL - Warranty Extension Options 20210517)**: Used to develop the model and reimbursement percentages, costs, and savings between the standard and extended warranties.
    a. The Warranty Period for a Series 3000 MTU begins upon the Installation Date and terminates 20 years after the Installation Date of that item.
    b. Starting with Year 16 after Installation Date, the Parts Credit to be received under Warranty is significantly reduced and the Labor Credit is eliminated.
4. **RMA Code Definitions (**Table 1**)**: Business rules were applied to the RMA codes, in conjunction with failure dates (630 and XAC qual dates), to categorize the failure codes. Together the in-use time (IUT) and status (failure or censor), the output was used in the JMP reliability analysis.

Table 1: RMA Code Definitions

Failure Code	Definition
NULL	NA
630	MTU Alarms
AGA	MTU Alarms
ENS	NA
GAP	MTU Alarms
ICH	Intermittent Comm
ICL	Intermittent Comm
MDF	MTU Error
NUS	MTU Error
OTH	NA
RNR	NA
SV1	MTU Error
WIL	MTU Error
WIT	MTU Error
WWB	MTU Alarms
XAC	MTU Alarms
ZCM	Non-Comm

Data Characteristics

This section describes the characteristics of the field data provided by SCG. The primary source of field failure data was a text (.txt) file containing over 7 million records and a reharvest text(.txt) file containing records for every MTU that was reharvested (removed from field and reinstalled in the field) and the related reharvest and failure information. Each record provided information

for a single meter including serial number, installation, removal, and other related dates, failure dates and codes, RMA codes, and other non-failure related data. Some of the specific data characteristics are:

1. Location data, in Latitude & Longitude, rounded to two decimal places for privacy, equating to ~1km accuracy.
2. MTU serial numbers were masked for privacy in the location data files. SCG has the key to decode the MTU serial numbers.
3. The files contain several RMA codes. Per SCG's direction, only the "1st RMA" code is used in our analysis, unless the 1st RMA code is "SV1"; in this event, then the 2nd RMA code is used.
4. All MTU failures are included in the data file. Most of the failures are related to (Too Many Alarms), TMA (XAC & 630).
5. MTUs included in the list provided to BCG have gone through SCG analysis to rule out the DCU as a cause of failure.
6. There is potential that the files contain external (vandalism, "dog chews", etc.) and environmental causes (lightning, flood, fire, etc.). However, SCG states that the quantity of these causes included in the data file is negligible.
7. MTU serial numbers remain the same when they are reharvested.
8. MTU batteries cannot be changed and are tested for ≥3.1V by SCG before being reharvested.
9. In order to be qualified for reharvesting, the MTUs are verified to have approximately 10 years of remaining life.

Data Cleanup Process

To develop a reliability model, the raw MTU and Reharvest CSV data files were processed to remove superfluous data and organize & combine multiple elements into meaningful data for use in the SAS JMP application; a set of Python modules was developed to implement these functions[1]. Four separate modules (p1,2,3, and a reharvest clean) were run in sequence to complete a full data cleanup process and produce the final output CSV files for import into JMP. Figure 1 depicts the data flow and logic path for the cleanup process.

[1] The python tool is maintained in a private github repository. The zipped source code is supplied as part of the project deliverables. File name: SoCalGas_MTU-v18r6_python_clean_data_code.zip

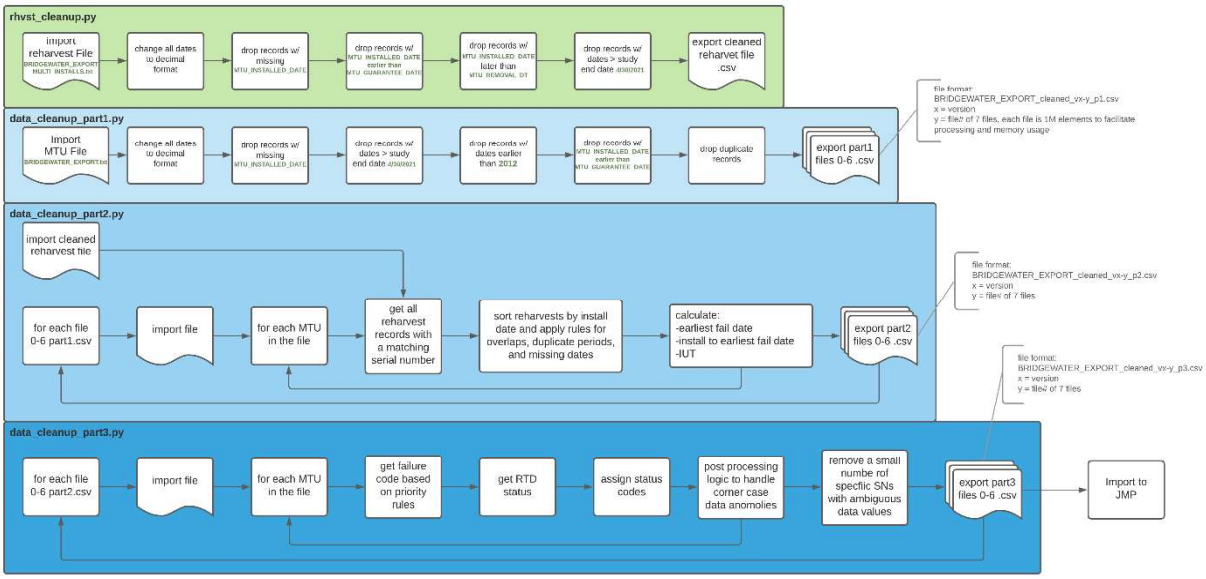


Figure 1: Data Cleanup Process Flow

The first step was to clean the reharvest data file. The following are the steps involved with this process:

1. Import the supplied SoCal Gas *BRIDGEWATER_EXPORT_MULTI_INSTALLS.txt* file dated 5/22/2021.
2. Change all dates to a decimal format.
3. Drop records with missing install dates.
4. Drop records with install dates earlier than the guaranteed date.
5. Drop records with the install date later than the removal date.
6. Drop records with install date later than the defined study end date of 4/30/2021.
7. Export the cleaned reharvest file in a .csv format.

The MTU data file is then processed and split into seven output files, each of which containing approximately 1 million entries. This is done to manage run-time and system memory usage during data processing. The following are the steps involved with this process:

1. Import the supplied SoCal Gas *BRIDGEWATER_EXPORT.txt* file dated 5/6/2021.
2. Change all dates to a decimal format.
3. Drop records with missing install dates.
4. Drop records with install date later than the defined study end date of 4/30/2021.
5. Drop records with install dates earlier than 2012.
6. Drop records with install dates earlier than the guaranteed date.
7. Drop duplicate records.
8. Export the cleaned files in a .csv format designated p1 files.

Each MTU record in the p1 files are merged with the reharvest data to create a set of output files for part 3 of the processing. The following are the steps in this process:

1. Import the cleaned reharvest .csv file.
2. Import each of the p1 .csv file and for each record in each file and:

a. Get all of the reharvest records that match the MTU serial number.
b. Sort the reharvests by date and apply the methodology rules for overlaps, duplicate periods, and missing dates to produce a set of reharvest periods for each MTU. As part of the processing, the reharvest periods for each MTU will summed to be used as the IUT.
c. Calculate the earliest failure date, installation time to earliest failure date, and IUTs for each MTU.
d. Add columns to the export data set to help with the analysis, debugging the code, and JMP import. The additional columns per MTU show the raw (from reharvest file) and calucalated reharvest periods, various calculated times for IUT and time to earliest fail, logic flags to help code debug based on code decisions, status values, and IUT.

3. Export the cleaned files in a .csv format and designate as p2 files.

On the final pass, each MTU within the p2 files are evaluated to:

- Identify and assign the appropriate status codes for the reliability analysis.
- Identify RTD status MTUs and assign these records as "Censor".
- Apply decision logic to account for a small number of corner cases (29), where the earliest MTU failure date is not within the last reharvest period.
- Remove records with ambiguous data values between the MTU data and reharvest data.
- Export the final cleaned files in a .csv format designated p3 files to be used for JMP import.

Failure Code Contributions to Total Failures

The critical results of the field data (Python) analysis needed for the reliability (JMP) model are the IUT, and the failure code or censor classification for each MTU. Based on direction from SCG, there were 6 failure codes assigned as censored units in the JMP reliability model; the censor failure codes are:

1. 1 = Ignore, coding error
2. ENS = N/A
3. MDF = manufacturing defect
4. OTH = Other
5. RNR = Remediation, no reimbursement
6. RTD = Retired
7. SV1 = Sprague defect
8. UNK = N/A

A failed MTU was assigned one of the following 11 failure codes in the JMP model:

1. 630 = 6 hours of alarm duration in 30 days
2. AGA = Above Ground Alarming
3. GAP = verified read gap
4. ICH = Intermittent Communications - High
5. ICL = Intermittent Communications - Low
6. NUS = Negative Usage/Usage Spike
7. WIL = Wrong Interval Length

8. WIT = Water Intrusion
9. WWB = Wireless Wire Break
10. XAC = Excessive Alarms Count
11. ZCM = Non-communicating

As depicted in Figure 2, the total significant failure codes include 630, AGA, GAP, ICH, ICL, NUS, WIL, WIT, WWB, XAC, and ZCM.

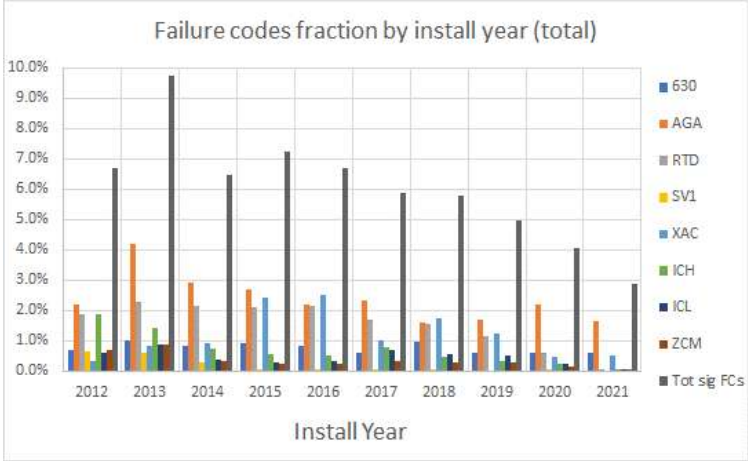


Figure 2: Failure Codes by Install Year (AGA included)

The annualized average failure is shown in Figure 3 and is derived by dividing the total by the IUT (9 years for install class 2012, 8 years for install class 2013, etc…).

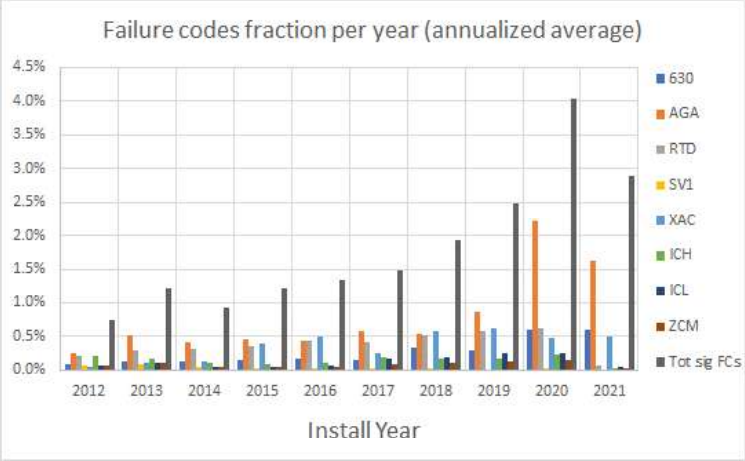


Figure 3: Annualized Average of Failure Codes by Year (AGA included)

Our results show that install classes 2012-2017 have average annualized failure rate of 1.25% (of the MTUs installed for the same year). In addition, the AGA failure code is the largest contributor with approximately 43,000 MTU counts (with the AGA failure code) per year from 2013 to 2016; there were 5,000 in 2017 and 2,500 MTUs in 2018.

In addition, the same analysis was conducted, but with the exclusion of the AGA failure code. Our results show that install classes 2012-2017 have average annualized failure rate of 0.71% (of the MTUs installed for the same year). Figure 4 depicts the results, noting that AGA is shown to maintain the bar colors, but there is no AGA contribution.

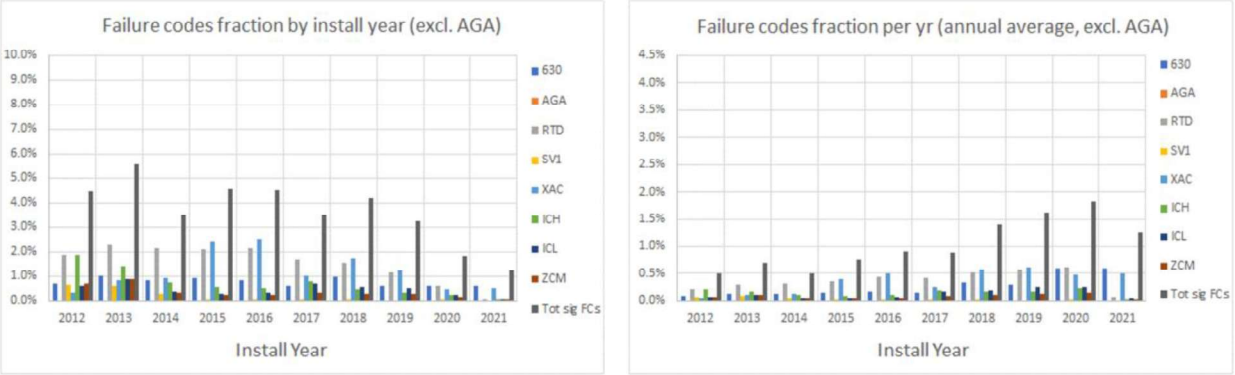


Figure 4: Failure Codes by Install Year and Annualized Average with AGA Excluded

Reliability Life Model Methodology

The complete dataset (~6.6M MTUs) was randomly assigned to one of three subsets for training, validation, and test purposes. For each install class (2013 to 2018) with an adequate quantity of failures, the training and validation subsets were independently fitted to reliability models and the results compared. Since the training subset for the 2012 install class had too few failures, the three subsets were combined for the 2012 reliability model. The reliability models are described in more detail below. There was good agreement, within the confidence bounds of the fitted life function F(t), the cumulative fraction failed, between the training and validation subsets.

As a note, the earliest install class of 2012 has an approximate IUT of 10 years or ~50% of the 20-year design life of the battery. Hence, extrapolation of >10 years is needed assess the battery EOL for the install classes.

As a result of our analysis, we found there were three models that provided reasonable fits to the data. The three models are:

1. Single Weibull distribution fit to the aggregated failure codes, treated as a single failure type. This linear model gave a relatively poor fit to the early life failures at <100 days, which have noticeable curvature.
2. Combined Weibull distributions; based on separate fits to the data for each failure code (with greater than 2 failures). Note, a minimum of ≥2 failure times are required to obtain a fit to a Weibull life function with two adjustable parameters.
3. Combined Weibull distributions, excluding failure codes NUS and WIL.

Figure 5 shows the Weibull fits to each failure code and the combined probability (the black line) or the cumulative fraction failed F(t), versus log (in-use time) for the failures (indicated by the black dots).

Model #2 above was selected for the reliability model for the following reasons:

- The Combined Weibull distributions gave the best overall fit to the aggregate data (cf. lognormal & exponential).
- The curvature of the failure data at early life was reproduced using a combination of 2-parameter Weibull or 3-parameter ZI Weibull life functions, the latter with a Zero Inflated correction was used for failure codes having failures at t = 0.

- In a few cases the best fit distribution to individual FCs was found to be other than Weibull (however the fit to the other functions often failed to converge in JMP)
- There was no basis for excluding NUS and WIL, and including them gave a higher extrapolated failure rate at t>3000 days, see Figure 5. Hence, including NUS & WIL better represents the actual field condition and results in a realistic (worst case) reliability prediction.

The reliability analysis for the 2013-2018 install classes, showed the failure codes NUS and WIL exhibit a rapidly increasing failure rate (Weibull slope parameter β = 4.7 & 6.0). (Note, β <1 indicates a decreasing failure rate with time, β =1 a constant FR, and β >1 an increasing FR.) These two failure codes are responsible for an increased cumulative fraction of failures F(t) at t >3000 days. Note, for the 2012 install class there were too few NUS & WIL failures to obtain a fit and these failure codes were excluded from the model for 2012. Two reliability models (#2 and #3) with different extrapolated results for the 2013 install class. The red circle indicates the portion of the combined probability, or cumulative fraction failed, that is most influenced by the high failure rates for the NUS & WIL failure codes. shows the extrapolated life functions and failure rates (in the inset box) for the two models (2 and 3) for the 2013 class, with and without the contributions from NUS and WIL.

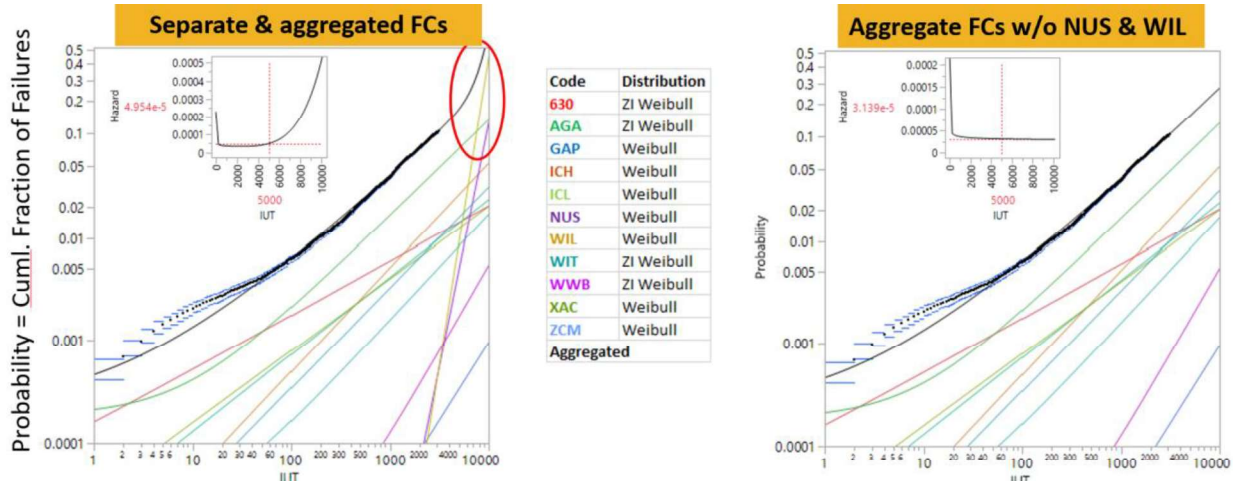


Figure 5: Two reliability models (#2 and #3) with different extrapolated results for the 2013 install class. The red circle indicates the portion of the combined probability, or cumulative fraction failed, that is most influenced by the high failure rates for the NUS & WIL failure codes.

The earlier installation classes (2012 to 2018) contained a wide range of MTU quantities installed and were found to have different life distributions (failure rate as a function of time). Due to this, separate reliability models were developed for each of these installation classes. Failures over a period of 3 years or longer are required for more accurate extrapolations. The life distributions for installation classes with shorter durations, 2019 and later, were estimated from the average annual failure rate of the three most recent classes, 2016-18.

The JMP results for each install class model comprise the cumulation fraction failed F(t) and the lower and upper 95% confidence levels, LCL & UCL, extrapolated over a period of t = 0 to 13,000 days. Interpolation was used (in Excel) to find the corresponding values at the mid-point of each calendar year over the period 2012 to 2040. For example, for calendar year-end 2014, the interval is 1-185 days for the 2014 class, 185-550 days for the 2013 class and 550-915 days for

the 2012 class. The annual failure rate FR(t) or ΔF(t) = F(t2) - F(t1) per MTU per year. The 95% confidence levels for each FR(t) were estimated from the standard error (SE) of F(t), calculated from the JMP LCL & UCL values, using statistics methodology for propagation of errors (i.e. the error in FR(t) is the square root of the sum of squares of the errors for F(t1) and F(t2)); the confidence level values are approximate. The method assumes the errors are independent and normally distributed. The 95% confidence interval corresponds to an UCL of 97.5%, or probability of 39 times out of 40 FR(t) will be below the UCL, the worst (most conservative) failure case.

The total failure rate is the sum of the field failure rate (obtained from the JMP reliability models) and the battery failure rate (weighted for the standard & extended range MTUs, described below). The failure rate summations were calculated at the same calendar time for each install class. As described above, the confidence limits for the total failure rate were also estimated from the standard errors using propagation of errors. The field only and total (field and battery) failure rates, at 95% UCL are shown in Figure 6.

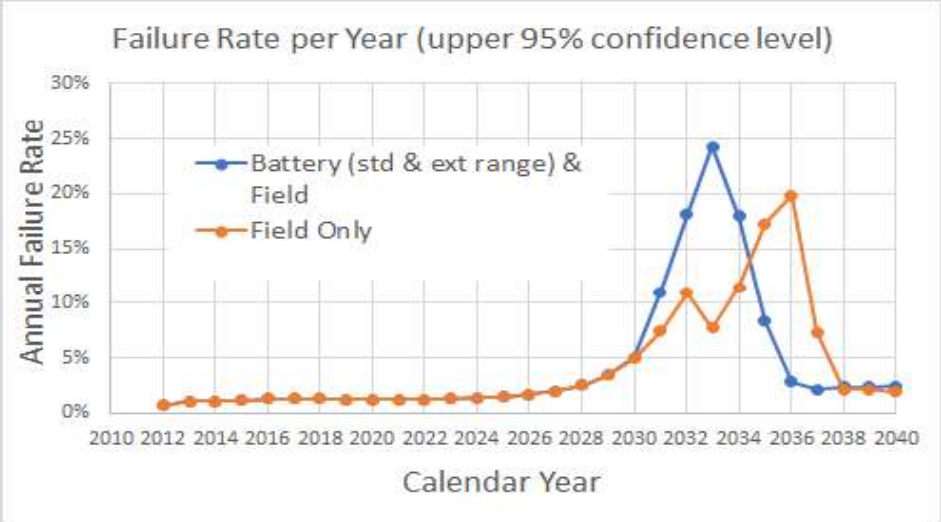


Figure 6: MTU annual failure rates for field only and field plus battery models, for the aggregate number of installs and all the install classes. The 95% UCL corresponds to probable worst-case estimated failure rate. The battery contribution is the dominant failure rate from 2030 and depletes the population within 5 years, causing the decreased failure rate at later years.

The total (field & battery) failure rate for each install class was used to estimate the aggregate number of MTU failures each calendar year to 2040, starting with the actual number of MTUs installed over 2012-18. For the 2019 and later install classes, the initial installs are the number of MTUs needed to maintain the total population at the peak of 6.7M, that occurred in calendar year 2018. The aggregate number of failures are shown in Figure 7.

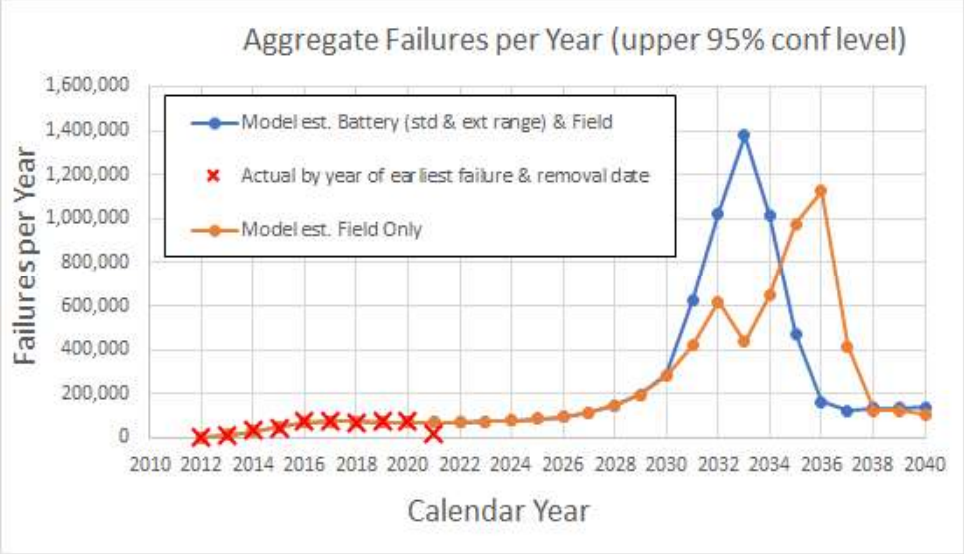


Figure 7: MTU failure per year for the field only and field plus battery models, for the aggregate number of installs and all the install classes. The 95% UCL corresponds to probable worst-case estimated number of failures. The red crosses are the number of actual MTU failures, estimated from the count of MTUs with a failure or removal date in the calendar year.

The estimated (at 95% UCL) aggregate number of failures, replacements, and annual failure rate for all install classes for the combined battery and field models are shown in Table 2.

Table 2: Aggregate number of failures for all install classes by calendar year, predicted by the combined field and battery life models at 95% upper confidence level. Note, the failure rate is determined by the number of failures and the field install population, it is not related to the number of MTUs that may (or may not) be removed or remediated.

Calendar YE	MTU Age (yrs)	Install base	Replace base	Replaces	Failures	Unfailed	Annual FR	Cuml FR
2012	1	23,016	0		167	22,849	0.7%	0.7%
2013	2	1,037,301	0		10,799	1,026,502	1.0%	1.1%
2014	3	2,684,808	0		29,245	2,655,563	1.1%	1.5%
2015	4	4,250,904	0		50,005	4,200,899	1.2%	2.1%
2016	5	5,430,275	0		69,435	5,360,840	1.3%	2.9%
2017	6	5,573,756	0		73,686	5,500,070	1.3%	4.2%
2018	7	5,661,874	0		71,955	5,589,919	1.3%	5.4%
2019	8	5,661,874	71,955	71,955	70,461	5,591,413	1.2%	6.6%
2020	9	5,661,874	141,324	70,461	69,735	5,592,139	1.2%	7.9%
2021	10	5,661,874	208,671	69,735	69,795	5,592,079	1.2%	9.1%
2022	11	5,661,874	275,026	69,795	70,959	5,590,915	1.3%	10.4%
2023	12	5,661,874	341,577	70,959	73,246	5,588,628	1.3%	11.6%
2024	13	5,661,874	409,473	73,246	77,406	5,584,468	1.4%	13.0%
2025	14	5,661,874	480,553	77,406	84,084	5,577,790	1.5%	14.5%
2026	15	5,661,874	557,296	84,084	95,471	5,566,403	1.7%	16.2%
2027	16	5,661,874	644,282	95,471	114,155	5,547,719	2.0%	18.2%
2028	17	5,661,874	748,609	114,155	145,091	5,516,783	2.6%	20.8%
2029	18	5,661,874	882,178	145,091	196,221	5,465,653	3.5%	24.2%
2030	19	5,661,874	1,064,696	196,221	286,206	5,375,668	5.1%	29.3%
2031	20	5,661,874	1,334,131	286,206	622,672	5,039,202	11.0%	40.3%
2032	21	5,661,874	1,935,470	622,672	1,025,867	4,636,007	18.1%	58.4%
2033	22	5,661,874	2,930,093	1,025,867	1,376,408	4,285,466	24.3%	82.7%
2034	23	5,661,874	4,258,467	1,376,408	1,016,232	4,645,642	18.0%	100.0%
2035	24	5,661,874	5,204,210	1,016,232	473,667	5,188,207	8.4%	100.0%
2036	25	5,661,874	5,590,725	473,667	162,508	5,499,366	2.9%	100.0%
2037	26	5,661,874	5,659,383	162,508	123,556	5,538,318	2.2%	100.0%
2038	27	5,661,874	5,661,874	123,556	136,235	5,525,639	2.4%	100.0%
2039	28	5,661,874	5,661,874	136,235	135,647	5,526,227	2.4%	100.0%
2040	29	5,661,874	5,661,874	135,647	137,064	5,524,810	2.4%	100.0%

Battery End-of-Life Wear-Out Period

By incorporating Aclara's battery life simulation model results with our reliability analysis of the field data, we were able to forecast the EOL WO period. Aclara stated that the battery life simulation was adopted from a previous MTU design version for the type installed at SCG (Series 3000 MTU with a Tadiran TL-4903 battery). In the simulation, a base transmission (Tx) rate of 4.456 transmissions per day is used; this accounts for an average transmission rate of 3.456 per day and an additional transmission (3.456 average + 1 additional transmission = 4.456) for alarms, time synchronizations, and extra reads. Aclara and SCG agreed that this is a representative base transmission rate and a Tx of 4.456 was used for the simulation results used to develop the battery life model. Additional variable parameters include additional current draw (for leakage and fault conditions) and the daily minimum and maximum temperature profile for the location of interest. Since the distribution of additional current draw experienced by the field MTUs is unknown, in terms of amount of current, time dependence and the fraction affected, zero additional current draw was used in the simulations for developing the battery model. The simulation model does not include humidity as a possible stress and has an estimated accuracy of +/- 10%.

To use the simulation model for the reliability analysis, we applied the following methodology:

1. 5-year min & max temperature profiles for Bakersfield (provided by Aclara) and LA County (courtesy of the National Oceanic and Atmospheric Administration or "NOAA").
2. Adjusted the power draw to simulate both extended range and standard range MTUs.
3. For the purposes of investigating how the battery life depends on the transmission rate and current draw, two parameters were varied to make an initial trend analysis:
    a. Transmission Rate (RF_TxRate_PerDay): Varied range from 4 to 40 per day and assumed a constant Tx rate throughout the battery life.
    b. Additional Current Draw (aveCurrDraw_mAh_PerHour): Varied range from 0 to 0.02 mAh (0-20 µAh).
4. Ran 1,000 simulations for each condition.

The battery life model was developed by fitting separate (3-parameter) Weibull life functions to the simulation results (histograms) for an extended range and a standard range MTU, each operating at a constant Tx of 4.456 per day and with zero additional current draw.

For the extended range MTU the fit to the 3-parameter Weibull life function gave the following parameter values:

1. γ = 16.81 yrs, failure free period (FFP)
2. μ = 1.206, scale: larger gives wider distribution
3. σ = 0.376, shape (or slope, β = 2.66): smaller gives narrower symmetric distribution

The simulation output histogram and the best fit Weibull probability distribution are show in Figure 8.

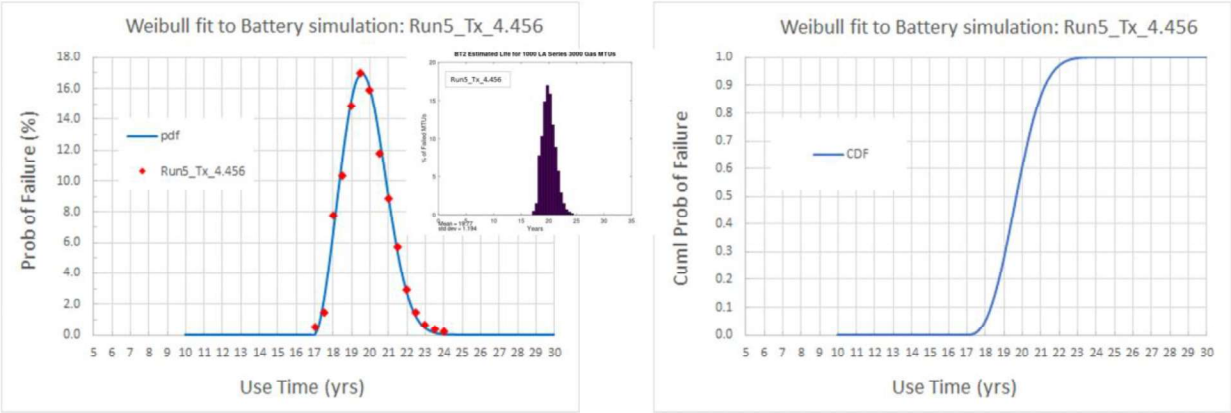


Figure 8: Weibull life function fit to Aclara's battery life simulation model results, for the extended range MTU. The red points are the simulation results taken from the output histogram shown in the inset. The corresponding cumulative life distribution function is shown to the right.

The failure-free period for the 3-parameter Weibull implies the battery does not fail within the initial 16.8 years. From the fit to the simulation results for the standard range MTU the failure-free period was 17.38 years, slightly longer than the extended range, and as expected since the standard range MTU consumes less energy.

Since the battery simulation has only the one environmental condition (temperature) there was concern the results may not be representative of the field conditions. For this reason, it was decided to base the confidence interval for the battery life model on the estimated accuracy of the simulation, ±10% the average life, instead of the relatively small variation (≈1 year) in average life obtained from repeat runs of the battery simulation (at the same condition).

For the extended range MTU, the median of the battery life model is the 3-parameter Weibull life distribution with failure free period of 16.81 years, the 95% UCL is approximated by a second 3-paramater Weibull distribution with a shorter FFP of 16.81 x 0.9 = 15.12 years and the LCL approximated by a third Weibull distribution with a longer FFP of 16.81 x 1.1 = 18.49 years, all three distributions having the same scale and shape parameters.

The resulting battery life functions for the extended range and standard range MTUs are shown in Figure 9.

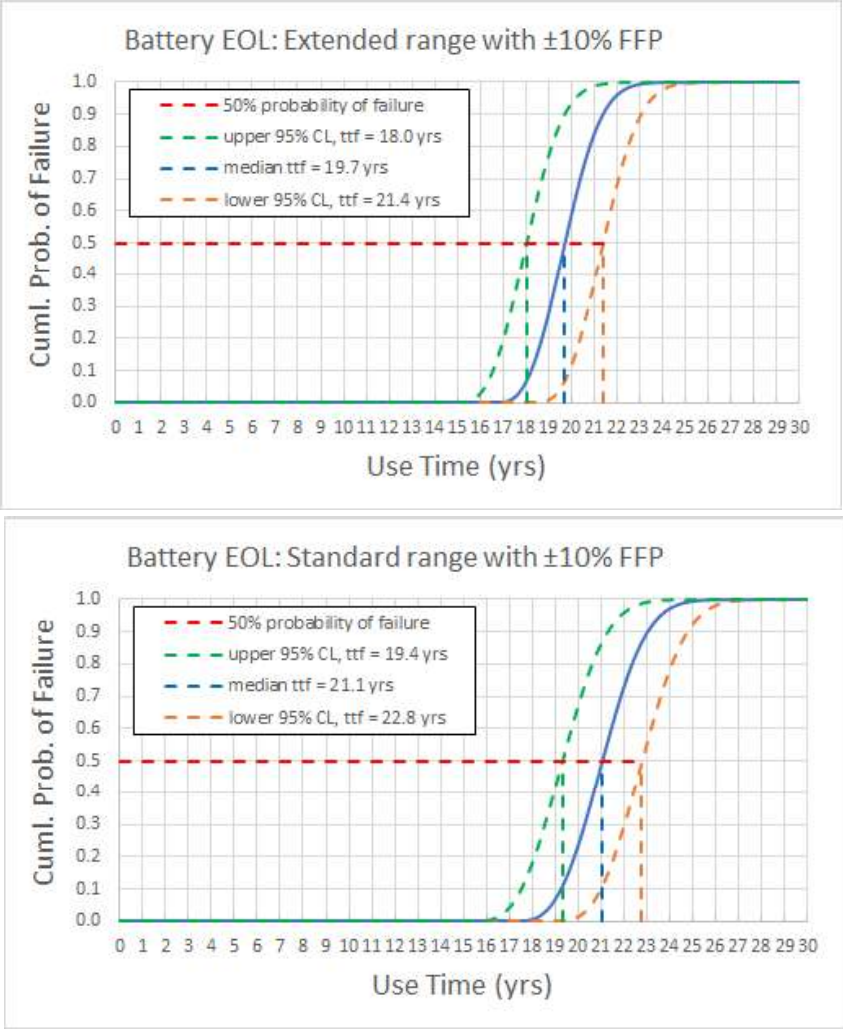


Figure 9: Battery life functions and 95% confidence levels for the extended range and standard range MTUs. The time-to-failure ttf at 50% probability of failure are show by the dashed lines. For the standard range MTU, the Weibull distribution parameters are FFP of 17.38 years (for the median), scale 1.434 and shape 0.356.

For the combined field and battery life model the failure rates were added as follows:

- Total FR(t) = Field_FR(t) + (ER_fraction).ERbattery_FR(T) + (1-ER_fraction).SRbattery_FR(t)
- Where ERbattery_FR(t) and SRbattery_FR(t) are the battery failure rates for extended and standard range MTUs, respectively, and ER_fraction is the weighting factor for the field population of extended range MTUs, which is ≈17.4%.

Like the method used for field reliability model, the failure rates were combined at the same calendar time periods for each install class and the confidence limits were estimated by statistical propagation of the standard errors.

The aggregated results for all install classes and the combined field and battery life model are shown in Figures 6 and 7, and Table 2, above.

Extended Warranty Cost Analysis

The warranty cost model is based on the information provided by SCG and the following assumptions, which were verified by SCG:

- The warrant cost model is applied to each install class individually, because each class has differing number of initial installs and annual failure rate (AFR)
- Failures occur at the AFR estimated from the combined (field & battery) reliability model.
- Warranty Failures (WF) are a fixed fraction of the AFR for each calendar year.
- The Standard warranty coverage for the initial 15-year period, is zero premium cost to SCG
- The Parts Purchase Cost (to SCG) is constant $ (no inflation adjustment) and the same for each install class
- The declining Parts Credit, from 25% to 5%, applies if there is no warranty extension. If the extension is taken, the Parts Credit is 100% for each of the 1-5 years of the extension period. The 1 to 5 year extension is a model variable.
- The labor cost (to SGC) is constant $ (no inflation adjustment) and the same for each install class
- The warranty Labor Reimbursement increases by 3% for each calendar year, and starts at the corresponding $ value for the install class
- The Labor Reimbursement for curb MTUs is applied as a combined (curbs and non-curbs) reimbursement, weighted by the Curbs Fraction of the warranty failures. The Curbs Fraction is the same for each calendar year but can be changed for each install class
- Warranty covers both parts & labor, not either one or the other
- The warranty coverage applies to the number of remaining MTUs at the anniversary year for each install class. The 1-10 anniversary year is a model variable. Note, this requires that SCG track the number of remaining MTUs in the field for each install class.
- The Warranty Failure (WF) %age can be used to compensate for failed MTUs (e.g. failure code AGA) that are not removed from the field, and any removals that do not become warranty failures. The WF fraction is a model variable that reduces the AFR and number of warranty failures by the same factor for each calendar year.

The variable (input) parameters used in the warranty cost model are summarized in Table 3 below.

Table 3: Warranty Model - Description of Variables

#	Variable Name	Description
1	Install Class	Enter the install class. Failure rates will be automatically adjusted for each install class.
2	Purchase Cost	Warranty purchase cost, before any warranty credits, to SCG for each MTU.
3	Labor Cost	Labor costs to SCG per MTU (must be greater than or equal to Labor Reimbursement).
4	Warranty Extension (Years)	Number of warranty extension years 1-5 for purchase.
5	Anniversary Year	Warranty extension anniversary year 1-10 for the install class. This is fixed to 10 years per SCG's agreement with Aclara.
6	Warranty Failure Percentage	Percentage of field failures that qualify for warranty.
7	Curbs Fraction	Percentage of warranty failures that are curb modules.

Some relevant observations revealed in developing the warranty cost model include:

- If just the net cost difference, between the standard warranty (without extension) and the standard plus extended warranty, is of interest, only the Warranty Extension period (plus any up-front premiums) need to be modeled.
- The net warranty cost is independent of SCG's labor cost (if labor cost exceeds the labor reimbursement), because the labor costs and Labor Reimbursement are fixed $, for each install year
- The net warranty cost depends on the MTU Purchase Cost because the Parts Credit is a %age of the purchase cost

A trends analysis of the net savings (or costs) obtained by taking the warranty extension was performed and the results are summarized here:

- For high AFR years (e.g. 2013) and at the 95% UCL, there is consistently net saving by taking the extended warranty (ER)
- For the relatively low AFR years (e.g. 2012) and at median confidence, some scenarios have net cost, and the scenarios of interest should be investigated individually
- The net saving (obtained by taking out WE) increases strongly with the MTU purchase cost
- The net saving is independent of SCG's Labor cost
- Net saving significantly increases with a longer Extension period to 5 years
- Taking a later anniversary year 1-10 years gives a small increase of the net saving
- Net saving increases with the Warranty Failures fraction to 100%. Hence, it is cost effective to remediate as many of the field failures as practically possible.
- A larger Curbs Fraction gives a relatively small increase in the net saving

The important recommendations resulting from the warranty cost model are summarized as follows:

1. Use the 95% UCL when determining estimates, to provide the worst-case scenario.
2. Purchase the 5-year warranty extension on the 10th anniversary of an install class. There is a significant increase in net savings for 5 years, and relatively small savings compared to purchasing the warranty extension before the 10-year anniversary.
3. If warranty extensions are purchased, it is recommended to remediate as many MTUs from the field as possible. The net savings are higher as the fraction of warranty return failures increases. This has the additional benefit of removing failing MTUs from the field sooner, before they drive additional cost/loss of revenue (e.g. read gaps).

The combined reliability and warranty cost models, together with the warranty cost scenarios, are in the Excel calculator distributed to SCG.

MTU Program Recommendations

As a result of our engagement and findings, we are providing 3 recommendations for SCG's consideration. We recommend the following:

1. Perform independent Accelerated Life Testing (ALT) of the fully assembled MTU with Data Collector Unit (DCU) communications present.
2. Develop a failure investigation strategy to collect data, mitigate, and reproduce failures observed in the field.
3. Perform thorough testing to failure under simulated field operating conditions (including temperature & humidity) for evaluating the next generation of advanced meters. This includes determining the cause(s) of failure and possibly re-assessing the assumption that the battery limits the life of the MTU.

Based on our findings and the data & information received from SCG and Aclara, our analysis provides a projection of likely failure quantities (by failure code). Our analysis was conducted based on field data (supplied by SCG), failure codes (categorized by SCG), and a battery life simulation model (supplied by Aclara); it is important to note that the battery life model is a simulation, not directly based on test results, but on model parameters derived from testing of battery-MTU assemblies. Note, Aclara did not share their test results or model with Bridgewater.

SCG and Aclara stated that the failure analysis, on the direct-mount MTUs were conducted, by both parties and were mutually agreed to be inconclusive. To identify and better understand the underlying failure modes that lead to the resulting failure codes, we recommend an accelerated life test (ALT) be performed by a third-party independent laboratory.

Our second recommendation includes developing and conducting a failure investigation strategy to collect MTU data, recording mitigation actions, and reproducing failures observed in the field.

The third recommendation relates to the planning for the next generation of AM; we understand that SCG is currently planning for this. During this planning, we recommend thorough reliability testing (test to failure) of the new advanced meters prior to field deployment. In this evaluation, the assumption that the battery limits the life of the MTU should be validated. In addition, the entire MTU assembly, with the battery installed, should be tested under environmental

conditions (humidity, temperature variations, etc.), expected operations (time synchronizations, regular transmissions, alarms, etc.), and with a connection to a DCU.

Terminology & Definitions

95% Upper Confidence Level (UCL)

95% is a commonly used confidence interval. For the 95% confidence interval (2-tailed), there is a 97.5% probability that a repeat (random) measurement will be below the UCL. Hence, the corresponding value is widely accepted as a worst case.

Anniversary Year

The year (10) of an Install Class that SCG may elect to extend the warranty coverage.

Censor

1. In reliability analysis, the term censor refers to a unit that has not yet failed, for example, an MTU that was operating normally and removed from the field for any reason (e.g. failure code RTD).
2. An MTU that was still in operation as of the censor date (4/30/2021).

Censor Time

The censor time is the total IUT for a censor MTU. For censor units that are still operating at the 30 April 2021 compilation date of the dataset, this censor date defines the end of the operating period.

Failure Cause

The cause(s) of failure are the underlying reason(s) for failure, typically a physical failure mechanism, failure to follow a procedure or process, lack of a defined process, or human error. The failure cause is typically determined by failure analysis, using tools such as fault-tree or "5-whys". An example of 5-whys questions for an MTU is:

- Failure mode: non-comm
- Failure cause (level 1): Q: why is the unit not communicating? A: there's no electrical function.
- Failure cause (level 2): Q: why is there no electrical function? A: the battery has no charge (<1 V drop with a 1 kOhm resistor placed across the terminals).
- Failure cause (level 3): Q: why is the battery discharged? A: found a partial short-circuit in the magnetic sensor circuit (1 kOhm path instead of the expected MOhm), that likely caused additional current leakage.
- Failure cause (level 4): Q: why is there a partial short-circuit. A: Found evidence of corrosion between the copper traces adjacent to reed switch RS2, using an optical microscope.
- Failure cause (level 5): Q: what is the cause or source of the corrosion? A: Found organic acid residues on the surface of the PCB by IR spectroscopy, indicating incompletely activated solder flux residues.

And so on, until the root cause is determined or an acceptable conclusion is reached (including all the supporting evidence, test results, etc.)

Failure Code

A failure code is the category name assigned to an MTU according to the SCG failure criteria, e.g. AGA is the code for 6 hours of alarm duration over 30 days for an above ground MTU. Note, the failure criteria (and codes) have changed over time and the reliability analysis used the assigned failure code in the shared field dataset.

Failure Mode

The failure mode is the top-level description of the symptom (actual or suspected) for a unit, based on failure to meet a functional performance, quality or reliability requirement. MTU functional failure modes include excess alarming, failure to alarm when there is a tamper, intermittent communication, or non-comm. Note, one or more failure codes may fall under the same (single) failure mode.

In-Use-Time (IUT)

The total operating time for an MTU in the field, including any reharvest periods.

Median Confidence Level

For a repeat measurement, there is a 50% probability the result will be below the median value, and 50% above.

Appendix

Suspected/Known Causes of Early Life Failure

The following issues are known suspected causes of early life failures based on SCG's history of the MTUs.

1. Aclara MTU potting void issue is known for Itron meters. This is a known cause of alarming and failure for curb installations.
2. Suspected causes of multiple alarms for Above-Ground MTUs (excluding actual tampers):
    a. SCG's TMA report stated alarming can be caused by a corrosion-induced open or short in the tamper sensor circuit (for tilt, cut-wire, magnetic, etc)
    b. Corrosion can be caused by excess solder flux residues, moisture ingression
    c. The mechanism is known as electrochemical migration. ECM occurs when voltage bias, moisture and ionic contamination (e.g. flux residue) are all present.
    d. To-date the cause of alarming has not been confirmed by Aclara, or by independent failure investigation
3. Read gaps are widely present in MTUs that exhibit too many alarm (TMA) characteristics.
4. Initial analysis of the Alarms field data showed:
    a. Alarming rates of up to 50-130 per 24 hours, over a period of 1-2 years
5. Battery life will be <<20 years if the battery degrades and/or the current load is higher than normal. Possible causes:

a. Increased Tx events & frequency due to alarming, est. life of 6-10 yrs for high alarm rate MTUs
b. Elevated T&H operating conditions
c. Phantom current draw, faulty component and/or electrochemical migration (ECM)

Attachment C

Bridgewater's Advanced Meter MTU EOL Analysis Addendum

Addendum to Final Report for
SoCalGas

"AM MTU EOL Analysis"

November 16, 2022

Prepared by Peter Arrowsmith, Reliability Engineering Consultant, Bridgewater Consulting Group, Inc.

SoCalGas requested BCG respond to a question from Aclara, the MTU supplier, concerning the MTU wireless transmission rate (Tx) used for the battery life model. This addendum describes in more detail (relative to the Final Report) why the Tx was selected, how it was applied and the development of the different models. The focus here is the battery life model, rather than the subsequent MTU field reliability and the MTU-battery combined models, which were described in project presentations and the final report.

The steps in the model development process were as follows:

1) **Investigate the affect of Tx, the (constant) number of MTU transmissions per day over the lifetime, on the battery life.**
   Tx = 4 is at the low end of the design spec transmission rate of once every 6 hours.
   Tx = 40 is the maximum allowed by the Octave battery life simulation model.
   A range of Tx 4 to 40 was used in the Octave simulation for the purposes of sensitivity analysis, to investigate the dependency of the battery life upon Tx for the standard & extended range MTUs (extended draws slightly higher battery current). The Octave simulation results are shown graphically below. A higher Tx gives a shorter battery life, as expected, although the dependency is not linear:

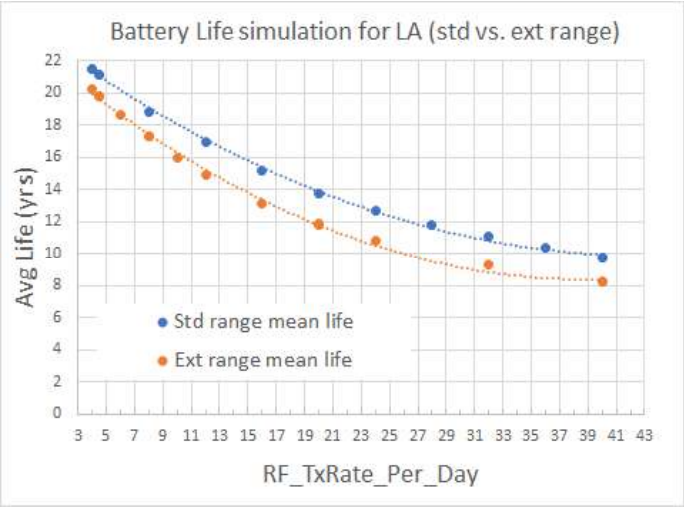


Figure 1, simulated standard and extended range battery life curves as a function of Tx.

2) Select a representative base Tx for MTUs in the field.

Following discussion with SCG & Aclara, Tx 4.456 was selected, for the reasons stated in the final report; this accounts for an average transmission rate of 3.456 per day and an additional transmission (3.456 average + 1 additional transmission = 4.456) for alarms, time synchronizations, and extra reads.

Notes:

a) A battery life model is required since we know all battery-MTUs have a finite (mean) life of about 20 years. A reliability model that incorporates only the field data, without the battery end-of-life contribution, will give an extrapolated life exceeding 20 years for a (small) fraction of the MTUs, which is unrealistic.

b) Since the field population data (supplied by SCG) used to develop the MTU reliability model includes early life failures (e.g. manufacturing and installation defects), failures caused by unexpected events (e.g. external and environmental stresses) and end-of-life or wear-out failures, possibly caused by battery depletion, as well as units that have not failed (known as censors or suspensions), it would be incorrect to use a higher than the base Tx for the battery life model. The affect of using a higher Tx and shorter battery life would be to overestimate the number of failures in the 1-20 year period.

3) Use the base Tx of 4.456 in the Octave simulation to determine the parameters for the battery life model, for standard and extended range MTUs.

The Octave output is a histogram of the fraction of failed MTUs (from 1000 simulations) versus the time to failure (years). The results shown here are for simulation Run #5 of an extended range MTU:

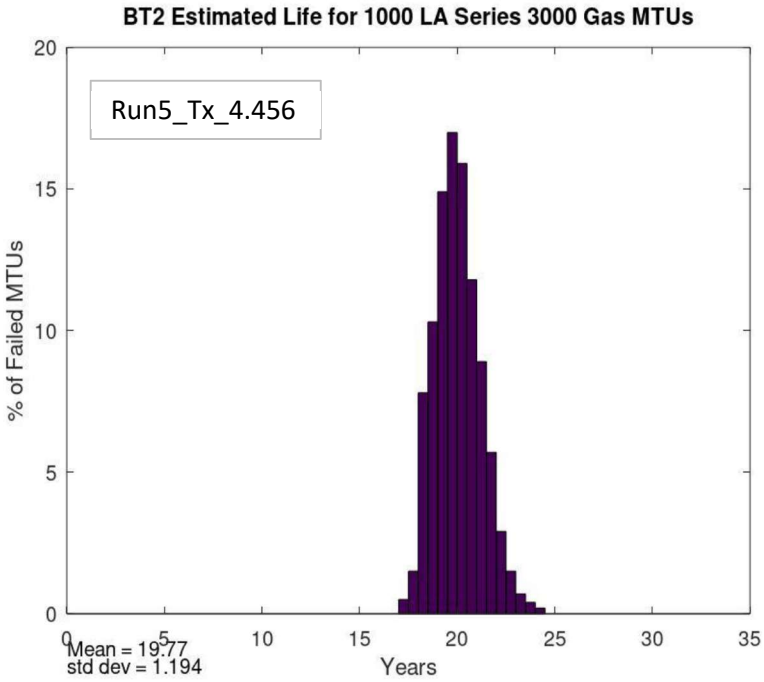


Figure 2, Octave simulation results for extended range battery at Tx of 4.456 per year.

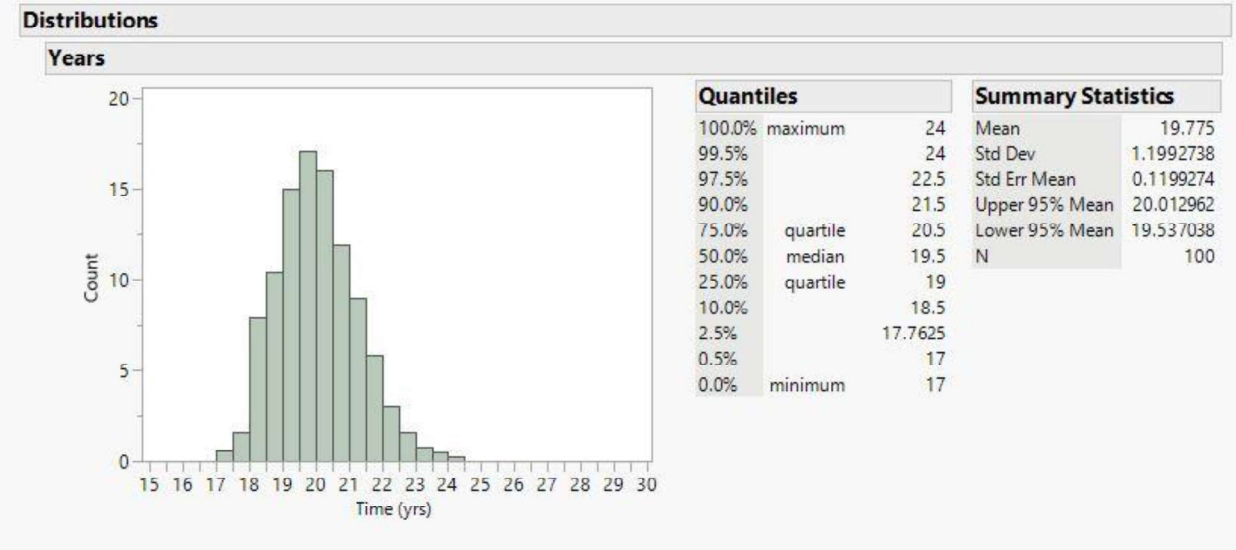
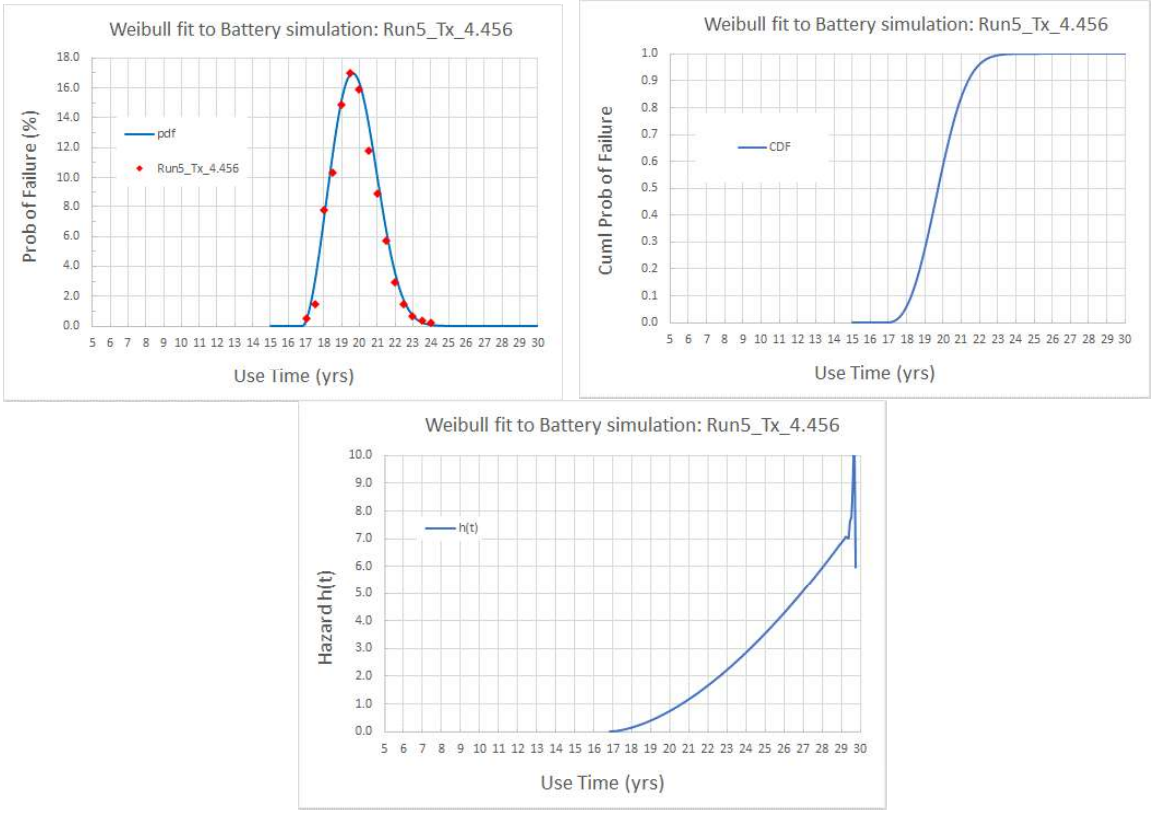


Figure 3, summary statistics for the Octave simulation of Figure 2, using JMP. Note, the small standard deviation and the error of the mean.

A 3-paramater Weibull life distribution gave an excellent fit to the Octave histogram, with little or no scatter of the data points around the model function:



Figures 4a, 4b and 4c, showing the Weibull distribution pdf, CDF and hazard function h(t) respectively, obtained by fitting to the Octave simulation results of Figure 2.

In the above Figure 4, the left plot 4a shows a fitted pdf or probability density function f(t), the right plot 4b is the corresponding CDF, or cumulative density function F(t), and the lower plot 4c is the hazard function h(t). The red data points in 4a are the values taken from the Octave simulation histogram and the blue lines are the fitted function. The best fit Weibull parameters were determined as:

Weibull parameter description	Symbol	Standard range	Extended Range
Failure free period or location (yrs)	γ	17.38	16.81
Characteristic life or scale (yrs) (the log-life, μ was given in the final report)	$\eta = \exp(\mu)$	4.20	3.34
Weibull shape or slope (unitless) (the inverse, σ was given in the final report)	$\beta=1/\sigma$	2.81	2.66

The battery life models used to determine the failure rate as a function of time, for standard & extended range operation, were based on the Weibull parameters in the above table.
Notes:

c) The PDF is the probability that a unit will fail at time t, the CDF is the cumulative probability of failure, or the fraction of units that fail over the time period. (The CDF is the integral of the PDF.) The reliability R(t) = 1 - F(t), is the fraction of units that are still operating at time t.

d) The failure rate FR(t), is the common term for the hazard function h(t) = f(t)/R(t), the fraction of failures divided by fraction of units still functioning. The battery failure rates (more correctly the hazard functions) for the standard and extended range MTUs were calculated from the Weibull parameters using Excel (spreadsheet file: Battery Life simulation results v3, available on request).

e) A Weibull slope $\beta>2$ is consistent with a wear-out type of failure mode, such as battery degradation or charge depletion.

f) The failure free period (FFP) is the initial time period when no failures occur.

g) The Octave simulation predicts zero failures in the failure free period of 1 to 17 years, prior to battery depletion. Hence, the Octave simulation is not a realistic representation of the actual performance of the installed MTUs (since early life failures occur in the field) and the Octave simulation cannot, by itself, be used to model the field reliability. Hence, the MTU field reliability model was also developed.

h) Since the Octave simulation histogram in Figure 2 is relatively narrow, the battery model appears to be relatively precise, i.e. the simulation indicates there is little variation in the mean battery life. Since real-life batteries will have variation, this was based on the estimated error of ±10% for the simulated battery life, as suggested by Aclara. Note, ±10% the mean life of 19.775 or ±2.0 years is similar to the 95% confidence interval of 22.5 - 17.76 = 4.7 years, from the statistics of Figure 3. The ±10% variation was incorporated in the subsequent MTU field reliability model by applying factors of 0.9 and 1.10 to the FFP and assuming this corresponds to the 95% confidence interval. This was done for the standard and extended range MTUs. The remaining two Weibull parameters needed to calculate the confidence intervals were unchanged from the values in the above table.

4) **Develop the MTU field reliability model, based on the operating times for each cohort of MTUs, including the reharvest MTUs (from SCG's install database).**
The methodology used to model the MTU field data to obtain the estimated failure rates as a function of the extrapolated time was reviewed in project presentations and described in the final report.

5) **Make the combined MTU-battery reliability model, including the failure rates from the field reliability model and the battery life model.**
The failure rates are additive and were combined using the formula:

Combined FR(t) = Field_FR(t) + (ER_fraction).ERbattery_FR(t) + (1-ER_fraction).SRbattery_FR(t)

Where:

Field_FR(t) are the MTU failure rates, determined from the MTU field reliability model, derived from SCG's installation data,

ERbattery_FR(t) and SRbattery_FR(t) are the battery failure rates, determined from the battery life model (using Tx 4.456) for extended and standard range MTUs, respectively,

ER_fraction is the weighting factor for the field population of extended range MTUs, which is ≈17.4%

Following the method used for field reliability model, the failure rates were combined for the same calendar year periods (t) for each install class and the confidence limits were estimated by statistical propagation of the standard errors, which included the battery life variation.

Notes:

i) Because the battery life model has a failure free period of ≈17 years, much longer than the 10-11 years of the earliest cohort of installed MTUs, there is no double-counting of failures from the MTU field and battery models over the initial life period. In other words, the MTU field reliability model is the only source of failures until the first few battery end-of-life failures occur at an earliest time of 16.81*0.9 = 15 years, applying the 10% variation, described in note h).

6) **Use the combined MTU-battery reliability model to predict the rate of MTU failures, the estimated annual number of replacements and warranty costs, over 25 years from the initial installs.**
Described in the final report.

Attachment D

Schedule C: Compensation, Invoicing and Payment Terms

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Attachment E

AMI Module Vendor Correspondence: Legacy Module Discontinuation

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From: Chaise, Joshua <jchaise@hubbell.com>
Date: Thursday, March 26, 2026 at 6:49 PM
To: [redacted]
Cc: [redacted]
Subject: [EXTERNAL] Series 3000 End-of-Life

CAUTION! External Sender
This email came from outside the company. If you're unsure whether this message is harmless, click the "Report Suspicious" button.
Report Suspicious

Hi [redacted]

Per our discussions, Aclara is planning to transition our customer base from Series 3000 Gas MTUs to our newer generation products over the next 5 years, with the target of end-of-life for Series 3000 by mid-2031.

Best,
Josh

Josh Chaise
VP, Product Management, Water and Gas

Attachment F

Third Amended and Restated AMI Equipment, Software and Services Agreement

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Attachment G

System Capabilities

SYSTEM CAPABILITIES

System	Backward Compatibility *	Forward Compatibility **	Network Capacity Constraints	Cyber Security Enhancements	Two-way request/ response reliability
DCU II/II+ & NCC	✓	✗	✗	✗	✗
DCU II/II+ & AclaraONE	✓	✓	✗	✗	✗
Base Station & AclaraONE	✓	✓	✓	✓	✓

* Backward compatibility is for billing read support of existing S3000 and S4000 devices

** Forward compatibility is for billing read support of new devices (USM, S3500, etc.) over 20 year expected system life

Attachment H

Schedule K: Warranties

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SCHEDULE K

WARRANTIES

Docusign Envelope ID: 037FDB48-6AD6-41A8-8888-688C23E71951

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1. DEFINITIONS

(a) For the purposes of this Schedule K:

(i) ***"Delivery Date"*** (1) with respect to Equipment means the date on which the Equipment has been (a) in the case of Network Devices and other equipment, delivered to Company; (b) in the case of MTUs, delivered to the Company, VAR or Meter manufacturer, as applicable; (2) with respect to Software, the date on which the Software is delivered to Company; and (3) with respect to Services, the date on which the applicable Services were performed.

(ii) ***"Labor Rate Adjustment"*** means, with respect to an amount, a 3% increase to that amount that is to be made annually with the first adjustment to be made on January 1, 2013 and on each anniversary of that date. In each case, the Labor Rate Adjustment shall be 3% of the amount as of the preceding December 31, including any prior Labor Rate Adjustments. Such Labor Rate Adjustment escalation on an annual basis is calculated in Schedule K-2 MTU Labor Rate Adjustment Table.

(iii) ***"Installation Date"*** means, with respect to an item of Equipment, the earlier of (i) the date the item was installed (which, in the case of an MTU, means the date that it became an Installed MTU). , or (ii) 12 months from the Delivery Date of the item.

(iv) ***"Product Continuity Period"*** means the period beginning on the Effective Date and ending twenty (20) years after the date on which Final System Acceptance occurs pursuant to Schedule G Acceptance Protocol and Criteria.

(v) ***"Warranty Requirements"*** means, with respect to an item of Equipment or Software, the applicable requirements set forth in Schedule A-19 Product Technical Requirements, Schedule A-20a Software Technical Requirements, and Schedule A-21 Security Technical Requirements, as amended and updated by the Parties from time to time, and as in effect on the Delivery Date; and, with respect to Services, those standards, specifications and descriptions of those Services, all as set forth or referenced in the Scope of Work as amended and updated by the Parties from time to time and as applicable to the Services on the Delivery Date.

(vi) ***"Warranty Failure"*** means, with respect to an item of Equipment or Software that, during the Warranty Period, the item suffers a failure or malfunction such that it does not comply with the Warranty Requirements.

(vii) ***"Warranty Period"*** means the applicable term of a warranty as specified in this Schedule K or elsewhere in this Agreement as to the subject item.

(b) Any other capitalized terms that are used in this Schedule and defined in other parts of the Agreement shall have the meanings given to them in the Agreement.

2. EQUIPMENT WARRANTIES

2.1. Series 3000 MTUs

(a) **Warranty**

Contractor represents and warrants for and during the Warranty Period as herein defined, that each Series 3000 MTU will comply in all material respects with the Warranty Requirements.

(b) **Warranty Period**

The Warranty Period for a Series 3000 MTU begins upon the Installation Date and terminates 20 years after the Installation Date of that item.

(c) **Remedies for Warranty Failure**

If any Series 3000 MTU suffers a Warranty Failure, then Contractor shall pay or credit to Company the applicable i) Parts Credit, or ii) 3151 Parts Credit and iii) Labor Reimbursement, if any, as determined pursuant to this Section 2.1.

(d) **Parts Credit** and 3151 Parts Credit

i. The ***"Parts Credit"*** due to Company for each Warranty Failure is an amount equal to the then current purchase price per Schedule C-1 of the failed MTU (or, if at that time Contractor supplies Company with a later version or replacement for the failed item, the then current purchase price of the later version or replacement) multiplied by the percentage specified in Table 2.1 below for the applicable warranty year. Company may utilize the Parts Credit to purchase MTUs and such MTUs (whether new or refurbished) shall have a full Warranty Period. At Contractor's sole discretion, Parts Credits can be paid by i) check or electronic funds transfer, or ii) a credit memorandum which can only be applied towards any amount owed to Contractor for MTU purchases at that time or in the future.

Example 1: If a Series 3000 MTU experiences a Warranty Failure just before the sixth anniversary of its Installation Date and the then current price for a Series 3000 MTU is [redacted], the Contractor will credit the Company a Parts Credit of [redacted] multiplied by 100% for a total of [redacted] per MTU (as described in Table 2.1 of this Schedule K Warranties).

Example 2: If a Series 3000 MTU experiences a Warranty Failure just before the eighteenth anniversary of its Installation Date and the then current price for a Series 3000 MTU is [redacted], the Contractor will credit the Company a Parts Credit of [redacted] multiplied by 20% for a total [redacted] per MTU (as described in Table 2.1 of this Schedule K Warranties).

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ii. The ***"3151 Parts Credit"*** due to Company for each 3151 MTU with an installed Collar, with part numbers 3151-031-RBS2-SCG, or 3151-031-RBS2-SCG-MM that has already been installed at customer premises at the time that it must be removed, and, after 12/31/14, for part numbers 3151-031-RBS2-SCG, 3151-031-RBS2W-SCG or 3151-031-RBS2-SCG-MM even without an installed Collar, whether such removal is by virtue of a Warranty Failure, Routine Meter Maintenance or Planned Meter Sample (as defined below), however, excepting any removal as a result of a meter recall, or group meter failure, is an amount equal to the then current purchase price of the 3151 MTU (or, if at that time Contractor supplies Company with a later version or replacement for the 3151 MTU, the then current purchase price of the later version or replacement) multiplied by the percentage specified in Table 2.1 below for the applicable warranty year. Company may utilize the 3151 Parts Credit to purchase MTUs and such MTUs (whether new or refurbished) shall have a full twenty (20) year Warranty Period. The 3151 Parts Credit shall apply in lieu of the Parts Credit described in Section 2.1d(i) for all 3151 MTUs described in this clause (ii). Notwithstanding the foregoing, Company will not programmatically remove 3151 MTUs without cause.

For the purposes of this 3151 Parts Credit, "***Routine Meter Maintenance***" shall mean those Endpoints removed from the field generated by Company, Customer, CPUC or FERC requests. Such requests shall include, but not be limited to, Meter damage, Meters that do not register, stuck Meters, noisy Meters, high bill investigations, CPUC tests or inactivity. ***"Planned Meter Sample"*** shall mean Meters removed for testing to support the Company meter performance plan pursuant to CPUC General Order 58A, Decision no. 04-12-015 and Decision no. 08-07-046. "***Collar***" shall mean the piece of equipment provided by Contractor that functions as a passive re-radiator consisting of a polypropylene collar containing copper flex tape that remediates Non-conforming 3151 MTUs with the part number 3151-031-RBS2-SCG.

(e) **Labor Reimbursement**

The ***"Labor Reimbursement"*** due to Company for each Warranty Failure is [redacted] per item as of 2012, increased annually on January 1st of each subsequent calendar year by the Labor Rate Adjustment stated in 1.a (ii). Provided that Contractor is not in material breach of the Agreement as described in Section 2.3, such Labor Reimbursement shall be Company's sole remedy for its costs of removal and/or reinstallation. For clarity, if Contractor is deemed to be in material breach of the Agreement pursuant to Section 2.3, then Company may recover damages and seek any other remedies available to it at law or in equity as a result of the material breach, but any Labor Reimbursement paid by Contractor with respect to any Warranty Failures that are included in the calculation of the Annualized Failure Rate pursuant to Section 2.3 shall be offset against any damages due to Company for the cost of removal and/or reinstallation of the Equipment that suffered those Warranty Failures.

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The Labor Reimbursement covering Warranty Failures of 3151 MTUs shall be limited as follows: Contractor shall only be responsible for, and Company shall only be entitled to, such Labor Reimbursement for those Non-conforming 3151 MTUs installed at customer premises, in excess of 55,000 Non-conforming 3151 MTUs. ***"Non-conforming 3151 MTU"*** shall mean those 3151 MTUs not meeting, or causing a failure to meet, the warranties described in this Schedule K. Labor Reimbursements will be promptly paid by check or electronic funds transfer.

(f) **Extension of Parts Credit and Labor Reimbursement**

(i) **Definitions**

For the purposes of this Section, ***"Installation Class"*** means a group of Series 3000 MTUs that have Installation Dates that fall within a calendar year. There is a separate Installation Class of Series 3000 MTUs for each calendar year in which those items are installed by Company. The ***"Installation Class Date"*** for an Installation Class is 30 June in the calendar year of that Installation Class. For example, for Series 3000 MTUs installed in calendar year 2012, the Installation Class is 2012 and the Installation Class Date is 30 June 2012.

(ii) In the month of March preceding the tenth anniversary of the Installation Class Date for each Installation Class, Contractor shall give Company a written notice (an ***"Option Notice"***) advising Company that if it wishes to exercise its option to purchase additional coverage pursuant to paragraph (iii) below for that Installation Class it must give notice pursuant to that section no later than 30 June of that year. For example, the Option Notice for the 2012 Installation class must be given in March, 2022.

(iii) On or before the tenth anniversary of the Installation Class Date for an Installation Class, Company may elect to extend the coverage provided for Parts Credit to 100% of the applicable item cost, and to extend coverage for Labor Reimbursement, for all Series 3000 MTUs in that Installation Class for years 16 through 20 of the Warranty Period by giving Contractor written notice of extension and paying the extension price per item shown in Table 2.1 below. If Contractor does not give an Option Notice as required by paragraph (ii), Company may exercise the extension option permitted under this paragraph at any time before the end of the calendar year in which such option is exercisable. Company's right to so exercise this option shall be Company's sole remedy for Contractor's failure to timely provide such an Option Notice. For clarification, such notice may specify one, or more than one, consecutive years, each beginning with year 16 and ending at the close of Warranty Period of year 16, 17, 18, 19, or 20, as selected by Company.

Table 2.1 Series 3000 MTUs			
Module Age (Years from Installation Date by Installation Class)	**Parts Credit**	**Extension Fee (Parts Credit)**	**Extension Fee (Labor Reimbursement)**
Years 1-15	100%	Standard Warranty	Standard Warranty
Year 16	25%	[redacted]	[redacted]
Year 17	20%		
Year 18	15%		
Year 19	10%		
Year 20	5%		

(g) **Remedies for Curb MTU Failure**

If a Curb MTU is subject to a Curb MTU Failure (as defined below) but not a Warranty Failure, the following shall apply in lieu of Section 2.1 (c)

(i) For the purposes of Curb MTU Failure:

*"**Curb MTU's**"* shall mean parts numbers listed in Schedule C-1 for Itron (3221-039-RBS2W-SCG, 3221-039-RBS2W-SCG-MM) and American Elster (3221-019-RBS2W-SCG, 3221-019-RBS2W-SCG-MM) curb meters.

"Curb MTU Failure" shall mean any Curb MTU which exhibits at least six cumulative hours, whether or not continuous, of Magnetic and/or Reverse Rotation alarms, excluding alarms within 24 hours of installation or reconfiguration, within any 30 day period.

If any Curb MTU suffers a Curb MTU Failure (whether or not it is also a Warranty Failure), a) a replacement Curb MTU shall be furnished in exchange for the failed Curb MTU subject to Section (ii) below and a Parts Credit shall not be due, and b) the Contractor shall pay to Company a Curb Labor Reimbursement in lieu of any labor reimbursement due. A **"Curb Labor Reimbursement"** shall mean a reimbursement of [redacted]. Such reimbursement shall be subject to all terms applicable to the Labor Reimbursement (Section 2.1.e), including without limitation the Labor Rate Adjustment stated in 1.a (ii).

For clarity, the Curb Labor Reimbursement of [redacted] was made

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effective on December 14, 2017, which date shall serve as the base for calculating the Labor Rate Adjustment stated in 1.a (ii).

(ii) Curb MTUs shall be furnished at no cost so long as they are being ordered in respect of Curb MTU Failures. To account for timing differences between the occurrence of Curb MTU Failures and the delivery of replacement product to Company, Contractor will not reject or delay new orders of no cost replacement Curb MTUs (even if there is, at the time of such new order, an insufficient balance of Curb MTU Parts Credits at time Company places such an order). Company agrees to provide Curb Failure MTU serial numbers to Contractor prior to receiving replacement Curb MTUs.

Company agrees to maintain a record of the serial numbers delivered by Contractor and the credit earned thru warranty replacement. This record will be provided to Contractor on a quarterly basis to ensure proper recordkeeping between the Customer and the Contractor.

(iii) Contractor shall produce Curb MTU's as specified in Schedule C-1, such product types intended for combination with Company's Curb Meters with an acceptance quality limit (**"*AQL*"**) of 0.4 based upon Contractor's current quality assurance inspection plan which is currently in use and agreed upon by the Parties. Such 0.4 AQL is hereby amended to incorporate a separate 2.5 AQL limit (which may be changed in other respects from time to time pursuant to further mutual agreement) for the magnet pocket area: any Curb MTU with a void in the magnet pocket area that exceeds 100 mils (0.10 inch) in diameter will count as a reject unit for the 2.5 AQL. Such quality assurance inspection plan includes verifying achievement of such AQL requirement by lot and furnishing a minimum of 75% of the destructively tested MTU's ***("DMTU's"***) at no cost to Company and photos of the remaining DMTU's. The DMTU's shall be destructively tested as specified in such quality assurance inspection plan. The foregoing shall not be construed to imply any level of void acceptability in Curb MTU's anywhere other than the magnet pocket area of Itron Curb MTU's subject to the 0.4 AQL. In all cases replacements for Curb MTU's shall bear the same Product Type number as the Curb MTU they replace and shall also constitute Curb MTU's.

(h) **Special Rule Regarding Dead MTUs**

MTUs which are subject to the RMA Code entitled "Dead" in Schedule K-1 and not subject to any other RMA Code ("Dead MTUs") shall be subject to the following modifications to Company's remedies in respect of such Warranty Failures as well as the following additional rights:

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(i) Company shall receive 94% of the Parts Credit for all such Dead MTU's

(ii) Company shall receive 94% of the Labor Reimbursement for all such Dead MTU's, except as described in (iii).

(iii) For those Dead MTUs removed due to Planned Meter Change, Shop Survey and Size, Company shall not receive a Labor Reimbursement.

Contractor and Company shall each have the right, once per calendar year, at a mutually convenient time to request a sample of 200 to 500 Dead MTUs scheduled for disposal and destruction to verify that they met the requirements for such RMA Code. With respect to the initial such request, if either less than 92% or more than 96% of MTUs within any such sample do not meet such requirements, then the Parties shall negotiate in good faith an adjustment to the foregoing 94% number commensurate with the results of such samples. With respect to the subsequent such request, the foregoing percentages shall be adjusted upward or downward in an amount equal to the amount of such adjustment. With respect to each subsequent such request thereafter, the percentages which resulted from the previous request shall be again adjusted upward or downward in an amount equal to the amount of the preceding adjustment.

For example, if the parties negotiate in good faith that the 94% number shall be adjusted to 93%, a further good faith negotiation shall result from the subsequent request if either less than 91% or more than 95% of MTU's within the corresponding sample do not meet such requirements.

If the parties pursuant to a subsequent request negotiate in good faith that the 93% number shall be adjusted to 91%, a further good faith negotiation shall result from the subsequent request if either less than 89% or more than 93% of MTU's within the corresponding sample do not meet such requirements.

(i) **Special Rule Regarding OOB MTUs**

MTUs which are subject to the RMA Code entitled "OOB" in Schedule K-1 ("OOB MTUs") shall be subject to the following modifications to Company's remedies in respect of such Warranty Failures.

(i) Company shall receive the entire Parts Credit for all OOB MTU's.

(ii) Company shall not receive any Labor Reimbursement for OOB MTU's.

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2.2. Series 4000 MTUs

(a) **Warranty**

Except for battery life (refer to paragraph 2.2(d)), Contractor represents and warrants for and during the Warranty Period that each Series 4000 MTU, including its battery, will comply in all material respects with the Warranty Requirements.

(b) **Warranty Period**

The Warranty Period for a Series 4000 MTU begins upon the Installation Date and terminates 15 years thereafter.

(c) **Remedies for Warranty Failure**

If any Series 4000 MTU suffers a Warranty Failure, then Contractor shall credit or pay Company the then current purchase price of the failed item (or, if at that time Contractor supplies Company with a later version or replacement for the failed item, the then current purchase price of the later version or replacement) upon receipt of the failed item from Company. Company may utilize any such credit to purchase MTUs and such MTUs (whether new or refurbished) shall have a full fifteen (15) year Warranty Period.

(d) **Battery Life**

Provided that Company operates the Series 4000 MTU in its standard reporting configuration of twenty four (24) transmissions per day, the Series 4000 MTU Battery shall have a Warranty Period of two (2) years.

2.3. Annualized MTU Failure Rates

(a) This Section 2.3 will not apply until the aggregate number of all types of installed Series 3000 and Series 4000 MTUs exceeds 10,000 units.

(b) If the Annualized Failure Rate (as defined below) is greater than 10% in any calendar year, Contractor shall be deemed to be in material breach of the Agreement. The ***"Annualized Failure Rate"*** (or ***"AFR"***) is a percentage calculated as follows:

AFR = [Failed MTUs/ Total MTUs] %

Where:

"Failed MTUs" means the total number of Series 3000 MTUs and Series 4000 MTUs that suffer a Warranty Failure during the calendar year for which the AFR is being calculated; and

"Total MTUs" means the total number of Series 3000 MTUs and Series 4000 MTUs that are within their Warranty Period and are

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held in Company inventory or are installed and in use as of December 31st of that calendar year.

2.4. Network Devices

(a) **Warranty**

Contractor represents and warrants for and during the Warranty Period that each Network Device will comply in all material respects with the Warranty Requirements.

(b) **Warranty Period**

The Warranty Period for a Network Device begins upon Installation Date of the item to Company and terminates 5 years after the Installation Date of that item.

(c) **Remedies for Warranty Failure**

If any Network Device suffers a Warranty Failure, then Company shall repair or replace the Network Device. In exchange for the parts provided by Contractor, Company agrees to self-maintain Network Devices at own expense.

(i) RESERVED.

(ii) RESERVED.

(d) **RESERVED.**

(e) **Network Device Replacements and Repairs**

(i) With respect to any purchased Network Device or Network Device parts, Contractor reserves the right to supply factory refurbished equipment, new equipment, or a newer model that provides equivalent or better performance (but only if such newer model has been certified and Accepted for use by Company). However, any purchased Network Device parts, whether new or refurbished, shall be warranted for a Warranty Period equal to one year from the date of delivery.

(ii) RESERVED.

(iii) RESERVED.

2.5. Other Equipment

(a) Contractor shall pass through to Company all available warranties offered by the suppliers and/or manufacturers of any third party equipment that is supplied to Company under this Agreement and that does not form part of the MTUs or Network Devices that are warranted pursuant to this

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Schedule, to the extent such warranties can be passed through to Company.

2.6. Programming Peripheral

"Programming Peripheral" is the physical device used to communicate with MTUs. A "USB Programming Peripheral" is a Programming Peripheral which consists only of the coil and the housing used to access the MTU and communicates via USB, and for warranty purposes, does not (notwithstanding Section 2.7(b)) include the USB cable. A "Wireless Programming Coil" is a Programming Peripheral which consists of the coil and the housing used to access the MTU and the STAR Programmer Software via Bluetooth. Any handheld device needed to operate the Programming Peripheral is not part of this device and is warranted separately.

(a) **Warranty**

Contractor represents and warrants for and during the Warranty Period that each USB Programming Peripheral will comply in all material respects with the Warranty Requirements. The USB Cable provided is warranted separately from the USB Programming Peripheral in accordance with Section 2.5 (a).

(b) **Warranty Period**

The Warranty Period for a Programming Peripheral begins upon the Delivery Date of the item to Company and terminates three (3) years after the Delivery Date of that item.

(c) **Remedies for Warranty Failure**

If any Programming Peripheral suffers a Warranty Failure, then Contractor shall repair or replace the item at no charge to Company.

2.7. Provisions Applicable to All Equipment Warranties

(a) **Batch Failures**

A Batch is a group of MTUs that either (i) share a common revision level or production run of a component or materials, or (ii) are subject to common environmental characteristics that affect that group of MTUs differently than other MTUs in the Company's Network Coverage Area, which group comprises at least 10,000 units (a ***"Batch"***).

A ***"Batch Failure"*** will be deemed to have occurred if: (A) 10% or more of the MTUs within a Batch experience a Warranty Failure having substantially the same root cause, or (B) a Warranty Failure in the MTUs within a Batch compromises safety, regardless of the percentage of the Batch that is affected or expected to be affected. If a Batch Failure occurs, then Company may elect either of the following remedies:

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(i) remove from service all units in the Batch, whether or not such items have suffered a Warranty Failure, in which case all such items shall be deemed to have suffered a Warranty Failure in accordance with this Schedule; or

(ii) exercise its warranty rights hereunder with respect to those units within the Batch that have suffered a Warranty Failure, while preserving its rights under this Schedule with respect to the remaining units in the Batch.

(b) **Peripherals and Accessories**

Pulsers, adapters, cables and other hardware provided by Contractor with an item of Equipment or as an accessory to it shall be considered part of the item for warranty purposes.

(c) **Returns**

All warranty claims will be handled in accordance with the warranty claims handling procedure set forth in Schedule K-1 (Equipment RCA and RMA Process and Forms). Company shall be responsible for freight costs for product returns (FOB Origin, Freight Prepaid and Allowed, Incoterms 2011). Contractor shall be responsible for freight and insurance for replacement products (FOB Origin, Freight Prepaid and Allowed, Incoterms 2011). Should Company reject, in accordance with Schedule A SOW, Section 12.2 (MTUs, Endpoints and Support Material), two or more product lots in any twelve month period, Contractor shall: a) in addition to its replacement product freight responsibility stated above, be responsible for the freight cost to return the second and any subsequent rejected lots that are the later occurring of i) 12 months from the date of rejection of the first lot, or ii) six months from the date of the immediately preceding lot rejection, to Contractor for repair or replacement, or, at Company's request, b) complete local sorting and testing of such lots, within the timeframes defined in the table below, dependent on lot size, so as to remove non-compliant product from the lot at Contractor's cost and arrange for replacement of product found to be non-compliant with the Warranty.

Lot Size Range	Completion Timeframe
0 to 1,200 MTUs	2 weeks
1201 to 4000	3 weeks
4001 or more	5 weeks

(d) **Exclusions**

The warranties set forth in this Section 2 do not cover failures resulting from:

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(i) Use, handling, storage, or installation that is not in accordance with the specifications and written instructions of Contractor;

(ii) The result of accident, modification, improper operation, Meter failures, theft, vandalism, repair by unauthorized personnel;

(iii) With respect to Series 4000 MTUs, battery life, as provided in Section 2.2(d); or

(iv) Loss of battery power due to use of the MTU for more than four (4) transmissions per day.

(e) **Replacements and Repaired Items**

(i) If Contractor replaces an item under warranty, then the replacement item shall be warranted for a Warranty Period equal to the longest of (A) the remainder of the Warranty Period for the replaced item or (B) six months from the date of delivery of the replacement to Company.

(ii) If Contractor repairs an item under warranty, then the repaired item will continue to be subject to warranty for the longer of (A) the remainder of the Warranty Period for that item, or (B) six months from the date of delivery of the repaired item to Company (in which case the Warranty Period for that item will automatically be extended by that length of time).

(f) **Exclusive Remedies for Equipment**

Except as provided expressly elsewhere in this Schedule or the Agreement, including with limitation in Section 2.3 (b) of this Schedule K, the foregoing remedies shall be the sole and exclusive remedies for Company for any Equipment purchased with respect to any breach of warranty by Contractor.

3. NETWORK PERFORMANCE

3.1. Definitions

(a) ***"Network Coverage Area"*** shall mean the geographic area with a boundary identified in the Propagation Analysis to be delivered pursuant to Section 2.2 of Schedule A SOW, which shall include the locations of the meter population specified in Appendix A25-101 Meter Location Data and electronic pressure monitors specified in Appendix A25-121 EPM Location Data.

(b) ***"Full Coverage"*** shall mean, when fitted with MTUs, all Meters within the Network Coverage Area as of the Effective Date will communicate with the Network in accordance with the Warranty Requirements.

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3.2. Network Performance

Contractor represents and warrants that commencing upon Network Device Installation Acceptance and continuing until the first anniversary of Final System Acceptance within the Network Coverage Area:

(a) The Network will meet the Warranty Requirements, including but not limited to any scalability described therein.

3.3. Read Success Rates

(a) **Warranty**

Contractor represents and warrants that the Network will achieve the Read Success Rates specified in paragraph (c) prior to Final System Acceptance, and for a period of 20 years after Final System Acceptance (the ***"Performance Warranty Period"***).

(b) **Definitions**

For the purposes of this Section 3.3:

(i) A ***"Read"*** is the incremental unit of Endpoint data as transmitted by the Installed MTU based on the MTU's read configuration.

(ii) A ***"Missed Read"*** is a Read that is not delivered to the Headend.

(iii) A ***"Suspect Module"*** is any Installed MTU that has more than 12 Missed Reads in a 30 consecutive day period.

(c) **Read Success Rates**

The ***"Read Success Rates"*** are as follows and shall be tracked and calculated on a monthly basis by Company.

(i) No more than [redacted] of the Activated MTUs shall have a Missed Read in a 30 consecutive day period.

(ii) No more than [redacted] of the Activated MTUs shall be Suspect Modules. Suspect Modules shall also be counted as Modules with Missed Reads for the calculation in paragraph (i). Special Location MTUs shall only be Suspect Modules if they have more than 72 Missed Reads in a 30 consecutive day period.

"Special Location MTUs" mean all Installed MTUs (other than Remote Mount MTUs that are or will be installed in accordance with Contractor's instructions Y20355-TEB MTU INSTALLATION REQUIREMENTS) located in an enclosed (i.e. not generally open to the outside) garage, crawlspace, basement or other metallic or metallic in significant part enclosure that

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materially interferes with the RF signal. Special Location MTUs are generally denoted as MTUs installed at GNNs with GNN Location Codes in the CIS that contain codes for Basement (J), Underset (U), or Inside Garage (IG). "Remote Mount MTU" mean any MTU consisting of a separate radio or antenna such that the radio or antenna portion is not intended to be affixed to the Meter."

(d) **Exclusions**

Any Missed Reads caused by any of the following exclusions shall be excluded from the calculation of the Read Success Rates metrics pursuant to paragraph (c) above:

(i) Any Activated MTU which has attained such status less than 24 hours before the calculation of the Read Success Rate shall be excluded.

(ii) If it is determined that an Activated MTU was not installed or activated according to the instructions in the Appendix A25-012 Installation Manuals – Communication Modules for that Module, then it shall be excluded, unless it is a Special Location MTU.

(iii) Any Activated MTU that has previously been identified as having a Warranty Failure but that has not been removed from service at the time of the Read Success Rate calculation shall be excluded.

(iv) Any Activated MTU that is installed underneath a curb lid (the lid of which covers a vault) made of steel or other metal is excluded. Reinforced concrete and reinforced composite curb lids with a steel read window are included.

(v) Any Read that is not delivered to the Headend due to a failure in the Company infrastructure that is not supplied by Contractor and that supports the System will not be counted as a Missed Read.

(vi) Equipment failures due to tampering, damage or vandalism.

(vii) Expansions or modifications to the Company service area as provided in Section 3.5.

(viii) Any failed Network Device is not replaced promptly by Company after Transfer Acceptance.

(e) **Remedies**

Should the Read Success Rate not be satisfied during the Performance Warranty Period Contractor shall undertake one or more of the following actions, at its option, within 30 days of being notified of the Read Success Rate failure:

(i) Provide additional Network Devices in accordance with Section 3.4.

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(ii) Relocate Network Devices at Contractor's expense. Such expenses include but are not limited to (a) De-installation and Network Installation Services for the Network Devices (including solar powered and pole mounted units and installation hardware) with Contractor being responsible for obtaining all permits and paying all installation-related expenses including taxes and permit fees; and (b) additional Network design, configuration and propagation studies as reasonably necessary to achieve and demonstrate Full Coverage following the relocation.

(iii) Replace Installed MTUs not meeting the Read Success Rate with Extended Range MTUs subject to Performance Parts Credit per Section 3.3.f. Extended Range MTUs will have the same Warranty Period as its equivalent (i.e. by meter compatibility) standard range MTUs.

(iv) Costs associated with the removal and/or reinstallation of a MTU shall be reimbursed by Contractor at the rate of [redacted] per occurrence as of 2012, increased annually on January 1st of each subsequent calendar year by the Labor Rate Adjustment as stated in 1.a (ii).

(f) **Performance Parts Credit**

(i) A ***"Performance Parts Credit"*** shall be due to Company for each MTU replaced per Section 3.3.e.iii and that has been returned to Contractor, or that has been subject to the certification described in Section 7.1 C in Schedule C **(*"Performance Warranty MTU"*).**

The ***"Performance Parts Credit"*** is an amount equal to the then current purchase price per Schedule C-1 of the replaced MTU (or, if at that time Contractor supplies Company with a later version or replacement for the replaced MTU, the then current purchase price of the later version or replacement) multiplied by the percentage specified in Table 2.1 of this Schedule K, for the applicable warranty year. Company may utilize the Performance Parts Credit to purchase MTUs and such MTUs (whether new or refurbished) shall have a full Warranty Period.

At Contractor's sole discretion, the Performance Parts Credits can be paid by i) check or electronic funds transfer, or ii) a credit memorandum which can only be applied towards any amount owed to Contractor for MTU purchases at that time or in the future.

Example 1: If a Performance Warranty MTU is replaced just before the sixth anniversary of its Installation Date and the then current price for a Series 3000 MTU is [redacted], the Contractor will credit the Company a Performance Parts Credit of [redacted] multiplied by 100% for a total of [redacted] per MTU (as described in Table 2.1 of this Schedule K Warranties).

Example 2: If a Performance Warranty MTU is replaced just before the eighteenth anniversary of its Installation Date and the then current price for a Series 3000 MTU is [redacted], the Contractor will credit the Company a Performance Parts Credit of [redacted] multiplied by 20% for a total [redacted] per MTU (as described in Table 2.1 of this Schedule K Warranties).

3.4. Additional Network Devices

Since more than 3,970 Network Devices are required to satisfy the warranties in Sections 3.2(a) and 3.3 above, when additional Network Devices are required, Contractor shall provide, [redacted] to Company:

(i) the additional Network Devices, which shall be subject to the warranty set forth in Section 2.4;

(ii) in its discretion, Construction Measurement Site Surveys for each additional Network Device;

(iii) additional Network Design, configuration and propagation studies as reasonably necessary to achieve and demonstrate Full Coverage;

(iv) a lump sum fee in the amount of [redacted] shall be paid by Contractor to Company per each additional Network Device. This amount shall be paid within 30 days after delivery of the Network Device, and shall be the sole and exclusive compensation to Company for all access, attachment, operation, and maintenance costs for such Network Device (to the extent not already paid for by Contractor pursuant any other provision of this Agreement), for the remainder of the Performance Warranty Period.

The costs specified in this paragraph (a) shall not be capped or limited except by the limitations of liability in Articles 51 and 52 of the Agreement.

3.5. Changes to Network Coverage Area

a. The warranties in Section 3.2(a) and Section 3.3 above do not apply to (i) expansions or modifications of the Network Coverage Area after the Effective Date, (ii) the deployment of MTUs in areas that were not specified as requiring coverage by Company as of the Effective Date, (iii) material changes in land use (e.g. the construction of new buildings) in the Network Coverage Area, or (iv) Installed MTUs in the City of Rancho Palos Verdes, the City of Rolling Hills, and unincorporated areas within the County of Santa Barbara, collectively the jurisdictions not completed as of January 1, 2019, in each case until such time as Contractor s revised network propagation plan and design is implemented to accommodate such changes, subject to (prior to Final System Acceptance) a mutually agreed upon Amendment (addressing among other things, any negotiated compensation and changes to the cost reimbursement per additional Network Device described in Section 3.4) if such revision is not contemplated under the current Schedule A SOW or (after Final System Acceptance) until an MTU is not a Suspect Module as calculated weekly for any period of 6 consecutive weeks. The Parties shall maintain a “Limited Network Coverage

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Exclusion List" consisting of MTU locations falling within the scope of clauses (i), (ii), (iii) or (iv) which shall be updated as conditions and factual circumstances change, such details are located in Section E of Schedule K-1.

3.6. RF Interference

The Parties acknowledge that Company s obligations pursuant to the last sentence of Article 53 of the Agreement shall survive Final System Acceptance and the Warranties in Section 3.2(a) and 3.3 shall remain subject to Company s satisfaction of such obligations to the extent third party RF interference or RF interference by Company systems other than the System affects the achievement of the performance guaranteed by such Warranties. Contractor shall provide reasonable evidence, that can be confirmed using data and tools such as those that are available through the Headend system, that such RF interference is causing such issue prior to denying a Warranty claim for this reason.

4. SOFTWARE

4.1. Warranty

Contractor represents and warrants that, throughout the Warranty Period, the Software will perform in compliance with the Warranty Requirements for such Software in all materials respects.

4.2. Warranty Period

The Warranty Period for each Release of either the Headend or the MDMS begins upon Software Release Acceptance for that Release of the Software and ends for all Releases upon Final System Acceptance.

4.3. Remedies for Warranty Failure

Subject to Section 4.4, if any Software Warranty Failure occurs during the Warranty Period, Contractor shall correct the Warranty Failure or replace the item (in either case, ***"Remediation"***) at no charge to Company within 120 days (or such longer period as provided in Schedule J Maintenance Service) after the Warranty Failure is first discovered by Contractor or notified to Contractor in writing. If Remediation is not provided by Contractor within that time period, Contractor shall be in breach of the Agreement and Company shall be entitled to all available remedies at law or in equity.

4.4. Exclusions

If a failure or malfunction of the Software is caused by any of the following, then such failure or malfunction shall not be deemed a Warranty Failure and the remedies set forth in Section 4.3 do not apply:

(a) the use of Software in combination with other software, equipment or communications networks that are not part of the System, except as

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contemplated under this Agreement or as consented to by an authorized representative of Contractor in writing;

(b) any modification to the Software that is made by a party other than Contractor and that is not made at Contractor's written direction;

(c) Company's failure to implement a Software patch or Update provided by Contractor as a Remediation, within a commercially reasonable time period after such patch or Update is made available to Company and without imposing material burdens on Company's operations;

(d) Viruses introduced despite Contractor's compliance with the Warranty Requirements; or

(e) Failure of Company's hardware specified in this Agreement.

4.5. Embedded Third Party Software

Contractor shall pass through to Company all available warranties offered by licensors of any software products that are embedded in, or bundled with, the Software (***"Embedded Third Party Software"***) to the extent such warranties can be passed through to Company.

5. SERVICES

(a) For Services rendered after Final System Acceptance, the Warranty Period starts when Company has received Contractor's invoice for that component of Services and ends twelve (12) months thereafter. Any claim for breach of Warranty under this Section 5 must be made within the applicable Warranty Period.

(b) Contractor represents and warrants that all the Services will be performed with promptness and diligence and in a professional and workmanlike manner, by appropriately skilled and experienced personnel.

(c) Contractor represents and warrants that the Services shall be performed in compliance with all Warranty Requirements set forth in this Agreement in all material respects, and the terms and conditions of the Agreement.

(d) Contractor represents and warrants that it will use efficiently any resources that are charged to Company on a resource-utilization basis, and that it will perform the Services in a cost-effective manner, consistent with the Warranty Requirements.

(e) If Contractor breaches any of the foregoing warranties with respect to any component of the Services during the applicable Warranty Period and if such breach is capable of being cured by re-performance of that Service, then Contractor shall perform that component of the Service again and correct the breach at no charge to Company promptly and in no case later than 120 days after the breach is first discovered by Contractor or notified to Contractor in writing. If such a correction is not provided by Contractor within that time period, or if the breach is not capable of being cured by re-performance, then Contractor

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shall be in breach of the Agreement and Company shall be entitled to all available remedies at law or in equity.

6. Reserved.

7. PRODUCT CONTINUITY

During the Product Continuity Period, Contractor:

(i) shall not discontinue or phase out support for any of the Equipment or Software provided under this Agreement that is then in service in the System, unless there is a commercially available replacement product that is backward compatible and has been certified and Accepted for use by Company (a ***"Replacement Product"***) and

(ii) shall provide such Replacement Product for the then current price for the product that the Replacement Product replaced and shall be subject to the same warranty terms as apply to the replaced product pursuant to this Schedule K.

8. PROVISIONS APPLICABLE TO ALL WARRANTIES

(a) All of the warranties provided in this Schedule are subject to Articles 51 and 52 of the Agreement titled "Waiver of Certain Damages" and "Limitation of Liability" respectively.

(b) In the event that Contractor incurs a Performance Credit, then that Performance Credit shall be the sole and exclusive remedy for Company with respect to the circumstances that led to the Performance Credit pursuant to Section 12.9 of the Agreement. For clarity, Company shall not also have a remedy for breach of warranty for the same circumstances, provided that all such circumstances are as described in Schedule A-7 Product Roadmap, Maintenance, and Support, and Schedule A-28 Network Management Service Level Agreement, with respect to the Performance Credit incurred.

(c) Company shall notify Contractor in writing of any breach of any of the warranties provided in this Schedule during the applicable Warranty Period. Company shall provide all non-privileged documentation and other non-privileged information available to it reasonably requested by Contractor in order to investigate and resolve any claim made by Company under this Schedule.

Attachment I

Schedule K-1: RMA Process and Form and RCA

Confidential

Attachment J

AMI Vendor Request for Proposal (RFP) Requirements

1. System Requirements

Item	Requirement
1.1	**System Requirements**
1.1.1	The end-of-life for the AMI System shall occur no earlier than twenty-five (25) years following acceptance of the AMI HeadEnd and MDMS (such duration, the "system operating life").
1.1.2	Following end-of-life, the AMI System is further expected to remain under OEM support from Bidder for up to three extensions of three years each, in order to enable replacement of the system at end-of-life (such duration the "extended system operating life").
1.1.3	The system shall support 12M endpoints which includes multiple meter types, meter communication modules, USM's, pressure monitors and volume correctors.
1.1.4	The system shall support 500 users with 50 concurrent users.
1.1.5	The system shall support hourly data collection with hourly data transmission (hourly/hourly).
1.1.6	The system shall support hourly data collection with hourly data transmission (hourly/hourly) while maintaining and sustaining a 20 year battery life.
1.1.7	The system shall support multiple USM's with alternative manufacturers.
1.1.8	The system shall support Quality of Service (QoS) for prioritization of specific data types such as alarms over reads, C&I data over residential data etc., including during recovery from outages.
1.1.9	The system shall support "peak" capacity of data throughput without degradation of service levels during larger data volume events such as after public cellular outages (As applicable) and other outages.
1.1.10	The system shall minimally support 2 USM meters manufactured by different vendors. It shall support minimally one (1) alternative USM meter manufacturer in addition to the Bidder's own USM meter (as applicable).
1.1.11	The system shall support multiple Endpoints such as EPM's, EVC's, and other devices with multiple payload types for telemetry data from these devices.
1.1.12	The system shall support the ability of a device or application, once deployed, to be repaired, diagnosed, or administered remotely without incurring an outage.
1.1.13	The system shall support end to end encryption across endpoints, network, devices, application, infrastructure and database layers.
1.1.14	The system shall adjust Consumption Day durations as required to operate normally across Daylight Savings Time ("DST") "time changes" in Spring and Fall without the need for settings changes or human intervention of any kind.
1.1.15	The system shall support fifteen-, thirty-, and sixty-minute recording for core (residential) meters.
1.1.16	The system shall support fifteen-, thirty-, and sixty-minute recording for gas non-core (commercial and industrial meters).
1.1.17	The system shall support open standards based interoperability and integration with DLMS, DNP, COSEM to ensure multiple type of endpoints are integrated and operational within the system.
1.1.18	The system shall support meter diversity including multiple meter types and endpoint devices.
1.1.19	The system shall support over-the-air (OTA) capabilities for various firmware, patches, commands and updates.
1.1.20	The system shall support EOC (Emergency Operations) requirements for real time endpoint telemetry data collection and transmission.
1.1.21	The systems shall provide redundancy, high availability architecture to ensure continuous operations and recovery from failures and outages.
1.1.22	The system shall have the ability to monitor received data for integrity and completeness; it shall have an option to automatically retrieve missing or corrupt data.
1.1.23	The system shall provide for expected Company and customer growth without significant cost impact (i.e. incremental Endpoints, or new Endpoint use-cases).
1.1.24	The system shall provide sufficient data/packet processing and transformation performance, sufficiently supporting fifty (50) concurrent user connections, concurrent processing sessions.
1.1.25	The system shall support the projected scale of the SoCalGas network and Endpoints for multiple payload types for meter reads, alerts, emergency alerts, leaks, events, pressure monitoring with sufficient data throughput and system design capacity.
1.1.26	Bidder's system shall capture and store timestamped data in Coordinated Universal Time ("UTC").
1.1.27	The system shall conform to all applicable IT standards and policies set forth in Appendix TB_IT Standards.
1.1.28	The system shall be able to fully operate and/or interoperate in the IT Environment described in Appendix AA_Current Company IT Environment.
1.1.29	The AMI system shall conform in all material respects to the specifications, functions, descriptions, standards, and criteria set forth in the Agreement and the Service Levels set forth in Appendix PH_Service Levels.

3. Meter & Modules

Item	Requirement
3.5	**Module Security**
3.5.1	Bidder's module shall be provisioned with a unique device identity (e.g., certificate or cryptographic ID) to support secure authentication.
3.5.2	Bidder's module shall support mutual authentication when communicating with head-end or intermediary network components.
3.5.3	Bidder's module shall reject all unauthorized connection attempts, including those from non-approved devices or field tools.
3.5.4	Bidder's module shall support AES-256 encryption for all data at rest (e.g., configuration settings, stored meter data).
3.5.5	Bidder's module shall encrypt all communications between the module and upstream systems using TLS 1.2 or higher.
3.5.6	Bidder's module shall support secure key exchange mechanisms, such as ECC or RSA, for session negotiation, with Bidder specifying in 'Bidder Comment'.
3.5.7	Bidder's module shall be compatible with standards-based key management protocols (e.g., NIST SP 800-57, IEC 62351).
3.5.8	Bidder's module shall support secure, remote provisioning of cryptographic keys at time of installation or reset.
3.5.9	Bidder's module shall support automatic key rotation and revocation without requiring physical access to meet evolving requirements over time.
3.5.10	Bidder's module shall have physical security features such as tamper-evident enclosures suitable for field use and compatibility with locking or sealing mechanisms.
3.5.11	Bidder's module shall include tamper detection sensors (e.g., case open, tilt, or vibration sensors).
3.5.12	Bidder's module shall log tamper events locally and report in real-time to the HeadEnd System.
3.5.13	Bidder's module shall support configurable tamper severity thresholds and escalation logic.
3.5.14	Bidder's module shall verify the integrity and authenticity of firmware updates using cryptographic signatures.
3.5.15	Bidder's module shall support over-the-air (OTA) firmware updates, and must reject unsigned or corrupted firmware files.
3.5.16	Bidder's module shall support a fallback or rollback function in the event of a failed update.
3.5.17	Bidder's module shall support role-based access control and secure user authentication for local interfaces (e.g., optical, USB).
3.5.18	Bidder's module shall require physical authentication (e.g., utility-issued key or credential) for access to local diagnostics or reconfiguration.
3.5.19	Bidder's module shall enforce zero trust principles, ensuring only pre-authorized tools and users may interact with the device.
3.5.20	Bidder's module shall require mutual authentication and session encryption for pairing between field tools and modules.
3.5.21	Bidder's module shall allow auditing of all field tool interactions, including parameter changes and diagnostic queries.
3.5.22	Bidder's module shall provide Denial of Service (DoS) mitigation.
3.5.23	Bidder's module shall provide protection from replay attack protection.
3.5.24	Bidder's module shall provide protection from packet injection and spoofing prevention.
3.5.25	Bidder's module shall provide rate limiting and connection throttling to prevent brute-force or scanning attacks.

Item	Requirement
3.5.26	Bidder's module shall maintain a security event log for authentication attempts (successful/failed).
3.5.27	Bidder's module shall maintain a security event log for firmware update history.
3.5.28	Bidder's module shall maintain a security event log for tamper and access events.
3.5.29	Bidder's logs must be timestamped, digitally signed, and retrievable both locally and remotely.
3.5.30	Bidder's module shall support secure time synchronization using authenticated protocols (e.g., NTP with MACs or IEEE 1588 with encryption).
3.5.31	Bidder's module shall provide cryptographic message authentication codes (MACs) to prevent tampering.
3.5.32	Bidder's module shall discard or log any message that fails sequence or time window validation with a 90-day log retention.
3.5.33	Bidder's module shall be housed in an enclosure that meets environmental protection requirements (e.g., NEMA 4X, IP66, IP67).
3.5.34	Bidder's module shall protect internal circuits and batteries from physical probing, external RF interference, and power line manipulation.
3.5.35	Bidder's module shall meet the NIST SP 800-53 and 800-82 standards.
3.5.36	Bidder's module shall meet the FIPS 140-3 standard for cryptographic modules.
3.5.37	Bidder's module shall meet, if applicable, the ISO/IEC 27001 standard.
3.5.38	Bidder's module shall meet the IEC 62443 standard for embedded device security.

3.9	**Alarms - Bidder's shall provide the following Safety and Environmental Alarms**
3.9.1	**Safety and Environmental Alarms**
3.9.1.1	Gas Leak Detected - Detected via pressure decay, external methane sensor, or flow anomaly.
3.9.1.2	High Flow Rate Alarm - Sustained or sudden high flow rate exceeding safety thresholds (e.g., rupture).
3.9.1.3	Backflow Detected - Flow in reverse direction; indicative of piping issue or failed regulator.
3.9.1.4	Low Pressure Alarm - Static or dynamic pressure below minimum threshold for normal operation.
3.9.1.5	High Pressure Alarm - Line pressure exceeds safe limit; may risk appliance or pipe integrity.
3.9.1.6	Rapid Flow Change Detected - Sharp delta in flow suggesting disconnection, burst, or abrupt usage event.
3.9.1.7	Gas Temperature Out of Range - Gas temperature exceeds operational range of meter or connected components.
3.9.1.8	Cabinet/Enclosure Tamper - Physical access to meter detected via door sensor or vibration trigger.
3.9.2	**Operational and Communication Alarms**
3.9.2.1	No Flow/Zero-Usage Anomaly - Flow remains zero for an extended period during expected consumption window.
3.9.2.2	Signal Quality Degradation (USM) - Transducer signal quality falls below threshold (e.g., due to contamination).
3.9.2.3	Time of Flight (ToF) Drift Detected - Deviation in ultrasonic ToF, indicating sensor degradation or contamination.
3.9.2.4	Meter Fault Detected - Internal meter diagnostics report fault, misalignment, or calibration issue.
3.9.2.5	Firmware Integrity Check Failed - Firmware signature or hash mismatch detected on meter or Meter Communication Module (MCM).
3.9.2.6	Communication Loss (Meter Communication Module (MCM) ↔ Meter) - Meter Communication Module (MCM) cannot retrieve data from the ultrasonic meter.
3.9.2.7	Communication Loss (Meter Communication Module (MCM) ↔ Network) - Meter Communication Module (MCM) loses contact with head-end or data concentrator for defined interval.
3.9.2.8	Meter Clock Drift/Sync Failure - USM internal clock out of sync with head-end system time.
3.9.2.9	**Maintenance and Diagnostic Alarms**
3.9.2.10	Self-Diagnostic Error (USM or Meter Communication Module (MCM)) - USM or Meter Communication Module (MCM) detects internal fault during routine health check.
3.9.2.11	Power Supply Voltage Low - Internal power supply (e.g., battery or supercap) drops below safe threshold.
3.9.2.12	Tamper Detection (Port/Field Tool) - Unauthorized attempt to access or reconfigure via optical/USB port.
3.9.2.13	Device Relocation Detected - Meter Communication Module (MCM) detects movement or is activated in a different location than registered.
3.9.2.14	Over-Range or Under-Range Flow - Flow exceeds calibrated meter range or is unreadable at low threshold.
3.9.2.15	Measurement Quality Alarm - Flow signal corrupted or failing to meet validation criteria.
3.9.2.16	Sensor Drift / Calibration Alarm - USM sensor requires maintenance based on signal deviation from baseline.

3.13	**Ultrasonic Meters (USM)**
3.13.1	Bidder's USM shall provide continuous, digital measurement of gas volume and flow rate.
3.13.2	Bidder's USM shall include integrated pressure and temperature sensors and report values via a digital interface.
3.13.3	Bidder's USM shall support bidirectional flow measurement with alarms for backflow and high/low flow thresholds.
3.13.4	Bidder's USM shall be certified for operation with up to 20% hydrogen gas blends.
3.13.5	Bidder's USM shall support firmware upgrades and self-diagnostics, including signal quality, calibration drift, and internal faults.
3.13.6	Bidder's USM shall provide alarms for tamper or movement events.
3.13.7	Bidder's USM shall support collection, logging, and transmission of gas pressure monitoring data from an integrated or externally connected pressure sensor with pressure readings time-synchronized with volume measurements and stored at a configurable interval.
3.13.8	Bidder's USM shall support alarm thresholds for high and low pressure conditions and enable remote visibility through the HeadEnd system.

3.18	**Battery Requirements (Provide written responses to 2.18.1 to 2.18.22)**
3.18.1	Bidder to state if proposed module battery supports 20-years of operational life while providing hourly/hourly collection and transmission, and if not, when or if this capability will be available.
3.18.2	Bidder to state if proposed module battery supports 20-years of operational life while providing alarms and control commands in addition to hourly/hourly collection and transmission, and if not, when or if this capability will be available.
3.18.3	Bidder to outline trade-offs for the proposed module to meet hourly/hourly collection and transmission, including reduction in battery life or other functionality.
3.18.4	Bidder to provide for the proposed module the assumed annual frequency and battery impact from firmware updates.
3.18.5	Bidder to provide for the proposed module the assumed annual frequency and battery impact from configuration updates.
3.18.6	Bidder to provide for the proposed module the assumed annual frequency and battery impact from alarm and event reporting.
3.18.7	Bidder to provide for the proposed module the assumed annual frequency and battery impact from remote commands (e.g., value shutoff).
3.18.8	Bidder to provide for the proposed module the assumed annual frequency and battery impact from any additional communication types or background processes.
3.18.9	Bidder to provide the battery chemistry (e.g., lithium thionyl chloride) of the proposed module.
3.18.10	Bidder to provide specifications for the battery chemistry (e.g., lithium thionyl chloride) of the proposed module.
3.18.11	Bidder to provide a list of the integrated power-saving features (e.g., sleep mode, low-power radio).
3.18.12	Bidder to confirm whether the module supports optional extended-life battery configurations, and if so describe the impact on device size, weight, cost, and expected lifecycle.
3.18.13	Bidder to describe if battery lifecycle tracking is supported with onboard diagnostics for state-of-health or voltage monitoring.
3.18.14	Bidder to describe integration with the HeadEnd system for remote battery status visibility.
3.18.15	Bidder to describe configurable low-battery alert thresholds and reporting logic.
3.18.16	Bidder to provide the expected and standard battery shelf life.
3.18.17	Bidder to describe how the battery will support warehousing for a period of 18 months with zero battery loss (passivation period) or estimated expected loss.
3.18.18	Bidder to provide any available warranty coverage for both storage and in-service battery life.

Item	Requirement
3.18.19	Bidder to describe out-of-the-box and default transmission configuration shipped from the factory.
3.18.20	Bidder to provide the warrantied operational life under default and alternative transmission schedules.
3.18.21	Bidder to describe how the systems supports configurable operating profiles to optimize battery life including available configurable options and methods for balancing performance versus longevity.
3.18.22	Bidder to state if profiles can be remotely updated via over-the-air (OTA).

4. Network Requirements

Item	Requirement
4.1	**Operational Specifications**
4.1.1	Bidder shall provide 8,760 scheduled meter reads per year (24 reads/day for 365 days).
4.1.2	Bidder shall provide 5 to 100 on-demand meter reads per year.
4.1.3	Bidder shall provide 5 firmware updates over a 20 year meter lifespan.
4.1.4	Bidder shall provide a 20-year battery life and support 2 to 4 configuration updates per year for residential diaphragm meters.
4.1.5	Bidder shall provide a 20-year battery life and support 5 to 10 configuration updates per year for large commercial, industrial diaphragm meters.
4.1.6	Bidder shall provide a 20-year battery life and support 20 configuration updates per year for USM meters.
4.1.7	Bidder shall provide a 20-year battery life and support 10 on demand commands per year for diaphragm meters.
4.1.8	Bidder shall provide a 20-year battery life and support 20 on demand commands per year for USM meters.
4.1.9	Bidder shall provide trend load downlink command with 54k trigger trend mode 2-4 times per year for residential modules (MCMs).
4.1.10	Bidder shall provide alarm and event reporting 500 to 2000 times per year for diaphragm meters.
4.1.11	Bidder shall provide alarm and event reporting 1 to 2 times per year for USM.
4.1.12	Bidder shall provide remote shut-off to occur 1 to 3 times per year for diaphragm meters.
4.1.13	Bidder shall provide IoT sensor data collection (e.g., pressure, methane, temperature, etc.) 8,760 to 17,520 times per year for all meters (assumes 30 minute or hourly reads).
4.1.14	Bidder shall provide "heartbeat" polling on a daily basis or better.
4.1.15	Bidder shall provide sufficient FAN bandwidth to support current and future data requirements, including hourly, sub-hourly, real-time, and sub-second interval operations at scale.

4.17	**Network Security**
4.17.1	Bidder shall ensure confidentiality, integrity, and availability of all transmitted and stored data.
4.17.2	Bidder shall use secure, authenticated interfaces for all downlink and uplink traffic.
4.17.3	Bidder shall use secure, authenticated interfaces for system configuration commands.
4.17.4	Bidder shall comply with SoCalGas's SCADA and ICS cybersecurity standards MIST 800-53, ISO 27001.

4.18	**Network Device Security**
4.18.1	Bidder's enclosures support locking with SoCalGas standard padlocks.
4.18.2	Bidder's enclosures have tamper evident sealing options.
4.18.3	Bidder's enclosures provide detection and reporting of door openings or physical tampering in real-time.
4.18.4	Bidder's devices will be installed in tamper-resistant enclosures or within physically secured environments (e.g., fenced stations, locked cabinets).
4.18.5	Bidder's solution provides, logs, and timestamps cabinet access attempts.
4.18.6	Bidder's solution transmits events and unauthorized access alerts in real-time.
4.18.7	Bidder's solution detects and provides an alert for unauthorized access to wired or wireless communication ports.
4.18.8	Bidder's solution detects and provides an alert in device is relocated or moved outside their registered deployment location.
4.18.9	Bidder's solution provides a heartbeat or polling mechanism to report operational status and flag offline or non-responsive units.
4.18.10	Bidder's solution supports Zero Trust Architecture principles.
4.18.11	Bidder's solution supports Multi-Factor Authentication (MFA) for all user access.
4.18.12	Bidder's solution supports client and device authentication protocols.
4.18.13	Bidder's solution supports Public Key Infrastructure (PKI) with unique keys per device.
4.18.14	Bidder's solution supports end-to-end data encryption at rest and in transit.
4.18.15	Bidder's solution supports built-in encryption at the device level.
4.18.16	Bidder's solution supports DNS/URL inspection and payload analysis capabilities.
4.18.17	Bidder's solution supports VPN tunneling for all public or third-party network connections.
4.18.18	Bidder's cabinet monitoring and tamper detection system remains operational during a power outage.
4.18.19	Bidder's cabinet monitoring and tamper detection system monitors and logs all power state changes, including unexpected outages.
4.18.20	Bidder's cabinet monitoring and tamper detection system provide alerts for abnormal power behavior as an indicator of potential security breach.
4.18.21	Bidder shall physically secure all cables and power sources from tampering or damage.
4.18.22	Bidder shall automatically isolate a device from the AMI network if it is compromised.

4.20	**Communications Infrastructure Security**
4.20.1	Bidder's solution leverages private or utility-controlled communications infrastructure where possible to reduce cyberattack surface and prevent unauthorized access.
4.20.2	Bidder's public networks (e.g., LTE, 5G), if used, uses VPNs, secure tunneling, or APN partitioning.
4.20.3	Bidder's public networks (e.g., LTE, 5G), if used, provides application-level isolation between AMI traffic and other services.
4.20.4	Bidder shall provide security controls applied to device authentication.
4.20.5	Bidder shall provide security controls applied to resilience during carrier outages.
4.20.6	Bidder shall provide redundant communication paths and automatic failover in the event of link degradation or infrastructure failure.
4.20.7	Bidder shall provide cyberattack defense mechanisms for protection against Denial of Service (DoS).
4.20.8	Bidder shall provide cyberattack defense mechanisms for intrusion detection or prevention capabilities.
4.20.9	Bidder shall provide cyberattack defense mechanisms and safeguards against packet injection, spoofing, and protocol manipulation.

5. HeadEnd & Network Management

Item	Requirement
5.1	**HeadEnd**
5.1.1	Bidder HeadEnd shall support data collection from multiple meters types, various endpoint types and devices from multiple manufacturers on the AMI network.

Item	Requirement
5.1.2	Bidder HeadEnd shall support on-request reading of any available information by meter/customer or configurable batch of meters/customers.
5.1.3	Bidder HeadEnd shall support configuration changes for all endpoints including changes to interval length.
5.1.4	Bidder HeadEnd shall support fifteen-, thirty-, and sixty-minute recording for core (residential) meters.
5.1.5	Bidder HeadEnd shall support fifteen-, thirty-, and sixty-minute recording for gas non-core (commercial and industrial meters).
5.1.6	The HeadEnd shall store actual interval read values with any transformation and conversion factor applied.
5.1.7	Bidder HeadEnd shall have a time accuracy of interval data to less than one minute of NIST synchronized on the hour.
5.1.8	Bidder HeadEnd shall ensure availability of daily interval data collection, 100% of all prior day interval data for a minimum of 99.5% of all meters prior to 6:00 AM on day following the Consumption Day.
5.1.9	Bidder HeadEnd shall have less than one percent (1%) missing or estimated data per interval; interval data shall be stored and time stamped to within one minute accuracy from the top of the interval (top of hour, top of thirty minutes, etc.).
5.1.10	Bidder HeadEnd shall provide to the MDMS all meter and all endpoint telemetry data instantaneously or as per configured timing.
5.1.11	Bidder HeadEnd shall support the ability to change interval recording length by individual meter, or batch of meters, remotely within one hour of initiation by system.
5.1.12	Bidder HeadEnd shall support corrected and uncorrected gas consumption where correctors are utilized (refer to Appendix xx Existing Meter, Corrector and Pressure Monitor Populations for details of the correctors currently in use by Company and Appendix xx Technical and Engineering Gas Meter and Gas Endpoint Specifications).
5.1.13	Bidder HeadEnd shall support full serial communication with correctors and reporting of available register data.
5.1.14	Bidder HeadEnd shall support the reading of up to 10% of the total meter population by segment via a daily off-cycle request. The off-cycle request must be initiated by 6:00 PM of the prior day. 99.5% of all off-cycle data must be available for 99.5% of all meters by segment within one (1) day of the request.
5.1.15	The system shall monitor the consumption and metering equipment for abnormal load conditions indicative of potential revenue loss via equipment failure or energy diversion, as follows
5.1.16	•Physical Tilt. The system shall detect an attempt at removing the device and or an attempt to change the orientation of the gas module. See Appendix TG (Gas Direct Mount Meter Module - Technical Engineering Meter Specifications) and Appendix TH (Gas Remote Mount Meter Module – Technical Engineering Specifications) for restrictions on the use of hazardous materials, such as mercury, that might be utilized in tilt switch technology.
5.1.17	•Magnetic Tamper. The system shall detect the presence of strong magnetic fields indicative of electromechanical meter tampering.
5.1.18	•Battery Monitoring. The system shall provide a mechanism to report battery status of all battery powered Endpoints including state of charge, notice of failure and other battery monitoring events/alarms.
5.1.19	•High/Low Flow Alarm. The system shall detect high and low flow conditions.
5.1.20	•Programmability. The system shall have the ability to change monitoring properties and event reporting thresholds by individual meter, or batch of meters, remotely within one hour of initiation.
5.1.21	•Reverse Rotation. The system shall detect reverse flow conditions.
5.1.22	•Index Cover Off. The system shall detect index cover removal.
5.1.23	•Cut Wire. The system shall provide a mechanism to report when a signal or communication wire is severed.
5.1.24	•Electronic Volume Corrector Alarm. The system should detect and report general discrete alarms where correctors are utilized.
5.1.25	•Programming Alarm. The system should detect a programming attempt by an un-authorized local or remote source.
5.1.26	Bidder HeadEnd shall support a response to a system request, by individual meter or batch of meters, to provide any available meter register (consumption, specific day interval data, meter/system status, etc.). System to timestamp requests and responses and calculate elapsed durations.
5.1.27	Bidder HeadEnd shall support on-demand data retrieval for given number of meters with a defined SLA.
5.1.28	Bidder HeadEnd shall support the collection of gas pressure data from EPM devices hourly for delivery to the AMI head-end system.
5.1.29	Bidder HeadEnd shall support collection of high/low pressure events detected from EPM devices based on Company configurable thresholds instantaneously.
5.1.30	Bidder HeadEnd shall provide support for Non-Core (Commercial and Industrial) Meter Communications Module reset.
5.1.31	The HeadEnd system must provide up to three (3) month of on-line storage for all collected AMI system information. Includes Reads, Events, Alarms, Network Device Telemetry.
5.1.32	Bidder HeadEnd shall support the ingestion and processing of real-time, semi-real-time, hourly, and sub-hourly data streams across various systems.
5.1.33	Bidder HeadEnd shall support real time consumption data, alarms, and backhaul reception data to any downstream application (edge systems).
5.1.34	Bidder HeadEnd shall support transparent data access to the backend database for authorized users to extract and load data for any analytical or reporting purposes.
5.1.35	Bidder HeadEnd shall support ingestion and integration of the company GIS data.
5.1.36	Bidder HeadEnd shall display the latitude and longitude information for endpoints and network assets.
5.1.37	Bidder HeadEnd shall provide integration with SoCalGas's Work Management solution for order completion with SAP and IFS.
5.1.38	The Head End system shall provide out-of-thebox open standards based API to integrate with a CRM/CIS system (example SAP S4).
5.1.39	The Head End system shall support integration with multiple other vendor HeadEnd systems for interoperability.
5.1.40	Bidder HeadEnd shall be fully integrated out of the box with no custom integration or configuration with open standards based API to the meter data management system. All integration to MDMS should be production grade. The integration shall include but not limited to meter reads, usage data, different types of alarms and flags.
5.1.41	The head end system shall provide tested, validated and production grade standards based API's, Batch Files, Flat Files and other high volume data integration methods for the following types of payloads:
5.1.31.1	•Non-core Electronic Volume Corrector (EVC) pressure values, alarms and events, device event logs,
5.1.31.2	•Core and Non-core- Meter Reads, Alarms, Interval Usage, Meter Status, Configurations, over -the-air command history,
5.1.31.3	•Trend mode data, EPM configuration limits, EPM alarms, EPM hourly gas pressure values,
5.1.31.4	•Network Hiearachy and association of Endpoints, Alarm Notifications.
5.1.32	The HeadEnd solution shall provide support for all Endpoints to be integrated into a device management system with the following capabilities:
5.1.32.1	•Remote Endpoint and network configuration,
5.1.32.2	•Backup the Endpoint configuration on a regular schedule,
5.1.32.3	•Ability to schedule and update the firmware of an Endpoint (individually or in bulk) over-the-air,
5.1.32.4	•Availability monitoring of all individual Endpoints,
5.1.32.5	•Provision an Endpoint on the network (individually or in bulk),
5.1.32.6	•Quickly disable the Endpoint (assumed to be compromised) from accessing the network.
5.1.33	Bidder HeadEnd shall support production grade integration to the MDMS and shall include, but not limited to, meter reads, usage data, alarms, and flags.
5.1.34	Bidder HeadEnd shall process backhaul data real-time without the reliance of batch jobs.
5.1.35	Bidder HeadEnd shall have the capability to generate configurable payloads for event driven data exports.
5.1.36	USM - Bidder's system shall suport the capability to perform valve shutoff of USMs remotely OTA.
5.1.37	USM - Bidder's HeadEnd shall support USM hourly transmission of 60-minute interval data.
5.1.38	Bidder HeadEnd shall provide functions that allow the system to archive data, purge data, and restore data from archive.
5.1.39	Bidder HeadEnd shall provide system troubleshooting tools available including use of system logs.
5.1.40	Bidder HeadEnd shall support integration of all system logs with Company's security data analytics solution (e.g., Splunk).
5.1.41	Bidder HeadEnd shall provide a user interface for real time monitoring of KPI metrics, allowing user defined thresholds for each metric, triggering visual warnings or notifications if values exceed defined limits.
5.1.42	Bidder HeadEnd shall provide a user interface to display the software versions running in the system.

Item	Requirement
5.1.43	Bidder HeadEnd shall encrypt all data at rest and in transit which include but is not limited to GNN, alarm data, reads and usage data.
5.1.44	Bidder HeadEnd shall provide the capability to perform locally at the site any actions that are supported over-the-air, such as firmware updates, configuration updates to the meter and communication module, read requests, etc.
5.1.45	Bidder HeadEnd shall support QoS for real time operations and disaster recovery situations to prioritize safety data including alarms over meter to cash data, and prioritize C&I data over residential data.
5.1.46	Bidder HeadEnd shall provide tools to import user generated/created lists.
5.1.47	Bidder system shall ensure that all reports can be easily integrated with spreadsheet and/or database products for tracking purposes.
5.1.48	Bidder HeadEnd shall enable reporting data to be easily extracted from the HeadEnd system and integrated with external systems and applications (e.g., Power BI, spreadsheet, database products).
5.1.49	Bidder HeadEnd shall allow different levels of role based access for user accounts and the ability to update/change user accesses at any time.
5.1.50	Bidder HeadEnd shall allow for user accounts to be suspended and reinstated.
5.1.51	The HeadEnd shall support a mass data download tool from the application UX with selection criteria or mass download of attributes in a flat file (CSV).
5.1.52	Bidder HeadEnd shall allow the administrator to update system settings, create new user accounts, set access privileges, audit and report on access and operations performed.

5.3	Over-the-Air (OTA) Updates for Firmware, Software, Module, and Endpoint Configuration
5.3.1	Bidder's system shall support software/firmware upgrade for endpoints, network devices, and communication modules without system service interruption. Such upgrades shall be processed remotely and run automatically once initiated and this support shall extend to network devices and communication module.
5.3.2	Bidder's system shall provide a secure, efficient, and resilient firmware management framework that supports over-the-air (OTA) updates, version control, rollback, and real-time visibility into upgrade status.
5.3.3	Bidder's system shall identify all system components that support remote firmware or software upgrades, including field devices (e.g., gRMSd), communication modules, network infrastructure such as collectors, gateways, access points.
5.3.4	Bidder's system shall provide detection, containment and recovery from firmware update failures, including automatic retry logic with defined intervals and thresholds.
5.3.5	Bidder's system shall provide detection, containment and recovery from firmware update failures, including safe rollback procedures to revert to the previous stable firmware version.
5.3.6	Bidder's system shall provide detection, containment and recovery from firmware update failures, including automatic retry logic with defined intervals and thresholds.
5.3.7	Bidder's system shall provide capabilities for over-the-air (OTA) firmware updates across groups of devices, including scheduling tools that allow updates during designated maintenance windows.
5.3.8	Bidder's system shall provide capabilities for over-the-air (OTA) firmware updates across groups of devices, including Targeting criteria, such as device type, location, or firmware version.
5.3.9	Bidder's system shall provide capabilities for over-the-air (OTA) firmware updates across groups of devices, including load balancing and bandwidth controls to prevent network congestion.
5.3.10	Bidder's system shall provide capabilities for over-the-air (OTA) firmware updates across groups of devices, including acknowledgement, verification, and confirmation of successful installation on each device.
5.3.11	Bidder's system shall accurately reflect the status of over-the-air (OTA) requests based on whether the endpoint responded to the request, or committed the requested change.
5.3.12	Bidder's system shall disable the over-the-air (OTA) feature in the user interface and display the status of any in-progress OTA requests to prevent multiple users from issuing duplicate requests.
5.3.13	Bidder's system shall provide the capability to enable and disable user configured USM alarms from triggering alerts in the HeadEnd/Network Management.
5.3.14	Bidder's system shall support changing the transmission frequency of the endpoint over the air.
5.3.15	Bidder's system shall provide detailed reporting on firmware upgrades, including current firmware version per device.
5.3.16	Bidder's system shall provide detailed reporting on firmware upgrades, including upgrade status (pending, completed, failed).
5.3.17	Bidder's system shall provide detailed reporting on firmware upgrades, including success and failure metrics across batches or campaigns.
5.3.18	Bidder's system shall provide capabilities to enable pilot testing of firmware updates prior to mass network wide updates for endpoints and devices. Specifically the systems shall allow groups of network and/or endpoint devices to be updated in staggered manner over several days to ensure pilot mode testing and validation prior to mass rollouts.
5.3.19	Bidder's system shall provide capabilities for firmware upgrade/updates using non-network methods locally, including the use of applicable handheld or mobile device or other secure methods, this includes Endpoints and network devices.

8. Mobile Tools

Item	Requirement
8.1	Mobile Tools
8.1.1	Bidder shall make available all necessary special purpose equipment, tools, and software to enable SoCalGas (or its installation designee) to install all meters and associated meter-site communications devices and ensure that local communications have been established prior to departure.
8.1.2	The mobile field tool shall support functionalities for the Installation of metrology and comms, swap out, troubleshooting, meter on-demand read, configuration updates, etc.
8.1.3	Bidder shall make available devices and/or software required to survey, install, field test, and troubleshoot all network equipment and associated links.
8.1.4	Bidder shall provide all necessary documentation and troubleshooting guides.
8.1.5	Bidder's field mobile tool shall support field operations including meter installation, maintenance and troubleshooting.
8.1.6	Bidder's mobile field tool shall support offline mode.
8.1.7	Bidder's mobile field tool shall integrate with SoCalGas's enterprise active directory for user provisioning and access control.
8.1.8	Bidder's mobile field tool shall provide capabilities within the mobile application for access control based on user roles.
8.1.9	The mobile tool shall generate activity logs which shall include user IDs and roles
8.1.10	The mobile tools shall be available and distributed through Apple B2B channel or IPA file standalone mode
8.1.11	Bidder's mobile field tools shall provide the capability to perform locally at the site any actions that are supported over-the-air, such as firmware updates, configuration updates to the meter and communication module, read requests, etc.
8.1.12	Bidder's mobile field tools shall be remotely managed and updated through the MDMS.
8.1.13	Bidder shall work with SoCalGas to define procedures for managing field tools (such field tools are anticipated to be iOS applications and shall not be required to have their own environments but may be required to be integrated with specific HeadEnd software in certain HeadEnd environments).
8.1.14	Bidder shall provide distinct releases of tools with unique release identifiers, and information about compatibility with the AMI headend system versions.
8.1.15	Bidder shall provide new versions of the field tools applications in advance to allow cybersecurity testing and application testing prior to releasing to production.
8.1.16	Bidder acknowledges that the release of field tools for both testing and production will be facilitated through the SoCalGas mobile device management tool and standard processes of those teams.
8.1.17	The Field Mobile Tool shall support Bluetooth Low Energy communications

Item	Requirement
8.1.17.1	Bidder shall support creation of a private utility profile per established SoCalGas requirements.

10. End-to-end Quality of Service (QoS)

10.2	Latency Requirements
10.2.1	Alarm and event reporting - critical safety and exception events (e.g., gas leak, tamper, pressure alarm)
10.2.2	Remote shut-off control (command + ack) - command must be executed and confirmed securely and reliably
10.2.3	OTA acknowledgments/receipts - acknowledges successful command or firmware/configuration delivery
10.2.4	IoT telemetry (alarm-triggered) - includes pressure spikes, leak sensor triggers, etc.
10.2.5	On-demand meter reads - response payload may include current and historical usage, status, and diagnostic data
10.2.6	Scheduled meter readings (hourly) - interval data (e.g., hourly), may include pressure or temperature with volume
10.2.7	IoT telemetry (normal conditions) - pressure, temperature, methane concentration, etc., at a fixed interval
10.2.8	Firmware updates (OTA) - sent with retries and error checking; scheduled during off-peak windows
10.2.9	Configuration updates - includes tariff, thresholds, or operational mode updates
10.2.10	Network diagnostics/ping checks - periodic or manual signal checks or connection status reports
10.2.11	Heartbeat/polling status - regular health status or basic presence indication from Meter Communication Module (MCM)

Attachment K

Overview of Residential Methane Detector Capabilities

Residential Methane Detector

DeNOva Detect
By New Cosmos USA, Inc.



- **10%** LEL gas alarm threshold alerts **11 mins faster** than competitor products at 25% LEL
- Virtually eliminates nuisance alarms from common household chemicals confirmed by GTI testing
- MEMS sensor technology offers 7 years of wireless battery life
- Battery powered device offers optimal installation near ceiling
- Voice alerts for residents (English and Spanish) vs. no voice with competitors
- Designed to protect against water ingress
- Complies with UL1484

Attachment L

Overview of Ultrasonic Meter (USM) Capabilities and Benefits

Data Sheet
GDS-10007-07

Sonix IQ™

For Residential Gas Meter Applications



Features

- 90-day hourly data log
- Built-in theft and tamper detection
- Pulse output (pulse output cable optional)
- Optional shutoff valve and pressure monitoring
- Optional FlexNet capability

Benefits

- Compact footprint
- Two-way communications when used with a Sensus FlexNet communication network
- Supports third party radios
- MC Canada approval AG-06456
- Continuous health checks through safety alerts and alarms

Configuration Options

- Meter only
- Meter + integrated FlexNet radio
- Meter + integrated FlexNet radio + integrated valve + integrated pressure sensor

Third Party Radio Options

- Itron® 100G, 500G, and 550G
- Landis+Gyr Gridstream® M110 and M120
- Aclara RF3500 STAR®

The Sonix IQ ultrasonic gas meter provides pinpoint measurement of natural gas using ultrasonic technology. This solid state meter has no moving parts to replace or wear out over time. Featuring an available FlexNet® radio integrated inside the meter housing – the Sonix IQ packs in value within a compact size.

Unprecedented Flexibility

The Sonix IQ provides 250 CFH or 425 CFH within the same form factor. The pulse output, scalable by user configuration, supports third-party endpoints. The Sonix IQ with the optional SmartPoint® module provides full two-way communications when combined with the Sensus FlexNet communication network.

Built-in Intelligence

The Sonix IQ offers continuous health checks with system safety alerts, hardware alarms, and battery management alerts. The base LCD offers reading volume and alarms. Optional scolling LCD items include uncorrected volume, temperature, pressure fixed, pressure monitor, and flow rate. The Sonix IQ logs hourly data and stores it for up to 90 days at a time. The Sonix IQ offers configurable alarms that can trigger the remote shutoff valve.

Additional Features with FlexNet V2

When installed in a FlexNet V2 system, Sonix IQ has enhanced security, remote shutoff capability, and correlated readings. The remote shutoff command is sent through FlexNet with no site visit required. In addition, the volume, pressure, and temperature data in the data logs can be transmitted over FlexNet.

Lifetime Value

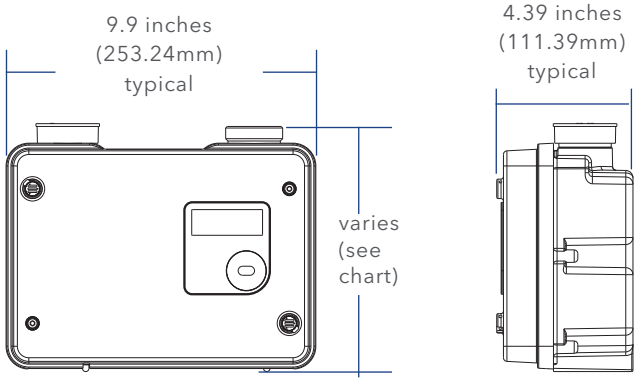
The Sonix IQ offers an extended battery life of 20 years. Planning for maintenance and asset management costs has never been easier. The Sonix IQ has a compact footprint enabling utilities to deploy it where other traditional gas meters do not fit. The small size creates the added benefit of incresed efficiency in shipping and storage.



Sonix IQ

Height

10 LT	7.93 in. (201.41mm)	**Sprague #1A**	7.98 in. (202.81mm)
20 LT	7.89 in. (200.40mm)	**Sprague #2**	8.07 in. (205.07mm)
30 LT	8.23 in. (209.03mm)	**Sprague #3**	8.33 in. (211.67mm)
45 LT	8.28 in. (210.28mm)	**1-1/4" NPT**	7.98 in. (202.81mm)



Specifications

	250 Series	400 Series
Capacity	250 CFH at ½" differential	425 CFH at ½" differential
Range	250 CFH (7 m³/hr) at ½" W.C. Differential ±1% from 10 CFH to Qmax 250 CFH with 0.6 specific gravity gas ±2% from 3 to 10 CFH, with 0.6 specific gravity gas	425 CFH (12 m³/hr) at ½" W.C. Differential ±1% from 15 CFH to Qmax 425 CFH, with 0.6 specific gravity gas ±2% from 5 to 15 CFH, with 0.6 specific gravity gas.
Low Flow Cutoff	0.25 cfh (7 liters/hr)	
Connections	10 LT, 20 LT, 30 LT, 45 LT, Sprague 1A, Sprague 2, Sprague 3, or 1-1/4" NPT connections are on 6 in. (152 mm) center to center. Recommended mounting with connections up.	
High Resolution Readings	Volume readings shown on LCD and sent via FlexNet in 0.1 ft³ or 0.001 m³ resolution.	
Dimensions (average)	9.94 in. L x 4.38 in. W x 7.89 in. H (252.5 mm L x 111.3 mm W x 200.4 mm H)	
Weight	6.3 lb (2.86 kg)	
Maximum Allowable Operating Pressure	10 psig	
Pressure Compensation	User configurable fixed factored for operating, base, and atmospheric pressure.	
Operating Temperature	Metrology: -30° to +130° F (-35° to +55° C) ±1.0% temperature or non temperature compensating options. Valve: -30° to +130° F (-35° to 55° C) and complies with BS EN -16314:2013.	
Storage Temperature	-40° to +150° F (-40° to +66° C) *	
Valve	Ball valve type. Meets EN16314 standard. Automatic shutoff option configuration scenarios: high pressure, low pressure, high temperature, high flow, reverse flow, air in meter.	
Pressure Sensor	Accuracy and range = 1 psig or 5 psig options. ±3% full scale accuracy.	
Enhanced Security (FlexNetV2)	Secure communication interfaces using best-in-class network security including AES-CCM-256, SHA-256, and P-256 Elliptic Curve Digital Signatures and Elliptic-Curve Diffie-Hellman algorithms.	
Accuracy	Complies with ANSI B109.1, PS-G-06.	
Intrinsic Safety	Complies with applicable sections of Class I, II, III, Division 2, Group D, F, G, T4 in accordance with IAS 12.12.01/ CSA C22.2 No 213.	

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GDS-10007-07

Attachment M

SoCalGas Advance Meter Semiannual Report (August 2016)

SOUTHERN CALIFORNIA GAS COMPANY
ADVANCED METER
SEMIANNUAL REPORT

August 31, 2016

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Southern California Gas Company
Advanced Meter Semiannual Report

Introduction

This is the seventh Semiannual Report ("Report") regarding the progress of Southern California Gas Company's ("SoCalGas") Advanced Meter project. In Decision ("D.") 10-04-027, the California Public Utilities Commission ("CPUC" or "Commission") authorized the project. Ordering Paragraph 5 required the following reporting requirements for SoCalGas:

> "Southern California Gas Company shall establish a system to track and attribute program costs and projected savings from conservation. Based on this tracking system, Southern California Gas Company shall submit a report to the Director of the Commission's Energy Division semiannually, tracking the gas conservation impacts of the advanced metering infrastructure project to date. These reports shall serve as a forum to adjust, as necessary the elements laid out in the final outreach plan described above. We expect that customer outreach, education and communications will continue to evolve and improve as SoCalGas conducts customer research, monitors customer reaction to new AMI technology and various customer usage presentation tools, and incorporates feedback from these activities into its AMI outreach and education activities. If the report shows that the company is falling short of its projections, it shall submit revisions to its conservation plan to increase awareness, participation, and durability of conservation actions among its customers. The semiannual reports and any revisions to the advanced metering infrastructure outreach and conservation plan shall be submitted to the director of the Commission's Energy Division and served on the most recent service list for this proceeding. Additional costs incurred in order to improve conservation response will be funded out of contingency funds, or otherwise subject to the risk sharing mechanism authorized in Ordering Paragraph 2."

Chapter 1 - Project Overview and Summary

In addition to the specific requirements identified in D.10-04-027, this Report provides overall status of SoCalGas' Advanced Meter project through June 30, 2016 and builds upon previous Reports by highlighting project changes and activities that have taken place since January 1, 2016. Previous Report filings may be accessed on SoCalGas' website.[1]

The Advanced Meter infrastructure consists of three primary components – a meter transmission unit ("MTU" or "module") attached to SoCalGas meters; a communications network consisting of data collection units ("DCU") installed across the SoCalGas service territory; and associated back-office software systems, including the "Head End" system and "Meter Data Management Software," which securely receive and process Advanced Meter

[1] http://www.socalgas.com/regulatory/A0809023.shtml.

data. Data from the modules is communicated to the DCUs and then transmitted to SoCalGas' back-office systems.

Operational highlights as of June 30, 2016 include:

- About 379 SoCalGas employees installing modules.
- Over 5.4 million meter modules installed representing 90% of the total meters to be upgraded.
- 3,722 data collector units (DCUs) installed and functioning On-Air representing nearly 81% of the estimated 4,600 DCUs required. These DCUs are fully or partially installed in 171 of the 221 cities and counties located within SoCalGas' service territory (77% of total).
- Approximately 97 percent of the installed modules have been deemed 'Billing Ready' and are now used or ready for billing customers.

SoCalGas also completed its third targeted heating season conservation campaign leveraging Advanced Meter-enabled usage data. The conservation campaign launched in November 2015 and extended through the heating season, with most treatments concluding in March 2016. It was the third in the series of four conservation "Test and Learn" campaigns to be conducted over the course of the Advanced Meter project. It incorporated the lessons learned and key findings from the prior two heating season campaigns which were conducted from October 2013 through March 2014 and from November 2014 through March 2015.

The goals of these consecutive conservation campaigns are demonstrating how to best meet the one percent energy savings goal[2] associated with the Advanced Meter rollout and tracking the resulting conservation savings. **Of significance in this most recent campaign was that every one of the thirteen new conservation treatments tested produced statistically significant gas savings.[3]**

These new treatments resulted in savings of over 1.4% total during the 2015-2016 fall/winter period. This is an increase in savings vs. total first year savings rates for the successful[4] treatments tested in the two prior heating season campaigns, and shows continued progress towards the conservation goal. Additional savings of nearly 1.7% were also realized for three of the treatments initially tested during the 2014-2015 campaign and repeated in the 2015-2016 campaign. Continued savings effects were also realized for a few treatments initially tested during the 2013-2014 campaign. **Overall, the new and continued successful treatments produced gas savings of almost 1.5% during the 2015-2016 fall/winter period.** The persistence and sustainability of these conservation results demonstrates the durability of conservation actions as outlined in Ordering Paragraph 5 above.

[2] This energy savings goal specifically refers to 1% of total *residential* gas usage.

[3] Four out of seven treatments tested during the 2014-2015 heating season campaign generated savings of about one percent total. Four out of eleven treatments tested during the 2013-2014 heating season campaign generated savings of about 1.3 percent.

[4] Successful treatments are comprised of the subset of treatments tested that were successful in producing statistically significant usage reductions.

The Advanced Meter project is currently meeting its schedule, budget and major project milestones; however, continued permitting and construction challenges impede completing the network in accordance with D.10-04-027. SoCalGas has implemented a proactive public outreach strategy to educate and inform impacted residents, businesses, and municipalities of network installation to help mitigate potential concerns. As noted in previous Reports, despite extensive engagement, select municipalities continue to require SoCalGas to secure discretionary permits refuting the CPUC's preemptory jurisdiction over utility facilities. This discretionary permitting process provides municipalities the unilateral right to significantly modify the planned location or design of the DCUs and even precludes the installation of DCUs by the utility.

Although there has been progress in select areas, by continuing to assert their position municipalities are considerably delaying or preventing the network installation timeline for approximately 150 DCUs or 3% of a total of 4,600 required DCUs. The inability to deploy the necessary infrastructure in these jurisdictions will likely result in SoCalGas having to maintain separate meter reading, communications, data processing and billing systems functions for longer than was anticipated in D.10-04-027 and will negatively impact expected customer, safety, operational and conservation benefits pursuant to Sections 3.C, 3.D and 9 of this report.

Chapter 2 - Module Installation and Network Construction Status

2.A Module Installation Status

SoCalGas has installed 5,435,846 modules through the end of June 2016, with its first installation dating back to October 2012. Table 1 displays the installations performed by Advanced Meter Mass Install personnel and identifies installations completed by other SoCalGas personnel.

Appendix A provides the latest timeline of planned warehouse opening and closings.

Table 1
Module Installations by Personnel Group

	Module Only	Meter Change w/Module	Total
Advanced Meter Installations	3,959,301	1,111,515	5,070,816
Other SoCalGas Personnel		365,030	365,030
Total Installations	**3,959,301**	**1,476,545**	**5,435,846**

About 93 percent of the modules are being installed by Advanced Meter personnel, with approximately 7 percent being installed by other SoCalGas personnel. Other SoCalGas personnel are involved when the installation requires extensive modifications to the existing meter configuration, such as installing the modules on complex industrial and commercial

meters; replacing existing curb meters with new curb meters containing a pre-installed module; and when meters are changed through the normal course of business.

As Table 1 displays, nearly 73 percent of the modules were installed on existing meters, while 27 percent of the time, the meter was replaced with a new meter with a module already installed.

Installation teams work out of warehouses leased specifically for the Advanced Meter project. As of June 30, 2016, there were 379 installers employed. Table 2 provides an overview of the installation workforce for each of the warehouses open through June 2016.

Table 2
SoCalGas Installation Workforce by Warehouse

Warehouse	Number of Employees
Oakley	34
Rancho Cucamonga	50
LAX	60
Statham	50
South Gate	38
Los Angeles	48
Mission Viejo	54
Anaheim	45
Total	**379**

Throughout the project, the Advanced Meter team has experienced some injuries and incidents. Table 3 displays safety results from January through June 2016. SoCalGas aspires to have zero incidents and has taken a proactive approach in providing its Advanced Meter team with additional safety and training resources. SoCalGas continues to have an additional day dedicated to safety in the installer training curriculum and as part of its “Safe and Sound” Safety Campaign, SoCalGas continues to create and share short safety films to promote safe behavior at the workplace and at home.

Table 3
Advanced Meter Safety Incidents
January 1, 2016 through June 30, 2016

Incident Type	Number of Incidents	Rate*
Occupational Safety & Health Administration ("OSHA")	19	5.2
Controllable Motor Vehicle Incidents ("CMVI")	18	5.0
Lost Time Incidents ("LTI")	4	1.1

*OSHA Rate is the number of incidents per 200,000 hours worked
*CMVI Rate is the number of incidents per million miles driven
*LTI Rate is per 100 workers

2.B Communication Network Construction Status

The communications network of the Advanced Meter system is designed to ensure that SoCalGas customers receive their hourly consumption data. It consists of DCUs deployed across the SoCalGas service territory that receive the meter reading data from the modules installed on each meter. Most modules transmit twelve hourly meter reads four times a day with at least three DCUs. Each module communicates for less than two minutes per year. The data is encrypted and transmitted across a licensed frequency from the module to the DCU.

SoCalGas continues to refine the network to improve system performance and based on the latest propagation study provided by Aclara, the technology vendor, the project will install nearly 4,600 DCUs. The actual number of DCUs to be installed is determined by a two-step process:

1. The specific DCU locations, referred to as design points, are determined based on the propagation study which takes into account the location of the modules on the six million meters, the topography of the surrounding area, and the influence of the environment on the transmission of the radio signal. The DCUs can be placed within a 500 foot radius of the design point.
2. After these DCUs are installed, SoCalGas evaluates the performance of the network and identifies gaps in the network. SoCalGas then installs additional DCUs to remediate these deficiencies in performance.

SoCalGas' plan is to install DCUs prior to the scheduled module installation so that data can be received soon after the module is installed. Overall, SoCalGas has achieved this goal. Table 4 displays the status of the SoCalGas network as of June 30, 2016.

Table 4
Status of DCUs through June 30, 2016

DCU Status	Number of DCUs	Percent of DCUs
Installed	3,724	81%
On – Air	*3,722*	*80.9%*
Ready to Construct	12	0.3%
Negotiating with Local Governments/Other Third Parties[5]	626	13.6%
Not Started	238	5.2%
Total To Be Installed	4,600	**100%**

81 percent of the network has been constructed or is ready to construct. By June 30, 2016, SoCalGas has installed 3,724 DCUs with an additional 12 DCUs ready for construction. Of the 3,724 installed, 3,722 DCUs have been commissioned on-air and are receiving reads from installed MTUs. SoCalGas continues to negotiate with local governments and third parties to install the remaining DCUs in the network. Table 5 displays the locations of installed DCUs to date.

Table 5
Location of Installed DCUs

DCU Location	Installed DCUs
SoCalGas Owned Poles in	
SoCalGas Facilities	65
Public Right of Way	2,534
Caltrans Right of Way	30
Private Easement	21
Total	2,650
Attached to Third Party Assets	
Los Angeles Bureau of Street Lighting	407
SCE Street Lights	335
PG&E Street Lights	27
SDG&E Street Lights	41
Other Cities Street Lights	236
Other Public/Private Assets	28
Total	1,074
Total DCUs Installed	**3,724**

[5] Includes municipalities refuting the CPUC's preemptory jurisdiction over utility facilities.

To date SoCalGas has installed DCUs on a SoCalGas owned pole in the public right of way under its franchise 71 percent of the time. The second most common method has been to install DCUs on local government-owned street lights.

When a DCU is attached to a third party owned asset, SoCalGas negotiates a contract with the asset owner which usually includes:

- Fees to lease the space on the asset; and,
- Energy rates for the electricity to power the DCU.

SoCalGas has executed contracts with the City of Los Angeles Bureau of Street Lights ("BSL"), Pacific Gas & Electric Company ("PG&E"), Southern California Edison Company ("SCE"), San Diego Gas & Electric Company ("SDG&E"), and has reached contract agreements with 143 cities and 6 counties.[6]

Of the 12 counties and 211 cities in the SoCalGas service territory, SoCalGas has finished installing DCUs in 7 counties and in 144 cities/communities.[7] SoCalGas is in active negotiations with several cities and counties to continue installing the remaining DCUs. A limited number of cities and counties have been reopened due to network optimization.[8] To ensure area coverage, the project has reassessed cities and counties that have been completed with the original design and added DCUs where necessary.

With 3,724 DCUs constructed, SoCalGas has received 180 complaints and 79 inquiries, including concerns about the DCUs aesthetics, glare, or location. In each case, SoCalGas contacted the complaining party to resolve the complaint. As a result of customer concerns, SoCalGas has relocated 71 DCUs. Otherwise, the concerns have been resolved without relocating the DCU.

Where the DCU design point falls entirely within private property, SoCalGas negotiates easements with the private property owner(s). Installations of this type usually require a contract to secure the right to locate on the third party property.

When SoCalGas installs a DCU on its own pole, the DCU is solar-powered. When installed on a street light, the DCU is most often powered by electricity from the street light. Given the preponderance of new poles, most of the DCUs are solar powered. Table 6 shows the breakdown between solar and A/C powered DCUs.

[6] Pursuant to Commission Resolution ESRB-1 dated May 10, 2013 (SCE), Resolution ESRB-2 dated June 27, 2013 (SDG&E) and Resolution ESRB-3 dated June 27, 2013 (PG&E) SoCalGas is able to permanently attach the DCUs to these electric utilities' street lights.

[7] Appendix B provides a list of the counties and cities with fully installed DCUs as of June 30, 2016.

[8] Appendix C provides a list of the counties and cities that have been reopened.

Table 6
Power Source for DCUs

Installed DCUs	Solar Powered	AC Powered
3,724	2,721	1,003

Chapter 3 - System Performance

Two key indicators of the overall Advanced Meter system performance are the performance of the network with respect to the delivery of hourly data for billing and online presentation purposes, and the resulting billing data-related performance. Additional improvements to SoCalGas' service delivery are also being realized as a result of meter read automation and enhanced data analytics capabilities enabled by the Advanced Meter system. Extended uses of the Advanced Meter system through a network sharing capability also have the potential to provide additional operational and conservation benefits to water agencies and their customers within SoCalGas' service territory.

3.A Network Performance

The most basic measure of system performance is to measure the data delivered as a percentage of the expected data to be delivered. This has direct impacts to both billing and the presentment of hourly gas consumption data to customers. In a perfect system, SoCalGas would receive data for every customer for every hour, each day of the year. To provide this data, the modules must communicate with the DCUs and the DCUs must transmit the data to SoCalGas back office systems 100 percent of the time.

Table 7 displays the breakdown of modules that have successfully communicated with SoCalGas' back office systems.

Table 7
Module Communication Status

Module Communication Status	Modules Installed	Percent Installed With Network
Total Modules Installed	5,435,846	-
Modules Installed – Incomplete Network	50,519	0.9
Modules Installed with Complete Network [9]	5,385,327	99.1
Delivering 100 Percent of Expected Reads	4,404,706	81.8
Missing 1-12 Reads	719,719	13.4
Missing More Than 12 Reads[10]	226,937	4.2
Missing All Reads	33,965	0.6

About 99 percent of the modules have been installed where network has been completed and only about 1 percent of modules are installed where the network is incomplete. SoCalGas generally installs modules where the network is available; however, some exceptions to installing outside of an available network include instances when new business meters are connected and routine meter changes are being performed. Additionally, when a meter fails in the field, it is replaced with an integrated meter and module, regardless of whether the network is installed or not.

As illustrated in Table 7, approximately 82 percent of the installed modules within a completed network are successfully communicating all of a customer's hourly data on a monthly basis. About 13 percent of the modules are missing 1-12 reads, which means that they have had only 1 or 2 unsuccessful communications per month. That is, one or two six-hour periods have not been successfully communicated to the SoCalGas back office systems. SoCalGas does not consider a module performing at this level to be problematic for billing as enough hourly data is being received for these purposes.

About 4 percent of the modules are missing more than 12 reads but have communicated at least one read. SoCalGas continues to examine module modifications and network enhancements to improve the performance of these modules.

3.B Billing Data Performance

The Advanced Meter modules replace the manual reads with an automated read, with the expectation that the system will produce more accurate reads (no data entry mistakes) and fewer estimated reads (meter access problems are largely eliminated).

Table 8 displays the progression of modules from installation to actual use for billing.

[9] Number of modules installed within full DCU coverage; full DCU coverage indicates that all planned DCUs for a given area are operational.

[10] Missing more than 12 reads but at least one read has been communicated.

Table 8
Advanced Meters Utilized for Billing

Modules Installed as of June 30, 2016	5,435,846
Modules in 'Billing Ready' Status	5,296,738
Advanced Meter Reads Requested for Billing	5,190,823
Billing Data Provided by Advanced Meter	5,178,544
Billing Data Not Provided by Advanced Meter	12,279
Percent Provided by Advanced Meter – Actual Read	99.6%
Percent Provided by Advanced Meter – Estimated Read	0.1%
Percent Not Provided by Advanced Meter	0.2%

Approximately 97 percent of the installed modules have been deemed 'Billing Ready' and are now used or ready for billing customers. Of the remaining three percent, most are still in the process of completing one of the test elements needed to become 'Billing Ready.' Others are located in areas with incomplete DCU coverage, or are located in areas with insufficient module density to support conversion to Advanced Meter billing.

Modules in areas with network coverage which do not pass the 'Billing Ready' tests are monitored and, if necessary, replaced. They may also point to insufficient network coverage or DCU problems, which are then remediated.[11]

For the Billing Ready modules, the system provides a high percentage of actual reads. The system also provided 0.12 percent of reads which were 'estimated reads' based substantially on reads received earlier in the month, rather than on a particular designated day. Only about 0.24 percent of the reads could not be provided by the Advanced Meter system.

In July 2013, SoCalGas implemented software that enabled the utilization of automated reads for the initiation of new service. With Advanced Meter automation, a field visit to collect a customer's starting read was no longer necessary for turn-on orders that did not require entry into the home. SoCalGas' Customer Service Field organization has seen a reduction of over 1,646,740 orders since the implementation of the automated reads for the initiation of new service.

3.C Service Delivery Enhancements resulting from Enhanced Data Analytics

As the Commission articulated in the AMI decision,[12] the Advanced Meter system "provides [a] system-wide technology platform with the ability to expand operating benefits as new applications emerge." In areas where the communications network is fully deployed, SoCalGas is leveraging Advanced Meter-enabled data analytics and technology by integrating data to develop algorithms that support the continued safe and reliable delivery of natural gas to its

[11] As referenced in Chapter 2, additional DCUs may have to be added to improve system performance.
[12] D. 10-04-027, page 40.

customers. These enhanced data analytics enable identification of unusual gas consumption patterns at customer facilities.

Though in the exploratory phase, this new and more granular awareness of energy data utilization is uncovering new opportunities and benefits potential. Leveraging the Advanced Meter network could result in faster identification of abnormally high gas usage, which enables SoCalGas to identify, investigate, and respond to potential safety situations quicker. By discovering abnormally high gas usage and notifying customers, SoCalGas can reduce methane emissions at customer facilities saving energy, improving air quality while also reducing the financial burden on customers from higher usage.

The Advanced Meter team assesses unusual consumption patterns on closed accounts using a Per Day Average and in some cases will look at the hourly reads to conduct further research. During the exploratory phase of SoCalGas' enhanced data analytics, the following results have been achieved. Table 9 summarizes the results of the 1103 exploratory service orders fielded through June 30, 2016.

Table 9
Gas consumption data analytics results through June 30, 2016

Findings from completed field visits (project to date)	Number of field visits	Percent
Total field visits generated by consumption analytics awareness	**2056**	
Gas services closed by SoCalGas field technician due to excessive registration. Resolution takes place at the time of the follow-up field visit to reinstate gas usage.	835	40.6
Gas or hot water leaks corrected by the customer as a result of SoCalGas field visit	445	21.6
Hot water leaks where the hot water heater was in continuous demand	416	20.2
Gas leak found by SoCalGas field technician	322	15.7
Abnormal gas usage resulting from an appliance in use for an extended period of time (e.g., forgotten pool heater left on).	38	1.8

Leveraging Advanced Meter consumption analytics is a component of a more comprehensive set of processes and inspections aimed at ensuring public safety and SoCalGas expects that, as it continues to build out enhanced analytics capabilities enabled by the Advanced Meter system, further customer service and safety benefits will accrue to its customers. More rapid detection and resolution of gas and hot water leaks provides enhanced safety for customers and their communities, as well as provides energy and financial savings, reduced greenhouse gas emissions, and conservation of our increasingly scarce water supplies.

3.D Extending the Use of the Advanced Meter Network

As articulated in our AMI Application, SoCalGas recognizes the State's priority and urgency in encouraging and enabling water conservation and as such included the requirement for an AMI technology capable of reading water meters. This network sharing capability has the potential to provide significant operational and conservation benefits to water agencies and their customers within SoCalGas' service territory.

In order to operationally evaluate the feasibility of the "Shared Network" concept, SoCalGas has established one-year pilots to be conducted by Aclara and SoCalGas with a limited number of water utilities. Three municipal water utilities are participating in this pilot, and as of June 30, 2016 there were approximately 1,400 water MTUs successfully transmitting data from water utility MTUs over the SoCalGas Advanced Meter Network.

SoCalGas, along with the other Energy IOUs in California, were asked to develop pilot proposals[13] to identify technical issues with a Commission-regulated water corporation "piggybacking" on electric corporation and/or gas corporation AMI infrastructure,[14] or to structure new pilots to explore different questions if pilots on AMI were already underway.[15] As part of this effort, SoCalGas submitted a proposal which in addition to network sharing, includes the identification and evaluation of potential hot water leaks based on analytics of both gas and water AMI data, as well a study of the potential benefits associated with hot water leak detection and resolution. This proposal was approved by the CPUC on June 9, 2016 with D.16-06-010, and SoCalGas has begun work with a technology vendor (Aclara), a 3rd party analytics vendor (Valor Water Analytics), and two separate Commission-regulated water utilities (San Gabriel Valley Water Company, California American Water) on this effort.[16]

In addition to the Advanced Meter network being shared by external water utilities, other groups within SoCalGas are leveraging the network. As part of a pilot project by the Pipeline Safety Enhancement Plan (PSEP) group, data from a sensor device to detect, measure and monitor methane in the area near a transmission pipeline is being transmitted over the Advanced Meter network. As of June 30, 2016, twelve of these methane sensor devices have been installed in the field and are successfully communicating over the Advanced Meter network with the ability to provide remote alarm registration and processing when the methane-in-air concentration, as measured by the sensors, exceeds limits established for our testing period.

Chapter 4 - Financial Status

To track expenses during the project, Ordering Paragraph 7 of the D.10-04-027, stated:

[13] D.15-09-023, p. 46.
[14] D.15-09-023, p. 47.
[15] D.15-09-023, p. 47.
[16] SoCalGas Advice No. 5014 and SoCalGas Advice No. 4992.

> "Southern California Gas Company shall file an advice letter no later than 30 days from the effective date of this decision, establishing a balancing account and detailing the cost recovery mechanism in conformance with this decision. Southern California Gas Company is authorized to recover deployment costs up to $1.0507 billion in this account, plus additional amounts, if any, consistent with the terms and conditions of the Risk Sharing Mechanism approved in Ordering Paragraph 2."

On August 4, 2010, the CPUC approved AL 4110, effective April 8, 2010, which established the Advanced Meter Infrastructure Balancing Account.

The CPUC approved budget of $1,050 million for the SoCalGas Advanced Meter project was augmented by re-directing $13.5 million of previously approved General Rate Case funding for a Remote Automated Meter Reading ("RAMR") project. SoCalGas halted the implementation of its RAMR project, a drive-by meter reading system, when its Advanced Metering Infrastructure ("AMI") application was submitted, and in the AMI application requested that this funding be re-directed to the Advanced Meter project. In D.10-04-027, the CPUC approved this request.[17][1] The total budget for the SoCalGas Advanced Meter project is $1,064 million, which included a contingency fund of $68.7 million.

The sequencing of the spending to date is typical of the pattern for many major projects. The early years of the project were spent organizing the large project team; developing new business processes; and building and implementing the information systems that support the construction of the DCUs and installation of the modules. SoCalGas' plan contemplated that the DCUs would be constructed prior to the installation of the modules so that the modules would be effective in delivering benefits to customers. As indicated in Chapter 2, SoCalGas began installing its DCUs in June 2012 and its modules in October 2012.

[17] A.08-09-023, Prepared Direct Testimony of Edward Fong, page 15.

Table 10
Financial Results (in $Thousands)
Recorded 2010 through June 2016

	2010	2011	2012	2013	2014	2015	YTD 2016	Project to Date
Project Management Office	2,619	6,477	6,634	4,945	4,023	3,415	1,663	29,776
Meters, Modules & Installation	120	3,718	28,067	116,030	183,117	170,210	38,721	539,983
Network	777	3,744	14,429	23,805	18,796	15,306	6,586	83,443
Information Technology	6,011	16,873	21,931	16,015	10,491	11,108	2,545	84,974
Customer Outreach	324	1,027	2,085	5,502	5,195	4,786	1,926	20,845
Employee Awareness	65	3,078	3,732	2,088	1,051	1,087	407	11,509
Support Organizations[18]	303	-	1,162	3,576	4,517	4,684	4,357	18,599
Overheads & AFUDC[19]	2,382	10,828	23,663	33,812	40,499	32,135	16,562	159,879
Total	***12,601***	***45,745***	***101,594***	***205,746***	***268,807***	***242,732***	***72,768***	***949,008***

Table 10 displays the Advanced Meter spending through June 30, 2016, by the major project activities. The purchase and installation of meters and modules continue to be the primary source of spending at approximately $540 million project to date. The next large areas of spend are in information systems and the construction of the communication network with approximately $85 and $83 million in spend, respectively. Although the project has fully absorbed the authorized contingency SoCalGas believes the project will be delivered within the approved budget.

Chapter 5 - Meter Reading Work Force Impacts

The Meter Reading work force is the most significantly impacted by the Advanced Meter project as Meter Reading positions will all but be eliminated by the project.[20] Both SoCalGas and the CPUC are concerned about these impacts. The Commission specifically addressed this concern. Ordering Paragraph 1 of the D.10-04-027 states:

[18] Support organizations are comprised of SoCalGas departments outside of Advanced Meter that are funded by the project for project related work or for work identified in business case.
[19] Overheads are the indirect costs associated with the work being performed (e.g. payroll taxes, benefits, general and administrative expenses). AFUDC is the net cost for borrowed funds used for construction purposes. The calculation of these costs is in accordance with the FERC Code of Federal Regulations.
[20] Some personnel may continue to manually read meters in support of the CPUC authorized Opt-Out program.

> "Southern California Gas Company shall supplement by $1 million, its funding for workforce retention and retraining. This fund is established to better protect the employment interests of Southern California Gas Company's meter reading workforce and should be used to extend severance, vocational training, and other transitional opportunities to employees affected by the decision to pursue advanced metering infrastructure."

In response to this direction, SoCalGas set aside funding in its Enhanced Educational Assistance Fund specifically to support the Meter Reading personnel in place in April 2010. As of June 30, 2016, meter readers had been reimbursed approximately $103,000 through this fund.

While meter readers have been active in seeking employment opportunities within SoCalGas the fund has not been heavily utilized, so as part of our continuing efforts to support our employees' transition to potential job opportunities, SoCalGas has expanded the retention and retraining efforts to include skills orientation workshops. These workshops are designed to familiarize employees with the mechanical and technical skills associated with piping, tools usage, natural gas appliance and distribution system construction work. The workshops are voluntary and are offered on Saturdays.

The orientation workshops offer transitional skills that could be applied toward job opportunities within and outside of SoCalGas. The target employee group has also been expanded to include all current meter reading employees as well as AMI Field Representatives. All of these employees will be affected when Advanced Meter implementation is completed in 2017.

SoCalGas has allocated $42,400 from the authorized funding from 4th Quarter 2014 through 2016 to provide these workshops for employees. SoCalGas will continue to offer enhanced educational assistance reimbursement to the remaining eligible meter reading employees.

Table 11 displays the current status of those Meter Reading personnel who were employed in April 2010, when the project was approved by the CPUC.

Table 11
Status of Meter Reading Personnel Employed in April 2010

Meter Reading Personnel	Work Force in April 2010	Remain in Meter Reading June 30, 2016	Left Company	Transition Within Company
Full-time	166	13	19	749
Part-time	818	21	182	
Management	46	12	8	26
Total	1,030	46	211	773
Percent of Work Force	**100%**	**4.5%**	**20.25%**	**75.25%**

As Table 11 shows, 773 employees (75 percent of the Meter Reading personnel from April 2010) have transitioned to another position within SoCalGas. Twenty percent of those employed in 2010 have left SoCalGas and 46 employees (4.5 percent) remain in the Meter Reading organization.

SoCalGas continues to encourage Meter Reading employees to explore all company opportunities outside of the Meter Reading organization.

Chapter 6 – Community Education and Outreach

SoCalGas personnel perform an array of outreach activities to inform customers about Advanced Meter project activity. SoCalGas developed a local stakeholder education and community outreach program to ensure every city and county SoCalGas serves is addressed. During the network construction process, outreach is done at the city level with initial city briefings to the city manager and staff including informational presentations to city councils as well as any other sub-committees as necessary. Outreach to the community includes, but is not limited to: one-on-one customer meetings, door knocking, and meetings with homeowner associations, community/neighborhood councils, community groups, and mailings. These efforts include briefing local elected officials, media outreach, community town hall events and local speaking engagements.

6.A Outreach Organizations and Events

To date, we have participated in over 3,080 events. In the time frame of January 1, 2016 through June 30, 2016, SoCalGas completed over 300 public outreach activities, including briefings, presentations, exhibit booths, door-to-door, public service announcements, etc.

Outreach efforts are complemented by a number of local organizations who simultaneously perform outreach activities under contract to SoCalGas. First quarter of 2016 was the last group of organizations brought on board to assist SoCalGas with outreach efforts. SoCalGas continued to partner with GeM Communications (GeM) to manage the solicitation and implementation for local organizations to perform community outreach on behalf of SoCalGas. GeM manages the request for proposal (RFP) process and contracts with community- and faith-based organizations (CBOs, FBOs), disability agencies, Chambers of Commerce, and business organizations that conduct outreach to sensitive communities and customers in specific Advanced Meter installation areas. As of June 2016, nearly 150 organizations have been contracted to support outreach activities for the project with seven active during the time period of this report. Due to the Advanced Meter project ramping down, SoCalGas will no longer be bringing on board organizations through this RFP process. Appendix D provides a list of organizations contracted through GeM.

Chapter 7 - Customer Awareness and Satisfaction

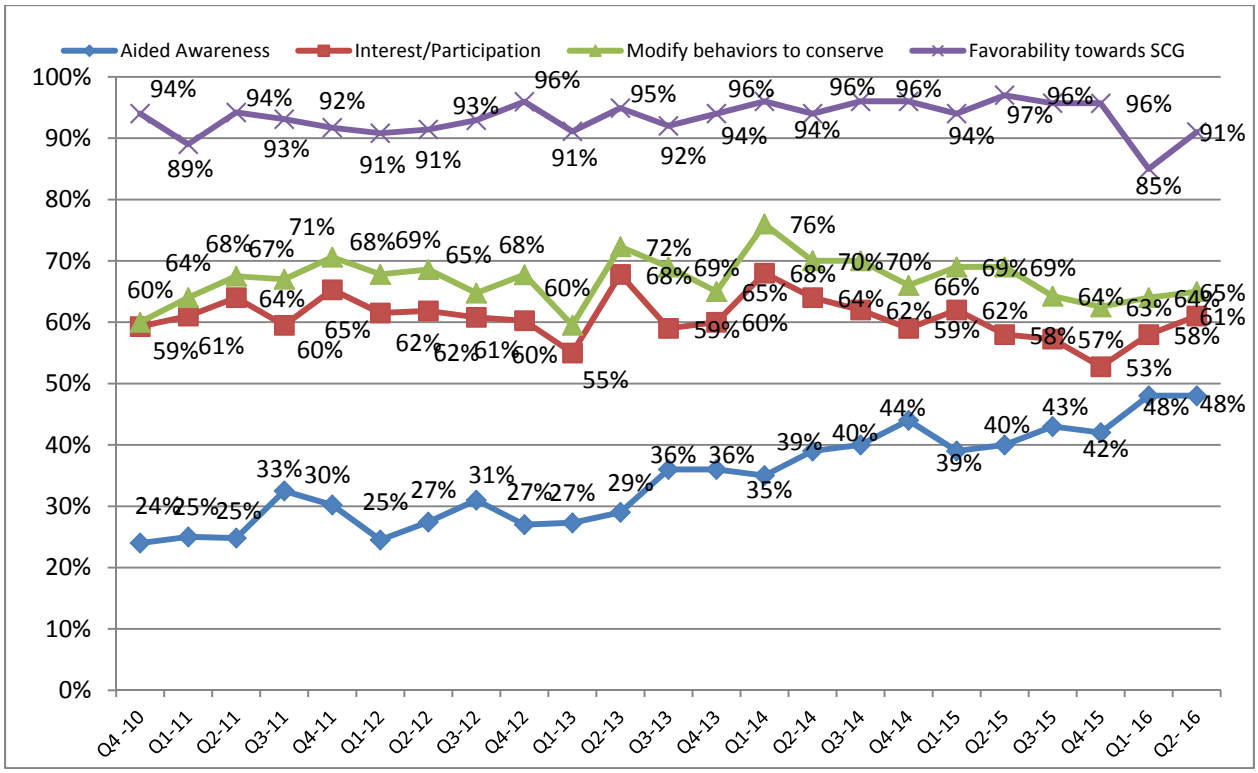
SoCalGas monitors the impact of its outreach activities in the areas of customer awareness and customer satisfaction as it relates to the Advanced Meter project. SoCalGas utilizes a variety of market research diagnostics to monitor the "pulse" of customers pertaining to the Advanced Meter installation process, customer communications, new programs and services, and customer attitudes and motivational drivers to behavioral change.

For purposes of monitoring overall customer awareness and perceptions, SoCalGas uses the Customer Insight Study ("CIS")[21] which is administered by Davis Research. CIS is SoCalGas' public opinion tracking study. It is a phone survey measuring residential (quarterly) and business (semiannually) customer opinion across several factors: favorability, price and value, safety, reliability and reputation. The survey is administered to a representative sample of SoCalGas' customer base, including customers for whom an Advanced Meter has not yet been installed.

Beginning in the fourth quarter of 2012, SoCalGas added three Advanced Meter related questions to the tracking survey. Figure 1 displays the CIS results for the general awareness questions about Advanced Meter for residential customers while Figure 2 displays the results for business customers.

[21] Formerly called iTracker Customer Perception Study.

Figure 1
Customer Insight Study – Residential Customers



Questions:
IM1. How would you rate SoCalGas overall on a scale of 1 to 7 where 1 means very unfavorable and 7 means very favorable?
AM1. Are you aware of a new gas meter that transmits natural gas usage information remotely and more frequently from the meter to SoCalGas?
AM2a. Having access to your daily natural gas usage (therms/dollars) information would make you interested in viewing it more than once a month? (% Agree)
AM2b. Having access to your daily natural gas usage (therms/dollars) information would cause you to modify your behaviors to conserve natural gas? (% Agree)

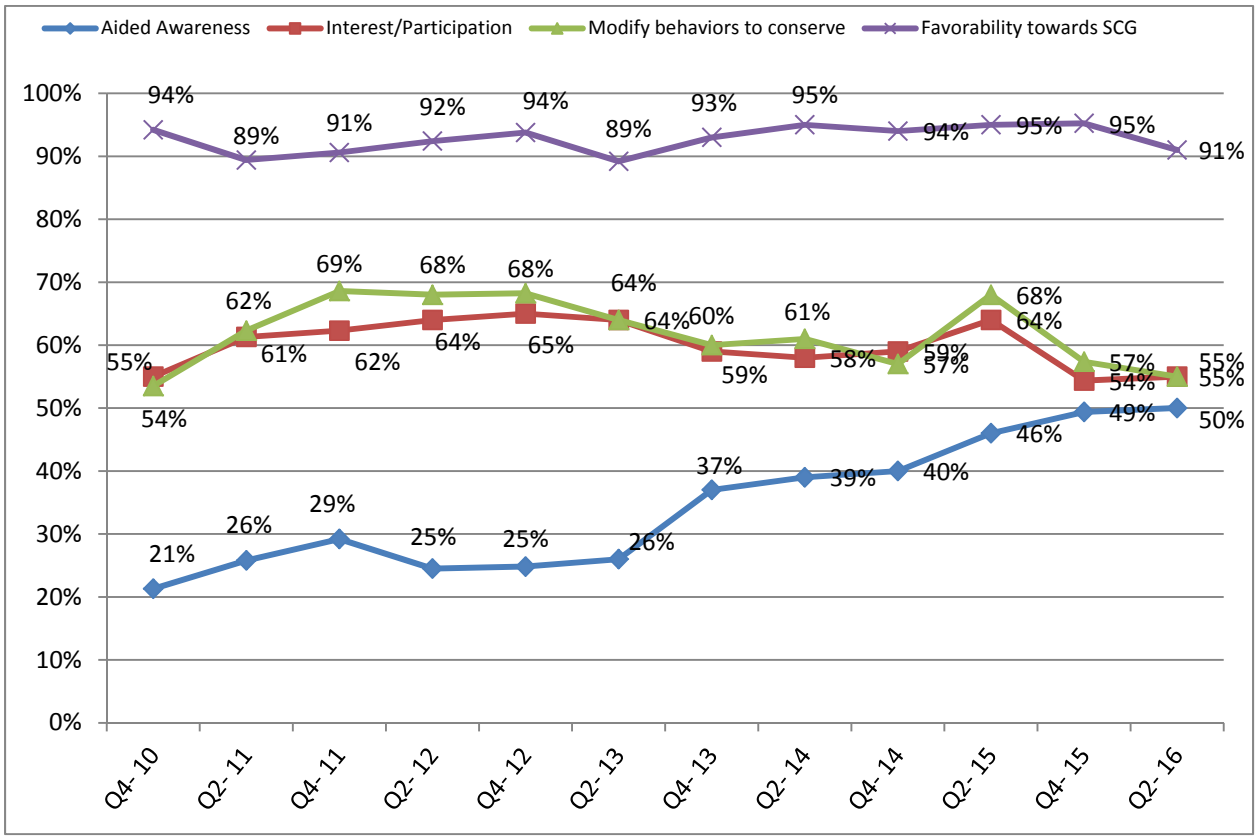
By Q2 2016 almost half of SoCalGas residential customers surveyed were aware of the Advanced Meter project. This 48 percent level of awareness is a new all-time high for CIS and represented a significant increase compared to Q4 2015. This general upward trend over the past several years seems to reflect the increased volume of customer communications about the project as well as an increase in installations. Of those customers who were aware of the project, 36 percent mentioned bill inserts or newsletters as their source, and 25 percent mentioned that a meter had been installed at their home.

Customer ratings for help answering billing questions and giving them information to control usage remained the highest rated motivators with 74% and 73% respectively. Customers' interest in viewing consumption data has been experiencing an upward trend for three straight

quarters from 53 percent in Q4 2015 to 61 percent in Q2 2016. Additionally, the interest in conserving natural gas has maintained constant levels for the past three quarters.

Figure 2

Customer Insight Study – Business Customers



Questions:

IM1. How would you rate SoCalGas overall on a scale of 1 to 7 where 1 means very unfavorable and 7 means very favorable?

AM1. Are you aware of a new gas meter that transmits natural gas usage information remotely and more frequently from the meter to SoCalGas?

AM2a. Having access to your daily natural gas usage (therms/dollars) information would make you interested in viewing it more than once a month? (% Agree)

AM2b. Having access to your daily natural gas usage (therms/dollars) information would cause you to modify your behaviors to conserve natural gas? (% Agree)

Advanced Meter awareness among business customers edged up to 50 percent in the second quarter of 2016, reaching its highest level to date. Despite the directional increase in awareness, business customers' interest in viewing the hourly consumption data has decreased to 55 percent after spiking to 64 percent Q2 2015. Similarly, intent to modify behaviors to conserve also experienced a directional decline to 55 percent, back to the levels seen prior to the Q2 2015 spike.

Chapter 8 – Elevated Customer Inquiries and Deferral/Opt-Out Program Enrollments

SoCalGas customers may inquire about the Advanced Meter project by contacting either the SoCalGas Customer Contact Center ("CCC") or the Advanced Meter Customer Information Center ("CIC"). The CCC addresses customer inquiries about any subject while the CIC typically makes appointment arrangements with customers to have their Advanced Meter installed. Advanced Meter "opt-out" requests are processed by the CCC.

Some customer inquiries were not routinely resolved and were escalated to Advanced Meter Customer Experience staff. There have been about 8,202 inquiries since the project's inception. The number of escalated customer inquiries is very low, considering the volume of Advanced Meter communications that have been distributed to SoCalGas customers. Through June 2016, over five million pre-installation letters were mailed to customers. The most common cause of the escalated inquiries is requests to defer/opt-out of the installation of the Advanced Meter communications module.

Although customers can call either the CCC or the CIC to have their deferral/opt-out requests recorded, some ask to speak to the Advanced Meter Customer Experience staff. Their questions usually revolve around safety and privacy concerns, as well as comments on the Advanced Meter Opt-Out Program fees.

Table 12 displays a breakdown of enrollment status for the Advanced Meter Opt-Out Program as of June 30, 2016.

Table 12
Advanced Meter Opt-Out Program Enrollment

Inquiry Type	Number Received	Explanation
Active customer-requested Opt-Out Program enrollments[22]	6,804	The number of customers actively enrolled and being billed for Opt-Out Program fees and charges.[23]
Active customers defaulted in to the Opt-Out Program	17,416	The number of customers that have been default enrolled[24] and are being billed for Opt-Out Program fees and charges.
Total Active Opt-Out Program enrollments	**24,220(0.4%)**	
Customer Opt-Out Program requests to "opt back in" to Advanced Meter installation	34,884	The number of customers that requested to be removed from the Opt-Out Program (includes customers in both an "Active" and "Pending Enrollment" Opt-Out Program status).

In March 2014, SoCalGas' Opt-Out Program became effective and the project team initiated efforts to inform employees of the Opt-Out Program and revised any impacted company communication materials. The interim opt-out fees approved by the Commission were consistent with those previously adopted for the other California Investor-Owned Utilities ("IOUs").[25] SoCalGas' Advanced Meter Opt-Out Program interim fees for residential customers were as follows:

- Non-CARE Customers: Initial fee of $75.00 and $10.00/month ongoing cost
- CARE Customers: Initial fee of $10.00 and $5.00/month ongoing cost

In December 2014, the Commission issued D.14-12-078 regarding the Smart Meter Opt-Out Phase 2 proceeding; this decision reiterated approval of the interim opt-out fees and charges

[22] "Active" includes only those customers who are enrolled in the Opt-Out Program and are currently being billed associated Opt-Out Program fees. Many customers in a "Pending" status, once presented with final communications regarding Opt-Out Program fees, elect to terminate their prior request for enrollment in the Opt-Out Program. Similarly, customers about to be default-enrolled due to repeated installation/access attempts sometimes contact SoCalGas to schedule an installation prior to being actively enrolled.
[23] SoCalGas implemented its Advanced Meter Opt-Out Program effective March 19, 2014, pursuant to D.14-02-019. These customers either requested to defer from an Advanced Meter module installation prior to March 19, 2014, or subsequent to March 19, 2014, requested to enroll in the Advanced Meter Opt-Out Program.
[24] These customers were defaulted (automatically enrolled) into the Opt-Out Program due to several unsuccessful attempts by SoCalGas to contact the customers to provide access for the installation of the Advanced Meter.
[25] D.12-02-014 (PG&E), D.12-04-018 (SCE), and D.12-04-019 (SDG&E).

and adopted them as permanent opt-out fees and charges for residential customers for each of the California IOUs.

In April 2015, pursuant to the Commission's Phase 1 and Phase 2 Opt-Out decisions, SoCalGas implemented modifications to its billing system to begin charging opt-out fees to Opt-Out Program participants, including customers who were defaulted into the program. Additionally, information regarding key new features introduced in the Phase 2 decision was incorporated into existing customer talking points and all relevant Advanced Meter customer and external communications materials.

SoCalGas still expects the total percentage of customers who will eventually opt-out to be within the planning assumption of 0.5 percent (0.4% as of June 2016).

Chapter 9 - Conservation Outreach Campaigns

D.10-04-027 set a goal for SoCalGas to reduce residential gas consumption by one percent and placed reporting requirements on SoCalGas which are referenced in the introduction to this report.[26]

In November 2015, SoCalGas initiated the third heating season campaign of a multi-year outreach campaign aimed at demonstrating how to best drive behavior change to reach the Advanced Meter one percent conservation goal. This campaign followed a "Test and Learn" approach and generally ran through March 2016.[27] The overall strategy for the 2015-2016 conservation campaign design was to incorporate lessons learned from the prior two heating season campaigns conducted in 2013-2014 and 2014-2015, with a goal towards increasing engagement levels in order to achieve behavioral change that would drive energy conservation of one percent or more. SoCalGas will continue to incorporate the lessons learned from each consecutive heating season campaign and adjust campaigns in future years to focus on the most promising customer segments and communication channels.

SoCalGas has continued to team with Nexant on several aspects of its conservation campaign implementations and post-campaign evaluations. The primary objectives were as follows:

1) Develop comprehensive conservation outreach plans incorporating a "Test and Learn" program development strategy with a focus on continuous assessment and improvement in the performance of feedback programs;
2) Perform evaluations of each year's conservation campaign results, as well as evaluating any continued conservation effects resulting from the prior years' campaigns; and
3) Provide recommendations and guidance for the next heating season's proposed "Test and Learn" plan, as well as associated follow-on evaluation of campaign results.

[26] This energy savings goal specifically refers to 1% of total *residential* gas usage.
[27] A few treatments tested also included year-round elements.

9.A Conservation Customer Engagement and Results

The major features of the 2015-2016 conservation campaign were:

- Given the cost-effectiveness of its delivery via electronic channels (email and text), a new, enhanced version of the default weekly "Bill Tracker Alert" (BTA) email featuring a more graphical data display was tested vs. the existing text and data-intensive version of the BTA email;
- Default BTAs with and without associated informational materials were tested in the same population to conclusively determine whether these costly supplemental materials are necessary for achieving significant reductions from BTAs;
- Innovative new behavioral methods that more fully leverage AM data were tested, including weather sensitivity-based reports ("Seasonal Energy Update" reports) and alerts targeted to customers identified through AM-enabled analytics as those with gas usage habits most sensitive to colder weather;
- The Opower Home Energy Report HER was tested on a new treatment population and with focused thermostat messaging and income-based segmentation with the goal of improving performance;
- Aclara HERs ("Home Energy Update") treatments from the 2014-2015 campaign were discontinued in their current form; a redesigned Aclara-facilitated HER campaign that builds on key lessons learned relative to the Aclara HER campaigns may be incorporated into the final 2016-2017 campaign;
- A Spanish language paper Opower HER and welcome materials were tested in lieu of the English language materials to customers in areas with high rates of Latino population who had indicated a Spanish language preference to determine whether providing English-only materials creates a language barrier for Spanish speakers; and
- Treatments continued to be tested with the top two usage quartiles of customers since they both produce measurable therm savings.

Of significance in this most recent campaign was that every one of the thirteen new conservation treatments tested produced statistically significant gas savings.[28]

As shown in Table 13, **these new treatments resulted in savings of over 1.4% total during the 2015-2016 fall/winter period.** This is an increase in savings vs. total first year savings rates for the successful[29] treatments tested in the two prior heating season campaigns, and shows continued progress towards the conservation goal.

[28] Four out of seven treatments tested during the 2014-2015 heating season campaign generated savings of about one percent total. Four out of eleven treatments tested during the 2013-2014 heating season campaign generated savings of about 1.3 percent.

[29] Successful treatments are comprised of the subset of treatments tested that were successful in producing statistically significant usage reductions.

Additional savings of nearly 1.7% were also realized for three of the treatments initially tested during the 2014-2015 campaign and repeated in the 2015-2016 campaign. Continued savings effects were also realized for a few treatments initially tested during the 2013-2014 campaign.

Table 13
Percent Reduction in Fall/Winter 2015-2016 Gas Usage
for Residential Conservation Treatments

Treatment	Percentage Reduction
13 New Treatments	1.42%
3 Repeated 2014-2015 Treatments	1.67%
Continued Effects from 2013-2014 Treatments	1.38%
Overall % Reduction	**1.48%**

Overall, the new and continued successful treatments produced gas savings of almost 1.5% during the 2015-2016 fall/winter period. The persistence and sustainability of these conservation results demonstrates the durability of conservation actions as outlined in Ordering Paragraph 5 included on page 4 of this Report.

Please refer to Appendix E, **"Evaluation of Southern California Gas Company's 2015-2016 Conservation Campaign, August 2016"** provided by Nexant for a comprehensive evaluation of the results of this conservation campaign, as well as recommendations for SoCalGas' 2016-2017 conservation "Test and Learn" campaign approach.

As outlined in the recommendations contained within Nexant's report, for the 2016-2017 conservation campaign, high performing program design options from the first three campaigns will be retained and enhanced. Additionally, new program design alternatives and segmentation approaches will be tested and re-tested. The goal is that, over the course of the Advanced Meter project, the most effective means for encouraging energy savings from information feedback will be identified and offered to customers. Underperforming customer segments have been excluded from the 2015-2016 campaign and going forward in order to allocate resources towards segments that have a higher propensity to change behavior and conserve energy.

Though some customers may be excluded from future targeted conservation campaigns, every SoCalGas customer receives a letter within 60 days of becoming Advanced Meter "Billing Ready" that outlines all the new energy information feedback options available to them enabled by an Advanced Meter. Customers who are "My Account" customer portal users also

receive an email and a notification message within the My Account portal highlighting the new functionality.

In addition to the conservation "Test and Learn" campaign treatments and outcomes described above, following is an update regarding related customer engagement metrics and indicators for the 2015-2016 customer conservation programs and associated Advanced Meter-enabled energy presentation and analysis tools.

9.B Conservation Campaign Update

9.B.1 Opower Home Energy Reports

As outlined above, given the success of Opower's Home Energy Reports in generating conservation savings in the prior two campaigns, SoCalGas contracted with Opower to implement numerous treatments for the 2015-2016 campaign. This included continuation into a second heating season for the three 2014-2015 Opower HER test cell treatments. Eight new test cells were also assigned to Opower HER treatments to test out variations of the HER approaches. These included further evaluation of their effectiveness for CARE and Non-CARE customers, for Spanish-language customers, and for alternative, Thermostat-focused messaging.

The Opower HER contains personalized usage information that is designed to help customers save energy and money. This report engages customers primarily through the "Neighbor Comparison" information. A customer's current gas usage is compared to approximately 100 nearby occupied homes with similar characteristics- such as square footage and heating system. These comparisons, along with personalized energy saving tips, can help customers understand how they can conserve natural gas.

A total of 587,157 paper HERs and 465,963 e-HERs (emailed HERs) have been sent from November 2015 through June 2016.

Table 14

Nov. 2015 - June 2016 New and Continuing Opower Home Energy Reports

Paper HERs	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Total
Continuing	72,545	59,579	57,962	57,350	0	0	0	0	247,436
New Treatments	107,740	82,562	75,943	73,476	0	0	0	0	339,721
Total Paper Report Sent	**180,285**	**142,141**	**133,905**	**130,826**	**0**	**0**	**0**	**0**	**587,157**
e-HERs									
Total eHERs Sent	**12,088**	**33,856**	**71,114**	**72,417**	**72,402**	**67,544**	**68,418**	**68,124**	**465,963**

As of June 30, 2016, 1,171 (0.6 percent) Opower HER program enrollees opted-out of receiving further Opower HERs during the current campaign. A total of 15,151 e-HERs have been opened from November 2015 through June 2016, an average of 1,894 per month. E-HERs delivered an average open rate of about 36.5% percent, and 3.0 percent of all e-HERs opened have resulted in click-through activity.

Customer acceptance of the Opower treatments remains strong as indicated by both the low opt-out rate for recipients of these reports, coupled with the findings of customer satisfaction research performed with a sampling of the recipients of the reports from the 2014-2015 campaign as reported in the August 2015 Report.

9.B.2 SoCalGas (Aclara-facilitated) "Seasonal Energy Update" Reports

As outlined in section 9.A, in the 2015-2016 campaign, SoCalGas tested innovative behavioral methods that more fully leverage AM data. In collaboration with Aclara, SoCalGas developed energy reports targeted to customers based on their individual weather sensitivity, called "Seasonal Energy Update" reports. The Seasonal Energy Update report campaign included paper reports and companion cold weather period alerts targeted to customers identified through AM-enabled analytics as those with gas usage habits most sensitive to colder weather.

Two test cells were assigned to these Aclara-facilitated treatments and include the following: Test Cell 1 customers received four paper reports, one Welcome Letter/Frequently Asked Questions, three Frequently Asked Questions inserts, one Repositionable Thermostat Setting Reminder Decal,[30] and three Cold Weather Email Alerts. Test Cell 2 customers received four paper reports, one Welcome Letter/Frequently Asked Questions, three Frequently Asked Questions Insert and one Repositionable Thermostat Setting Reminder Decal.

The Aclara-facilitated Seasonal Energy Update reports contained personalized usage information to help customers understand their home energy usage when temperatures get cold and to offer tips on how to save energy. Each monthly report provided three pieces of information: 1) Comparison to Neighbors during cold weather; 2) Normal Day vs Cold Day Usage Comparison; and 3) Savings Tips. Customers were also encouraged to lower their thermostat settings to 58 degrees when they're away and 68 degrees when they're at home.

A total of 168,212 paper Seasonal Energy Update reports were mailed and 51,963 Cold Weather Alert emails were sent from November 2015 through February 2016.

[30] Note: Some customers might have received the repositionable thermostat setting reminder decal twice. The decal was intended to go out in the December mailing, but due to some printing issues, not all customers received the decal in their mailing. In order to ensure that all customers received the decal, it was mailed in the January mailing as well.

Table 15
Aclara Home Energy Update Reports

	Nov	Dec	Jan	Feb
Paper Seasonal Energy Updates	42,619	42,535	41,849	41,209
Emailed Alerts	No Alert	17,713	17,356	16,894

As of June 30, 2016, 262 (0.61 percent) of program enrollees opted-out of receiving further Seasonal Energy Update reports. For the emailed alerts delivered November 2015 through February 2016, on average, 40 percent of the email alerts have been opened and one percent of all email alerts opened have resulted in click-through activity.

Customer acceptance of the Seasonal Energy Update report treatments was also strong as indicated by both the very low opt-out rate for recipients of these reports, coupled with the findings of customer satisfaction research performed with a sampling of the recipients of the reports from the 2015-2016 campaign as reported in Appendix E.

9.B.3 Bill Tracker Alerts Enrollment

SoCalGas Bill Tracker Alerts (BTAs) offer several key features to help customers maintain a high level of energy usage awareness and engagement with SoCalGas. They help customers maintain "top of mind" awareness of their natural gas consumption which is critical to creating the ongoing behavioral change necessary to achieve energy conservation.

Bill Tracker Alerts provide "Advanced Meter Billed" customers with the following information on a weekly basis and are sent alerts via email and/or mobile phone SMS text message:

- Bill-to-Date ($)
- Projected Next Bill ($)
- Last year, Same Month Bill Amount ($) [Seasonal comparison]
- Days Remaining in the Current Billing Cycle (#)
- Last Month's Bill Amount ($)*
- Days Elapsed in the Current Billing Cycle (#)*
- Choice of weekly email and/or SMS text messages

** provided via email only, due to 160 character text limitation*

As outlined in Section 9.A, given continued proven savings results coupled with the cost-effectiveness of BTA delivery via electronic channels (email and text), the SoCalGas 2015-2016 "Test and Learn" campaign treatments included continued testing of different BTA options and approaches. Treatments included testing the existing default (auto-enrolled) BTA, as well as a new, enhanced BTA. The new, enhanced version of the default weekly BTA email features a more graphical data display, vs. the existing text and data-intensive version of the BTA email.

The 2015-2016 campaign also incorporated testing the two versions of the BTAs with and without associated informational materials in the same population to conclusively determine whether these costly supplemental materials are necessary for achieving significant reductions from BTAs. Samples of both the current and enhanced weekly Bill Tracker Alert emails, as well as the associated supplemental paper and email communications, may be found in Appendix E.

Through June 30, 2016, 306,489 SoCalGas customers are actively enrolled in Bill Tracker Alerts (see Table 16 below, which provides cumulative enrollments-to-date). These enrollments support the Advanced Meter project conservation savings goal as well as SoCalGas' 2013-2016 Energy Efficiency behavior change program household participation goals.[31]

Table 16
SoCalGas Bill Tracker Alerts Enrollment

Item	Count through June 30, 2016
Total Subscriptions	**377,795**
Auto Enrollment	306,192
Microsite – Online @ billtracker.socalgas.com	13,516
Microsite – Business Response Cards	7,611
Microsite – Hard-to-Reach Events	724
My Account/CSR – "Manage Alerts"	49,752
Total Unsubscriptions[32]	**71,306**
By Customer (subscribed via Microsite/Auto Enrollment)	8,127
By Customer (subscribed via My Account)	1,995
By System (i.e., Account Closed)	61,184
Total Active Subscriptions	**306,489**

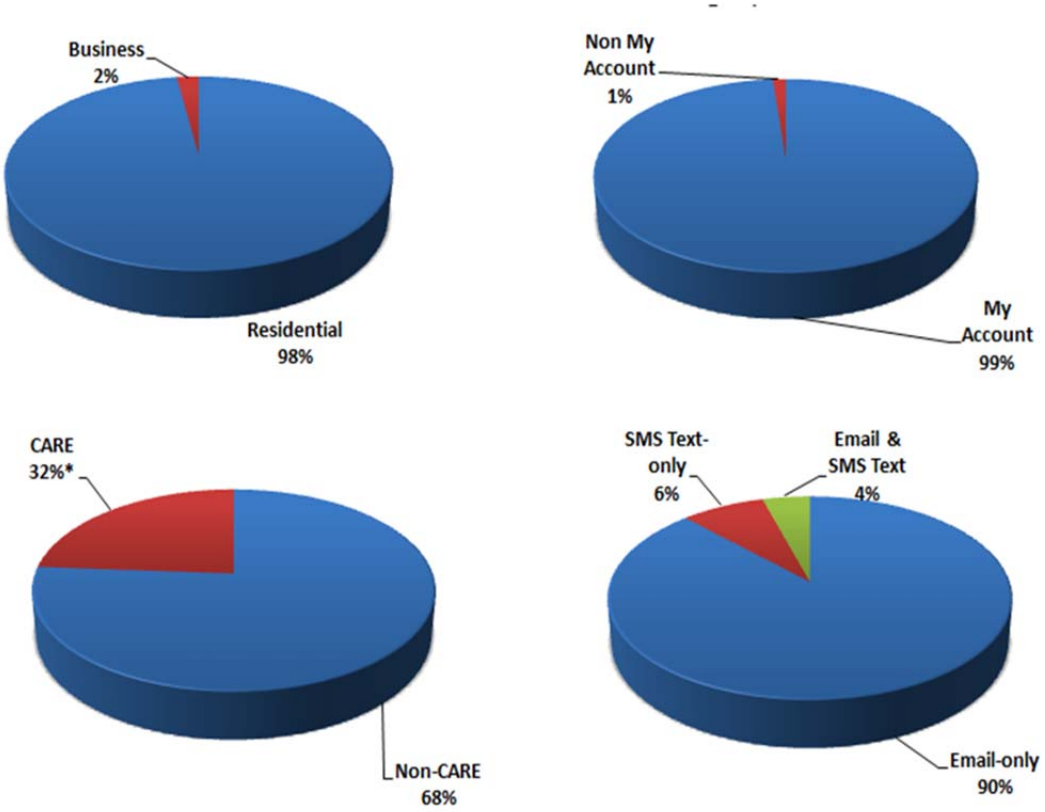
The BTAs retention rate continues to remain high at 81 percent. Eighty-five percent of the "unsubscribes" are due to system factors, such as customer account closures, which results in a customer-initiated unsubscribe rate of less than two percent since the program's inception.

[31] Pursuant to D.12-11-015, SoCalGas is also utilizing its Advanced Meter project to support its Energy Efficiency non-resource behavior goals, which contain a 5% behavioral target for residential households. This five percent behavioral target remains in place through current Energy Efficiency program cycles as outlined in D.14-10-046.
[32] The majority of cancelled subscriptions are system-related (e.g., Account closures); currently 2% are due to customers unsubscribing.

This is a strong indicator that customers value weekly email and/or SMS text messages that keep them apprised of their bill-to-date, projected next bill, last month's bill, last year's same month bill, and the number of days remaining in their current billing cycle.

Figure 3 displays some of the customer characteristics of customers enrolled in Bill Tracker Alerts as of June 30, 2016.

Figure 3
SoCalGas Bill Tracker Alert Characteristics as of June 30, 2016



* As of June 30, 2016, California Alternative Rates for Energy ("CARE") customers accounted for approximately 28.05% of percent of SoCalGas' residential customer base.

9.C My Account "Ways to Save" Tool Utilization

Another key indicator of enhanced customer engagement enabled or stimulated by Advanced Meter includes customer utilization of the SoCalGas.com, My Account-based "Ways to Save" online tools.

As described in prior Reports, SoCalGas has implemented energy presentation and analysis tools within its My Account customer portal, as well as within the SoCalGas Mobile App. Through June 30, 2016, a total of 442,794 residential My Account users (both new and returning users) have engaged with the Ways to Save tool "My Savings Plan" web page from

which users could view their personal energy use profile and initiate a savings plan, as well as navigate to view their hourly and daily gas usage and other energy usage and bill-related information.

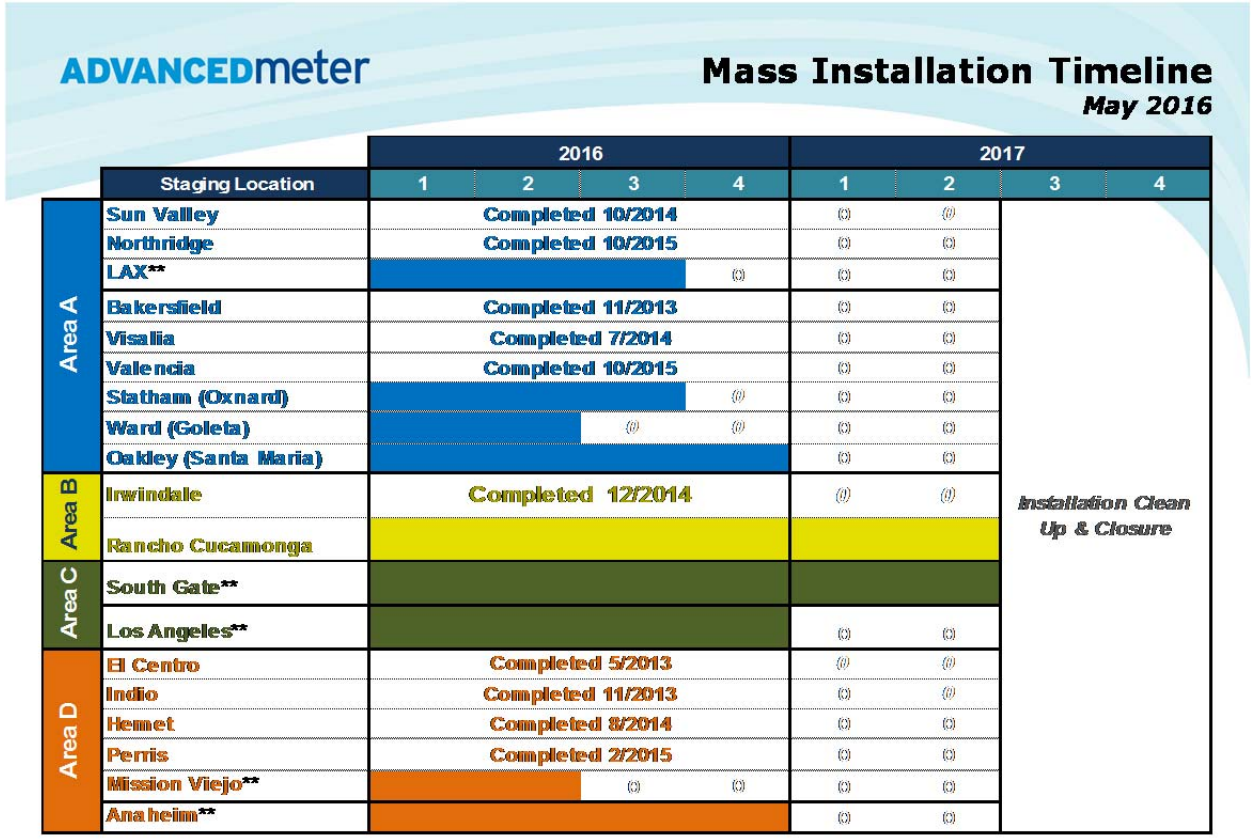
For further details regarding the Advanced Meter-enabled online energy information feedback options rolled out to customers, please refer to prior Reports.

Appendices

Appendix A - Mass Install Timeline

This timeline represents above ground installation work only. Warehouses assigned to perform curb meter work may require extensions.

Note: Planned warehouse closure dates are subject to change. Advanced Meter deployment will continue into 2017. Warehouse closures may be modified based on project close activities including transition to regular operations and workforce availability amongst Mass Installation and other SoCalGas personnel to perform remaining installations.



** This timeline represents Above Ground Installation work only. Curb assigned warehouses may require warehouse extension.

Appendix B - List of Cities and Counties with Fully Installed DCUs

Adelanto	Diamond Bar	Lake Elsinore	Rosemead
Arroyo Grande	Dinuba	Lake Forest	San Bernardino
Azusa	Duarte	Lakewood	San Bernardino County
Baldwin Park	Eastvale	Lancaster	San Dimas
Banning	El Centro	Lawndale	San Gabriel
Beaumont	El Segundo	Lemoore	San Jacinto
Bell Gardens	Fillmore	Loma Linda	San Luis Obispo
Beverly Hills	Fontana	Lomita	Santa Fe Springs
Blythe	Fresno County	Lompoc	Santa Maria
Bradbury	Gardena	Los Alamitos	Santa Monica
Brawley	Goleta	Lynwood	Seal Beach
Brea	Grand Terrace	Manhattan Beach	Shafter
Buellton	Grover Beach	Menifee	Simi Valley
Buena Park	Guadalupe	Mission Viejo	Solvang
Calexico	Hanford	Monrovia	South Gate
California City	Hemet	Montclair	South Pasadena
Calimesa	Hermosa Beach	Montebello	Taft
Calipatria	Highland	Moorpark	Temecula
Camarillo	Holtville	Moreno Valley	Torrance
Carpinteria	Imperial	Murrieta	Tulare
Carson	Imperial County	Norco	Tulare County
Cathedral City	Indian Wells	Palm Springs	Tustin
Cerritos	Indio	Palmdale	Twentynine Palms
Chino	Industry	Paramount	Upland
Chino Hills	Irwindale	Paso Robles	Ventura
Claremont	Jurupa Valley	Perris	Vernon
Coachella	Kern County	Pismo Beach	Villa Park
Colton	Kings County	Placentia	Visalia
Commerce	La Canada Flintridge	Pomona	Walnut
Compton	La Habra	Port Hueneme	Wasco
Corcoran	La Habra Heights	Porterville	West Covina
Corona	La Mirada	Rancho Cucamonga	Westminster
Costa Mesa	La Palma	Rancho Mirage	Westmorland
Covina	La Puente	Redlands	Wildomar
Cudahy	La Quinta	Reedley	Yorba Linda
Culver City	La Verne	Rialto	Yucaipa
Delano	Laguna Hills	Riverside County	Yucca Valley
Desert Hot Springs	Laguna Niguel	Rolling Hills Estates	

Appendix C - List of Cities and Counties that are no longer Fully Installed due to increased number of sites needed for Network Optimization

Agoura Hills
Alhambra
Aliso Viejo
Artesia
Bakersfield
Bell
Burbank
Cypress
El Monte
Fountain Valley
Garden Grove
Hawaiian Gardens
Maywood
Norwalk
Ontario
Pico Rivera
San Fernando
South El Monte
Stanton
West Hollywood

Appendix D – Community Based Organizations, Business Organizations and Chambers

Active January 1 – June 30, 2016

Caregivers

El Centrito Learning Centers

Manna Conejo Valley Food Distribution Center

Mixteco/Indigena Community Organizing Project (MICOP)

Ojai Chamber of Commerce

United Way of Ventura

Ventura Chamber of Commerce

Appendix E - Evaluation of Southern California Gas Company's 2015-2016 Conservation Campaign, August 2016
Prepared by Nexant

REPORT



Evaluation of Southern California Gas Company's 2015–2016 Conservation Campaign

August 31, 2016

Prepared for
Southern California Gas Company

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1 Executive Summary

Southern California Gas Company (SoCalGas®) began deploying "Advanced Meters"[1] (AM) in its service territory in late 2012, pursuant to California Public Utilities Commission (CPUC) Decision (D.)10-04-027. These meters are capable of providing enhanced information services that can help customers better manage and control their energy costs. By rigorously evaluating these types of information services, SoCalGas can demonstrate how to meet its 1% energy savings goal that is associated with its AM rollout.[2] Each year of the AM rollout, SoCalGas implements a Conservation Campaign that is designed to test various enhanced information programs. This document summarizes the evaluation of the third Conservation Campaign, which primarily ran from November 2015 through March 2016.[3] This document also includes results on continuation and persistence of energy savings from the first and second Campaigns that occurred during the same time period the previous two years.

Unlike the first two campaigns, the 2015–2016 Conservation Campaign (third Campaign) tested three information feedback options—Bill Tracker Alerts (BTAs), Seasonal Energy Updates (SEUs), and Home Energy Reports (HERs). These three information feedback options were chosen because they have the potential to reach large numbers of customers and demonstrate how to meet the 1% energy savings goal in a cost-effective manner. SEUs were introduced for the first time in the third Campaign. They were designed by SoCalGas specifically for customers with natural gas usage that is highly weather sensitive, which means that their usage increases substantially under cold weather conditions. This information feedback option leveraged AM data to target the most weather sensitive customers and also to present cold day usage patterns to customers.

Table 1-1 summarizes the estimated natural gas savings for the 2015–2016 SoCalGas Conservation Campaign. As with the first two Campaigns, energy savings for the third Campaign were found to be in line with the 1% savings goal. Overall, the new and continued treatments produced gas savings of over 1.46 million therms, or almost 1.5% during the fall / winter period (November 2015 to March 2016) for the subset of treatments tested that were successful in producing statistically significant usage reductions.[4] Of these 1.46 million therm savings, nearly 972,000 therms were conserved as a result of the new treatments for the 2015–2016 Conservation Campaign, also representing a savings of nearly 1.5%.

Roughly 402,000 therms of energy savings conserved from November 2015 to March 2016 were the result of continued effects of the treatments in the 2014–2015 Conservation Campaign (second Campaign). The continuation of the effects of these treatments over spring and

[1] The Advanced Meter infrastructure consists of two primary components—a meter transmission unit (communications module) attached to SoCalGas meters and a communications network consisting of data collection units installed across the SoCalGas service territory.

[2] This energy savings goal specifically refers to 1% of total residential gas usage.

[3] A few programs included a year-round email element that continued after March 2016.

[4] Gas savings are only calculated for the treatments that produced statistically significant usage reductions, which includes the default BTA and the Opower Paper & Email HER from the 2013–2014 Conservation Campaign, the three Opower treatments from the 2014–2015 Conservation Campaign, and all the treatments from the 2015–2016 Conservation Campaign.

summer 2015 (April through October) were also evaluated and found to be about 93,000 therms.

Roughly 91,000 therms of energy savings conserved from November 2015 to March 2016 were the result of continued effects of the treatments in the 2013–2014 Conservation Campaign (first Campaign). The first Campaign treatments did not produce measurable savings over spring and summer 2015 (April through October). In all, the effects of the new 2015–2016 treatments and the continued effects of the 2014–2015 and 2013–2014 treatments resulted in savings of about 1.5 million therms over the 12 month period from April 2015 to March 2016.

Table 1-1: Estimated Gas Savings for the 2015–2016 SoCalGas Conservation Campaign

Initial Treat-ment Year	Treatment	Group	Number of Treatment Customers	% Reduction	Aggregate Therms Saved (Nov-Mar)
2015-2016	Opower Email HER (1 paper HER +12 eHER)	T-16	13,086	0.86%	35,853
	Opower Email Thermostat HER (1 paper HER +12 eHER)	T-19	13,094	1.28%	53,364
	Paper & Email SEU (4 paper reports + Email alerts)	T-24	17,877	3.04%[5]	174,125
	Old BTA, w/supplemental materials	T-26	19,069	0.70%	42,602
	Old BTA, w/o supplemental materials	T-27	19,032	0.49%	30,416
	New BTA, w/supplemental materials	T-28	19,035	1.04%	59,864
	New BTA, w/o supplemental materials	T-29	19,062	0.86%	52,159
	Opower Paper-only HER (4 paper HER)	T-17	13,364	1.50%	62,422
	Opower Paper-only Thermostat HER (4 paper HER)	T-20	13,342	1.32%	56,253
	Paper-only SEU (4 paper reports)	T-25	23,494	3.08%[5]	225,147
	Opower Paper & Email CARE HER (4 paper HER + 12 eHER)	T-15	13,082	1.01%	38,220
	Opower Paper & Email Thermostat CARE HER (ESAP & Non-ESAP) (4 paper HER + 12 eHER)	T-18	26,205	1.53%	116,069
	Opower Spanish Paper-only HER (4 paper HER)	T-21	13,319	0.82%	25,187
Overall for 2015-2016 treatments (fall / winter)			**223,061**	**1.42%**	**971,680**
2014-2015	Opower Email HER (1 paper HER +12 eHER)	T-8	11,964	0.96%	38,479
	Opower Paper & Email HER (4 paper + 12 eHER)	T-10	12,000	1.38%	57,428
	Opower Paper-only HER (4 paper reports)	T-13	47,910	1.86%	306,621
Overall for 2014-2015 treatments (fall / winter)			**71,874**	**1.67%**	**402,529**
2013-2014	Opower Email HER (1 paper HER + 4 eHER)	T-3	9,167	1.59%	37,016
	Default BTA w/supplemental materials	T-4	18,461	1.28%	54,284
Overall for 2013-2014 treatments (fall / winter)			**27,628**	**1.38%**	**91,300**
Overall for November 2015-March 2016			**322,563**	**1.48%**	**1,465,508**
2014-2015	Opower Paper & Email HER (4 paper + 12 eHER)	T-10	12,367	1.35%	28,172
	Opower Paper-only HER (4 paper reports)	T-13	48,915	0.77%	64,571
Overall for 2014-2015 treatments (spring / summer)			**61,282**	**0.84%**	**92,743**
Overall for April 2015-October 2015			**61,282**	**0.84%**	**92,743**
Overall for April 2015-March 2016			**383,845**	**1.42%**	**1,558,251**

[5] This result is not directly comparable to the other results because the treatment population was selected differently than the rest of the treatments. The SEU treatment was only tested on the top 25% most weather sensitive customers.

1.1 Key Research Questions and Lessons Learned

Lessons learned from the first and second Campaigns were incorporated into the program designs tested during the third Campaign, with the goal of answering six key research questions related to cost-effectiveness for information feedback programs. Table 1-2 summarizes the key research questions explored in the 2015–2016 Conservation Campaign as well as the findings identified.

Table 1-2: Key Research Questions and Lessons Learned from the 2015–2016 Conservation Campaign

Key Research Question	Key Lessons Learned
How do energy savings vary for the Old vs. New version of the BTA?	The New BTA performs better than the Old BTA. The percent savings for both the New BTA with supplemental promotional materials and the New BTA without promotional materials were higher than both of the Old BTAs that were tested. The New BTA featured a more graphical design to convey information vs. the Old BTA, which was more text-based.
For the BTA treatments, does the addition of promotional materials to the treatment increase energy savings?	Although the BTA treatments with promotional materials produced slightly higher gas savings than the BTA treatments without those materials, the difference was not statistically significant. Given that sending printed promotional materials in the mail is relatively costly, it may not be cost-effective to send these materials in future BTA rollouts. However, the difference in savings for customers with and without promotional materials may become larger over time, so these treatments from the third Campaign will continue to be compared beyond March 2016 to reach a more definitive conclusion.
How do customers identified as highly weather sensitive respond to the SEU treatment?	The SEU treatment produced the highest percent reductions out of any of the treatments in the third Campaign. Both the Paper & Email SEU and the Paper SEU produced a savings rate of over 3%. However, this treatment was only delivered to the top 25% most weather sensitive customers sampled, so these findings are not directly comparable to the other treatments that were delivered to all sampled customers.
How do Opower Thermostat HERs compare to the standard Opower HERs?	The Thermostat HERs differed from the standard Opower HER in that they featured thermostat-focused messaging, including how to set the thermostat when a customer is away or at home. The Thermostat HERs produced savings rates above 1.2% for each of the three treatments. As a group, the Thermostat HERs performed slightly better than the standard HERs. When comparing the three different types (Email, Paper-only, Paper and Email) individually, only the difference between the Thermostat and Standard version of the Paper and Email HERs is statistically significant.

Key Research Question	Key Lessons Learned
How do CARE customers respond to treatment compared to Non-CARE customers?	In the third Campaign, CARE customers were segmented into their own treatment groups that were separate from the Non-CARE customers in the population. The two treatments tested in the CARE population were the Opower Paper and Email HER and the Opower Paper and Email Thermostat HER.[6] Both treatments produced comparable results to the Non-CARE customers. The Opower Paper and Email HER produced a percent reduction of 1% while the Opower Paper and Email Thermostat HER produced a percent reduction of 1.5%. However, there is not a direct comparison in the Non-CARE population as these exact treatments were not tested in the Non-CARE population.
Does the Opower Spanish Paper-only HER treatment produce comparable energy savings to the Opower [English] Paper-only HER?	Hispanic ethnicity customers (based on census block data) in the third Campaign receiving the Spanish HERs were those identified as preferring Spanish communications over English. This treatment produced a savings rate of 0.82% during the 2015–2016 winter. This was the lowest savings rate of any of the Opower HER treatments tested in the third Campaign. Furthermore, when compared against the Opower Paper-only [English] HER tested in the Third Campaign, the savings from the Spanish HER are lower than the Opower Paper-only HER. The Opower Paper-only HER was tested on a population that was selected for English language treatments (based on census block data) and customers that were Non-My Account customers.

1.2 Proposed 2016–2017 Conservation "Test & Learn" Plan

Throughout the AM rollout until the end of 2017, SoCalGas is implementing a cycle of innovation in which continuous assessment and improvement in the performance of feedback programs is the primary objective. This is referred to as the "test and learn" process, which is consistent with what the CPUC envisioned in D.10-04-027. The lessons learned from each testing cycle are a direct input to this process and will inform the research design for the 2016–2017 Conservation Campaign.

A fundamental tenant of the "test and learn" process is to continuously improve toward more cost-effective solutions. Therefore, to test ways of improving cost-effectiveness, the 2016-2017 Conservation Campaign may adjust the program offerings as follows:

- Continue to track savings for all customers receiving BTAs. Monitor any change in savings that occur once all customers currently receiving the Old BTA are transitioned to receiving the New BTA;

[6] The monthly Email HER was only sent to those CARE customers within the treatment group registered for SoCalGas' My Account customer portal and with a valid email address

- Continue to explore ways to improve the BTA, as it has proven to be one of the most cost effective treatments for My Account customers. Test a new enhanced version of the New BTA with an additional view of usage patterns based on market research findings;
- Test the New BTA with and without seasonal savings tips in the same population to determine whether these tips increase savings;
- Explore how SEUs perform on CARE customers;
- Test new weatherization focused SEU on Non-CARE customers;
- Compare the Paper SEU treatments against the Opower Paper-only HER by ensuring that both treatments are tested on comparable populations;
- Retest Aclara Paper HERs;
- Develop an in-house paper HER to test against Aclara and Opower paper HERs;
- Test a combination of two different information feedback options, BTA with tips and Opower Paper HER, to see if there are incremental savings relative to other populations that only received the BTA treatment;
- Potentially test the impact of providing a Bilingual English-Spanish language paper HER and welcome materials in lieu of the either a single language English or Spanish HER for customers in areas with high rates of Latino population or to customers indicating a Spanish language preference. Test whether a self-comparison is more effective on this population than the neighborhood comparison used previously in the Spanish and English HERs;
- Continue to test treatments with the top two usage quartiles since they both produce measurable therm savings; and
- Test the BTA on Small and Medium Business (SMB) customers.

2 Introduction

SoCalGas began deploying AM in its service territory in late 2012. According to its meter deployment plan, AM will be fully deployed to SoCalGas' approximately 6 million customers by the end of 2017. These meters are capable of providing enhanced information services that can help customers better manage and control their energy costs. By rigorously evaluating these types of information services, SoCalGas can develop cost effective information feedback programs designed to meet its 1% energy savings goal that is associated with its AM rollout.[7] Each year of the AM rollout, SoCalGas is conducting a Conservation Campaign that is designed to test various enhanced information programs, primarily during the heating season from November through March.[8] In approving SoCalGas' AM application in D.10-04-027, the CPUC directed SoCalGas "to establish a system to track and attribute the conservation impacts of its AM rollout" and to report the measured savings every six months. This document is the third of the biannual reports to include impact results of the Conservation Campaign, which was implemented as outlined in prior semiannual reports.

2.1 Research Objectives and Design

This report addresses the following primary objectives:

- Meet the requirements of D.10-04-027 to track and attribute the conservation impacts of the AM rollout and to report measured savings every six months; and
- Help demonstrate how SoCalGas can achieve its 1% energy savings goal in a cost-effective manner.

Meeting the first objective requires a rigorous research strategy that conclusively determines whether or not information feedback provided by SoCalGas through various programs caused changes in gas usage. Usage varies significantly across months, seasons, and years. As a result, comparing usage before and after customers receive information treatments is not a suitable approach to estimating conservation effects. Instead, impacts must be estimated by comparing usage for two groups of customers that are identical except for the fact that one group receives information feedback (the treatment group) and the other does not (the control group).

Meeting the second objective requires adherence to a "test and learn" strategy that quickly identifies the marketing strategies and service options that are most cost-effective for achieving energy savings through information services. This strategy was envisioned by D.10-04-027, which stated, "we expect that customer outreach, education and communications will continue to evolve and improve as SoCalGas conducts customer research, monitors customer reaction to new AM technology and various customer usage presentation tools, and incorporates feedback from these activities into its AM outreach and education activities."

[7] This energy savings goal specifically refers to 1% of total *residential* gas usage.

[8] Some treatments, such as the alert component of the default BTAs and the email HER component of the Opower treatments from the second and third Campaigns, are continued into the spring and summer months.

2.2 Overview of Information Services Tested

Unlike the previous two campaigns, the 2015–2016 Campaign tested three information feedback options—Bill Tracker Alerts (BTAs), Home Energy Reports (HERs), and Seasonal Energy Updates (SEUs). These three information feedback options were chosen because they have the potential to reach large numbers of customers and demonstrate how to cost effectively meet the 1% energy savings goal. As outlined in sections 2 and 2.1, variations to the segmentation, targeting, and messaging for each of these information feedback approaches were refined based on the findings and associated learnings from the 2013–2014 and 2014-2015 campaigns.

2.2.1 Home Energy Reports

As in the previous two campaigns, the 2015–2016 Campaign tested the standard Opower HERs, but this year two new variations of Opower HERs were also tested. These included a new thermostat-focused HER as well as a Spanish language HER. In the third Campaign, approximately 41,250 customers received standard Opower HERs, 55,000 received Opower Thermostat HERs, and 13,750 received Spanish Opower HERs throughout the fall/winter months. All customers receiving HERs were defaulted onto the service and received HERs either through direct mail, email, or a combination of direct mail and email (with varying frequencies of each in the different treatments tested). In addition to displaying comparisons of households' natural gas consumption with that of neighbors, and other self-comparative information, the HERs provided tips on how to reduce gas consumption.

Table 2-1 summarizes the features and timeline of the residential HER treatments that Opower began implementing in November 2015. In total, approximately 110,000 customers were sampled for HER treatments, split between the different types of Opower HERs. Of the 110,000 customers sampled for Opower HERs, one-quarter (27,500) were split evenly between the Email HER and the Thermostat Email HER for My Account customers;[9] one-fourth (27,500) were split evenly between the Paper HER and the Thermostat Paper HER for Non-My Account customers; one-eighth were sampled for the Opower Spanish HERs for Spanish Preference customers; and the remaining 41,250 were split between the Paper & Email HER (13,750) and the Paper & Email Thermostat HER (27,500) for CARE customers.[9] 18,656 of the "ESAP-eligible" CARE customers receiving the Paper & Email Thermostat HER received reports containing tips that encouraged Energy Savings Assistance Program (ESAP) participation.

Treatment Schedule

All treatments began around the second week of November 2015 with an initial paper HER and welcome insert. The Paper-only and Paper & Email HER then included another three monthly paper HERs sent via direct mail between December 2015 and February 2016.[10] In addition, the Paper & Email HER treatment and the Email HER treatment included a total of 12 monthly HERs sent via email. This treatment schedule was slightly different from the treatment schedules in previous two campaigns.

[9] Targeted treatment cell sizes were grossed up initially during the research design phase to account for naturally occurring attrition over the campaign period due to customer account closures.

[10] Certain test cells did not receive a paper report in December due to data issues and received a report in March to account for the missing report.

Table 2-1: Features and Timeline of Residential Opower HER Treatments (November 2015 through November 2016)

		Opower HERs					
		Nov	Dec	Jan	Feb	Mar	Apr-Nov
Paper-only	Paper HER	✓	✓	✓	✓		
	Welcome Insert	✓					
	Door Hanger		✓				
	Email HER						
Email	Paper HER	✓					
	Welcome Insert	✓					
	Door Hanger	✓					
	Email HER		✓	✓	✓	✓	✓
Paper & Email	Paper HER	✓	✓	✓	✓		
	Welcome Insert	✓					
	Door Hanger		✓				
	Email HER		✓	✓	✓	✓	✓

Opower Standard HER treatment overview

Figure 2-1 and Figure 2-2 provide examples of the front and back sides of the Opower paper HER sent in November (additional HER materials are shown in Appendix A). These paper HERs were similar but not identical from month to month. They featured the following four sections that were for the most part consistently shown in each monthly report:

- Previous winter's natural gas usage (in initial HER) or previous month's gas usage compared with usage by similar neighbors, including an emoticon rating;
- Historical monthly gas usage compared with usage by similar neighbors (except January);
- Neighbor efficiency rank (except the initial November HER); and
- Personalized energy-saving tips.

In addition, the “Warm home. Cool savings.” module with visual conservation tips (shown in Figure 2-1) was included in the introductory November HER and a prior year comparison of personal usage from the current month was included in the January HER.

Figure 2-1: Opower Paper November HER Example (Front)

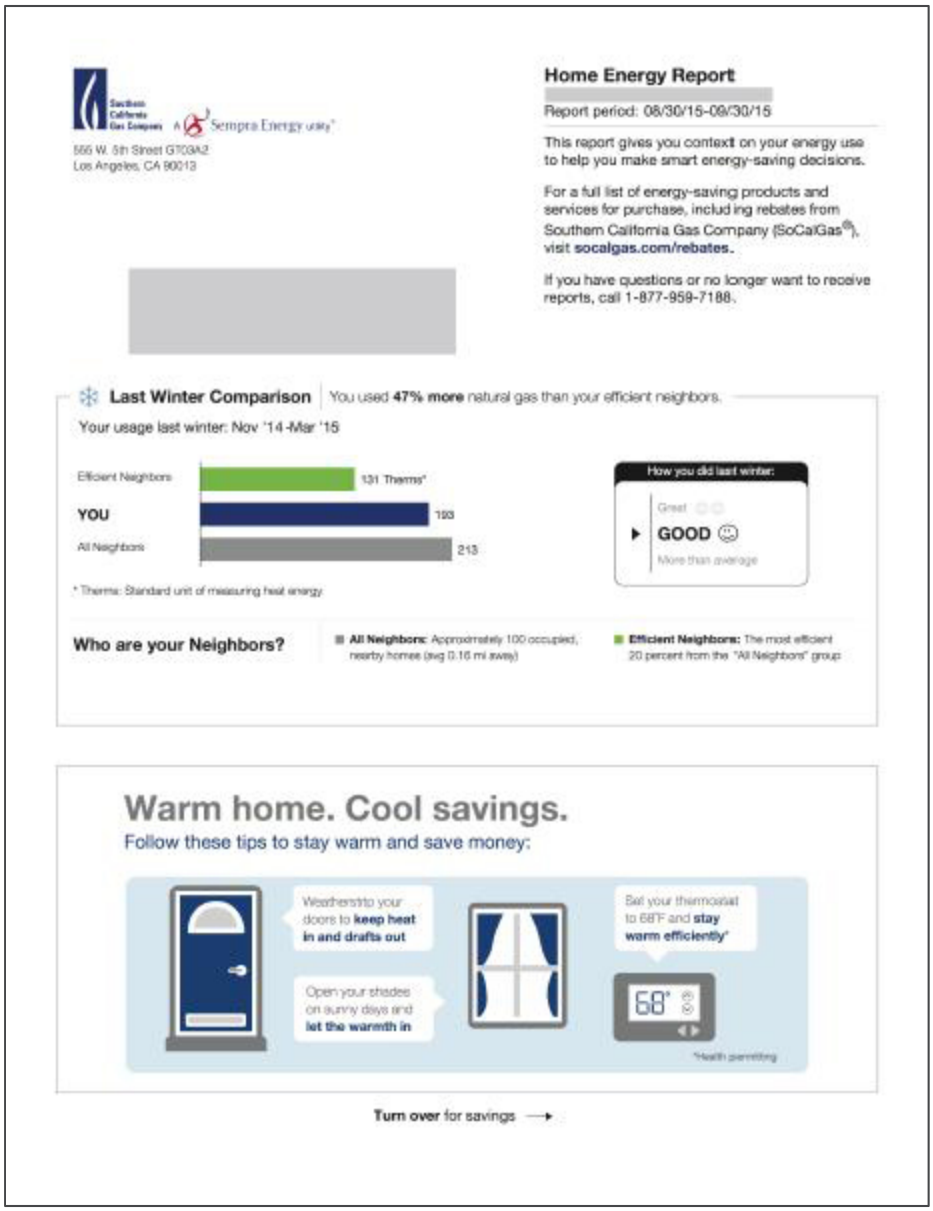


Figure 2-2: Opower November Paper HER Example (Back)

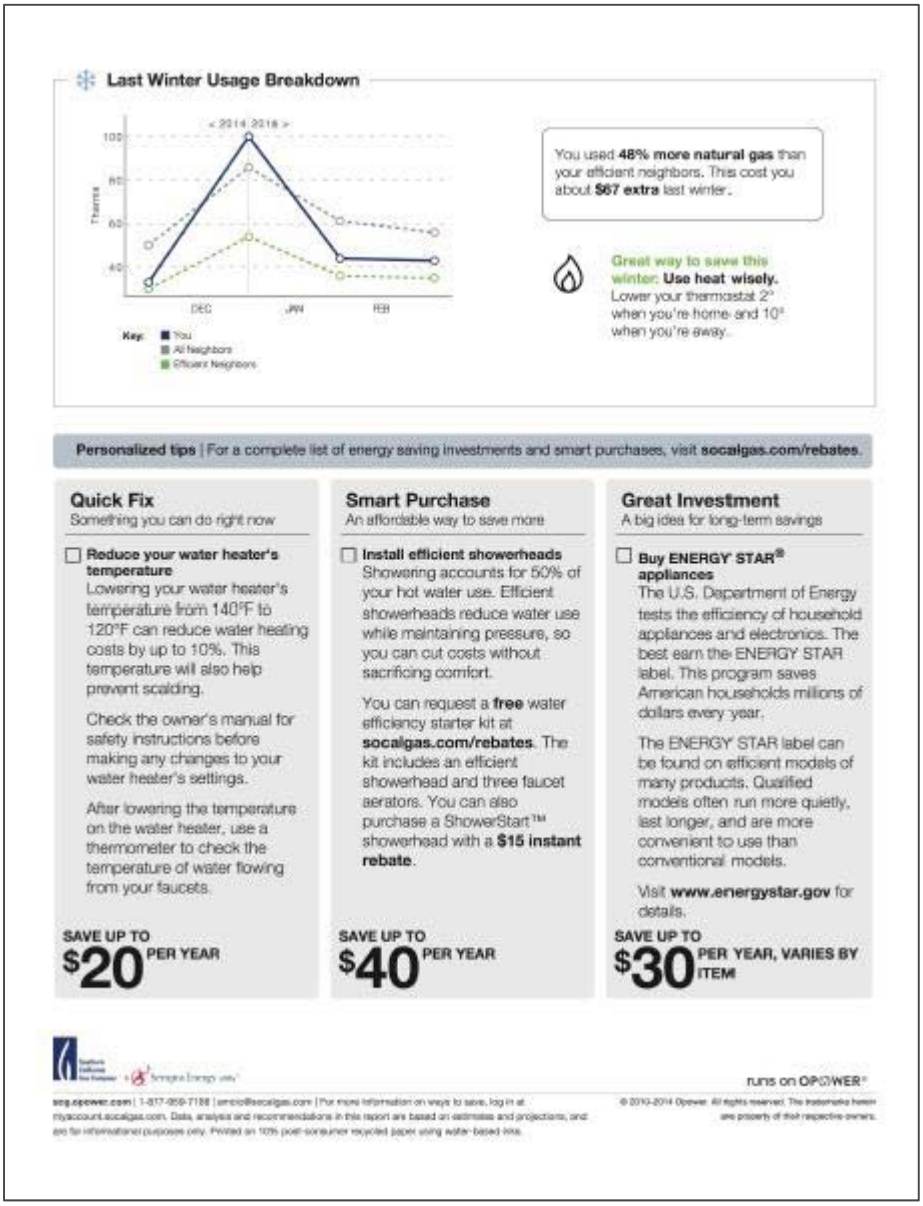
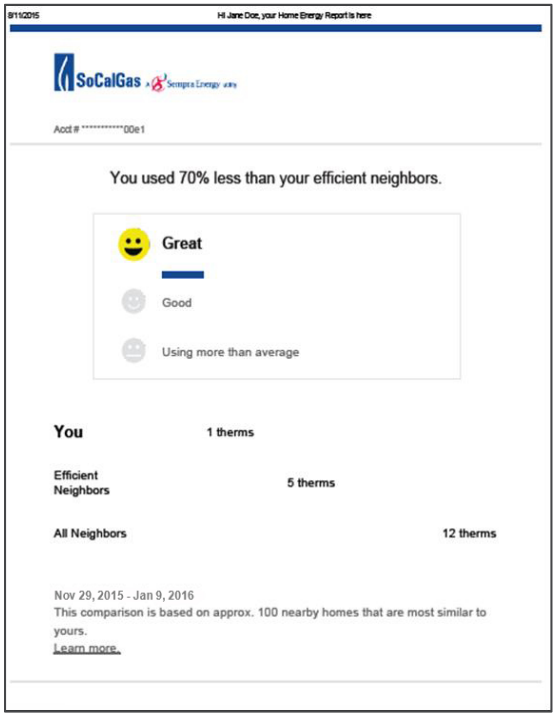
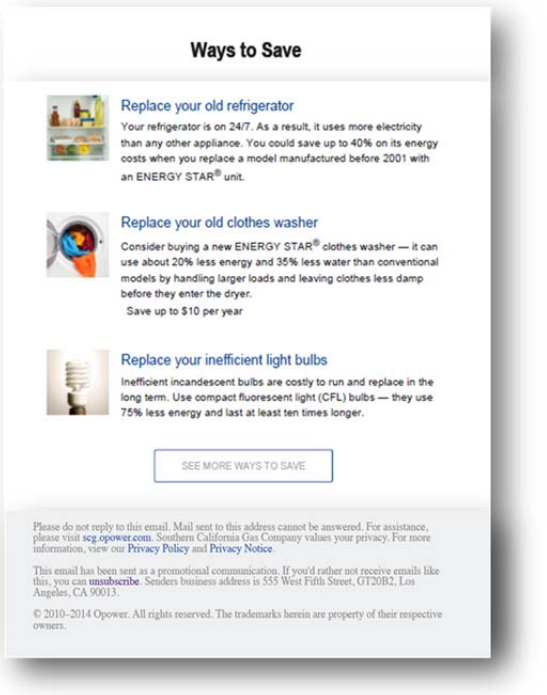


Figure 2-3 provides an example of the Opower email HER that was sent starting in December. The email HER was simpler than the paper HER and included just one main section—previous month's/winter's natural gas usage compared with similar neighbors—followed by several conservation tips. This comparison section is similar to the first section of the paper HER and was consistently shown in each monthly report. Examples of both HERs and the remaining materials that Opower sent—the welcome insert and the door hanger—are provided in Appendix A.

Figure 2-3: Opower Email HER Example, December and Subsequent Months





Opower Thermostat HER treatment overview

Figure 2-4 provides an example of the front side of the Thermostat paper HER (all additional materials can be found in Appendix B). These paper HERs were similar but not identical from month to month. Similar to the standard HER, the Thermostat paper HERs featured the following four sections that were for the most part consistently shown in each monthly report:

- Previous winter's natural gas usage (in initial HER) or previous month's gas usage compared with usage by similar neighbors, including an emoticon rating;
- Historical monthly gas usage compared with usage by similar neighbors (except January);
- Neighbor efficiency rank (except the initial November HER); and
- Personalized energy-saving tips.

In addition to the features contained in the standard HER, the thermostat HER included thermostat-focused messaging and tips. The bottom half of each paper HER includes a

motivating message and how to set the thermostat when customers are home and when they are away. This message encouraged customers to set their thermostat to 68 degrees when they are home and 58 degrees when they are away. The back sides of the paper thermostat HERs were identical to the back sides of the standard paper HERs.

Figure 2-4: Opower Paper Thermostat HER Example (Front)

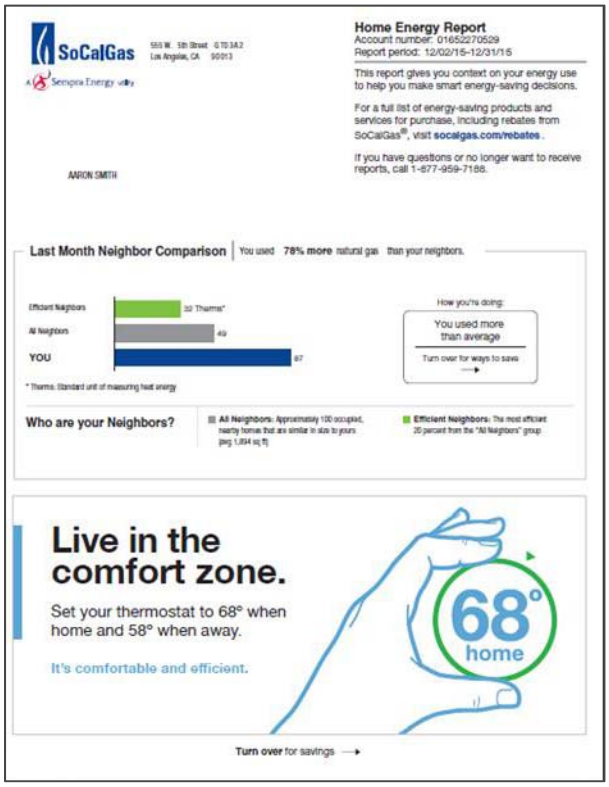
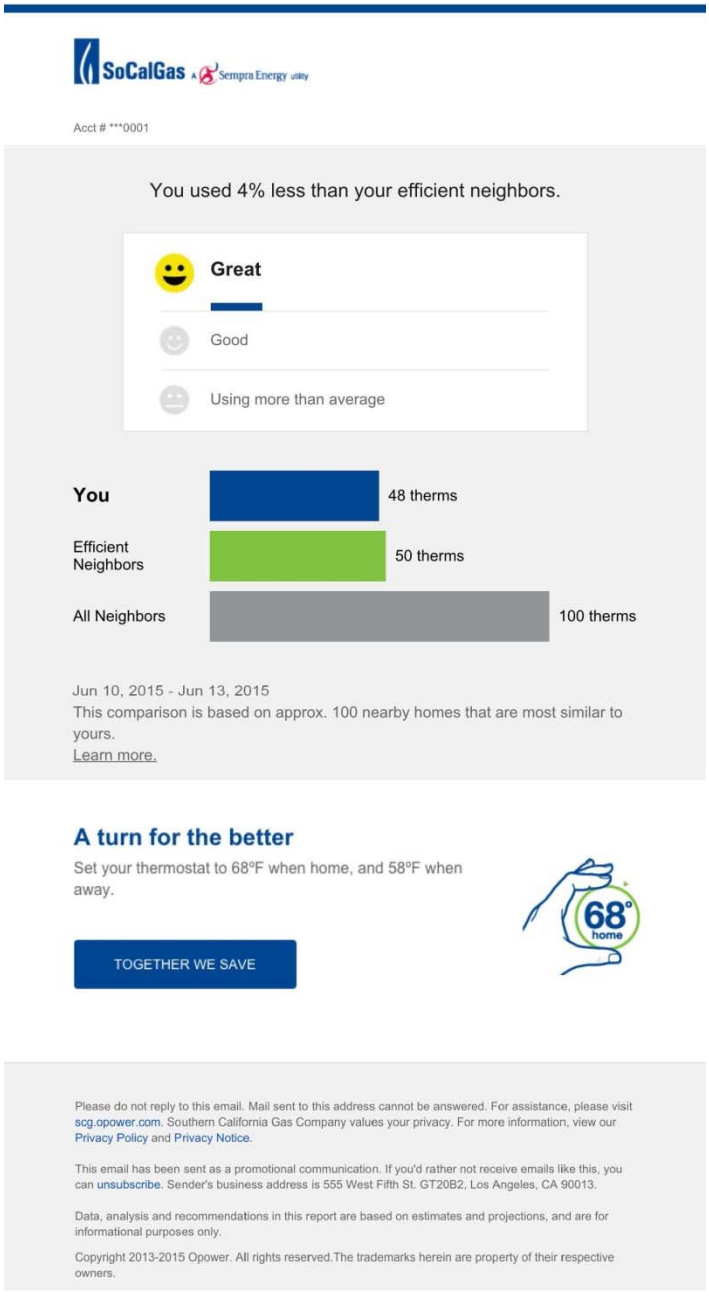


Figure 2-5 provides an example of the Opower email Thermostat HER. The email Thermostat HER included one additional section compared to the standard email HER. This section was almost identical to thermostat messaging contained on the bottom half of the paper Thermostat HER. Examples of both HERs and the remaining materials that Opower sent—the welcome insert and the door hanger—are provided in Appendix B.

Figure 2-5: Opower Email Thermostat HER Example



Opower Spanish HER treatment overview

Figure 2-6 and Figure 2-7 provide an example of the front and back sides of the Spanish paper HER sent in November (all additional materials can be found in Appendix C). The Spanish HERs were only sent in paper form (there were no email Spanish HERs). These paper HERs were similar but not identical from month to month. The Spanish paper HERs contain the same content as the standard Paper HERs except that text is written in Spanish. The Spanish paper HERs featured the following four sections that were for the most part consistently shown in each monthly report:

- Previous winter's natural gas usage (in initial HER) or previous month's gas usage compared with usage by similar neighbors, including an emoticon rating;
- Historical monthly gas usage compared with usage by similar neighbors (except January);
- Neighbor efficiency rank (except the initial November HER); and
- Personalized energy-saving tips.

Figure 2-6: Opower November Spanish Paper HER Example (Front)

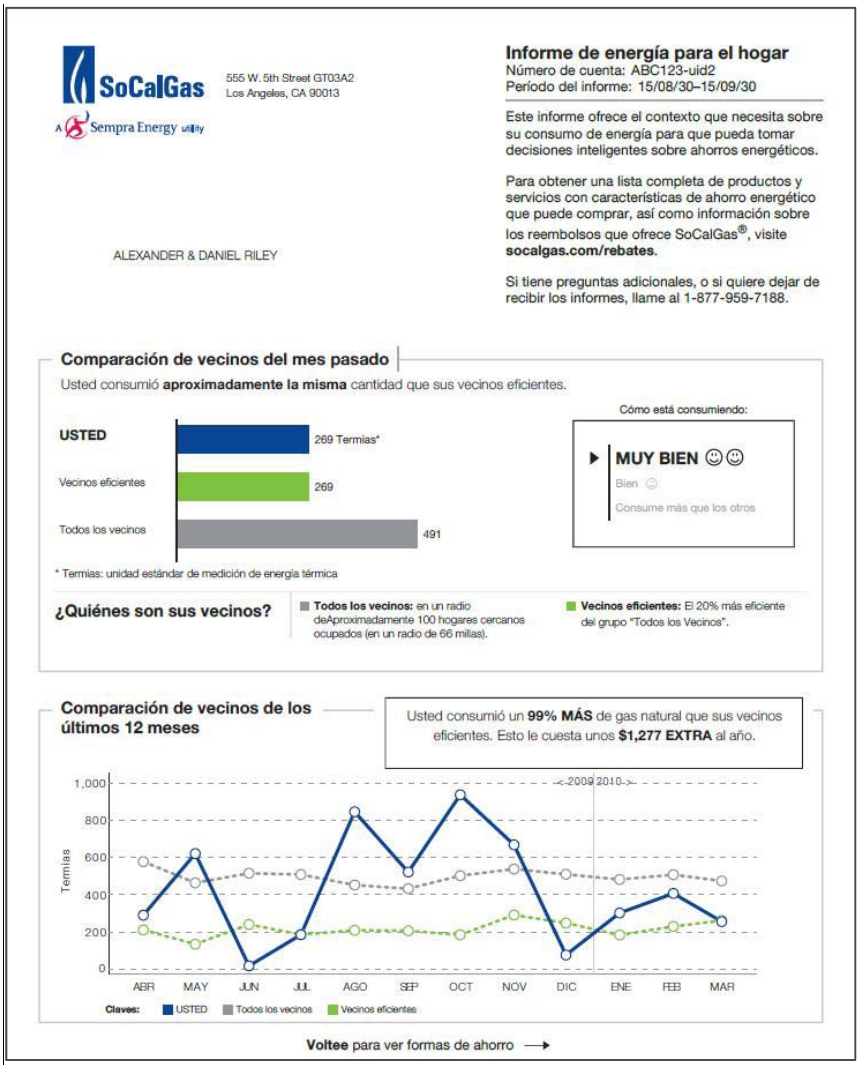
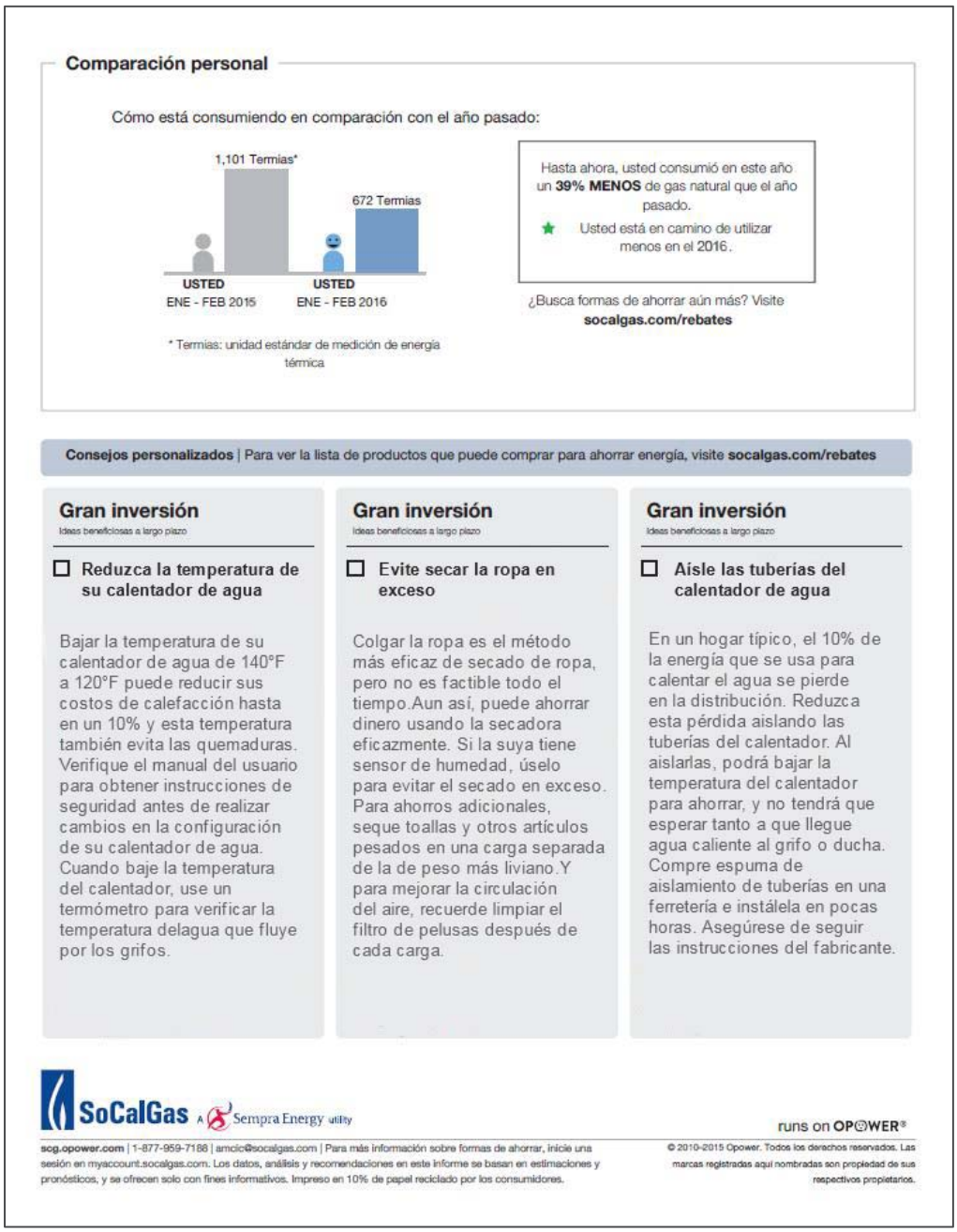


Figure 2-7: Opower November Spanish Paper HER Example (Back)



2.2.2 Bill Tracker Alerts (BTA)

BTAs are weekly reports developed and provided by SoCalGas to customers by email and/or text message. The reports describe the cost of the natural gas that customers have consumed since receiving their last bill. BTAs also provide a forecast of what a customer's gas bill will be at the end of the billing period if they continue to consume gas at the same rate. Customers are not able to set specific goals for daily or weekly gas consumption. BTAs are designed to raise customers' awareness of the amount of gas they are using and its impact on their bill.

The BTA service was tested on an opt-in and default enrollment basis for residential and small/medium business (SMB) customers in the first Campaign (2013–2014). This service was also initially accompanied by a welcome letter and three monthly informational letters with various supporting materials sent via direct mail[11] and email.[12] All BTA customers from the first Campaign who did not opt out or otherwise choose to discontinue the BTA service continued to receive BTAs throughout year two but no longer received the additional informational materials. However, in 2014–2015 SoCalGas decided to forgo the supplemental direct mail and email communications that accompanied the BTAs in 2013–2014. This reduction in communications was meant to test whether comparable energy savings could be achieved without these additional communications, thereby improving cost-effectiveness.

In the second Campaign (2014–2015), enrollment in weekly BTAs was expanded to an additional 55,346 residential My Account customers on a default enrollment basis only.[13] These default BTA customers received an initial Welcome email followed by the weekly email BTA notifications, which included a link to SoCalGas.com My Account-based *Ways to Save* online tools.

In the third Campaign (2015–2016), SoCalGas introduced a new, graphically enhanced version of the BTA email. Enrollment in weekly BTAs was split into four different treatment groups, including a total of approximately 80,000 residential My Account customers enrolled on a default basis only. The 80,000 customers were evenly split between four different treatment categories: Old BTA with supplemental promotional materials; Old BTA without promotional materials; New BTA with supplemental promotional materials; and New BTA without promotional materials. The New BTA email featured a more graphic and less text based design. This treatment design was meant to test which version of the BTA produced the most energy savings and whether the addition of promotional materials to the BTAs produced additional energy savings.

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[11] A Welcome letter was sent in October; a letter with "3 Easy Ways to Save" insert was sent in November; a letter with a "Winter Savings Checklist" in January; and a letter with links to My Account *Ways to Save* in February. These materials were sent to all BTA participants in the first Campaign, both default and opt-in.

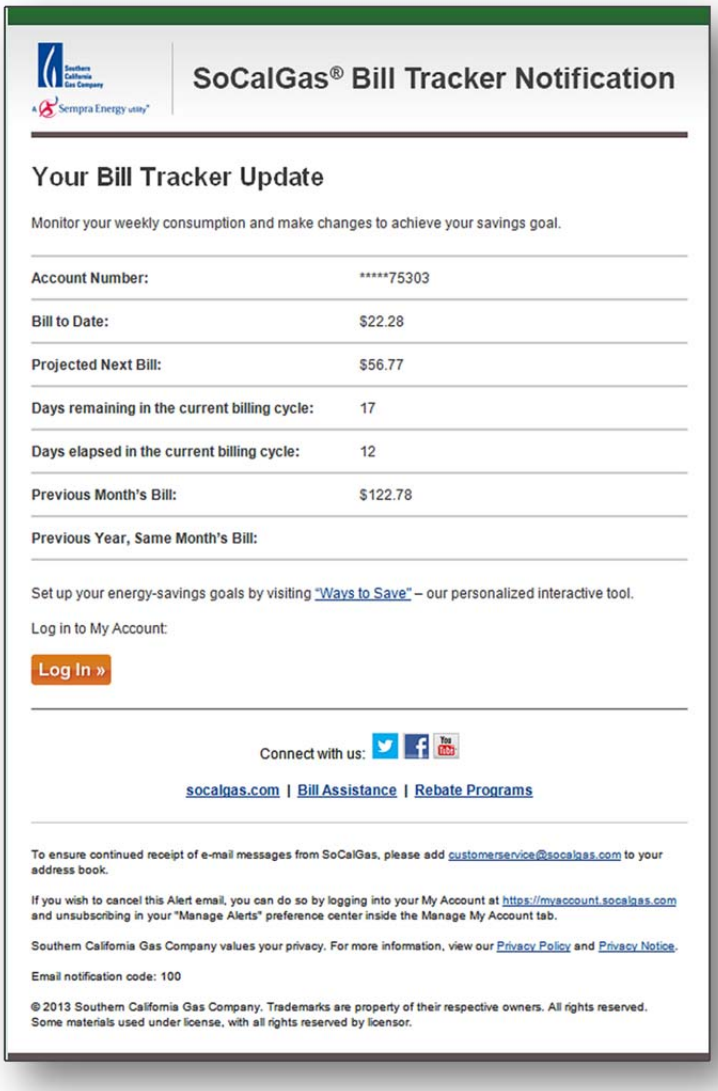
[12] A Welcome email was sent in October (to default customers only); an email titled "Save More This Winter" including links to My Account *Ways to Save* was sent in November; an email titled "How much more can you save" including links to My Account *Ways to Save* was sent in January; an email titled "Tools and Tips to help you save energy and money" including links to My Account *Ways to Save* was sent in February; and an email titled "Helping you save more" including links to My Account *Ways to Save* was sent in March.

[13] Of these 55,346 accounts selected for default enrollment into BTAs, 1,229 were suppressed from receiving BTAs because the accounts were in a collections status due to payments significantly past due. It is SoCalGas' procedure to not send BTAs to accounts undergoing collections activity.

Figure 2-8 shows the template for the Old BTA email notification, which was identical to the notification template used in the first and second Campaigns. The email BTAs feature the following information:

- Bill amount ($) to date;
- Projected amount ($) for next bill;
- Days remaining and days elapsed in the current bill cycle;
- Last month's bill amount ($);
- Bill amount ($) for same month in the prior year; and
- Links to the SoCalGas *Ways to Save* tool and rebate programs.

Figure 2-8: Template for SoCalGas Old BTA Email Notification



SoCalGas® Bill Tracker Notification

Your Bill Tracker Update

Monitor your weekly consumption and make changes to achieve your savings goal.

Account Number:	*****75303
Bill to Date:	$22.28
Projected Next Bill:	$56.77
Days remaining in the current billing cycle:	17
Days elapsed in the current billing cycle:	12
Previous Month's Bill:	$122.78
Previous Year, Same Month's Bill:	

Set up your energy-savings goals by visiting "Ways to Save" – our personalized interactive tool.

Log in to My Account:

Log In »

Connect with us:

socalgas.com | Bill Assistance | Rebate Programs

To ensure continued receipt of e-mail messages from SoCalGas, please add customerservice@socalgas.com to your address book.

If you wish to cancel this Alert email, you can do so by logging into your My Account at https://myaccount.socalgas.com and unsubscribing in your "Manage Alerts" preference center inside the Manage My Account tab.

Southern California Gas Company values your privacy. For more information, view our Privacy Policy and Privacy Notice.

Email notification code: 100

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Figure 2-9 shows the template for the New BTA email notification. The New BTA emails featured the following information along with several graphic representations of these numbers:

- Bill amount ($) to date;
- Projected amount ($) for next bill;
- Days remaining and days elapsed in the current bill cycle;
- Last month's bill amount ($);
- Bill amount ($) for same month in the prior year; and
- Links to the SoCalGas *Ways to Save* tool and rebate programs.

Figure 2-9: Template for SoCalGas New BTA Email Notification

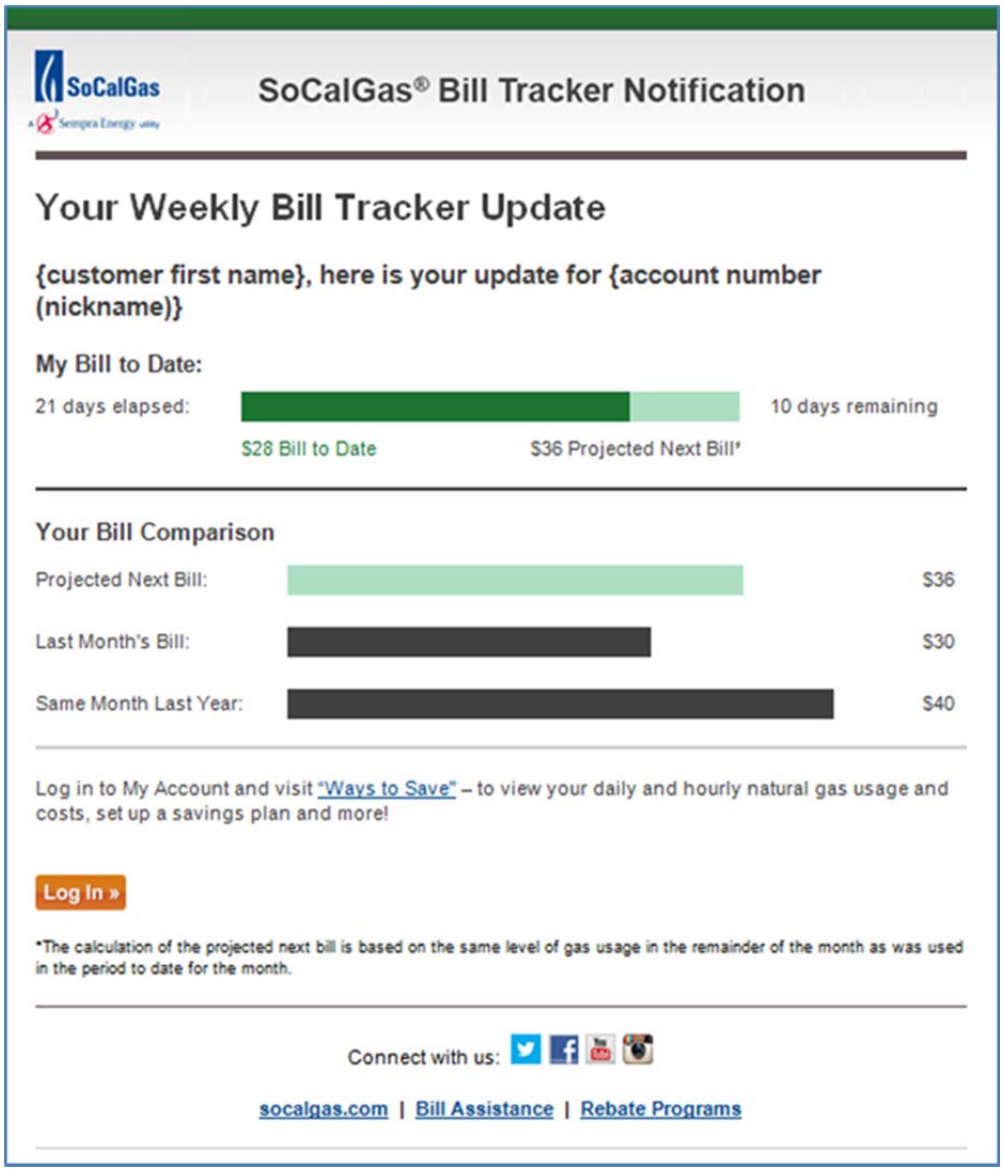


Figure 2-10 provides an example of a text message BTA notification, which is similar to the email BTA notification. However, due to limits on the number of characters that can be included in a single text message, links to the *Ways to Save* tool and rebate programs were not provided in the text message BTAs.

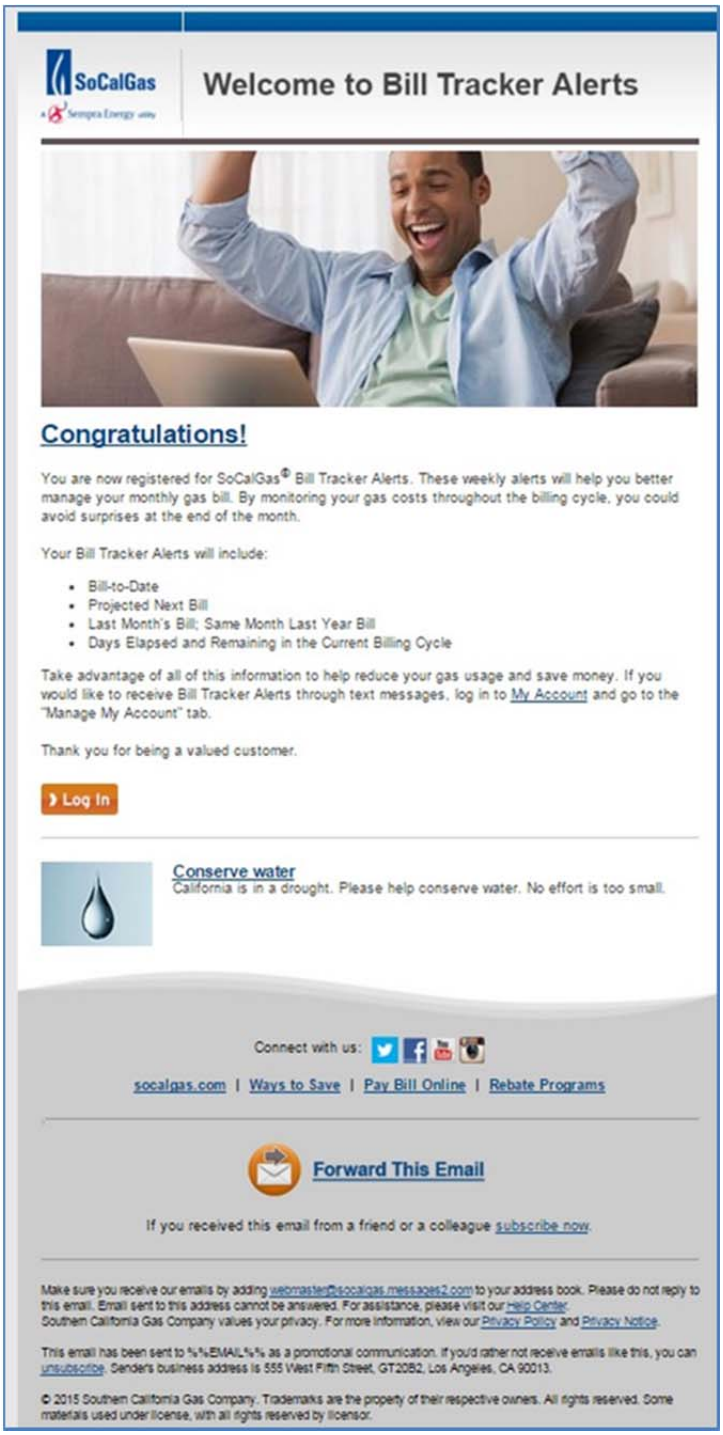
Figure 2-10: Example SoCalGas Text Message BTA Notification



Communications Sent to Default BTA Customers

In mid-October 2015, approximately 80,000 residential customers were defaulted onto BTA and started automatically receiving BTAs through their primary My Account email address (non-My Account customers could not be defaulted onto BTA because SoCalGas does not have their email address). The default customers could also log into My Account and change their notification preferences to receive BTAs through text message, but the vast majority remained with the BTAs through email alone. In addition to the 15 or more weekly BTAs that these customers received throughout the 2015–2016 Conservation Campaign, SoCalGas sent a Welcome email as shown in Figure 2-11.

Figure 2-11: SoCalGas – November Bill Tracker Alert Welcome Email



Supplemental Promotional Materials Sent to Customers

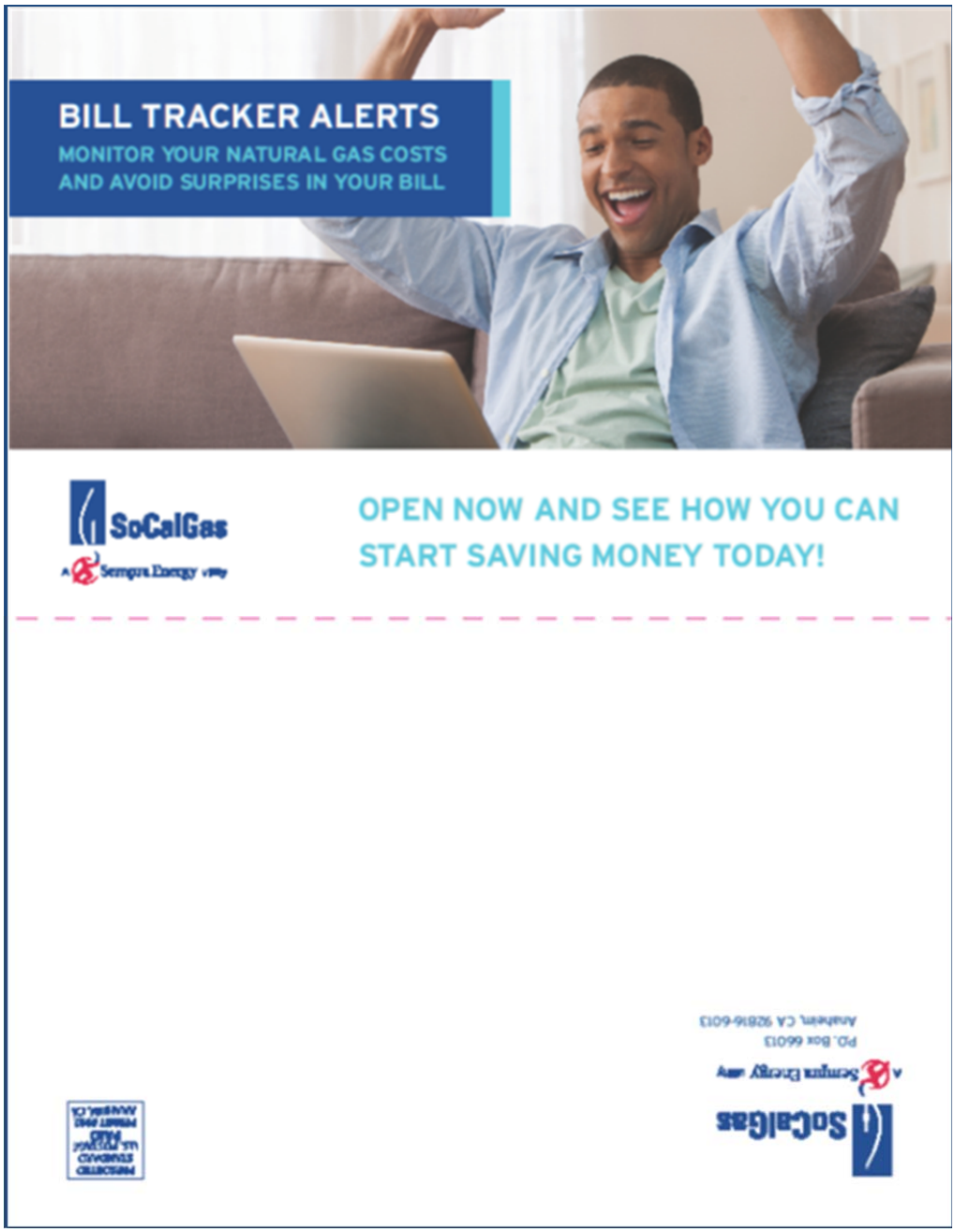
Two of the four BTA treatments tested in the Third Campaign included supplemental promotional materials customers received through email or direct mail in addition to the BTAs. The supplemental materials helped to introduce customers to the BTAs and provide additional information encouraging customers to access energy analysis tools within the My Account

website. The November supplemental mailer can be seen in Figure 2-12 and Figure 2-13. Content in the supplemental materials varied slightly from month to month. (All additional materials can be found in Appendix D.)

Figure 2-12: SoCalGas – November Bill Tracker Alert Supplemental Mailer (inside)



Figure 2-13: SoCalGas – November Bill Tracker Alert Mailer (outside)



2.2.3 Seasonal Energy Updates (SEU)

SEUs are monthly energy reports that were developed based on data analytics provided by SoCalGas and implementation facilitated by Aclara. These reports are targeted to customers based on their individual sensitivity to colder weather as determined by their historical AM usage data. The SEU treatment included paper reports and email cold weather alerts. Using AM data, SoCalGas was able to measure how customers react to changes in temperature. Customers that are highly responsive to cold weather are called weather sensitive customers. SEUs are designed to target these weather sensitive customers and inform them on how to change their habits to reduce energy during colder weather periods.

SoCalGas developed SEUs based on learnings, insights, and hypotheses arising from the first two Campaigns, and first tested SEUs in the Third Campaign. Enrollment was split into two treatment groups, one containing My Account customers and the other containing Non-My Account customers. The treatment groups contained a large number of customers in comparison to the other treatment cells from the Third Campaign. However, only 25% of the customers in the treatment group received treatment (SEU reports). In the My Account treatment group there were 75,000 total customers, but only the top 25% most weather sensitive customers received reports (18,750). There were 96,600 total customers in the Non-My Account treatment group but only the top 25% most weather sensitive customers received reports (24,150). Customers selected to be in either of the SEU treatment groups were required to pass one additional filter of having historical AM bill data for at least one year prior to receiving treatment. This filter was applied so that SoCalGas could run a regression analysis to determine the weather sensitivity of customers.

The My Account customers in the SEU treatment received the following: four paper reports; one welcome letter/frequently asked questions; three frequently asked questions inserts; one repositionable thermostat setting reminder decal;[14] and three cold weather email alerts. The Non-My Account customers received four paper reports; one welcome letter/frequently asked questions; three frequently asked questions inserts; and one repositionable thermostat setting reminder decal.[15]

Figure 2-14 and Figure 2-15 provide examples of the front and back sides of the paper SEU sent in November (all additional materials can be found in Appendix E). The paper SEU featured the following information:

- Comparison to Neighbors during cold weather days;
- Normal Day vs. Cold Day Usage [self] Comparison; and
- Savings tips.

[14] Some customers might have received the repositionable thermostat setting reminder decal twice. The decal was intended for inclusion in the December 2015 mailing, however due to unanticipated printing issues, not all customers received the decal in their mailing. In order to ensure that all customers received the decal, it was mailed again in the January 2016 mailing.

[15] Some customers might have received the repositionable thermostat setting reminder decal twice. The decal was intended for inclusion in the December 2015 mailing, however due to unanticipated printing issues, not all customers received the decal in their mailing. In order to ensure that all customers received the decal, it was mailed again in the January 2016 mailing.

Figure 2-14: Aclara/SoCalGas Paper SEU (Front)

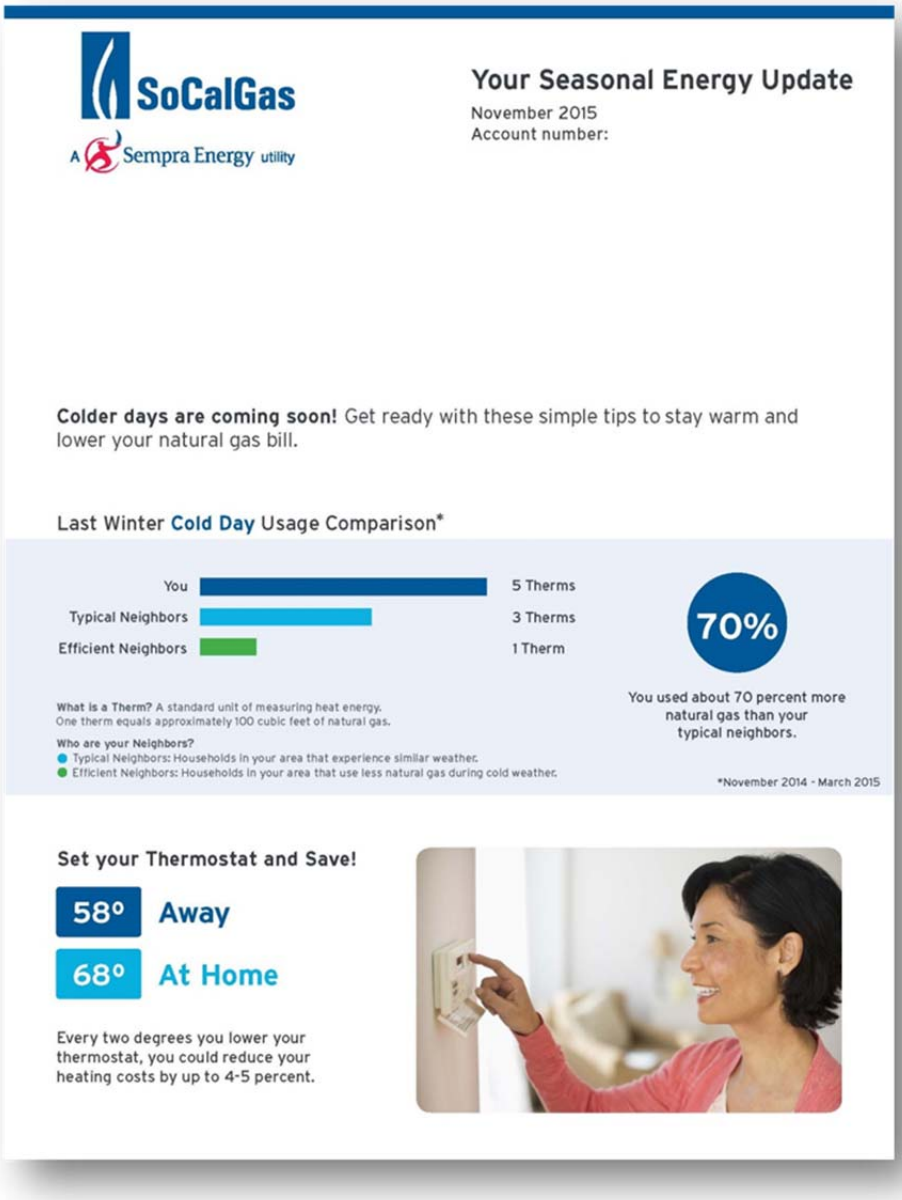


Figure 2-15: Aclara/SoCalGas Paper SEU (Back)

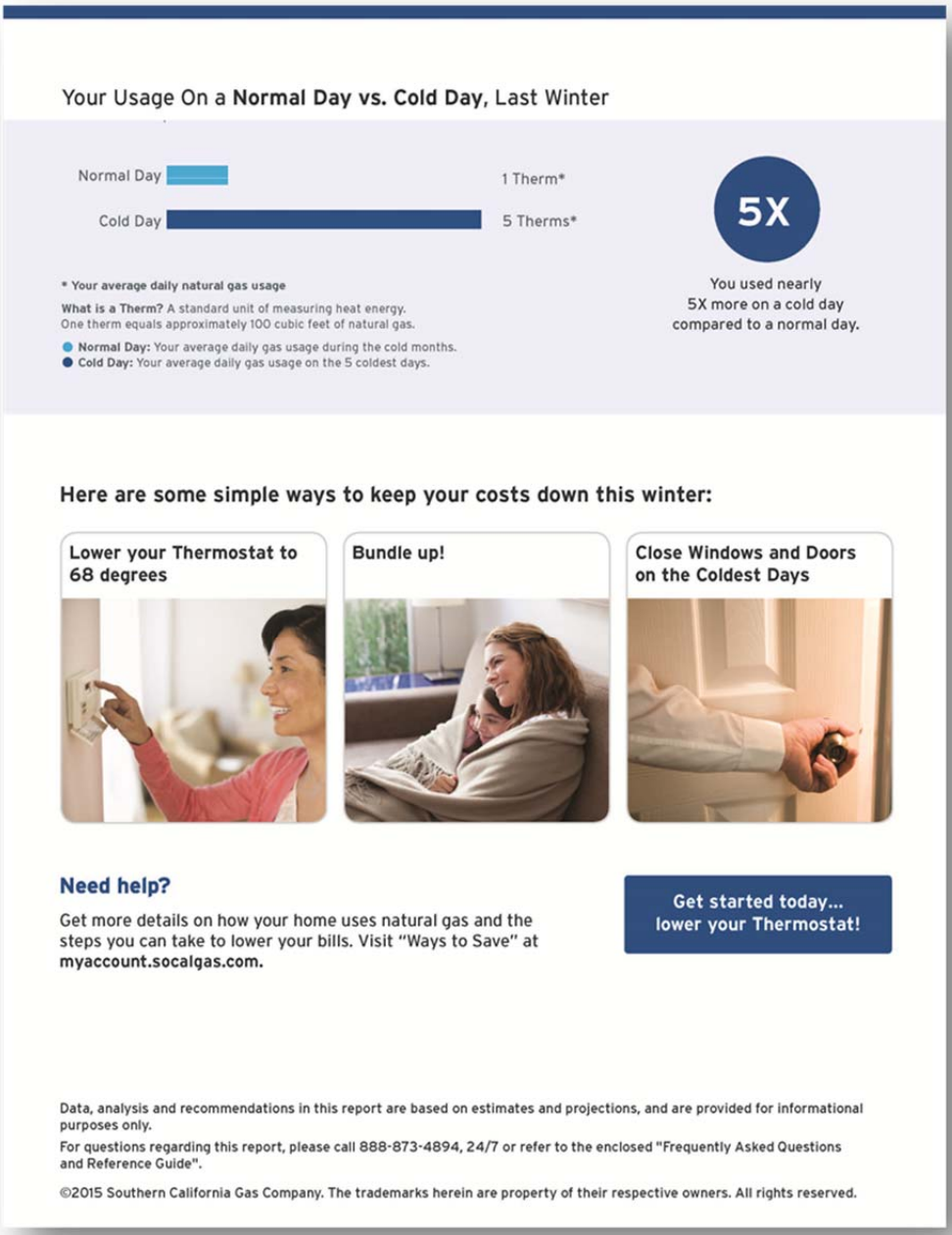


Figure 2-16 provides an example of the email SEU. The email SEU combines portions of the two sided paper SEU into the email format. It includes the last winter cold day usage neighbor comparison as well as tips to reduce energy costs during the winter. Examples of the remaining materials that Aclara/SoCalGas sent for the SEU treatment—the welcome letter, the cold weather alerts, the frequently ask questions insert, and the repositionable sticker—are provided in Appendix E.

Figure 2-16: Aclara/SoCalGas Email SEU



This message contains graphics. If you do not see the graphics, click here to view

SoCalGas
A Sempra Energy utility

Cold Weather Alert

Tips to keep you warm

Last Winter Cold Day Usage Comparison*

Account Number: *****71879

You 61 Therms

Typical Neighbors 35 Therms

Efficient Neighbors 21 Therms

70%

You used about 70% more natural gas than your typical neighbors.

What is a Therm? A standard unit of measuring heat energy.
One therm equals approximately 100 cubic feet of natural gas.

Who are your Neighbors?

- Typical Neighbors: Households in your area that experience similar weather.
- Efficient Neighbors: Households in your area that use less natural gas during cold weather.

November 2014 - March 2015

Here are some simple ways to keep your costs down this winter:

Lower your Thermostat to 68 Degrees

Install a Programmable Thermostat

Maintain your Heating System

Please do not reply to this email. Mail sent to this address cannot be answered. For assistance, please visit http://pages.socalgas.aclara.com/WSFAQ. Southern California Gas Company values your privacy. For more information, view our Privacy Policy and Privacy Notice.

Data, analysis and recommendations in this report are based on estimates and projections, and are provided for informational purposes only.

This email has been sent as a promotional communication. If you'd rather not receive emails like this, you can unsubscribe. Sender's business address is 555 West Fifth Street, GT20B2, Los Angeles, CA 90013.

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2.3 Customer Acceptance of Information Services

This report focuses primarily on the energy savings impact of the information services described above. A related aspect of these services is customer experience. Two gauges of customer acceptance are available: participant opt-out rates and customer experience surveys. For the Third Campaign, SoCalGas administered customer experience surveys for SEU and BTA toward the end of the winter treatments in 2015–2016.

All treatments in the third Campaign were administered on a default basis but participants were able to opt-out of the service. For the 2015–2016 HER campaigns, as of June 30, 2016, a total of 602 (.5 percent) of Opower HER initial program enrollees opted-out of receiving further Opower HERs. For the same time period, a total of 452 (1%) of SEU initial program enrollees opted-out of receiving further SEUs. Additionally, since the inception of the Bill Tracker Alert offering in fall 2013, less than 2% of enrollees have unsubscribed. This implies that customer acceptance rates were quite high for all treatments.

The customer experience survey for the SEU treatment[16] reflected overall customer satisfaction with SoCalGas. However, SEU customers showed little difference in customer satisfaction, interest in reducing energy use, or lowered thermostat settings compared to the control group.

Other key findings included:

- The slight differences found between Treatment and Control groups suggests that the program has had a very little impact on customers overall views of SoCalGas and their self-reported actions to reduce energy usage;
- In general, customers from both the Treatment and Control groups are satisfied with SoCalGas and feel motivated or somewhat motivated to reduce their natural gas usage;
- The majority of Treatment group customers recall receiving the SEU report in the mail (81% of My Account customers and 70% of Non-My Account customers); and
- 79% of customers did not recall receiving Cold Weather Alerts via email. Upwards of 50% of customers clicked on the Cold Weather Alert email, so the low recall may be due to confusion regarding the name and description of the alert or an abundance of email messages in their inboxes causing low recall.

SoCalGas sent an email invitation to customers in the Third Campaign receiving the New and Old BTA treatment, as well as customers in the previous Campaigns receiving the BTA treatment, to participate in a brief survey about the alerts. The survey reflected that customers are reading their BTAs and that they find the BTAs easy to understand. Here are some of the key findings:

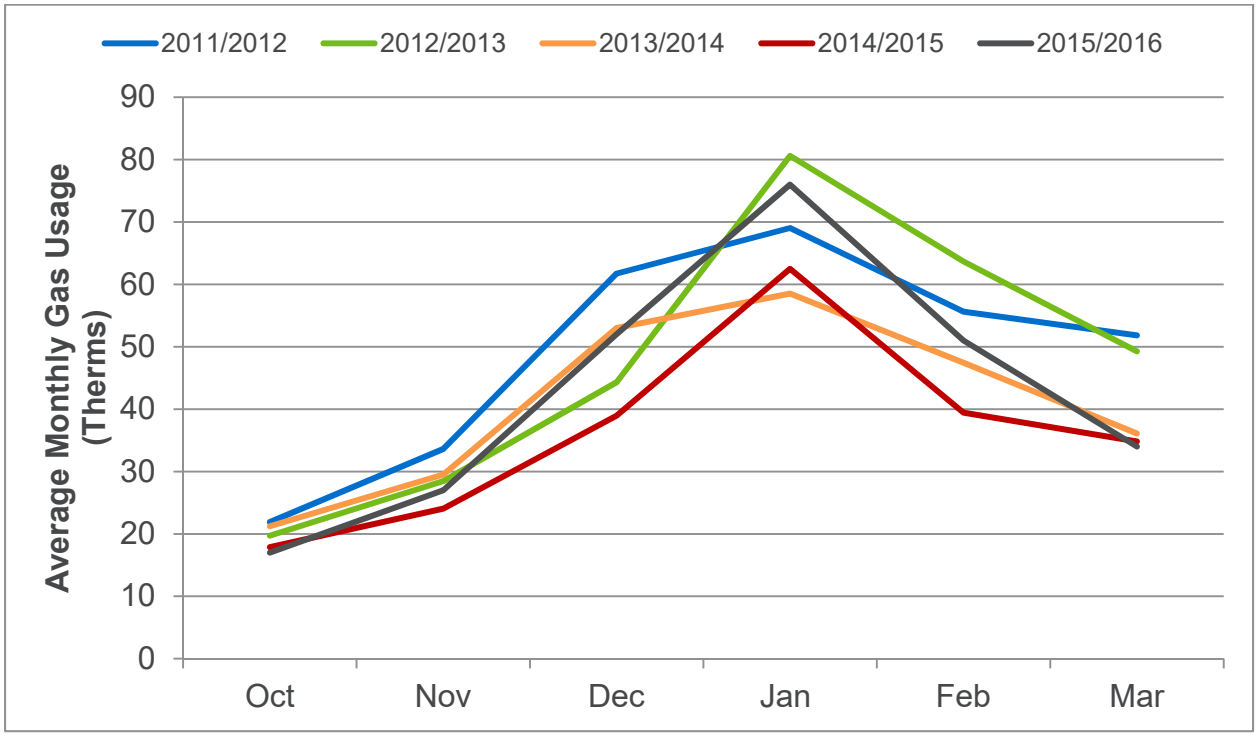
- The majority of the customers answered that they were currently receiving BTAs (88%);
- Over half of these customers responded they “always” read their BTA (67%);
- Approximately 87% of these customers agreed or strongly agreed that the BTAs were easy to understand; and
- Customers agreed or strongly agreed they were more aware of usage (77% agree or strongly agree).

[16] Opinion Dynamics, SoCalGas Customer Survey: Summary Results, March 2016.

2.4 2015–2016 Winter Weather Conditions

To fully interpret the energy savings that resulted from the 2015–2016 Conservation Campaign, it is important to consider the winter weather conditions. The winters of 2013–2014 and 2014–2015 were in turn the warmest on record in California.[17,18] Unlike the previous two years, the winter of 2015–2016 was not the record warmest but it was still above average. This is particularly relevant for all three Campaign winters as the analysis uses each year prior to the start of the Campaign as pretreatment data. This unseasonably warm weather for the first and second Campaign winters was reflected in the overall gas usage for residential SoCalGas customers in both years, as shown in Figure 2-17, which provides a comparison of residential gas usage over the past five winters. From October 2013 through December 2014, residential gas usage in the 2013 heating season was similar to gas usage in the prior two years. However, in January through March 2014, residential gas usage was substantially lower in 2014 than it was in the prior two years. Further, gas usage for the 2014–2015 heating season was the lowest in four years for all months except January 2015. The residential gas usage for the 2015–2016 heating season was substantially higher than the prior two years due to the relatively colder temperatures. The higher observed gas usage was also associated with higher percentage savings relative to the prior campaigns. This is reasonable given there are more opportunities to conserve when the usage is higher. Based on the weather and results observed to date, it would be reasonable to expect that in warmer years the conservation savings may be lower compared to years with relatively colder weather.

Figure 2-17: Comparison of SoCalGas Residential Gas Usage over the Past Five Winters



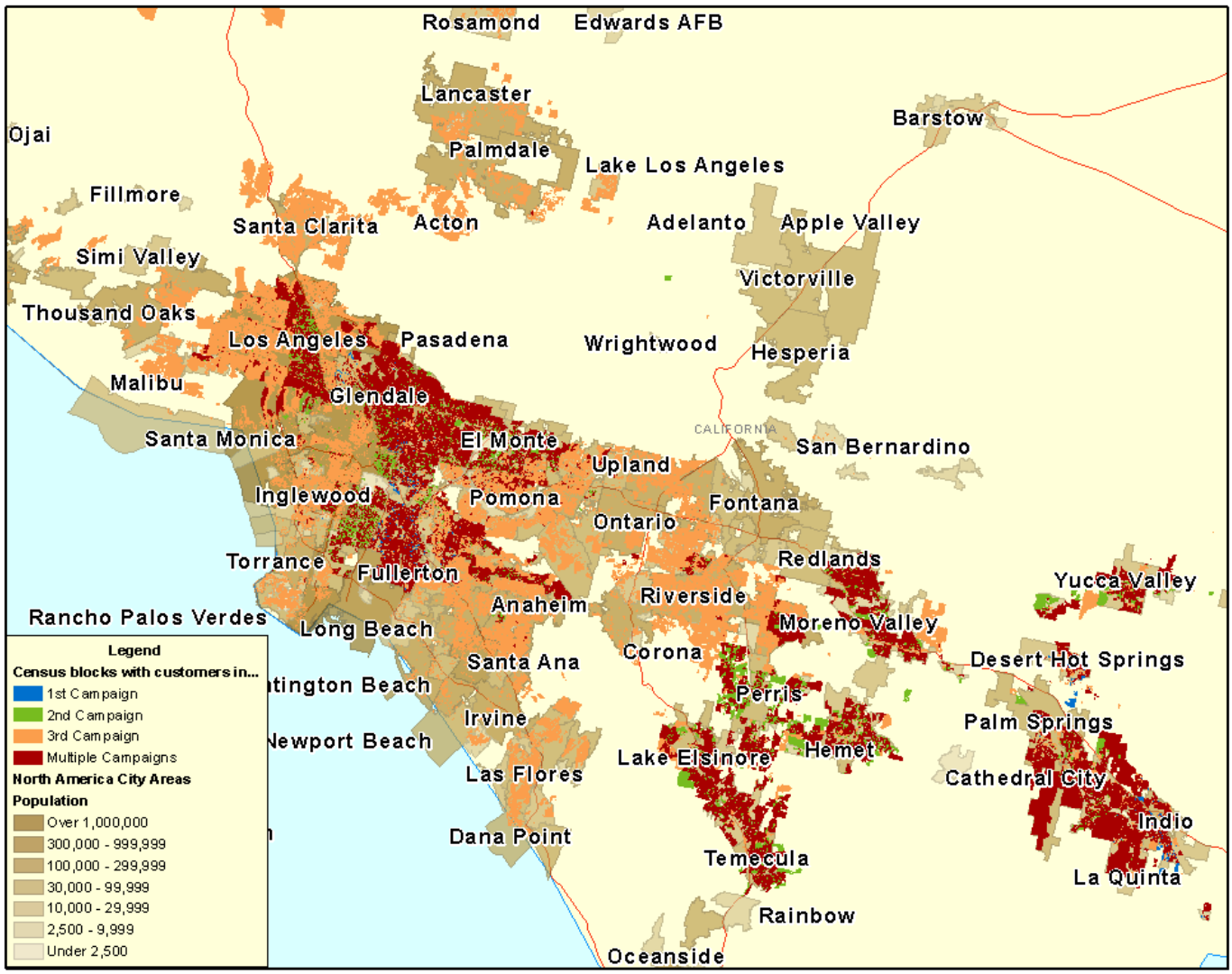
[17] http://www.ncdc.noaa.gov/sotc/service/national/statewidetavgrank/201312-201402.gif

[18] http://www.ncdc.noaa.gov/sotc/service/national/statewidetavgrank/201412-201502.gif

2.5 Geographic Distribution of 2013–2014, 2014–2015, and 2015–2016 Conservation Campaigns

The customer populations for the all three Campaigns were significantly influenced by the geographic distribution of the SoCalGas advanced meter rollout. Figure 2-18 shows the geographic distribution of the populations from the first, second, and third Campaigns, highlighting the fact that the populations in the three Campaigns contained geographic overlap. This overlap is mainly due to the additions of customers in the third Campaign, as previously the first and second Campaigns were very geographically distinct. Census blocks that only contained customers in the first Campaign are blue; those only containing customers from the second Campaign are green. Census blocks that only contained customers in the third Campaign are orange; and finally, census blocks containing customers from more than one Campaign are red. While populations from the Campaigns were geographically diverse, the first Campaign was more concentrated in denser urban areas—Glendale, areas along the 605 corridor, central areas of Bakersfield and Palm Springs—while the second campaign was more of a mix of urban, suburban, and rural areas—the San Fernando Valley, outer edges of Riverside County, towns along I-5 near the Grapevine, etc.). The third Campaign was also more of a mix of urban, suburban, and rural areas—the Inland Empire, Northern Orange County, Eastern Los Angeles, the San Fernando Valley, and California's Central Valley.

Figure 2-18: SoCalGas Conservation Campaign Population Distribution by Year



In addition to mapping out the geographic distribution of the sample populations for the three different campaigns, census block data was also used to analyze the extent to which populations for the three Campaigns varied demographically.

Table 2-2 summarizes certain customer characteristics and demographics for the populations included in the original sample for the three Campaigns. Similar to the second Campaign, the customers in the third Campaign show a lower representation from areas with high concentrations of renters [19] and a lower representation from areas with high population density.[20] The most notable difference for the customers in the third Campaign as compared to

[19] "High" defined as census block with rental rates above the 75th percentile among census blocks included in the first, second, or third campaign

[20] "High" defined as census block with densities above the 75th percentile among census blocks included in the first, second, or third campaign

the first and second campaigns is the lower representation from areas with high concentrations of Latino households. [21] This lower representation of areas with high concentrations of Latino households is mainly due to the initial segmentation that occurred during the sampling process to separate the customers into English-only and English + Spanish groups.[22] After the population was segmented into English-only and English + Spanish groups, only the customers who had indicated a Spanish language preference with SoCalGas (27% of English + Spanish group) were included in the treatment and control groups. The focus on specifically researching the customers with a Spanish language preference ultimately resulted in a smaller overall number of Latino households being included in the Third Campaign.

Table 2-2: Comparison of Select Demographics for Customer Populations in the First, Second, and Third Campaigns[23]

Segment	First Campaign (2013–2014)	Second Campaign (2014–2015)	Third Campaign (2015–2016)
% Areas with high concentrations of renters	34%	17%	18%
% Areas with high population density	35%	23%	19%
% Areas with high concentrations of Latino households	27%	16%	4%

These are all characteristics that may affect both the ability and the propensity of participants to respond to conservation efforts such as the SoCalGas Conservation Campaign. As such, one should not necessarily expect to find similar overall impacts from similar treatments in the three different campaigns. One may expect, however, for impacts from similar treatments within each demographic group to be more similar.

[21] "High" defined as census blocks with Latino populations above the 75th percentile among census blocks included in the first, second, or third campaign

[22] The English + Spanish group was formed with customers who resided in a census blocks with high concentrations of Latino households

[23] Based on 2010 Census Block demographics

2.6 Report Organization

The remainder of this report proceeds as follows:

- Section 3 describes the research design, including the treatment and control group assignments for residential customers;
- Section 4 summarizes the methodology used to evaluate energy conservation;
- Section 5 summarizes the energy conservation estimates for all of the treatments;
- Section 6 provides recommendations for the 2016–2017 SoCalGas Conservation Campaign; and
- Appendix A through Appendix E include additional example communications and informational materials for the treatments.

3 Research Design

In order to determine if the new information services made available by SoCalGas change energy use for consumers who have access to them, it is necessary to estimate what energy use would have been for those customers if they did not have access to the information. Conceptually, this can be accomplished by comparing usage before and after a group of customers receives the information, but other factors such as differences in weather or economic conditions can make such comparisons highly inaccurate. Side-by-side comparisons of customers that do (the treatment group) and don't (the control group) have access to the service of interest is the most robust approach, but only if the two groups of customers are identical except for the fact that one gets the information service and the other doesn't. Obtaining well matched treatment and control groups is the fundamental challenge to getting accurate impact estimates.

In the evaluation plan[24] for its 2013–2014 Conservation Campaign, SoCalGas considered the full spectrum of options before determining that a randomized control trial (RCT) design was the preferred option for these default programs. The evaluation plan provides a summary of the reasons why other options were rejected.

Finally, an important input into development of the evaluation plan was the size of the participant population and control groups required to estimate the effects of the planned information/behavioral treatments. The evaluation plan provided a detailed description of the process used for sample size determination and this will not be repeated here. However, it is relevant to note that sample sizes were adjusted upward in the second and third Campaigns to control for the effects of anticipated customer attrition.

3.1 Residential Treatment and Control Group Assignments

Several factors were taken into consideration in assigning customers to test cells in the 2015–2016 Conservation Campaign and how the target market should be segmented.

The first important consideration is usage. Experience has shown that customers with low annual usage may not be interested in or respond to information feedback since their bills are so low that even significant percent changes in energy use would produce only very small economic benefit in the form of bill savings. Even if these customers produced above average savings relative to other customers (which, for reasons just mentioned, may be unlikely), their contribution to the target of 1% savings in aggregate for the overall population would be small and the implementation costs for these customers per therm conserved would be relatively high. In short, it is highly unlikely that low usage customers are cost-effective and almost certain that they would be less cost-effective than customers with larger usage. In fact, the 2013–2014 Campaign found that customers in the second usage quartile (the first quartile was excluded from default treatments in that testing cycle) delivered the lowest absolute and percent gas savings, relative to high users in the third and fourth usage quartiles. Therefore, considering that the 2015–2016 Conservation Campaign was able to take advantage of an expanded

[24] Southern California Gas Company's Evaluation Plan for Estimating Conservation Effects from Information Feedback Services. August 9, 2013. (Included as Appendix O in the "Southern California Gas Company Advanced Meter Semi-Annual Report" filed with the CPUC on August 30, 2013).

footprint in terms of AM installations, SoCalGas had a sufficient amount of customers to improve its targeting strategy for the third Campaign as follows:

- Focus on the top two usage quartiles;
- Only include customers who have passed the Opower Screen; and
- Only include customers who have pretreatment data from October 2014 through March 2015.

Another important segmentation factor is whether customers are My Account users. My Account customers register with SoCalGas to receive a variety of online services, including receiving, viewing, and paying their bills online, accessing historical usage data, making payment arrangements, and service scheduling changes such as starting or stopping service. Given their demonstrated interest in online transactions, My Account customers may be more likely than non-My Account customers to take advantage of the new information available through BTAs or HERs. They also are a population for whom SoCalGas has email addresses and, thus, can receive email solicitations and information feedback through this inexpensive channel. For all of these reasons, the population of customers targeted for both BTAs and HERs was segmented into My Account and non-My Account customers in the all three Campaigns.

For the 2015-2016 Campaign there were two new segmentations used. The first segmentation was whether customers were English-only speaking customers or English and Spanish speaking customers. The customers who were in the English and Spanish segment were split between customers who had a confirmed Spanish Preference or a preference that was unknown. This segmentation was done to test how customers who preferred using Spanish performed when receiving a Spanish language HER.

The second new segmentation in 2015–2016 was between CARE (low income) and Non-CARE customers. The CARE population of customers may behave differently after receiving new information available through HERs.

An important distinction to note about the residential and control group assignments for the 2015–2016 campaign is that this population included carryover/leftover customers from the 2013–2014 campaign. These included customers from the Opt-in BTA treatments as well as the control groups that were no longer part of the study population. For the Third Campaign evaluation, the control groups from the First Campaign that passed the Opower Screen were cut down to 25,000 customers each. Similarly, the Non-My Account control group from the Second Campaign was reduced to 53,500 customers.

Figure 3-1 provides a summary of the population segmentation and treatment and control group assignments for residential customers in the 2015–2016 Conservation Campaign. The research sample for the third Campaign excluded customers in the lower two usage quartiles: customers who did not have 2014–2015 pretreatment data and who did not pass the Opower screen. About 781,000 customers remained after removing customers in these three groups.

The remaining customers were then split into English Only and English + Spanish groups based on census block data. The 32,729 customers in the English + Spanish group that were identified

as having a Spanish language preference by a call center were assigned to the Opower Spanish HER treatment (13,750) and its corresponding control group (18,798). The remaining 87,491 customers who had an unknown Spanish Preference were not used in the campaign.

Among the roughly 661,000 customers in the English Only segment, about 114,000 were CARE customers and about 547,000 were Non-CARE customers. In the CARE segment 13,750 customers were assigned to the Opower Paper and Email HER and 27,500 customers were assigned to the Opower Paper and Email Thermostat HER. The remaining 71,641 CARE customers were assigned to the control group.

The 547,000 Non-CARE customers were divided into the My Account or Non-My Account groups. Since SoCalGas did not have email addresses for the non-My Account customers, this group was assigned to test the paper-only treatments. The Opower standard Paper HER and the Opower Thermostat Paper HER were assigned to randomly selected groups of 13,750 each. The paper SEU contained 96,600 customers but only top 25% most weather customers received treatment.

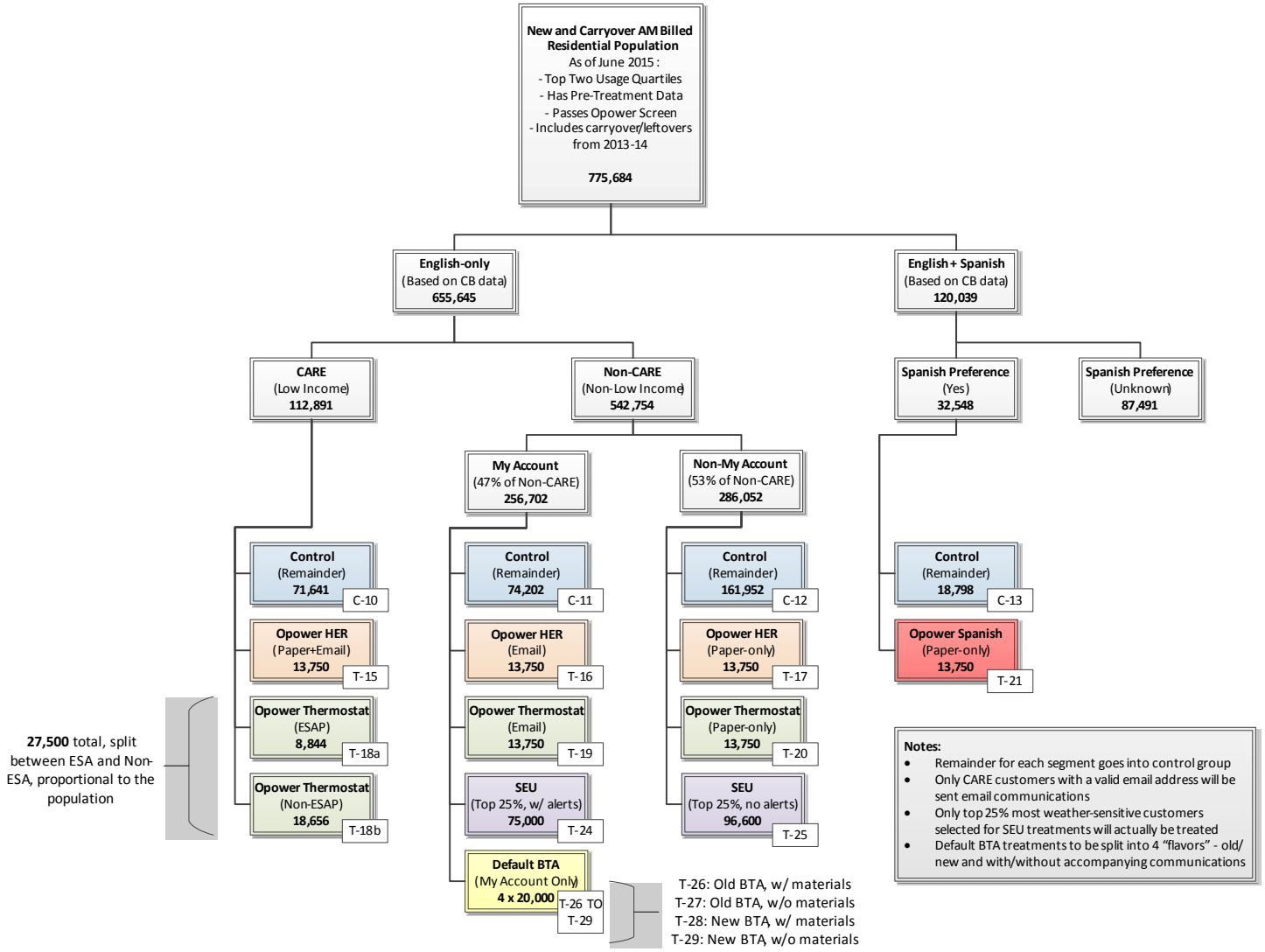
Since SoCalGas had email addresses for the roughly 259,000 My Account customers, it used this group to test default BTAs, Email HERs, and SEUs. The four BTA treatments were assigned to randomly selected groups of 20,000 each. Both the Opower standard email HER and the Opower Thermostat email HER contained 13,750 customers. Of the remaining My Account Customers 75,000 customers were placed in the Email SEU treatment but only the top 25% most weather sensitive customers received treatment.

In summary, the 780,979 residential customers in the eligible AM population were allocated as follows:

1. **Default BTA:** 80,000 customers;
2. **Opower Paper-only HERs:** 41,250 customers (33% standard, 33% thermostat, 33% Spanish);
3. **Opower Email HERs:** 27,500 customers (50% standard email, 50% Thermostat email);
4. **Opower Paper & Email HERs:** 41,250 customers (33% standard paper & email, 66% thermostat paper & email);[25]
5. **SEUs:** 42,900 customers (44% email SEU, 56% paper SEU); and
6. **Control Group:** 326,593 customers.

[25] The monthly Email HER was only sent to those CARE customers within the treatment group registered for SoCalGas My Account customer portal and with a valid Email address.

Figure 3-1: Residential Treatment and Control Group Assignments for the 2015–2016 Conservation Campaign



3.2 Residential Data Sources

In the analysis, Nexant used daily gas usage data in therms for the post-treatment period from November 1, 2015 through March 31, 2016. Monthly billing data from the same months a year prior was used as the pretreatment data because daily AM data was largely not available for customers in the sample.[26] These data sources yielded 10 months of gas usage data for the study period of interest—spanning from November 1, 2014 through March 31, 2016—with the 2014 non-heating months—April through October—omitted. For estimation purposes, October was dropped from the pre- and post-treatment period both because usage is quite low in

[26] As previously stated, only customers with pretreatment data were included, but this simply means that the sample was limited to customers who had active SoCalGas accounts in the pretreatment period, not explicitly limited to customers with pretreatment AMI data.

that month relative to the other "winter" months and also because treatments began in early November.[27] Thus, the impact estimates discussed in Section 5 span the five month period from November 1, 2015 through March 31, 2016.

In an RCT design that uses difference-in-differences to estimate the energy savings, customers must have a full panel of pre- and post-treatment usage data in order to be included in the analysis that assesses impacts and statistical significance across all months. Basically, customers that were not active SoCalGas accounts from November 1, 2014 through March 31, 2016 were excluded from the analysis of the overall impacts of the third Campaign. As long as the percentage of customers dropped is consistent between each treatment group and associated control group, this exclusion of customers from the analysis does not produce bias in the conservation estimates. To verify that the percentage of customers dropped is consistent within each segment, Table 3-1 shows the number of customers that were included in the analysis by treatment/control group, compared to the original number of customers that was sampled. All treatment and control groups retained around 96% of the customers that were originally sampled. Most importantly, the percentage of customers retained is highly consistent within each statistically equivalent group, which ensures that the integrity of the original sample design is held intact even though some customers had to be dropped from the analysis that assesses impacts and statistical significance across all months.[28]

[27] In the first Campaign some customers began treatment in October but October was likewise excluded from the analysis for similar reasons.

[28] For the purposes of estimating whether the treatments produced a statistically significant reduction in overall gas usage throughout the 2015-2016 Conservation Campaign, these customers were dropped. However, once Nexant identifies a statistically significant usage reduction within a given test cell, the analysis can be done at the monthly level, which allows for the re-inclusion of some customers that may not have had usage data for every month, but do have data for some pre- and post-treatment months. Basically, when the analysis is conducted at the monthly level, as long as a customer has data for an individual pre- and post-treatment month, that customer can be included in the analysis for that month.

Table 3-1: Residential Customers Included in Analysis by Treatment/Control Group

Segment	My Account	Group	Number of Customers in Original Sample	Number of Customers in Analysis	% of Original Sample in Analysis
Non-CARE	Yes	C-11	74,202	70,797	95.41%
		T-16	13,750	13,086	95.17%
		T-19	13,750	13,094	95.23%
		T-24	75,000	71,418	95.22%
		T-26	20,000	19,069	95.35%
		T-27	20,000	19,032	95.16%
		T-28	20,000	19,035	95.18%
		T-29	20,000	19,062	95.31%
	No	C-12	161,952	157,117	97.01%
		T-17	13,750	13,364	97.19%
		T-20	13,750	13,342	97.03%
		T-25	96,600	93,535	96.83%
CARE	Yes/No	C-10	71,641	68,293	95.33%
		T-15	13,750	13,082	95.14%
		T-18a	8,844	8,509	96.21%
		T-18b	18,656	17,696	94.85%
Spanish		C-13	18,798	18,194	96.79%
		T-21	13,750	13,319	96.87%
All		**Total**	**688,193**	**661,044**	**96.06%**

4 Gas Savings Impact Estimation Methodology

Nexant estimated models using panel data to determine energy savings. Panel data is a data structure in which multiple observations over time are present for multiple individuals. In the evaluation[29] for the 2013–2014 Conservation Campaign, Nexant took the opportunity to test three different model specifications for using panel data to estimate energy savings—a fixed-effects (FE) model, a random-effects (RE) model, and a lagged dependent variable (LDV) model. All models featured time-effect variables as well as error estimates clustered at the customer level. Each of these model specifications has merit under the appropriate circumstances, but they are fundamentally different approaches to estimating treatment effects. All three model specifications were carefully considered before determining that a LDV model was the preferred evaluation model. The evaluation of the first Campaign provides a summary of the reasons why the LDV model was chosen as the appropriate model for this evaluation.

The LDV model incorporates individual heterogeneity by explicitly including past values of an individual's energy consumption as control variables on the right-hand side of the regression equation. The LDV regression model as used in this evaluation is specified in this equation:

$$therms_{i,t} = a + b \cdot T_i + c \cdot u_t + d \cdot therms_{i,t-12} + \varepsilon_{it}$$

In this equation, *t* indexes months November 2015 through March 2016 and *i* indexes individuals. The intercept is the same for everyone and the term $therms_{i,t-12}$ represents the energy consumption for individual i in a previous period (in this case, the same month from the prior year). This is akin to saying that what makes consumers unique is captured entirely by their past levels of consumption. The model variables are defined in Table 4-1. This model can be estimated using pooled OLS, provided that there is no serial correlation in the error term and that there are no omitted variables that are correlated with the treatment. The underlying identification assumption is that average consumption without the treatment would be the same for both treatment and control customers. Given that the research design features an RCT with random assignment to large treatment and control groups, this assumption is clearly valid in this case.

[29] Southern California Gas Company's Evaluation Plan for Estimating Conservation Effects from Information Feedback Services. August 9, 2013. (Included as Appendix O in the "Southern California Gas Company Advanced Meter Semi-Annual Report" filed with the CPUC on August 30, 2013).

Table 4-1: Definition of Lagged Dependent Variable Model Variables

Variable	Definition
$therms_{i,t}$	average daily gas consumption of participant i during month t
a	estimated intercept
b	estimated treatment effect
c	estimated monthly time effect on treatment and control group
d	estimated effect of an individual's consumption in month $t-12$
T_i	indicator of whether or not the participant is assigned to the treatment condition
$therms_{i,t-12}$	average daily gas consumption of participant i during month $t-12$
u_t	Time effects for each month that control for unobserved factors that are common to all treatment and control customers but unique to month t
$\varepsilon_{i.t}$	error for each participant and month

Nexant conducted an evaluation of impacts for the third Campaign using winter 2014–2015 as the pretreatment period ($t-12$). In addition, Nexant estimated the impacts for customers in the second Campaign including the Aclara HER customers who no longer received HERs and the Opower HER and Default BTA customers still receiving treatment. Nexant also estimated the persistence of energy savings for customers from the first Campaign—the Opower HER customers who no longer received HERs and the BTA customers who continued to receive BTAs in the absence of any promotional materials. For the first Campaign customers, the treatment period (*t*) was 2015–2016 and pretreatment period was still 2012–2013 so that energy savings in the third year could be compared to energy savings in the first year. For the second Campaign customers, the treatment period (*t*) was 2015–2016 and pretreatment period was still 2013–2014 so that energy savings in the second year could be compared to energy savings in the first year.

Due to only the top 25% of the SEU treatment groups receiving the treatment, one additional analysis step was required compared to the other treatments. While the other treatments are part of a RCT, the SEU treatment was technically a Randomized Encouragement Design (RED). A RED is similar to an RCT, and used when treatment cannot be delayed or denied, or when a known subset of treatment customers within an RCT receives a unique treatment—such as the SEU group. The observed treatment effect was measured by comparing the complete group of treatment customers—including the 75% not treated and 25% treated—against their corresponding control group. For the Paper SEU treatment group there were 96,600 customers originally selected to be part of the treatment cell and for the Email SEU treatment group there were 75,000 customers originally selected to be part of the treatment cell. However, only 24,150 customers (25%) received the Paper SEU treatment and 18,750 customers (25%) received the Email SEU treatment. There is no uncertainty that the remaining customers in either of the treatment cells did not receive treatment and would produce zero impacts. Therefore, in the resulting average impact per customer, it is known that only 25% of the customers were treated, so it needs to be adjusted to reflect that fact. To calculate the average

savings rate per treated customer, we scaled the measured impact by the % of customers who were actually treated, which was 25%. This resulted in the average impact per customer from the original difference between the full treatment and control group being multiplied by four. To calculate the reference load for the treated customers we take the scaled impact and add this to the observed load for customers that were treated.

This analysis also reflects the same data management protocols developed during the 2013–2014 and 2014–2015 Campaigns and agreed upon during a knowledge sharing meeting with SoCalGas and other stakeholders.

5 Energy Conservation Estimates

This section begins with a summary of the results and conclusions for the 2015–2016 SoCalGas Conservation Campaign, followed by a detailed assessment of how gas savings vary by customer segment and a summary of the third year savings results for customers from the 2013–2014 and 2014-2015 Conservation Campaigns. At the end of the section, an estimate of the total 2015–2016 gas savings for all three groups is provided.

5.1 Percent Reductions for 2015–2016 Conservation Campaign

Table 5-1 shows the estimated percent reductions in gas consumption for the 13 new residential treatments deployed for the 2015–2016 Conservation Campaign. Percent reductions were derived using the LDV regression model. P-values for the coefficient estimates from the regression models are also displayed. The data used for model estimation covers the months of November 2015 through March 2016 as compared to the pretreatment period (the months of November 2014 through March 2015). It only includes customers who were active for the full period.

All of the 13 treatments yielded statistically significant impacts. The Third Campaign was the first of the three Campaigns that yielded statistically significant results for all of the treatments that were tested. This reflects the value of the adaptive design process being utilized within the "test and learn" approach. The SEU treatments both produced the highest percent reductions—approximately 3%—for both the email and paper SEU. However, it is important to note that these treatment cells are not directly comparable to the other treatments as they only include customers identified as being highly sensitive to cold weather. Both of the Old BTA treatments produced the smallest savings rates.

The Opower Spanish Paper-only HER produced statistically lower savings than the Opower Paper-only HER. Besides the Opower Spanish HER, the two other Opower Paper-only HER treatments produced savings rate of at least 1.30%. This includes the Opower Paper-only HER (1.50%) and the Opower Paper-only Thermostat HER (1.32%). The Opower Thermostat Email HER and the Opower Email HER produced lower savings rates than the Paper-only treatments. The Opower Email HER produced a savings rate of .86% and the Opower Email Thermostat HER produced a rate of 1.28%. These results suggest that, at least for the Opower treatments, the Paper-only HER treatments were more effective than the Email HER treatments in this case.[30]

[30] The Opower Email HER treatments include test cells T-16 and T-19. Customers in these treatments received 1 paper report and 12 email reports.

Table 5-1: Estimates of Percent Reductions in Gas Energy Consumption for the 2015–2016 Conservation Campaign, November 2015 through March 2016

Segment	My Account	Treatment	Group	Number of Treatment Customers	% Reduction	P-value
Non-CARE	Yes	Opower Email HER HER	T-16	13,086	0.86%	0.00
		Opower Email Thermostat HER	T-19	13,094	1.28%	0.00
		Paper & Email SEU	T-24	17,877	3.04%	0.00
		Old BTA, w/materials	T-26	19,069	0.70%	0.00
		Old BTA, w/o materials	T-27	19,032	0.49%	0.04
		New BTA, w/materials	T-28	19,035	1.04%	0.00
		New BTA, w/o materials	T-29	19,062	0.86%	0.00
	No	Opower Paper-only HER	T-17	13,364	1.50%	0.00
		Opower Paper-only Thermostat HER	T-20	13,342	1.32%	0.00
		Paper-only SEU	T-25	23,494	3.08%	0.00
CARE	Yes/No	Opower Paper & Email HER	T-15	13,082	1.01%	0.00
		Opower Paper & Email Thermostat HER	T-18	26,205	1.53%	0.00
Spanish		Opower Spanish Paper-only HER	T-21	13,319	0.82%	0.00

5.2 Comparison to 2013–2014 and 2014–2015 Percent Reductions

In 2014–2015 the second Campaign tested seven treatments, which included default BTAs and HERs. The two different varieties of HERs were implemented by Aclara and Opower. The three Opower HERs—Paper-only, Email, and Paper & Email—all produced statistically significant results while the Aclara Paper-only HER was the only Aclara HER that produced statistically significant results. The default BTA did not produce measurable savings. The Aclara treatments were stopped while the default BTA and Opower treatments continued into the third Campaign.

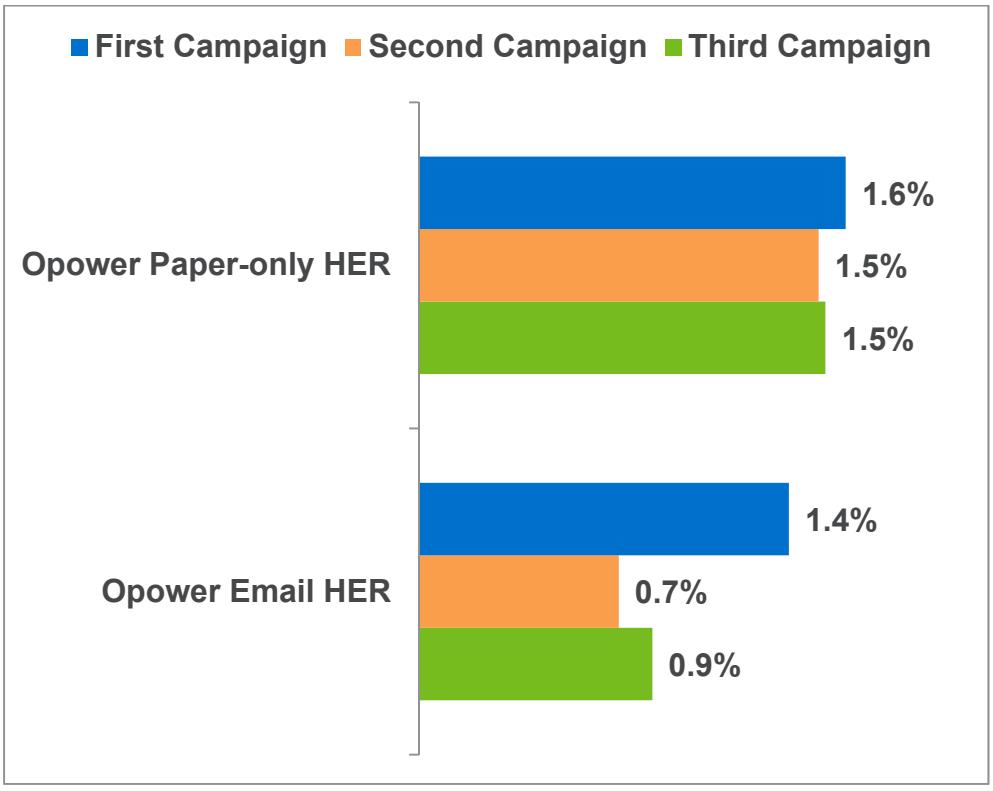
The four treatments from the first Campaign that produced statistically significant gas usage reductions were the default BTAs and three variations of the Opower HER reports—Paper-only, Email, and Paper & Email. The default BTA customers continued to receive treatment but the Opower treatments have not received reports since the first Campaign.

The treatments that produced measurable savings from the first and second Campaigns were also tested in the third Campaign. An important distinction to note is that the third Campaign tested two versions of the default BTA, the Old BTA and the New BTA. Moving forward, the default BTAs from the first and second campaign will be called the Old BTA as well.

However, to interpret the comparisons of the treatments from the three Campaigns it is important to note several key differences between the Campaigns. First, as discussed in Section 2.5, the research sample in each year was pulled from the population that received advanced meters in the year leading up to the summer before each Campaign. These meters were rolled out to different geographic areas each year and the underlying characteristics of the three different populations could bias the results from one year to next. In particular, the second and third Campaigns included geographic areas with lower population densities and lower rates of renters. Due to the process of sampling customers in the third Campaign, there are very few areas with high rates of a Latino population. Second, as explained in Section 3.1, the HERs eligibility screens applied in the second Campaign resulted in a much higher exclusion rate, with 35% of advanced meter customers being screened out in the second year versus only 4% in the first year. This large difference may have created systematic differences between the populations of the second Campaign and that of the first and third Campaigns, potentially biasing the comparison of results between the three Campaigns. Third, as described in Section 2.2, the implementation of the default BTAs differed in that the first and third Campaigns included several paper and email educational and promotional materials in addition to BTAs, whereas in the second Campaign, only an email welcome message was included in addition to the BTAs.

With these caveats considered, Figure 5-1 shows the comparison of results for the similar Opower HER treatments across the three Campaigns. The results shown in Figure 5-1 are the savings rates from the first year of treatment for each of the different Campaigns. The Opower Paper-only HER provides consistent measurable percent reductions for each of the Campaigns. The email HER produced lower percent reductions in the second and third Campaigns. These results indicate that the email HER percent reductions from the first Campaign are an anomaly rather than what we should expect to see from future treatments. The Opower Paper and Email HER is not included in this comparison because the treatment population in the third Campaign was dramatically different from the first two Campaigns as this treatment was only applied to CARE customers.

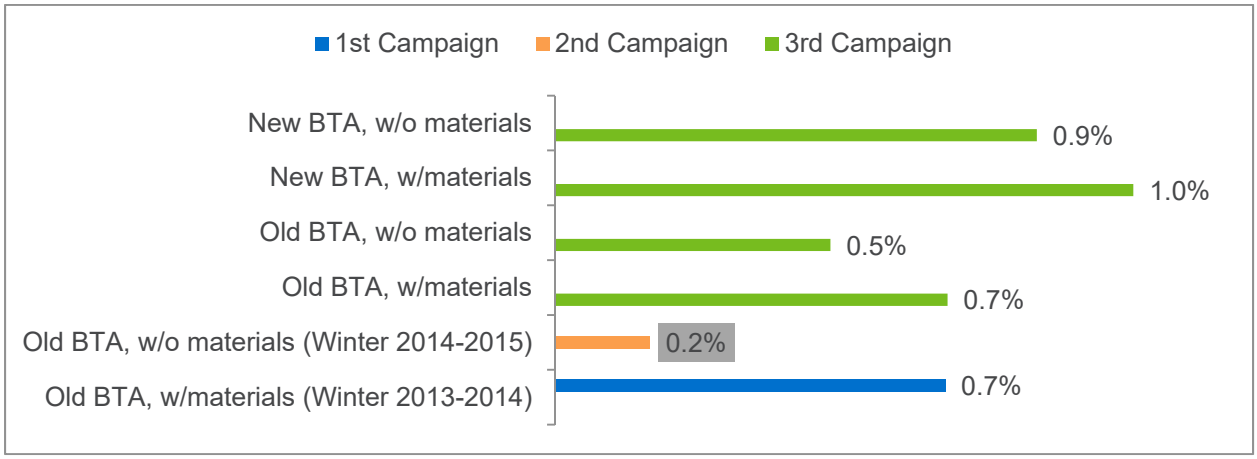
Figure 5-1: Comparison of Opower Treatments Percent Reduction Estimates for the First, Second, and Third Campaigns



The Opower Email HER treatment was virtually identical in all three Campaigns, meaning that a difference in treatment design does not explain the difference in impacts. This suggests that the difference in populations from one year to the next is a more plausible explanation for the difference in impacts for both the Email HERs.

Figure 5-2 shows the comparison of results for BTA treatments across the three Campaigns. The results shown in Figure 5-2 are the savings rates from the first year of treatment for each of the different Campaigns. The New BTA with supplemental promotional materials produced the highest savings rate of the default BTA treatments. Both BTA versions produce higher savings with promotional materials.[31] The difference in performance between the New BTA and the Old BTA was marginally statistically significant, with a P-value of 0.09.

Figure 5-2: Comparison of BTA Treatments Percent Reduction Estimates for the First, Second, and Third Campaigns (Statistically Insignificant Results are in Gray)



The Old BTA with materials produced almost identical results in the first and third Campaigns. The results from the four BTA treatments from the third Campaign showed that the New BTA outperforms the Old BTA. Although the percent reductions are higher for the BTA treatments with promotional materials the difference between including materials and not including materials is not statistically significant.

5.3 HER Gas Savings by Usage Quartile

As input into planning for next year's Conservation Campaign, it is useful to examine how natural gas savings vary across customer segments. If some segments do not respond well to the information treatments and others do, it will be more cost-effective to focus future campaigns on segments that are more responsive to the information offerings.

One potentially useful segmentation scheme is by usage, grouped into quartiles. To put these usage quartiles in context, it is helpful to note their likely influence on the contents of a participant's HER. A key component of HER messaging is the neighbor comparison component, which informs the participant whether their household gas usage is above, below, or in-line with usage for similar homes. Due to the nature of this comparison, top usage quartile customers are more likely to receive messages indicating that their usage is higher than usage for similar homes, thereby providing a signal to conserve. This segmentation was explored in the report for the first Campaign, leading to the conclusion

[31] The difference between the BTA treatments with promotional materials and the BTA treatments without promotional materials is not statistically significant.

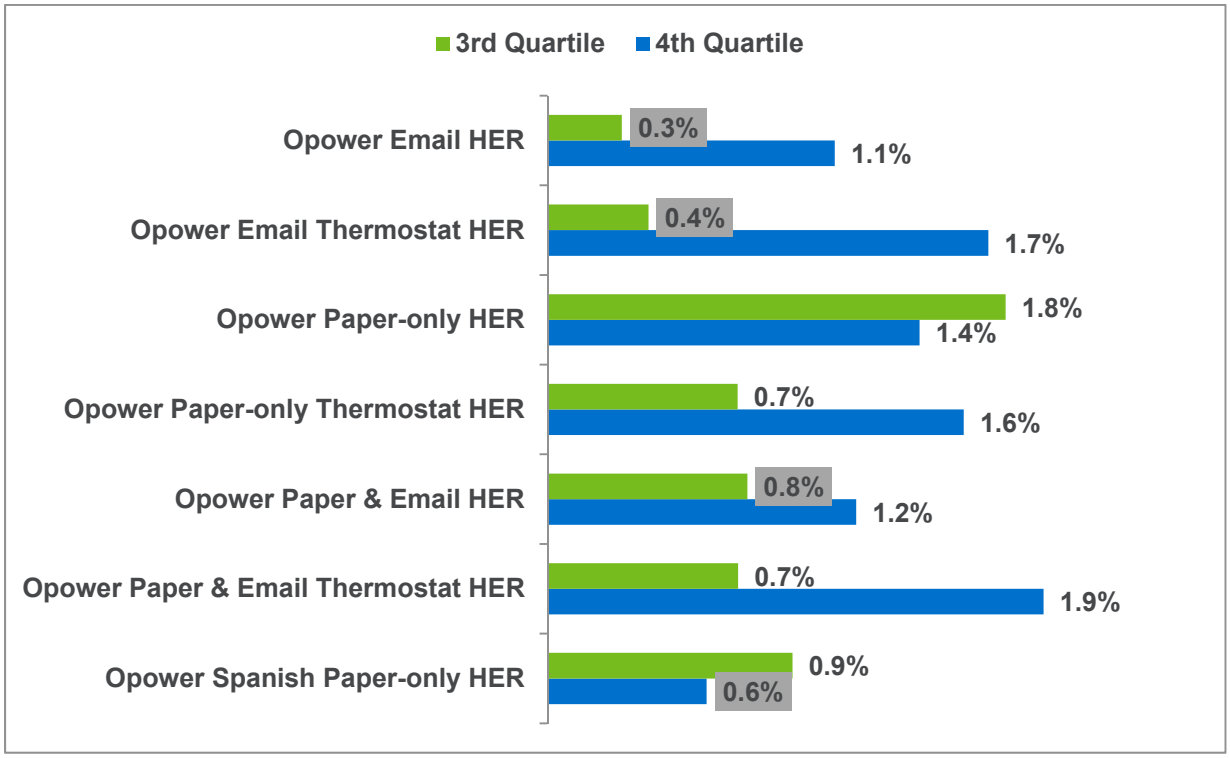
that "both the magnitude of savings and percent savings consistently increase as usage increases."[32] This conclusion led to the decision to focus the second and third Campaigns on the top two usage quartiles only.

Opower HER Gas Savings by Usage Quartile

Figure 5-3 compares percent reductions for the top two quartiles for each of the Opower HER treatments in the third Campaign. As in the prior two campaigns, the HER treatments consistently show similar or higher reductions for the fourth usage quartile as compared to the third quartile. The only exceptions are the Spanish HER and the paper-only HER. In the previous Campaigns the third quartile usage was much lower than the fourth quartile usage for the paper-only HER. This suggests that for this population the participants were more responsive to paper-only HERs than in the past.

The second takeaway from Figure 5-3 is that the third quartile usage impacts for three of the treatments including email HERs were close to zero and statistically insignificant, whereas the fourth quartile impacts were comparable to those of the Opower treatments that featured several paper communications. For this sample population, this finding implies that Opower Email HERs were often not effective for the participants in the third usage quartile, leading to a substantial reduction in the overall savings as compared to the other Opower treatments.

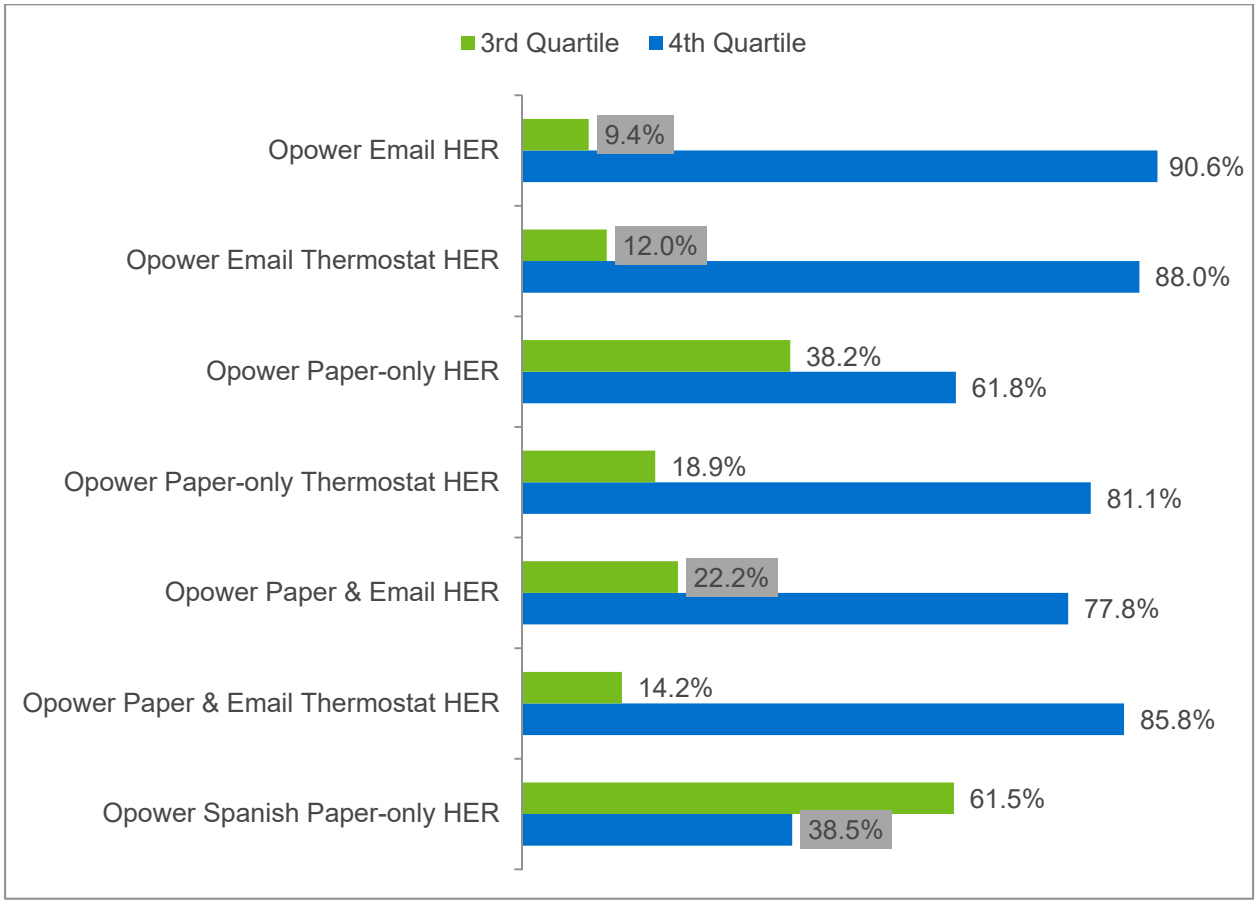
Figure 5-3: Comparison of Opower HER Third Campaign Treatments by Quartile (Statistically Insignificant Results are in Gray)



[32] For further details, refer to Exhibit E: "Evaluation of Southern California Gas Company's 2013-14 Conservation Campaign," included in the "Southern California Gas Company Advanced Meter Semi-Annual Report" filed with the CPUC on August 29, 2014.

Figure 5-4 shows the share of aggregate gas savings in therms attributable to the third versus the fourth usage quartile for each treatment. Even though customers in the third quartile account for one-half of each treatment group, the gas savings for those customers range from 9% to 60% of the overall savings across treatments. Besides the Spanish Paper-only HER, the rest of the Opower treatments have less than 50% of their aggregate savings come from the customers in the third quartile. As in the previous Campaigns, both the magnitude of savings and percent savings consistently increase as usage increases. For fourth usage quartile customers, high usage combined with larger impacts leads to a large percentage of the overall therm savings. Considering that customers in the top usage quartile consistently produce the largest share of therm savings, it may make sense for SoCalGas to further hone conservation efforts by focusing on customers in this group going forward.

Figure 5-4: Percent of Gas Savings Attributable to Each Usage Quartile for Opower HER Treatments (Statistically Insignificant Results are in Gray)



SoCalGas BTA and SoCalGas/Aclara SEU Gas Savings by Usage Quartile

Figure 5-5 compares percent reductions for the top two quartiles for each of the BTA and SEU treatments in the third Campaign. Both of the SEU treatments show higher reductions for the fourth usage quartile as compared to the third quartile. However, for the BTA treatments the percent reductions for the fourth quartile are very similar or lower to the percent reductions for the third quartile. This suggests that customers in the third and fourth quartiles are responsive to the BTA treatment.

Figure 5-5: Comparison of BTA and SEU Third Campaign Treatments by Quartile (Statistically Insignificant Results are in Gray)

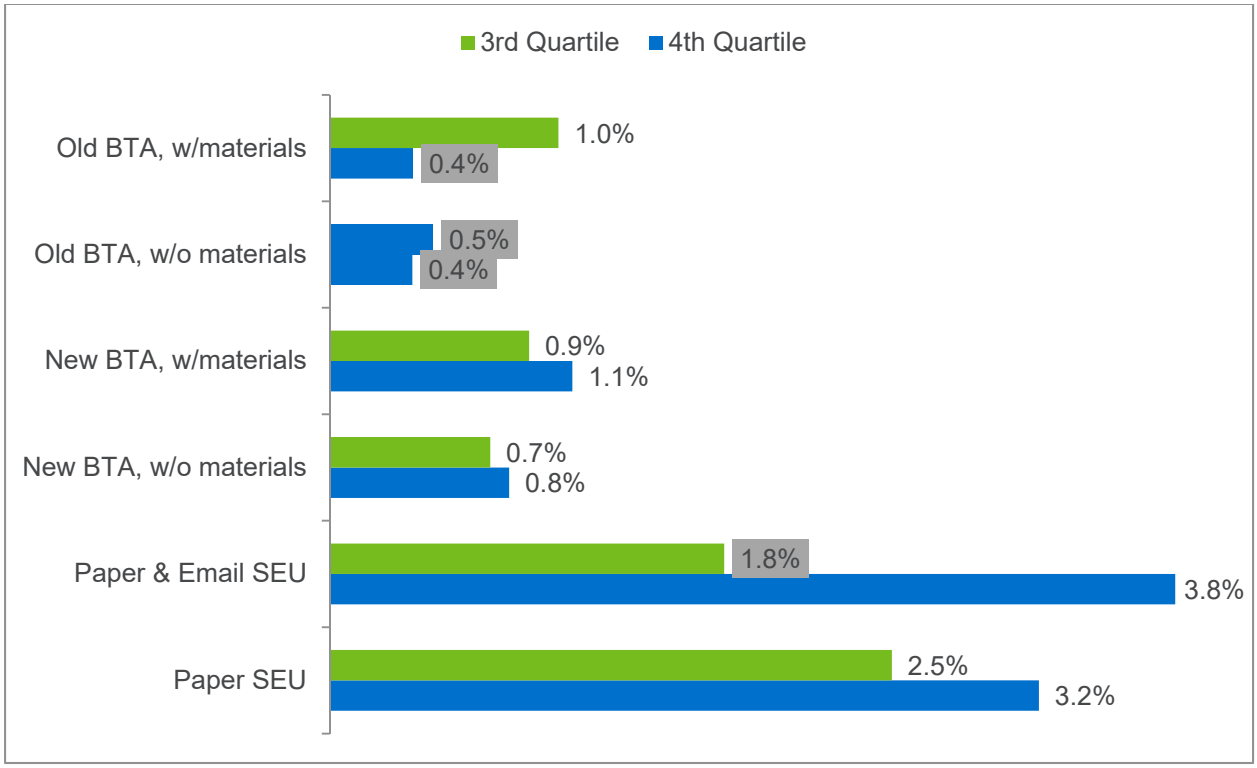
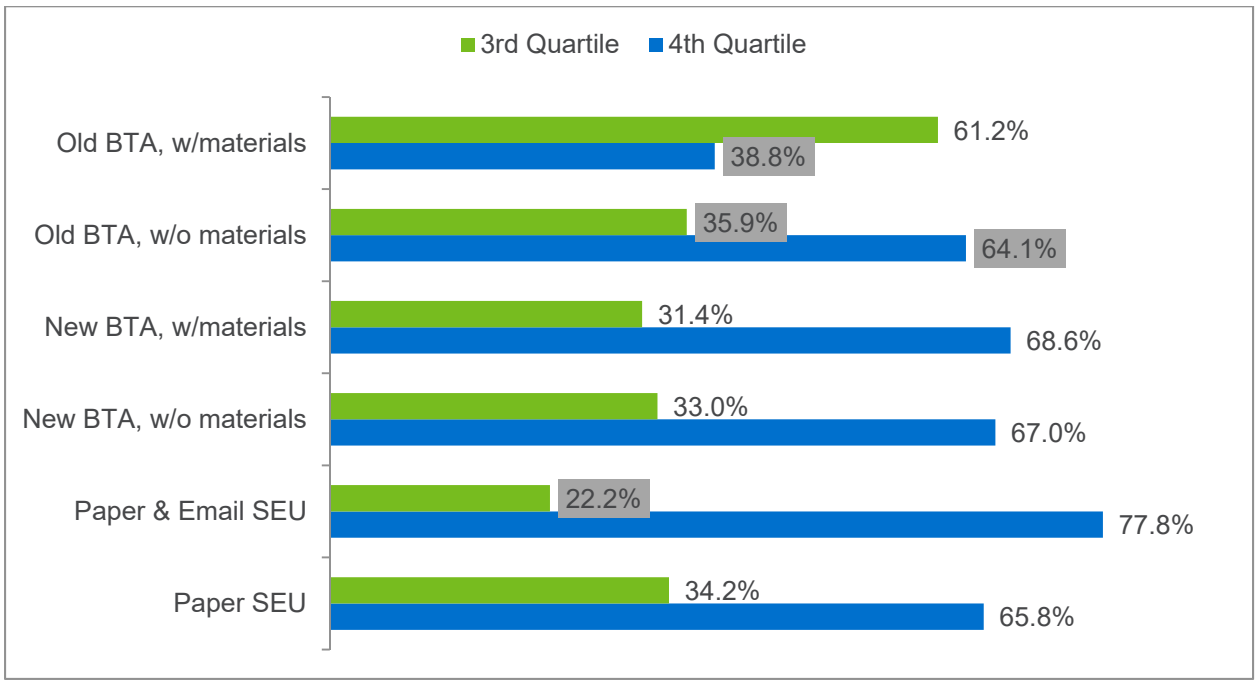


Figure 5-6 shows the share of aggregate gas savings in therms attributable to the third versus the fourth usage quartile for each treatment. Even though customers in the third quartile account for one-half of each treatment group, the gas savings for those customers range from 22% to 61% of the overall savings across treatments. Besides the Old BTA with materials, the rest of these treatments have less than 50% of their aggregate savings come from the customers in the third quartile. For fourth usage quartile customers, high usage combined with larger impacts leads to a large percentage of the overall therm savings.

Figure 5-6: Percent of Gas Savings Attributable to Each Usage Quartile for BTA and SEU Treatments (Statistically Insignificant Results are in Gray)



Other Segmentations Analyzed

As with each treatment in the first two Conservation Campaigns, Nexant segmented the 2015-2016 gas savings results by several demographic variables using granular block-level data from the 2010 U.S. Census. However, there weren't any consistent trends in 2015-2016 gas savings to report here. Given that the test cell design of the third Campaign leveraged many segmentation-based insights from the first two Campaigns, consistent drivers of differences in gas savings across demographic characteristics have been accounted for in the segmentation of the treatment population. For example, gas savings for CARE customers were consistently lower in the first two Campaigns for email-based treatments, so the design for the 2015-2016 Campaign segmented those customers into a sub-population that received paper-based treatments. Similarly, gas savings for customers in census blocks with a high percentage of Latinos were also consistently lower, so those customers were segmented into a population that received a Spanish-language treatment instead. These data-driven improvements from one year to the next highlight the benefits of the adaptive "test and learn" strategy. The rigorous research design, data analysis and segmentations of the results yielded several quick insights that led to SoCalGas identifying the types of treatments that are most cost-effective for each segment of the population.

5.4 Percent Reductions in Second Year for 2014-2015 Conservation Campaign

Table 5-2 provides the estimated second year percent reductions for treatments from the second Campaign, shown alongside the impacts from the previous year (year 1) for these same treatments. The estimates were derived by using the LDV model to compare customer usage from November 2015 through March 2016 as compared to usage in the pretreatment period (November 2013 through March 2014). These reductions were for the most part slightly lower than the savings from those estimated for first year of the 2014–2015 Conservation Campaign, except the savings for Opower Email HER and the Opower Paper-only HER, which were somewhat higher.

Table 5-2: Estimates of Percent Reductions in Gas Energy Consumption for Residential Treatments Initiated in 2014–2015, November 2015 through March 2016 (Statistically Insignificant Results are in Gray)

My Account	Treatment	Group	Number of Treatment Customers	Year 2 results (LDV)		Year 1 results (LDV)	
				% Reduction	P-value	% Reduction	P-value
Yes	Opower Email HER	T-8	11,964	0.96%	0.02	0.74%	0.05
	Aclara Email HER	T-9	12,037	-0.35%	0.39	-0.04%	0.92
	Opower Paper & Email HER	T-10	12,000	1.38%	0.00	1.45%	0
	Aclara Paper & Email HER	T-11	11,967	-0.34%	0.42	0.04%	0.9
	Default BTA	T-12	48,333	0.08%	0.80	0.17%	0.51
No	Opower Paper-only HER	T-13	47,910	1.86%	0.00	1.48%	0
	Aclara Paper-only HER	T-14	47,940	0.34%	0.11	0.51%	0

Table 5-3 provides the estimated percent reductions during spring and summer of 2015 for the treatments from the second Campaign. The estimates were derived by using the LDV model to compare customer usage from April 2015 through October 2015 as compared to usage in the pretreatment period—April 2014 through October 2014. Reductions were only statistically significant for the Opower Paper-only HER treatment (.77%, less than half of the savings during the treatment period) and the Opower Paper and Email HER (1.35%, only slightly less than the savings during the treatment period). The Opower Email HER did not produce measurable savings during the spring / summer period. An interesting distinction between the Opower Email HER and the Opower Paper and Email HER in the second Campaign is that the latter received email reports during the non-winter period while the email-only group did not receive email reports during this time period.

Table 5-3: Estimates of Percent Reductions in Gas Energy Consumption for Residential Treatments Initiated in 2014–2015, April 2015 through October 2015 (Statistically Insignificant Results are in Gray)

My Account	Treatment	Group	Number of Treatment Customers	Year 1 spring / summer results (LDV)	
				% Reduction	P-value
Yes	Opower Email HER	T-8	12,332	0.37%	0.41
	Aclara Email HER	T-9	12,397	-0.49%	0.25
	Opower Paper & Email HER	T-10	12,367	1.35%	0.00
	Aclara Paper & Email HER	T-11	12,354	0.45%	0.26
	Default BTA	T-12	49,766	0.21%	0.50
No	Opower Paper-only HER	T-13	48,915	0.77%	0.00
	Aclara Paper-only HER	T-14	48,976	0.15%	0.52

5.5 Persistence of Percent Reductions in Third Year for 2013–2014 Conservation Campaign

Table 5-4 provides the estimated third year percent reductions for treatments from the first Campaign, shown alongside the impacts from the previous two years (year 1 and year 2) for these same treatments. The estimates were derived by using the LDV model to compare customer usage from November 2015 through March 2016 as compared to usage in the pretreatment period (November 2012 through March 2013). The results for the Opower Paper-only and the Opower Paper and Email HER were significantly lower than the prior two years. These two treatments stopped producing measurable savings in the third year. It is important to note that these customers have not received reports since winter 2013–2014. The Opower Email HER percent reductions persisted into the second year without treatment and actually increased from last year (1.6 in year 3 as compared to 1.3 in the previous year).The default BTA continued to produce statistically significant savings as well. For the default BTA, SoCalGas continued to send alerts in years 2 and 3.

Table 5-4: Estimates of Percent Reductions in Gas Energy Consumption for Residential Treatments Initiated in 2013–2014, November 2015 through March 2016 (Statistically Insignificant Results are in Gray)

My Account	Treatment	Group	Number of Treatment Customers	Year 3 results (LDV)		Year 2 results (LDV)		Year 1 results (LDV)	
				% Reduction	P-value	% Reduction	P-value	% Reduction	P-value
Yes	Opower Email HER	T-3	9,167	1.59%	0.00	1.33%	0	1.37%	0
	Opower Paper & Email HER	T-2	9,159	-0.08%	0.87	1.12%	0.01	1.54%	0
	Default BTA	T-4	18,461	1.28%	0.00	1.20%	0	0.70%	0.02
No	Opower Paper-only HER	T-1	20,214	0.29%	0.43	1.03%	0	1.58%	0

Table 5-4 illustrates that savings for these two treatments persisted into the second winter after the treatments began in first Campaign. Some savings also persisted into the spring and summer months (April through October) just after the treatments ended.[33] While gas usage is typically much lower in these months, understanding the level of percent savings will show to what extent savings persist immediately after treatment as well as begin to inform what relative level of savings can be achieved in months with lower underlying gas usage.

Table 5-5 provides the estimated percent reductions during spring and summer of 2015 for default treatments from the first Campaign. The estimates were derived by using the LDV model to compare customer usage from April 2015 through October 2015 as compared to usage in the

[33] Treatments ended in March 2014 for all groups but the BTA groups who continued to receive alerts.

pretreatment period (April 2013 through October 2013). Reductions were not statistically significant for any of the treatments for the second year of spring / summer results.

Table 5-5: Estimates of Percent Reductions in Gas Energy Consumption for Residential Treatments Initiated in 2013–2014, April 2015 through October 2015 (Statistically Insignificant Results are in Gray)

My Account	Treatment	Group	Number of Active Customers	Year 2 spring / summer results (LDV)		Year 1 spring / summer results (LDV)	
				% Reduction	P-value	% Reduction	P-value
Yes	Opower Email HER	T-3	9,799	0.54%	0.31	0.87%	0.02
	Paper & Email HER	T-2	9,830	-0.34%	0.49	1.13%	0.00
	Default BTA	T-4	19,684	0.37%	0.36	0.32%	0.29
No	Paper-only HER	T-1	21,081	0.49%	0.21	0.47%	0.06

5.6 Estimated Gas Savings

Once a statistically significant usage reduction within a given test cell is identified, the analysis can be done at the monthly level, which allows for the re-inclusion of some customers that may not have had usage data for every month, but do have data for some pre- and post-treatment months.

Table 5-6 summarizes the estimated gas savings for the 2015–2016 SoCalGas Conservation Campaign, based on the monthly-level analysis. Gas savings are only calculated for the treatments that produced statistically significant usage reductions using the LDV model, which includes the Opower Email HER and the Default BTA treatments from the 2013–2014 Conservation Campaign, the three Opower treatments from the 2014–2015 Conservation Campaign, and all of the treatments from the 2015–2016 Campaign. Overall, the new and continued treatments produced gas savings of over 1.5 million therms between April 2015 and March 2016, or about 1.4%.

In total, approximately 971,000 therms were conserved as a result of the new treatments for the 2015–2016 Conservation Campaign, representing a savings of almost 1.5%. Roughly 41% of the 971,000 therms conserved came from the two SEU treatments.

The treatments initiated in the 2014–2015 Conservation Campaign conserved a total of almost 403,000 therms during the 2015–2016 winter. This was higher than the 359,000 therms estimated for the Campaign in its first year, though this could be due to a combination of factors including colder weather in the 2015–2016 winter. Roughly 76% of the 403,000 therms conserved came from the Opower Paper-Only HER, though this treatment had almost four times as many customers as the other two Opower treatments.

An additional almost 93,000 therms were saved over the summer / spring of 2015 as a result of treatments in the 2014–2015 Conservation Campaign with statistically significant reductions. Only the Opower Paper and Email HER and the Opower Paper-only HER produced measureable savings during this time period.

Roughly 91,000 therms were conserved during the winter as a result of the treatments in the 2013–2014 Conservation Campaign. This was somewhat lower than the nearly 142,000 therms estimated for the Campaign in its second year, however this is expected as it looks as though the persistence dropped off for the Opower HERs after two years of not receiving reports. Only the default BTA and the Opower Email HER continued to produce measureable savings in the third year. Roughly 59% of the 91,000 therms conserved came from treatment group default BTA, which had more than double the amount of customers in the Opower Email HER.

None of the first Campaign treatments produced measurable savings over the summer/spring of 2015.

Table 5-6: Estimated Gas Savings for the 2015–2016 SoCalGas Conservation Campaign

Initial Treatment Year	Treatment	Group	Number of Active Customers per Month	Average Customer Total Usage for November-March			Aggregate Usage for November-March		
				Reference Therms	Observed Therms	Therms Saved	Reference Therms	Observed Therms	Therms Saved
2015-2016	Opower Email HER	T-16	13,086	314.2	311.5	2.7	4,111,884	4,076,032	35,853
	Opower Email Thermostat HER	T-19	13,094	312.6	308.6	4.1	4,093,756	4,040,393	53,364
	Paper & Email SEU	T-24	17,877	316.7	306.9	9.7	5,661,238	5,487,113	174,125
	Old BTA, w/materials	T-26	19,069	313.2	310.9	2.2	5,971,615	5,929,013	42,602
	Old BTA, w/o materials	T-27	19,032	313.5	311.9	1.6	5,966,453	5,936,037	30,416
	New BTA, w/materials	T-28	19,035	313.4	310.3	3.1	5,966,207	5,906,343	59,864
	New BTA, w/o materials	T-29	19,062	313.6	310.9	2.7	5,978,142	5,925,983	52,159
	Opower Paper-only HER	T-17	13,364	325.2	320.5	4.7	4,345,668	4,283,247	62,422
	Opower Paper-only Thermostat HER	T-20	13,342	324.1	319.9	4.2	4,323,997	4,267,745	56,253
	Paper-only SEU	T-25	23,494	312.5	302.9	9.6	7,342,636	7,117,488	225,147
	Opower Paper & Email CARE HER	T-15	13,082	294.6	291.7	2.9	3,854,234	3,816,014	38,220
	Opower Thermostat CARE HER (ESAP & Non-ESAP)	T-18	26,205	293.1	288.7	4.4	7,680,287	7,564,218	116,069
	Opower Spanish Paper-only HER	T-21	13,319	218.9	217.0	1.9	2,915,111	2,889,924	25,187
Overall for 2015-2016 treatments (winter)			**223,061**	**305.8**	**301.4**	**4.4**	**68,211,228**	**67,239,550**	**971,680**
2014-2015	Opower Email HER	T-8	11,964	326.7	323.5	3.2	3,908,946	3,870,467	38,479
	Opower Paper & Email HER	T-10	12,000	326.9	322.2	4.8	3,923,325	3,865,897	57,428
	Opower Paper-only HER	T-13	47,910	338.9	332.5	6.4	16,237,812	15,931,191	306,621
Overall for 2014-2015 treatments (winter)			**71,874**	**334.9**	**329.3**	**5.6**	**24,070,084**	**23,667,555**	**402,529**
2014-2015	Opower Paper & Email HER	T-10	12,367	179.8	177.5	2.3	2,223,411	2,195,239	28,172
	Opower Paper-only HER	T-13	48,915	179.6	178.2	1.3	8,783,175	8,718,603	64,571
Overall for 2014-2015 treatments (spring/summer)			**61,282**	**179.6**	**178.1**	**1.5**	**11,006,586**	**10,913,842**	**92,743**
2013-2014	Opower Email HER	T-3	9,167	240.2	236.1	4.0	2,201,611	2,164,595	37,016
	Default BTA	T-4	48,915	90.2	89.1	1.1	4,410,978	4,356,695	54,284
Overall for 2013-2014 treatments (winter)			**58,082**	**113.8**	**112.3**	**1.6**	**6,612,589**	**6,521,290**	**91,300**
Overall			**414,299**	**265.3**	**261.5**	**3.8**	**109,900,487**	**108,342,237**	**1,558,251**

6 Recommendations for 2016–2017 Conservation Campaign

Throughout the AM rollout until the end of 2017, SoCalGas is implementing a cycle of innovation in which continuous assessment and improvement in the performance of feedback programs is the primary objective. This is referred to as the "test and learn" process, which is consistent with what the CPUC envisioned in D.10-04-027. This decision approved SoCalGas' AM application, as discussed in Section 2. As the implementation proceeds, high performing program design options will be retained and offered to an increasingly larger share of customers who receive advanced meters. At the same time, new program design alternatives will be tested based on the experiences gained from the prior round of implementation. Programs and program design features that are less effective will be abandoned or modified. In this way, over the course of the AM rollout, the most effective means for encouraging energy savings from information feedback will be identified and offered to customers.

SoCalGas also conducted market research to evaluate the 2015-2016 Campaign treatments. Additional qualitative research was conducted utilizing in-depth interviews to evaluate the current treatments from the 2015-2016 Campaign, including potential enhancements for the upcoming season. The outcomes from the research included the additional graphics for the BTA and the upcoming enhancements for the SEU, as described below.

As discussed in Section 2.4, the 2015-2016 winter was colder than the previous two winters. As a result, the residential gas usage was substantially higher than the prior two years. The higher observed gas usage was also associated with higher percentage savings relative to the prior campaigns. This is reasonable given there are more opportunities to conserve when the usage is higher. Based on the weather and results observed to date, it would be reasonable to expect that in warmer years the conservation savings may be lower compared to years with relatively colder weather.

Furthermore, a fundamental tenant of the "test and learn" process is to continuously improve toward more cost-effective solutions. The third Campaign was the first of the three Campaigns to have all treatments produce statistically significant results. However, it is still possible to produce comparable (or higher) energy savings at a lower cost. Therefore, to test ways of improving cost-effectiveness, the 2016-2017 Conservation Campaign may adjust the program offerings for residential customers as follows:

- Continue to track savings for all customers receiving BTAs. Monitor any change in savings that occur once all customers currently receiving the Old BTA are transitioned to receiving the New BTA;
- Continue to explore ways to improve the BTA, as it has proven to be one of the most cost effective treatments for My Account customers. Test a new enhanced version of the New BTA with an additional view of usage patterns based on market research findings;
- Test the New BTA with and without seasonal savings tips in the same population to determine whether these tips increase savings;
- Explore how SEUs perform on CARE customers;
- Test new weatherization focused SEU on Non-CARE customers;
- Compare the Paper SEU treatments against the Opower Paper-only HER by ensuring that both treatments are tested on comparable populations;

- Retest Aclara Paper HERs;
- Develop an in-house paper HER to test against Aclara and Opower paper HERs;
- Test a combination of two different information feedback options, BTA with tips and Opower Paper HER, to see if there are incremental savings relative to other populations that only received the BTA treatment;
- Potentially test the impact of providing a Bilingual English-Spanish language paper HER and welcome materials in lieu of the either a single language English or Spanish HER for customers in areas with high rates of Latino population or to customers indicating a Spanish language preference. Test whether a self-comparison is more effective on this population than the neighborhood comparison used previously in the Spanish and English HERs;
- Continue to test treatments with the top two usage quartiles since they both produce measurable therm savings; and
- Test the BTA on Small and Medium Business (SMB) customers.

6.1 Conservation Programs for Non-residential Customers

The first Campaign tested BTAs with SMB customers on both an opt-in and default basis. However, at the time of the first Campaign there were too few SMB customers with AM data to accommodate a randomized controlled trial. SoCalGas decided to exclude SMB customers from the second and third Conservation Campaigns until there were sufficient numbers with advanced meters.

SoCalGas has decided to start testing BTAs with SMB customers again in the 2016–2017 Conservation Campaign, enabled by the larger numbers of SMB customers that have advanced meters at this point. These SMB BTAs will target specific segments with higher interest and propensity to save, such as the restaurant / food industry. As SoCalGas explores these SMB options it will be important to factor known challenges into program design. Different methods will be tested to pick the best evaluation approach to estimate the expected small savings. As shown by the low BTA opt-in rates observed for the SMB segment in the 2013–2014 Campaign, it can be difficult to identify and contact the key decision makers for SMB customers. Similar behaviors have been observed in other “Business Energy Report” pilot programs.

Appendix A Opower Home Energy Report Materials

Appendix A presents only the standard Opower HER materials. The thermostat Opower HER materials can be found in Appendix B and the Spanish Opower HER materials can be found in Appendix C.

In addition to the paper and email HER examples in Section 2.2, Opower also sent a HER welcome insert and a door hanger, which are included in this appendix. There were also differences between the paper HERs sent each month as well as a slight difference between the email HERs sent in the first month (November 2015) and in subsequent months. Samples of each are included in this appendix.

Figure A - 1 shows the front and back of the Opower HER welcome insert, which was delivered to nearly 13,750 Opower paper-only HER customers,13,750 Opower paper & email HER customers, and 13,750 email HER customers in November 2015. Figure A - 2 shows the inside page of the HER welcome insert. Figure A - 3 displays the door hanger that was delivered to all of the Opower HER customers.

Figure A - 4 through Figure A - 11 show the front and back of the paper HER sent in each month. Figure A - 12 shows the email HER sent December and in subsequent months (January 2016 and after).

A.1 Opower HER Welcome materials

Figure A - 1: November Opower HER Welcome Insert (Front and Back)

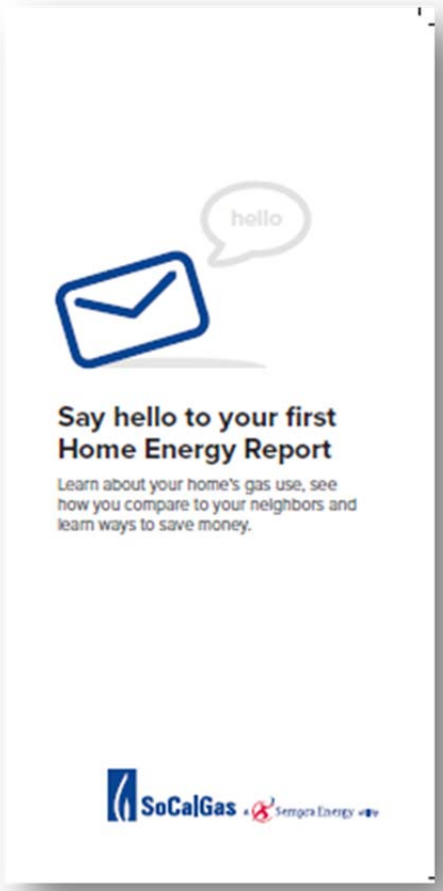
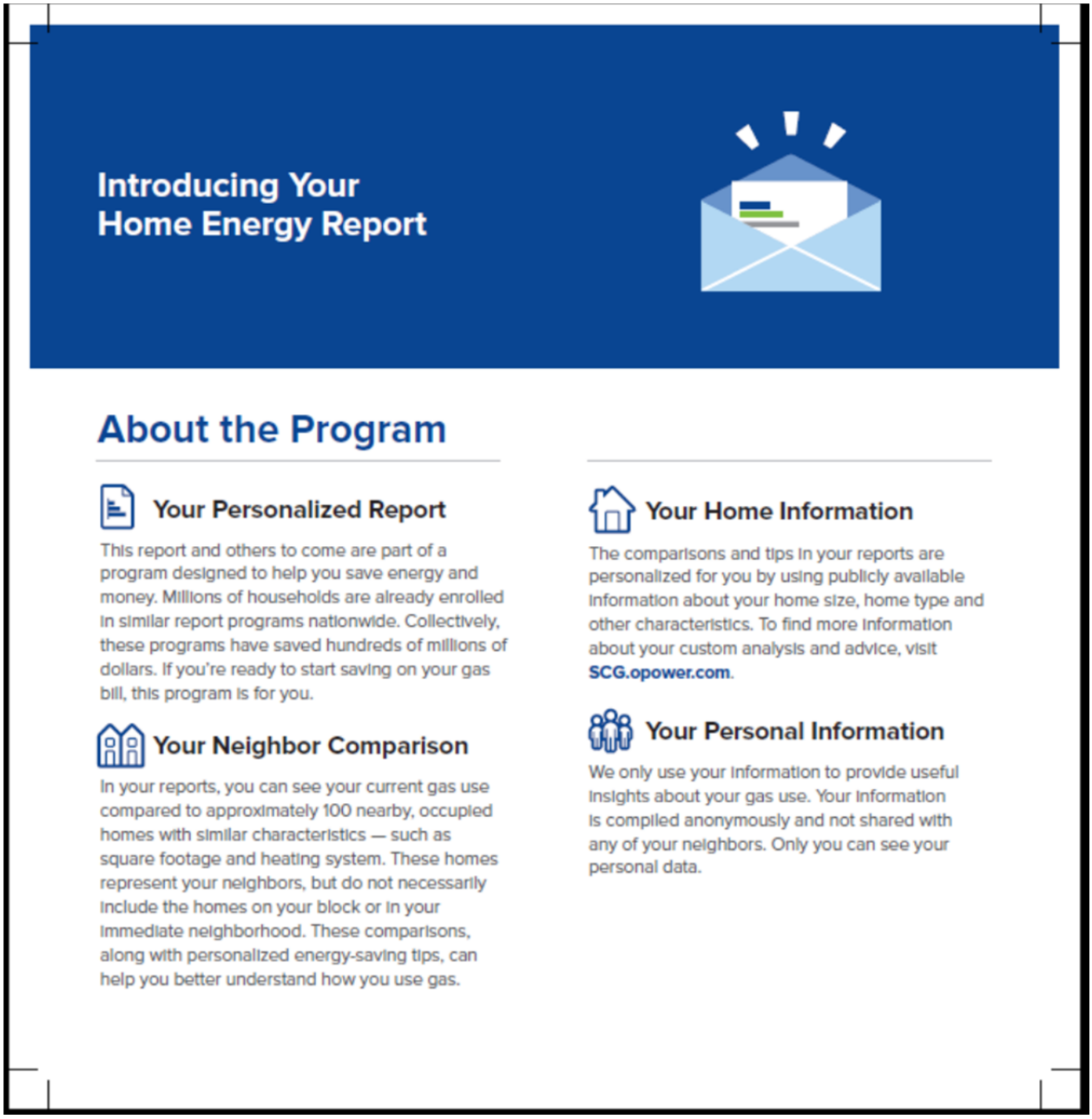




Figure A - 2: November Opower HER Welcome Insert (Inside Page)



Introducing Your Home Energy Report

About the Program

Your Personalized Report

This report and others to come are part of a program designed to help you save energy and money. Millions of households are already enrolled in similar report programs nationwide. Collectively, these programs have saved hundreds of millions of dollars. If you're ready to start saving on your gas bill, this program is for you.

Your Neighbor Comparison

In your reports, you can see your current gas use compared to approximately 100 nearby, occupied homes with similar characteristics — such as square footage and heating system. These homes represent your neighbors, but do not necessarily include the homes on your block or in your immediate neighborhood. These comparisons, along with personalized energy-saving tips, can help you better understand how you use gas.

Your Home Information

The comparisons and tips in your reports are personalized for you by using publicly available information about your home size, home type and other characteristics. To find more information about your custom analysis and advice, visit **SCG.opower.com**.

Your Personal Information

We only use your information to provide useful insights about your gas use. Your information is compiled anonymously and not shared with any of your neighbors. Only you can see your personal data.

Figure A - 3: Opower HER Door Hanger

Front **Back**



A.1 Opower Paper HERs

Figure A - 4: Opower Paper November HER Example (Front)



Figure A - 5: Opower November Paper HER Example (Back)

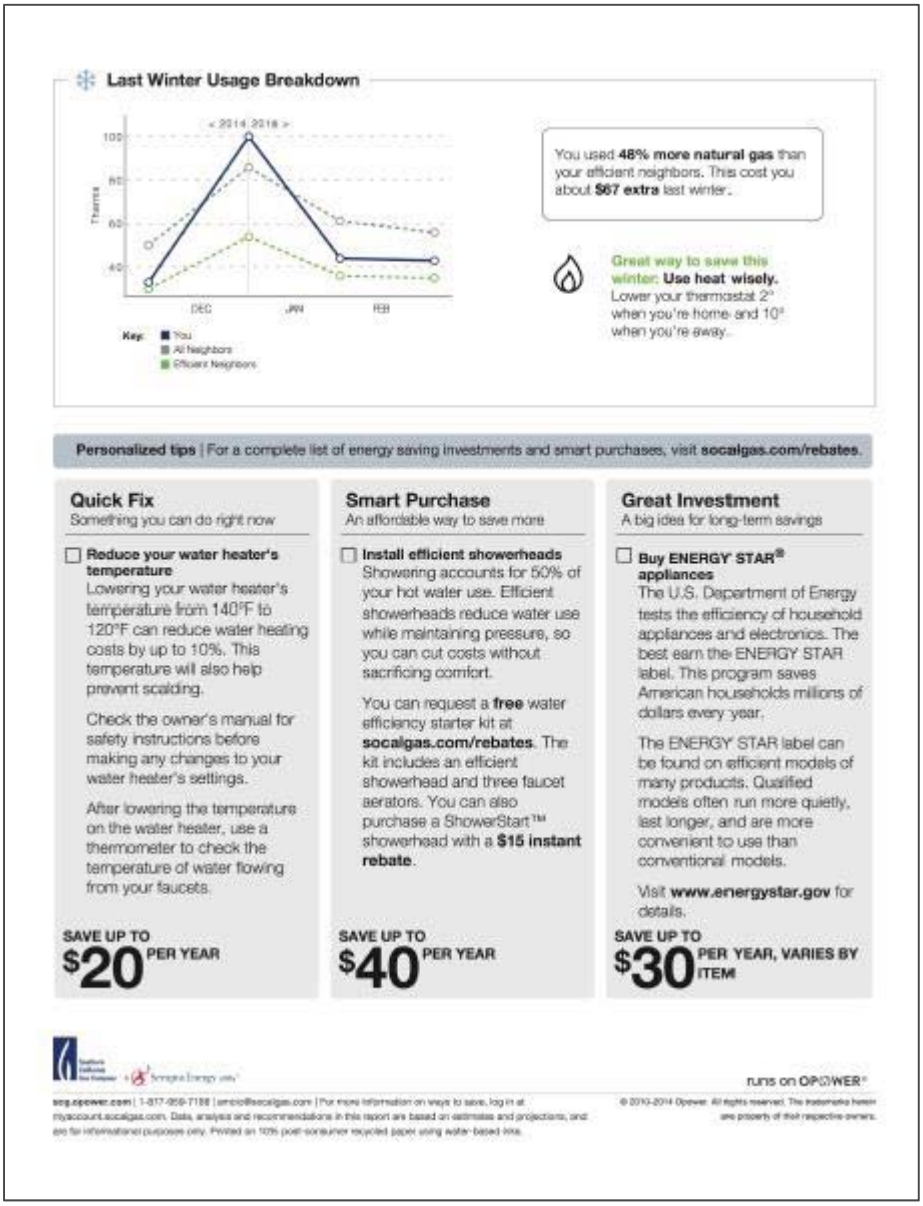


Figure A - 6: Opower Paper December HER Example (Front)

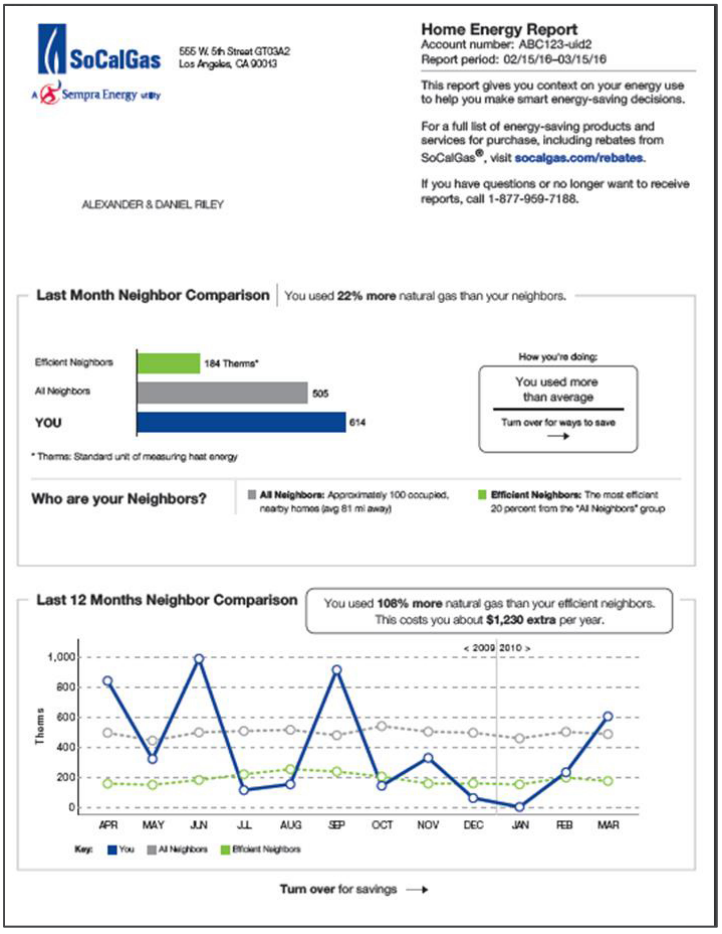
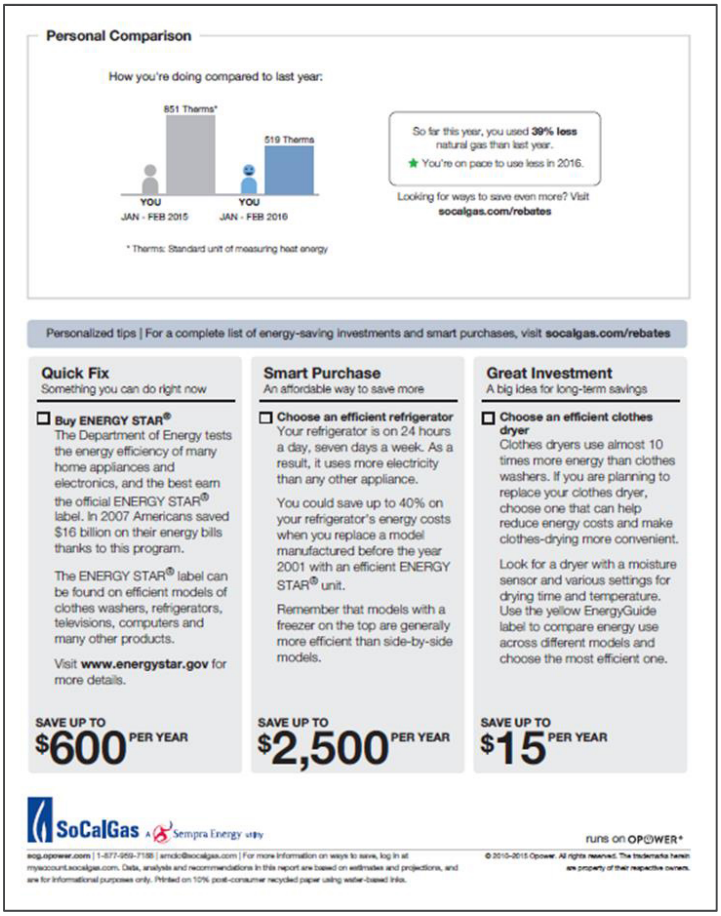


Figure A - 7: Opower December Paper HER Example (Back)



Personal Comparison

How you're doing compared to last year:

851 Therms*
519 Therms
YOU JAN - FEB 2015
YOU JAN - FEB 2016

* Therms: Standard unit of measuring heat energy

So far this year, you used **39% less** natural gas than last year.
★ You're on pace to use less in 2016.

Looking for ways to save even more? Visit **socalgas.com/rebates**

Personalized tips | For a complete list of energy-saving investments and smart purchases, visit **socalgas.com/rebates**

Quick Fix
Something you can do right now

☐ **Buy ENERGY STAR®**
The Department of Energy tests the energy efficiency of many home appliances and electronics, and the best earn the official ENERGY STAR® label. In 2007 Americans saved $16 billion on their energy bills thanks to this program.

The ENERGY STAR® label can be found on efficient models of clothes washers, refrigerators, televisions, computers and many other products.

Visit **www.energystar.gov** for more details.

SAVE UP TO **$600** PER YEAR

Smart Purchase
An affordable way to save more

☐ **Choose an efficient refrigerator**
Your refrigerator is on 24 hours a day, seven days a week. As a result, it uses more electricity than any other appliance.

You could save up to 40% on your refrigerator's energy costs when you replace a model manufactured before the year 2001 with an efficient ENERGY STAR® unit.

Remember that models with a freezer on the top are generally more efficient than side-by-side models.

SAVE UP TO **$2,500** PER YEAR

Great Investment
A big idea for long-term savings

☐ **Choose an efficient clothes dryer**
Clothes dryers use almost 10 times more energy than clothes washers. If you are planning to replace your clothes dryer, choose one that can help reduce energy costs and make clothes-drying more convenient.

Look for a dryer with a moisture sensor and various settings for drying time and temperature. Use the yellow EnergyGuide label to compare energy use across different models and choose the most efficient one.

SAVE UP TO **$15** PER YEAR

SoCalGas A Sempra Energy utility

runs on OPOWER*

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Figure A - 8: Opower Paper January HER Example (Front)

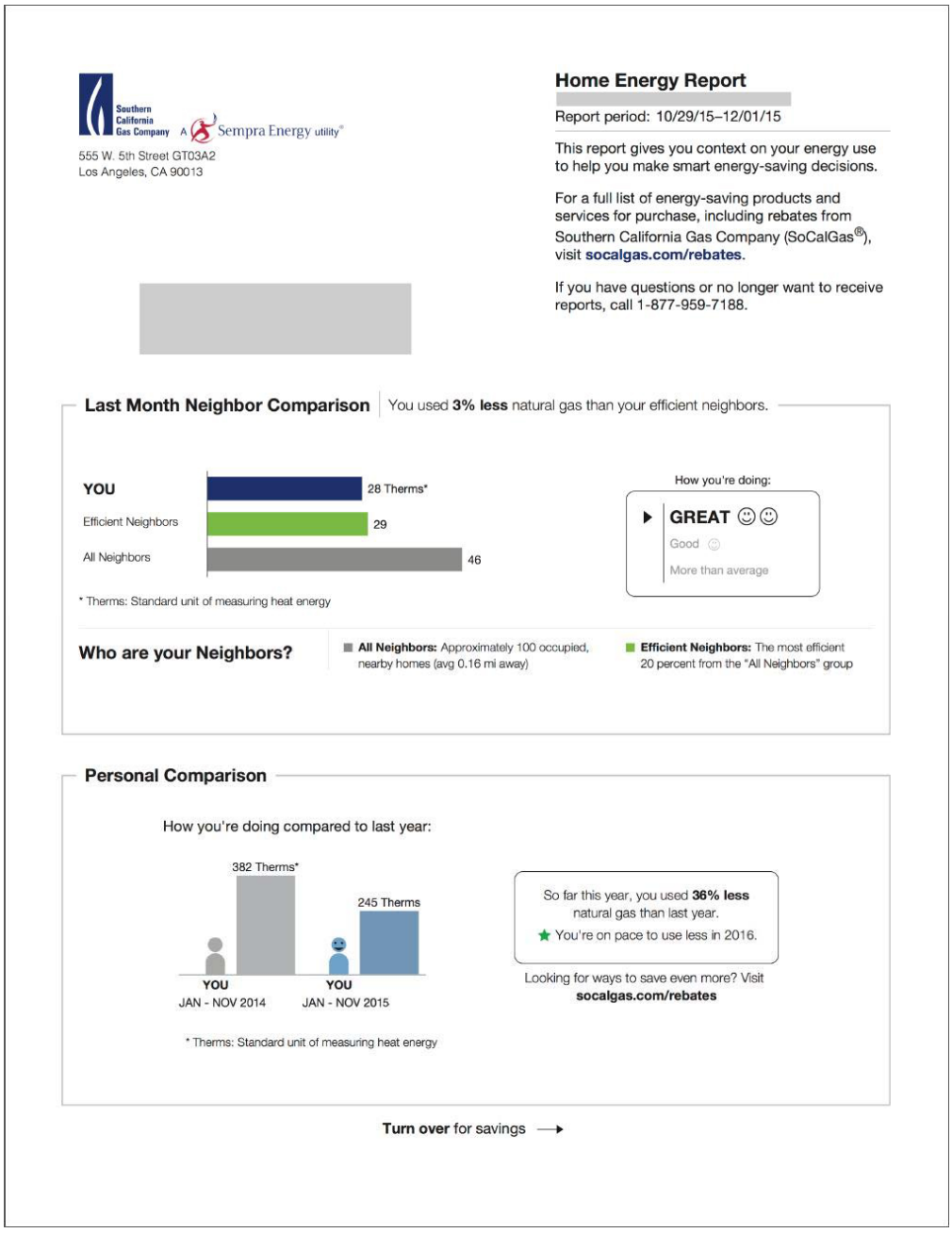


Figure A - 9: Opower January Paper HER Example (Back)

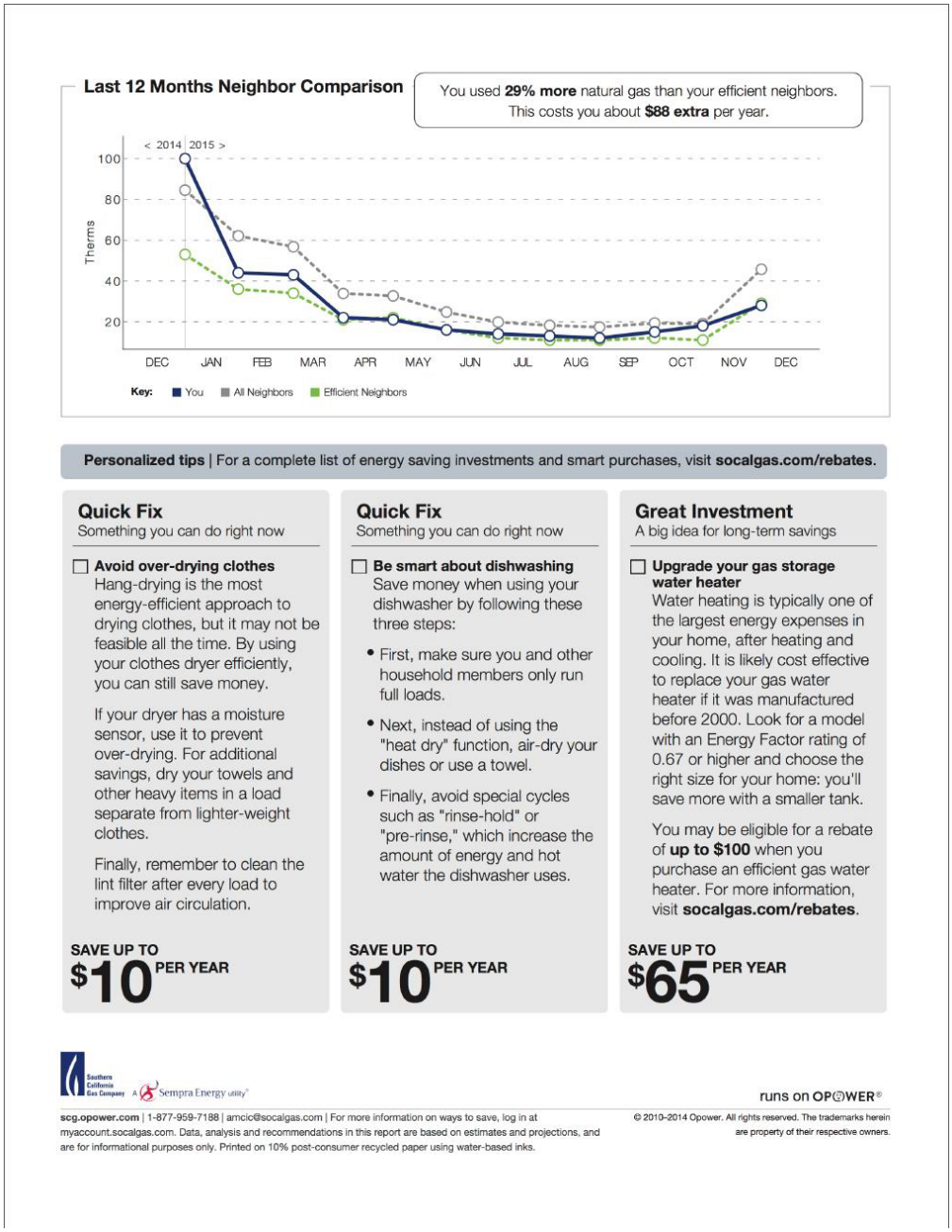


Figure A - 10: Opower Paper February HER Example (Front)

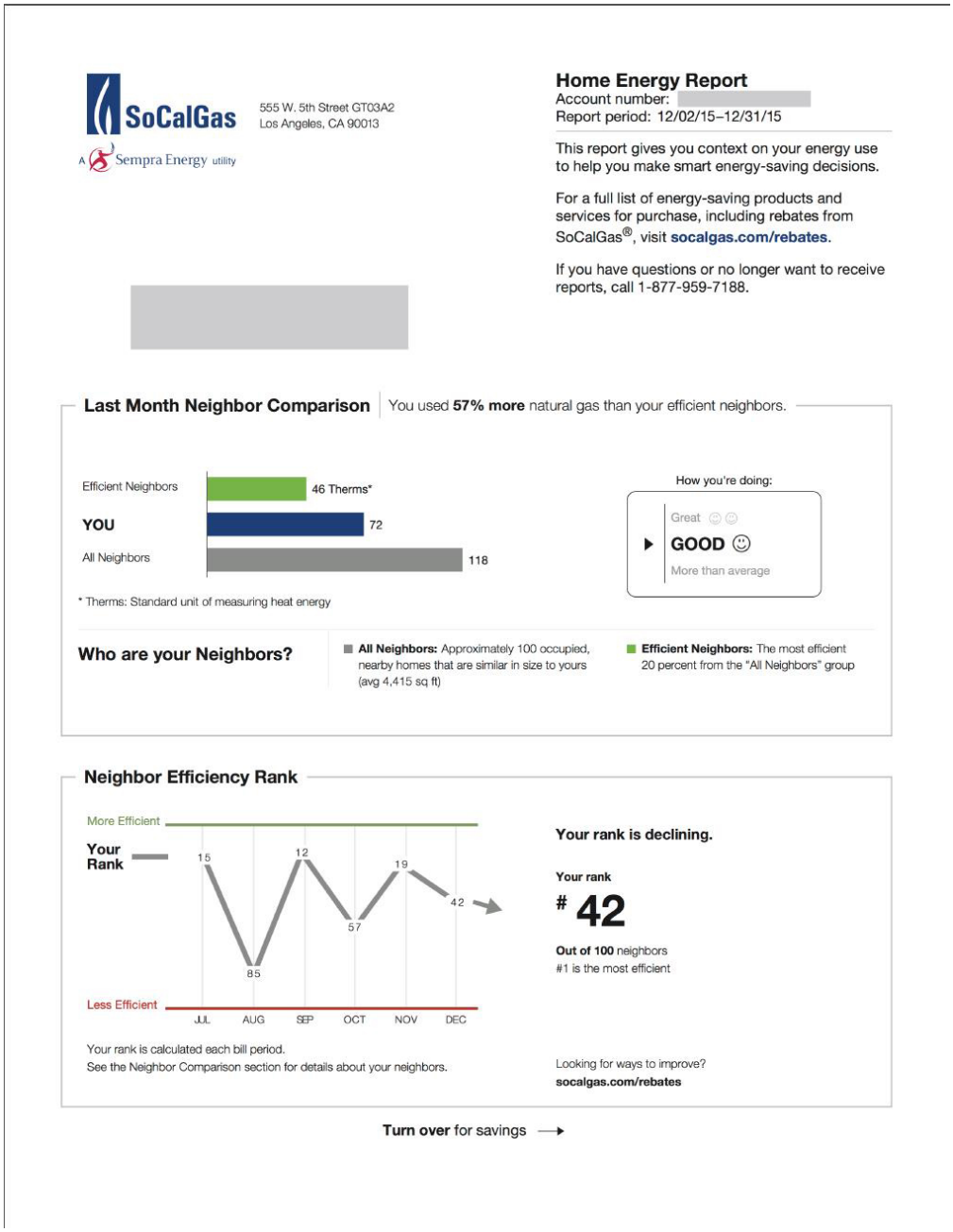
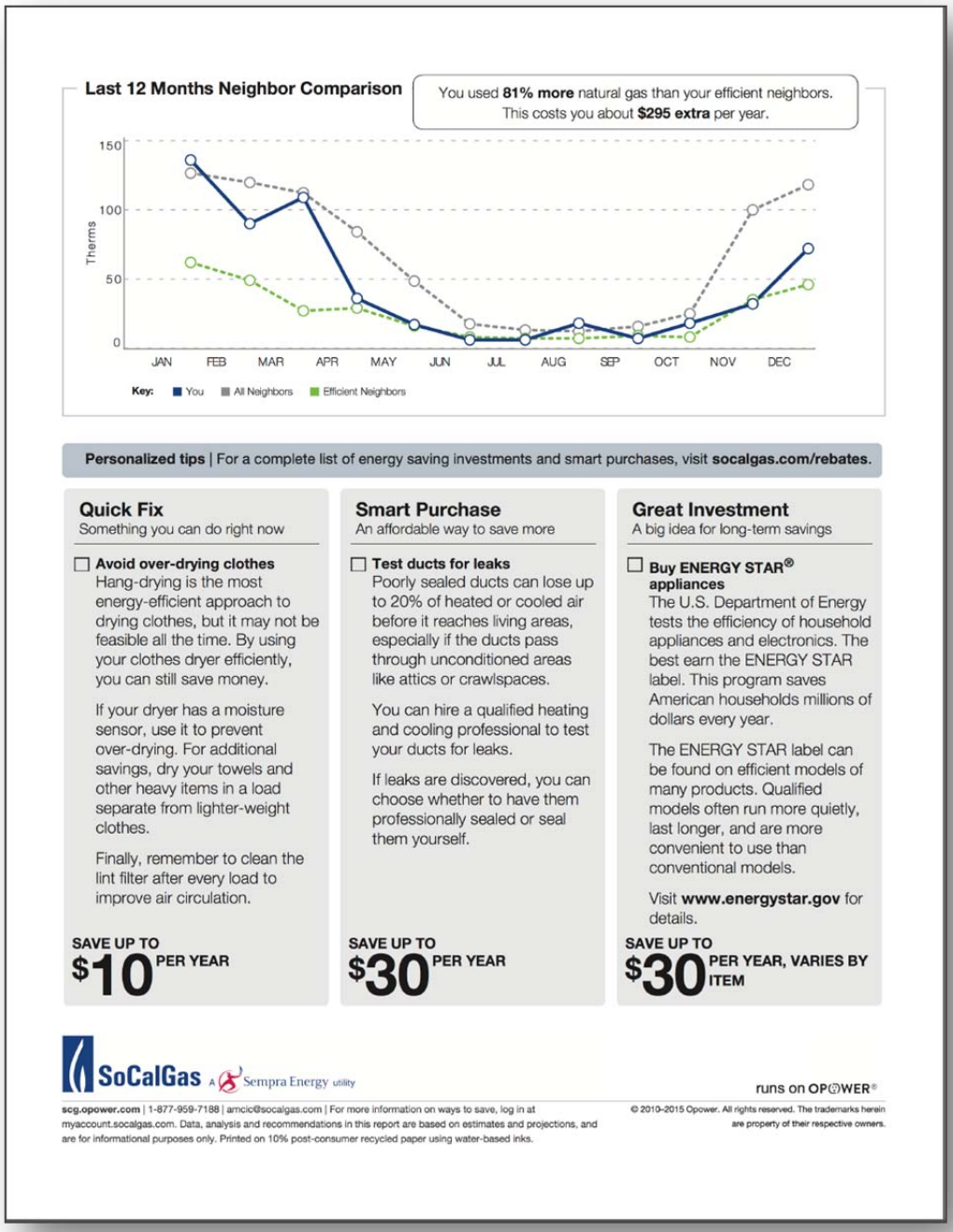


Figure A - 11: Opower February Paper HER Example (Back)



Last 12 Months Neighbor Comparison

You used **81% more** natural gas than your efficient neighbors.
This costs you about **$295 extra** per year.

Personalized tips | For a complete list of energy saving investments and smart purchases, visit **socalgas.com/rebates**.

Quick Fix
Something you can do right now

☐ **Avoid over-drying clothes**
Hang-drying is the most energy-efficient approach to drying clothes, but it may not be feasible all the time. By using your clothes dryer efficiently, you can still save money.

If your dryer has a moisture sensor, use it to prevent over-drying. For additional savings, dry your towels and other heavy items in a load separate from lighter-weight clothes.

Finally, remember to clean the lint filter after every load to improve air circulation.

SAVE UP TO $10 PER YEAR

Smart Purchase
An affordable way to save more

☐ **Test ducts for leaks**
Poorly sealed ducts can lose up to 20% of heated or cooled air before it reaches living areas, especially if the ducts pass through unconditioned areas like attics or crawlspaces.

You can hire a qualified heating and cooling professional to test your ducts for leaks.

If leaks are discovered, you can choose whether to have them professionally sealed or seal them yourself.

SAVE UP TO $30 PER YEAR

Great Investment
A big idea for long-term savings

☐ **Buy ENERGY STAR® appliances**
The U.S. Department of Energy tests the efficiency of household appliances and electronics. The best earn the ENERGY STAR label. This program saves American households millions of dollars every year.

The ENERGY STAR label can be found on efficient models of many products. Qualified models often run more quietly, last longer, and are more convenient to use than conventional models.

Visit **www.energystar.gov** for details.

SAVE UP TO $30 PER YEAR, VARIES BY ITEM

SoCalGas A Sempra Energy utility

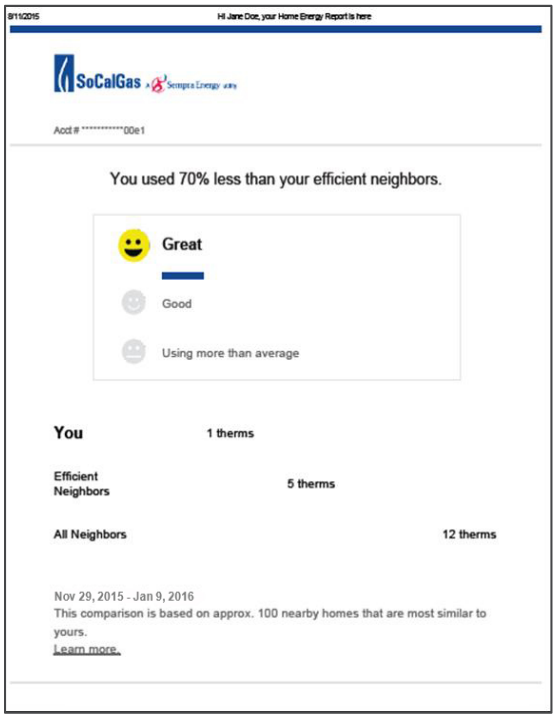
runs on OPOWER®

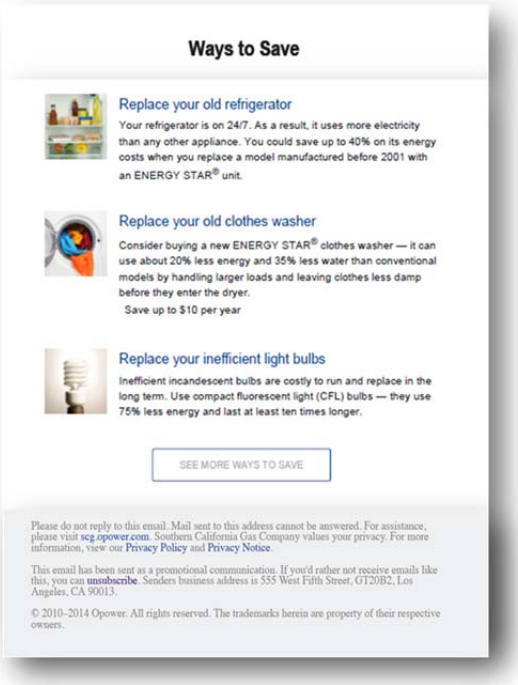
scg.opower.com | 1-877-959-7188 | amcic@socalgas.com | For more information on ways to save, log in at myaccount.socalgas.com. Data, analysis and recommendations in this report are based on estimates and projections, and are for informational purposes only. Printed on 10% post-consumer recycled paper using water-based inks.

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A.2 Opower Email HERs

Figure A - 12: Opower Email HER Example, December and subsequent months





Appendix B Opower Thermostat Home Energy Report Materials

This appendix contains all the Opower **Thermostat** HER materials. In addition to the paper and email HER examples in Section 2.2, Opower also sent a Thermostat HER welcome insert that was the same welcome insert that was sent to Opower standard HER customers and can be found in appendix A. Opower also sent a Thermostat HER door hanger which was slightly different from the standard HER door hanger.

Figure B-1 shows the Opower Thermostat HER door hanger, which was delivered to nearly 13,750 Opower paper-only HER customers, 27,500 Opower paper & email HER customers, and 13,750 email HER customers in November 2015 in addition to the welcome insert.

Figure B -1: November Opower Thermostat HER Welcome Insert (Front)

Front **Back**



Appendix C Opower Spanish Home Energy Report Materials

In addition to the paper HER examples in Section 2.2, Opower also sent a HER welcome insert and a door hanger, which are included in this appendix.

Figure C – 1 shows the front of the Opower Spanish HER welcome insert, which was delivered to nearly 13,750 Spanish Opower paper-only HER customers in November 2015. Figure C – 2 shows the back of the HER welcome insert. Figure C – 3 displays the door hanger that was delivered to all of the Opower Spanish HER customers.

Figure C - 1: November Opower Spanish HER Welcome Insert (Front)



Salude a su primer Informe de energía para el hogar

Averigüe el consumo de gas natural de su hogar, vea cómo se compara con sus vecinos y descubra formas de ahorrar dinero.

SoCalGas A Sempra Energy utility

1-877-959-7188 | amcic@socalgas.com

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SCG_0010_WELCOME_NEI3

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Figure C - 2: November Opower Spanish HER Welcome Insert (Back)

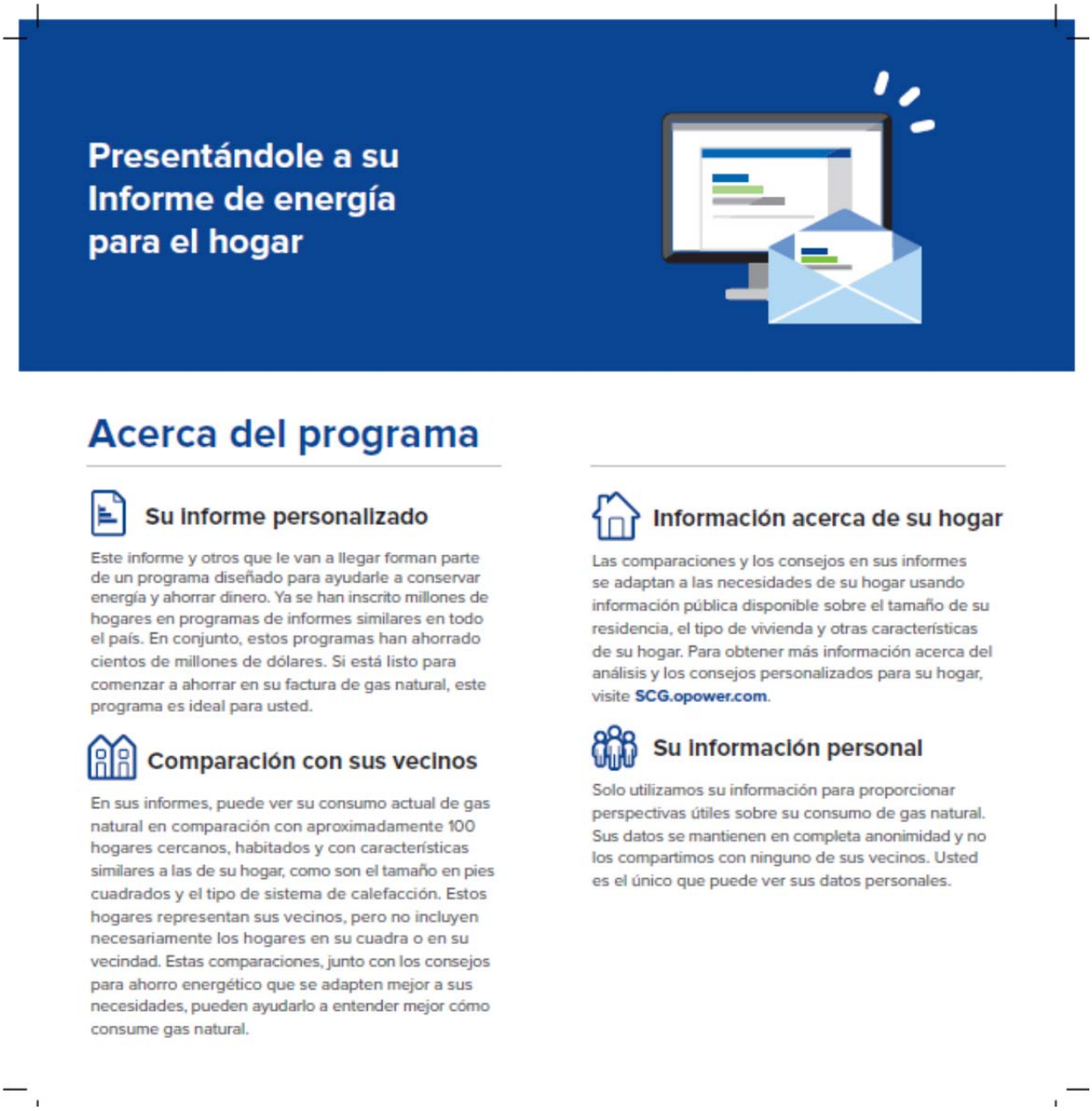


Figure C - 3: Opower Spanish HER Door Hanger

Front



Back



Appendix D SoCalGas Bill Tracker Alert Materials

In addition to the New and Old email BTA, the text message notification, the November welcome email, and the November supplemental letter example in section 2.2, SoCalGas also sent additional supplemental letters, some of which included inserts and are included in this appendix. SoCalGas also sent additional supplemental emails in January and March. The supplemental materials in this appendix were only sent to customers in either the Old BTA with supplemental materials treatment group or the New BTA with supplemental materials treatment group.

Figure D – 1 shows the January supplemental letter. Figure D – 2 and Figure D – 3 show the front and back of the January insert that came with the January supplemental letter. Figure D – 4 shows the February supplemental letter. Figure D – 5 shows the supplemental email that was sent in January and March.

Figure D - 1: SoCalGas January BTA Supplemental Letter

SoCalGas
A Sempra Energy utility

January 23, 2016

Albert Johnstonson
C/O SoCalGas
GT20B2
555 W 5th St.
Los Angeles, CA 90013-1010

V0081613

ADVANCEDmeter
SAVING MORE IS WITHIN REACH
VISIT MY ACCOUNT NOW

RE: Service Address

Dear First Name Last Name,

SoCalGas® is committed to helping you save.

To understand your usage even better, set up your energy-savings goals by visiting *"Ways to Save"* –our personalized interactive tool through **myaccount.socalgas.com**.

- Set savings goals and get tips on how to achieve them.
- Create a personalized energy profile.
- View your daily and hourly gas usage.
- Analyze your monthly bill history to understand how different factors affect your natural gas usage.



Bill Tracker Alerts are also available via text message. Log in to **myaccount.socalgas.com** and go to the "Manage My Account" tab to change or add your preferences.

Sincerely,

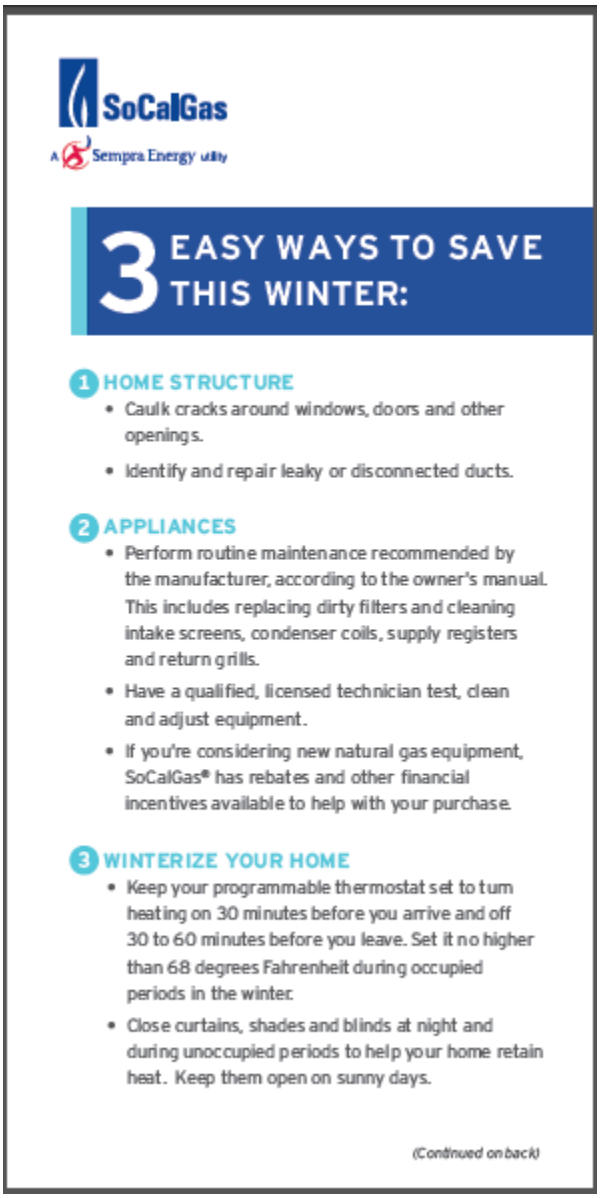
Jeffery L. Walker
Director, Advanced Meter Project

If you no longer want to receive Bill Tracker Alerts, simply log into your SoCalGas My Account or call 1-800-427-2200.

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Printed on recycled paper.
NISC01378 1115 XX

Figure D - 2: SoCalGas January BTA Insert (Front)



SoCalGas
A Sempra Energy utility

3 EASY WAYS TO SAVE THIS WINTER:

1 HOME STRUCTURE

- Caulk cracks around windows, doors and other openings.
- Identify and repair leaky or disconnected ducts.

2 APPLIANCES

- Perform routine maintenance recommended by the manufacturer, according to the owner's manual. This includes replacing dirty filters and cleaning intake screens, condenser coils, supply registers and return grills.
- Have a qualified, licensed technician test, clean and adjust equipment.
- If you're considering new natural gas equipment, SoCalGas® has rebates and other financial incentives available to help with your purchase.

3 WINTERIZE YOUR HOME

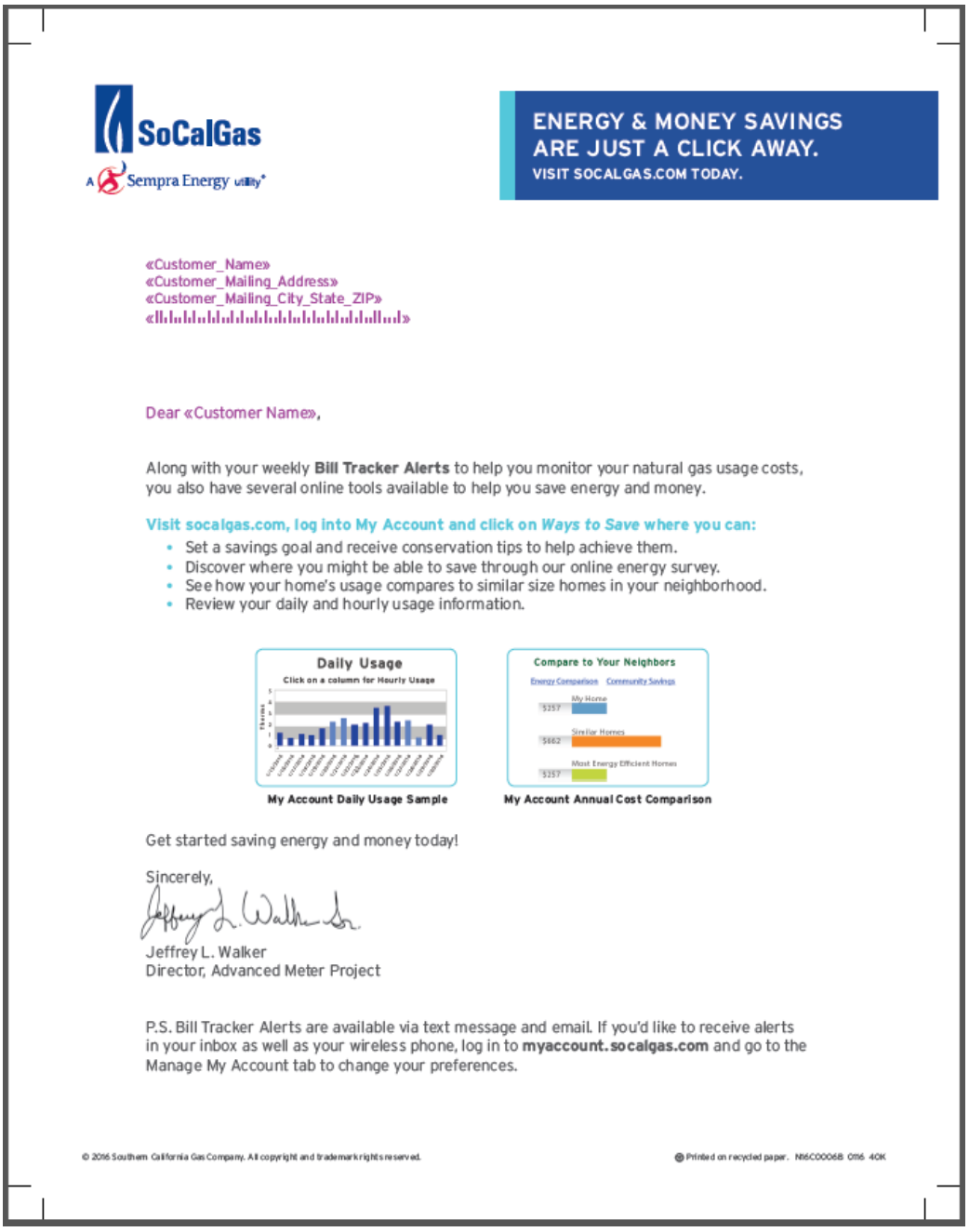
- Keep your programmable thermostat set to turn heating on 30 minutes before you arrive and off 30 to 60 minutes before you leave. Set it no higher than 68 degrees Fahrenheit during occupied periods in the winter.
- Close curtains, shades and blinds at night and during unoccupied periods to help your home retain heat. Keep them open on sunny days.

(Continued on back)

Figure D - 3: SoCalGas January BTA Insert (Back)



Figure D - 4: SoCalGas February BTA Supplemental Letter



SoCalGas
A Sempra Energy utility

ENERGY & MONEY SAVINGS ARE JUST A CLICK AWAY.
VISIT SOCALGAS.COM TODAY.

«Customer_Name»
«Customer_Mailing_Address»
«Customer_Mailing_City_State_ZIP»
«IMB»

Dear «Customer Name»,

Along with your weekly **Bill Tracker Alerts** to help you monitor your natural gas usage costs, you also have several online tools available to help you save energy and money.

Visit socalgas.com, log into My Account and click on *Ways to Save* where you can:

- Set a savings goal and receive conservation tips to help achieve them.
- Discover where you might be able to save through our online energy survey.
- See how your home's usage compares to similar size homes in your neighborhood.
- Review your daily and hourly usage information.

My Account Daily Usage Sample

My Account Annual Cost Comparison

Get started saving energy and money today!

Sincerely,

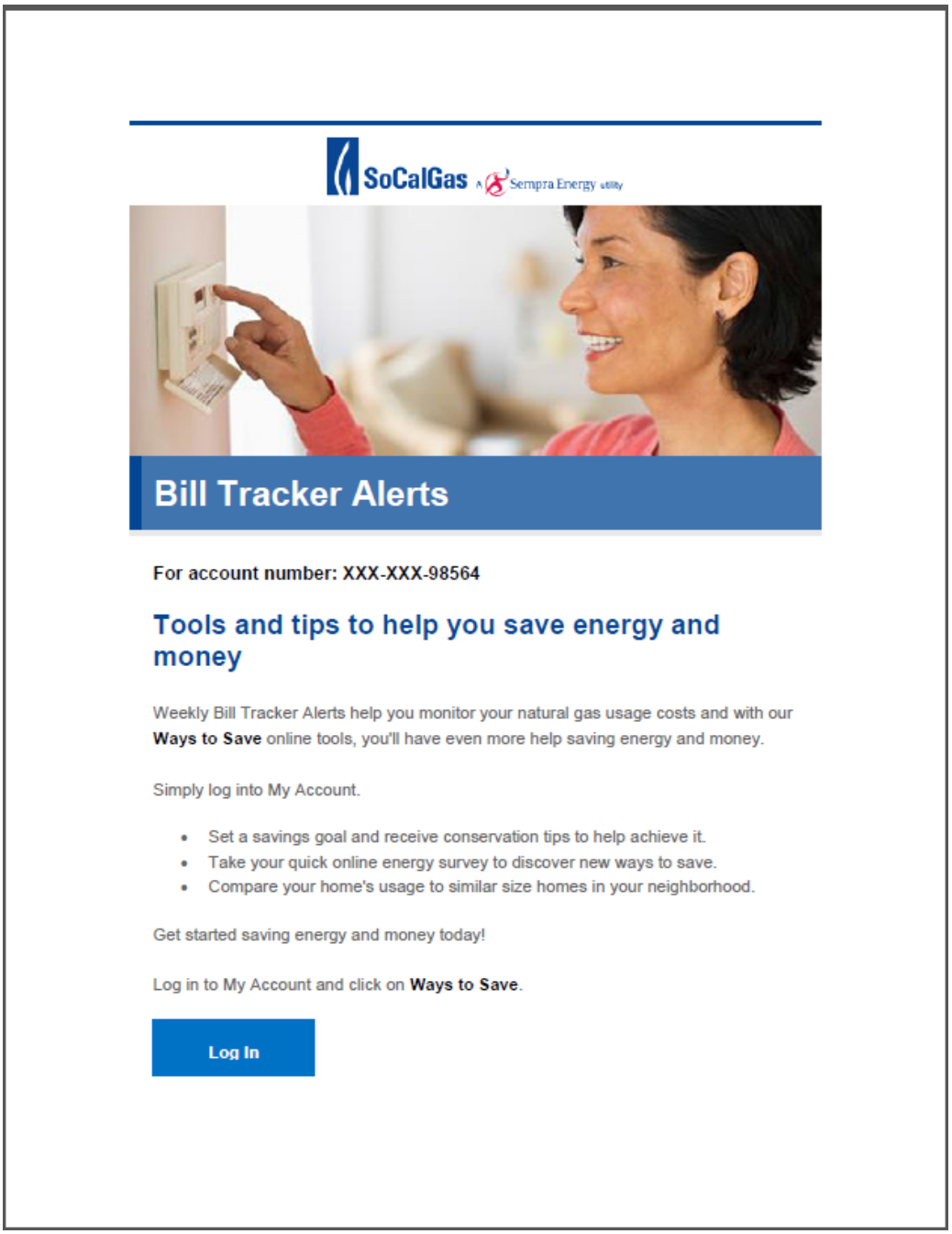
Jeffrey L. Walker
Director, Advanced Meter Project

P.S. Bill Tracker Alerts are available via text message and email. If you'd like to receive alerts in your inbox as well as your wireless phone, log in to **myaccount.socalgas.com** and go to the Manage My Account tab to change your preferences.

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Figure D - 5: SoCalGas January/March BTA Supplemental Email

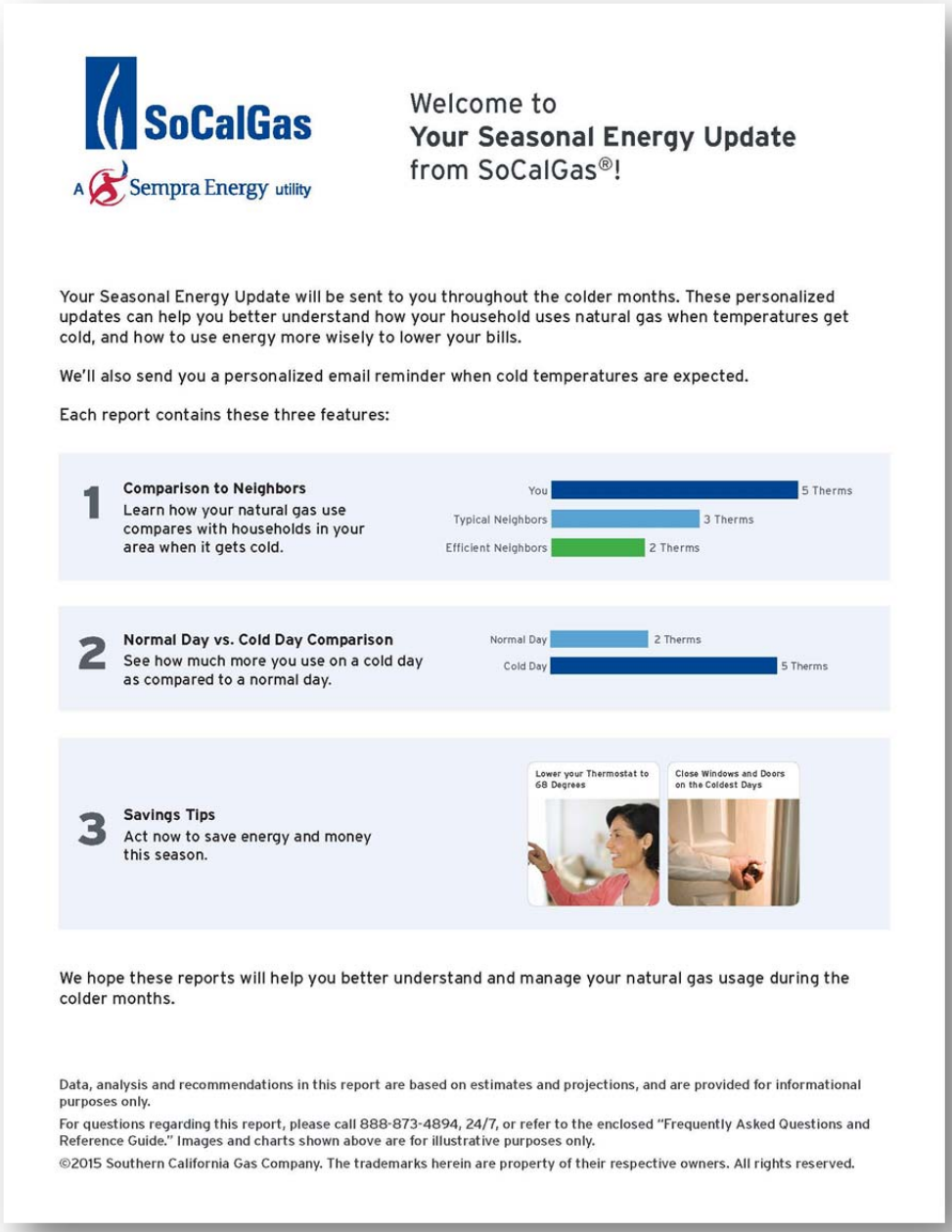


Appendix E Aclara/SoCalGas Seasonal Energy Update Materials

In addition to the paper SEU and email SEU examples in Section 2.2, Aclara/SoCalGas also sent a welcome letter, frequently asked questions insert, and a repositionable sticker, which are included in this appendix. Different SEU email updates were sent depending on if there was cold weather at the time. There was also a slightly different version of the paper SEU reports sent in January and February which is included in the appendix.

Figure E – 1 shows the front of the Aclara facilitated SEU welcome letter, which was delivered to nearly 42,900 SEU customers in November 2015. Figure E – 2 shows the back of the SEU welcome letter. Figure E – 3 displays the SEU frequently asked question insert. Figure E – 4 displays the repositionable sticker that was sent to all of the SEU customers. Figure E – 5 and Figure E – 6 show the front and back of the November paper SEU report. Figure E – 7 and Figure E – 8 show the front and back of the January paper SEU report. Figure E – 9 shows the “cold weather” email SEU update. Figure E – 10 shows the “no cold weather” email SEU update.

Figure E - 1: Aclara-Facilitated November SEU Welcome Letter (Front)



SoCalGas
A Sempra Energy utility

Welcome to
Your Seasonal Energy Update
from SoCalGas®!

Your Seasonal Energy Update will be sent to you throughout the colder months. These personalized updates can help you better understand how your household uses natural gas when temperatures get cold, and how to use energy more wisely to lower your bills.

We'll also send you a personalized email reminder when cold temperatures are expected.

Each report contains these three features:

1 **Comparison to Neighbors**
Learn how your natural gas use compares with households in your area when it gets cold.

2 **Normal Day vs. Cold Day Comparison**
See how much more you use on a cold day as compared to a normal day.

3 **Savings Tips**
Act now to save energy and money this season.

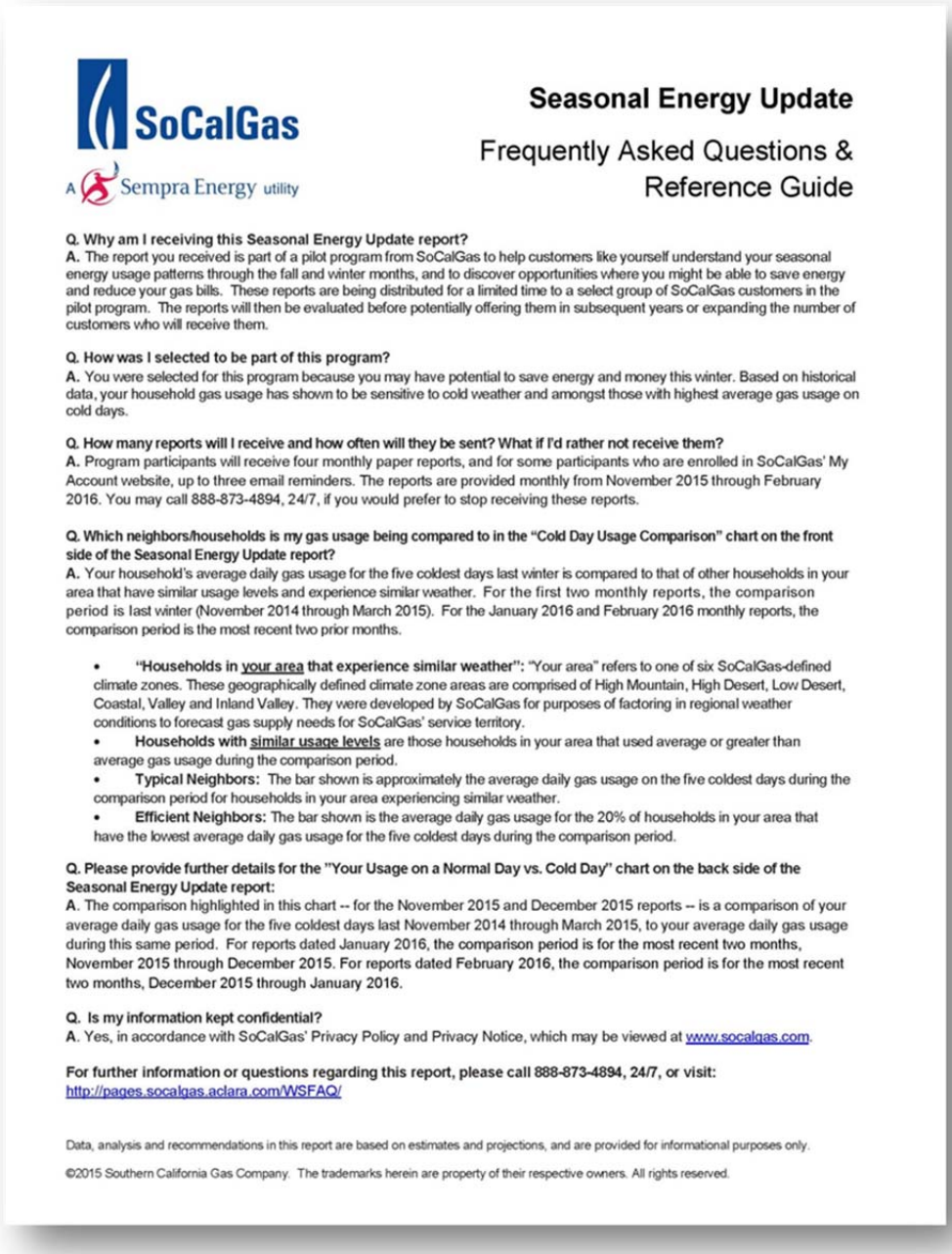
We hope these reports will help you better understand and manage your natural gas usage during the colder months.

Data, analysis and recommendations in this report are based on estimates and projections, and are provided for informational purposes only.

For questions regarding this report, please call 888-873-4894, 24/7, or refer to the enclosed "Frequently Asked Questions and Reference Guide." Images and charts shown above are for illustrative purposes only.

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Figure E - 2: Aclara-Facilitated November SEU Welcome Letter (Back)



SoCalGas
A Sempra Energy utility

Seasonal Energy Update

Frequently Asked Questions & Reference Guide

Q. Why am I receiving this Seasonal Energy Update report?
A. The report you received is part of a pilot program from SoCalGas to help customers like yourself understand your seasonal energy usage patterns through the fall and winter months, and to discover opportunities where you might be able to save energy and reduce your gas bills. These reports are being distributed for a limited time to a select group of SoCalGas customers in the pilot program. The reports will then be evaluated before potentially offering them in subsequent years or expanding the number of customers who will receive them.

Q. How was I selected to be part of this program?
A. You were selected for this program because you may have potential to save energy and money this winter. Based on historical data, your household gas usage has shown to be sensitive to cold weather and amongst those with highest average gas usage on cold days.

Q. How many reports will I receive and how often will they be sent? What if I'd rather not receive them?
A. Program participants will receive four monthly paper reports, and for some participants who are enrolled in SoCalGas' My Account website, up to three email reminders. The reports are provided monthly from November 2015 through February 2016. You may call 888-873-4894, 24/7, if you would prefer to stop receiving these reports.

Q. Which neighbors/households is my gas usage being compared to in the "Cold Day Usage Comparison" chart on the front side of the Seasonal Energy Update report?
A. Your household's average daily gas usage for the five coldest days last winter is compared to that of other households in your area that have similar usage levels and experience similar weather. For the first two monthly reports, the comparison period is last winter (November 2014 through March 2015). For the January 2016 and February 2016 monthly reports, the comparison period is the most recent two prior months.

- **"Households in your area that experience similar weather":** "Your area" refers to one of six SoCalGas-defined climate zones. These geographically defined climate zone areas are comprised of High Mountain, High Desert, Low Desert, Coastal, Valley and Inland Valley. They were developed by SoCalGas for purposes of factoring in regional weather conditions to forecast gas supply needs for SoCalGas' service territory.
- **Households with similar usage levels** are those households in your area that used average or greater than average gas usage during the comparison period.
- **Typical Neighbors:** The bar shown is approximately the average daily gas usage on the five coldest days during the comparison period for households in your area experiencing similar weather.
- **Efficient Neighbors:** The bar shown is the average daily gas usage for the 20% of households in your area that have the lowest average daily gas usage for the five coldest days during the comparison period.

Q. Please provide further details for the "Your Usage on a Normal Day vs. Cold Day" chart on the back side of the Seasonal Energy Update report:
A. The comparison highlighted in this chart -- for the November 2015 and December 2015 reports -- is a comparison of your average daily gas usage for the five coldest days last November 2014 through March 2015, to your average daily gas usage during this same period. For reports dated January 2016, the comparison period is for the most recent two months, November 2015 through December 2015. For reports dated February 2016, the comparison period is for the most recent two months, December 2015 through January 2016.

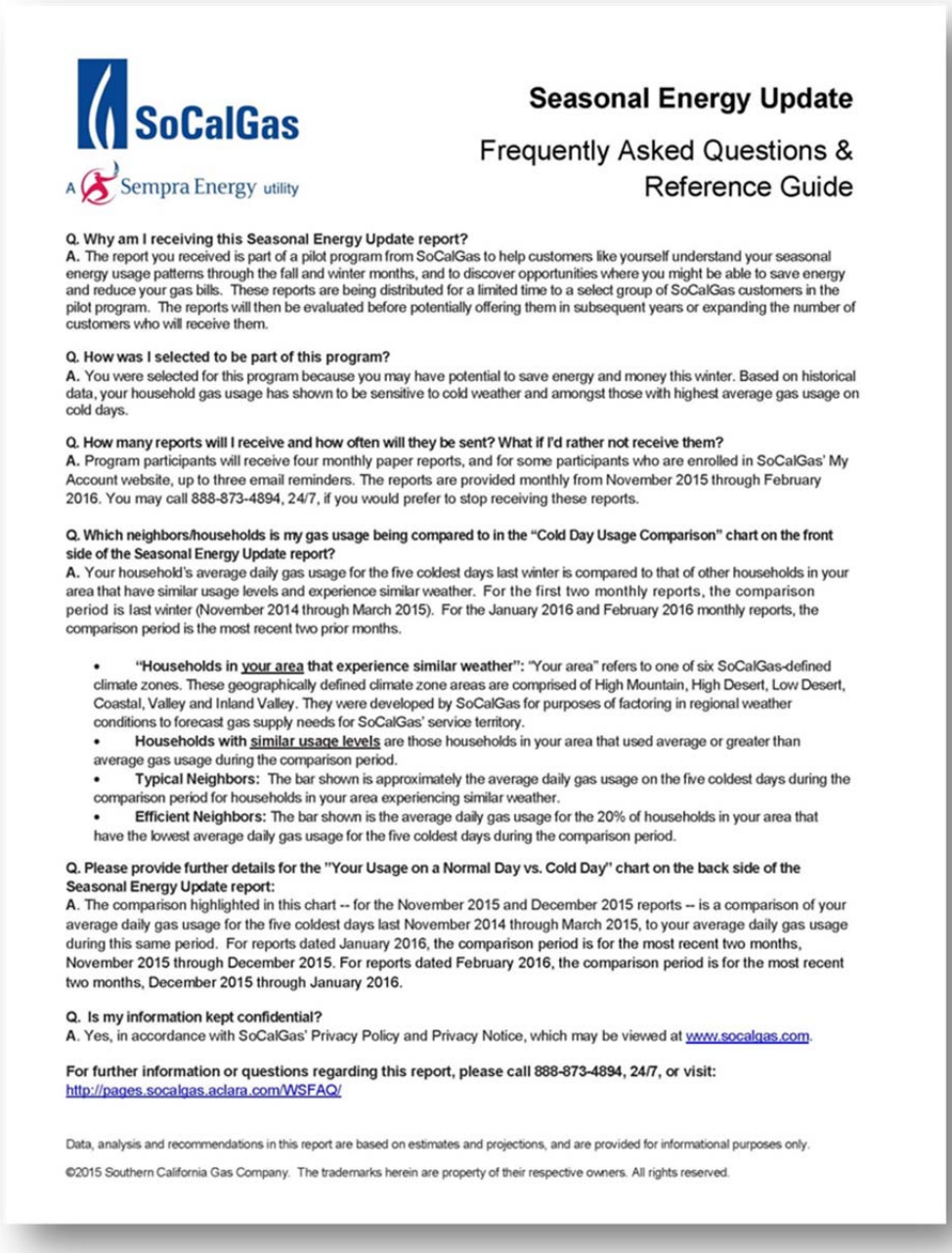
Q. Is my information kept confidential?
A. Yes, in accordance with SoCalGas' Privacy Policy and Privacy Notice, which may be viewed at www.socalgas.com.

For further information or questions regarding this report, please call 888-873-4894, 24/7, or visit:
http://pages.socalgas.aclara.com/WSFAQ/

Data, analysis and recommendations in this report are based on estimates and projections, and are provided for informational purposes only.

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Figure E - 3: Aclara-Facilitated SEU Frequently Asked Questions Insert



SoCalGas
A Sempra Energy utility

Seasonal Energy Update

Frequently Asked Questions & Reference Guide

Q. Why am I receiving this Seasonal Energy Update report?
A. The report you received is part of a pilot program from SoCalGas to help customers like yourself understand your seasonal energy usage patterns through the fall and winter months, and to discover opportunities where you might be able to save energy and reduce your gas bills. These reports are being distributed for a limited time to a select group of SoCalGas customers in the pilot program. The reports will then be evaluated before potentially offering them in subsequent years or expanding the number of customers who will receive them.

Q. How was I selected to be part of this program?
A. You were selected for this program because you may have potential to save energy and money this winter. Based on historical data, your household gas usage has shown to be sensitive to cold weather and amongst those with highest average gas usage on cold days.

Q. How many reports will I receive and how often will they be sent? What if I'd rather not receive them?
A. Program participants will receive four monthly paper reports, and for some participants who are enrolled in SoCalGas' My Account website, up to three email reminders. The reports are provided monthly from November 2015 through February 2016. You may call 888-873-4894, 24/7, if you would prefer to stop receiving these reports.

Q. Which neighbors/households is my gas usage being compared to in the "Cold Day Usage Comparison" chart on the front side of the Seasonal Energy Update report?
A. Your household's average daily gas usage for the five coldest days last winter is compared to that of other households in your area that have similar usage levels and experience similar weather. For the first two monthly reports, the comparison period is last winter (November 2014 through March 2015). For the January 2016 and February 2016 monthly reports, the comparison period is the most recent two prior months.

- **"Households in your area that experience similar weather":** "Your area" refers to one of six SoCalGas-defined climate zones. These geographically defined climate zone areas are comprised of High Mountain, High Desert, Low Desert, Coastal, Valley and Inland Valley. They were developed by SoCalGas for purposes of factoring in regional weather conditions to forecast gas supply needs for SoCalGas' service territory.
- **Households with similar usage levels** are those households in your area that used average or greater than average gas usage during the comparison period.
- **Typical Neighbors:** The bar shown is approximately the average daily gas usage on the five coldest days during the comparison period for households in your area experiencing similar weather.
- **Efficient Neighbors:** The bar shown is the average daily gas usage for the 20% of households in your area that have the lowest average daily gas usage for the five coldest days during the comparison period.

Q. Please provide further details for the "Your Usage on a Normal Day vs. Cold Day" chart on the back side of the Seasonal Energy Update report:
A. The comparison highlighted in this chart -- for the November 2015 and December 2015 reports -- is a comparison of your average daily gas usage for the five coldest days last November 2014 through March 2015, to your average daily gas usage during this same period. For reports dated January 2016, the comparison period is for the most recent two months, November 2015 through December 2015. For reports dated February 2016, the comparison period is for the most recent two months, December 2015 through January 2016.

Q. Is my information kept confidential?
A. Yes, in accordance with SoCalGas' Privacy Policy and Privacy Notice, which may be viewed at www.socalgas.com.

For further information or questions regarding this report, please call 888-873-4894, 24/7, or visit:
http://pages.socalgas.aclara.com/WSFAQ/

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Figure E - 4: Aclara-Facilitated SEU Repositionable Sticker



Figure E - 5: Aclara-Facilitated November SEU Paper Report (Front)

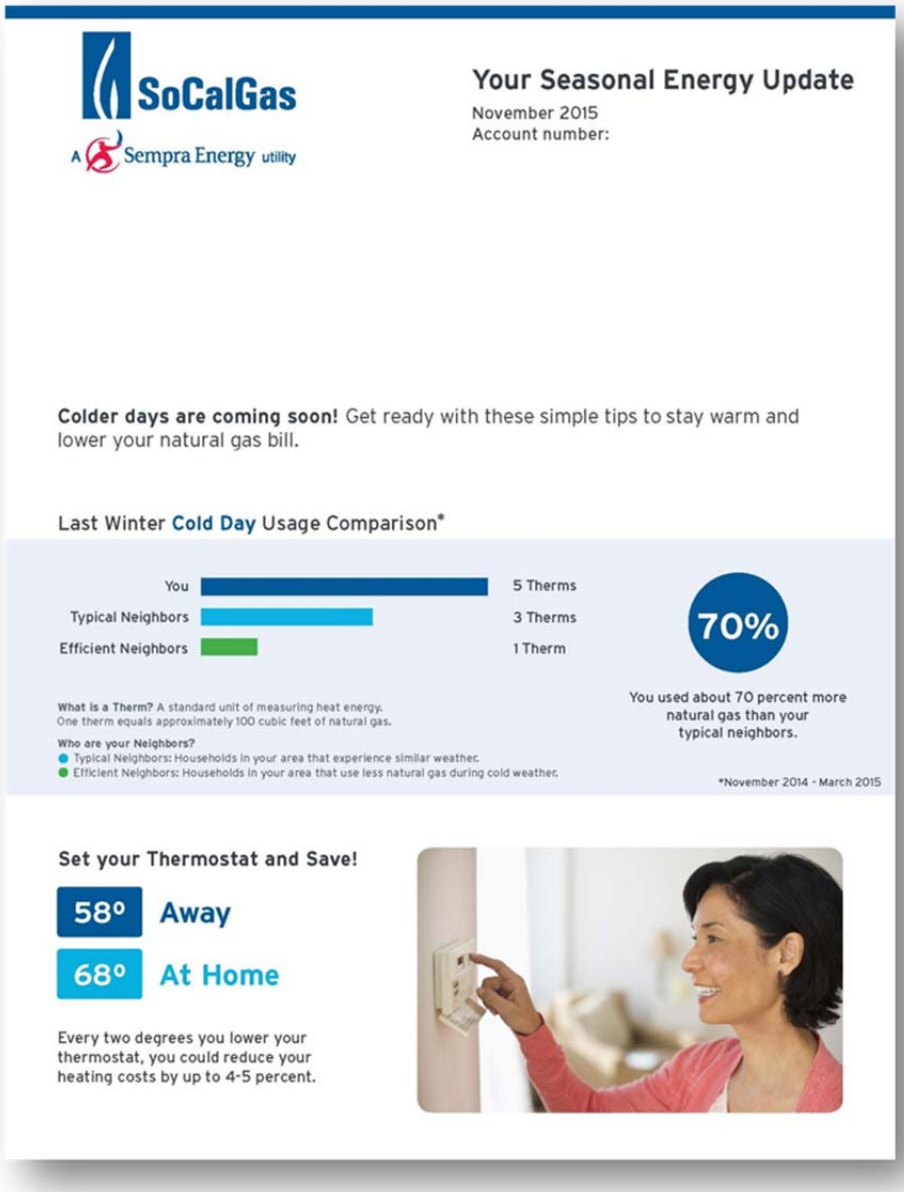
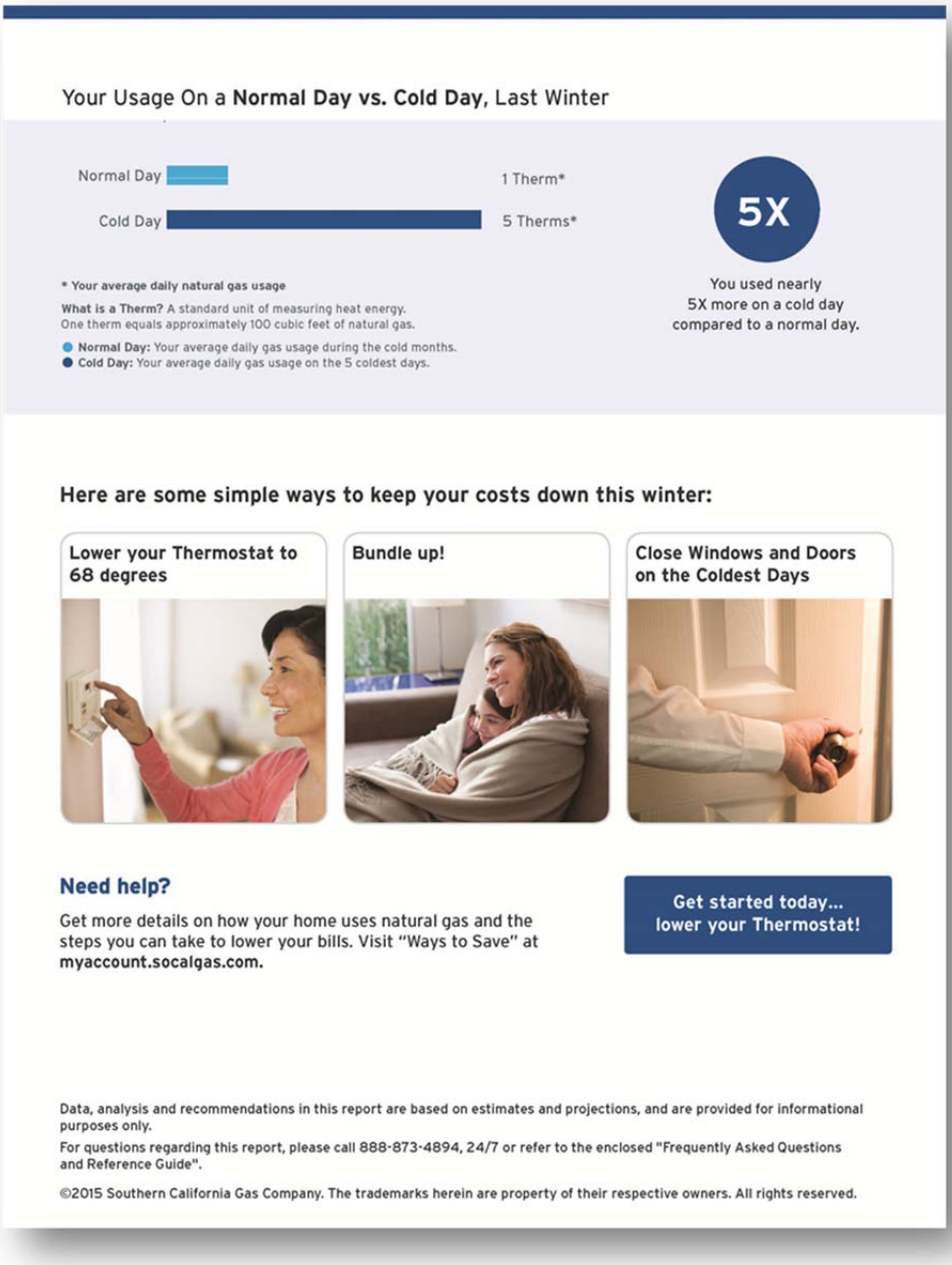


Figure E - 6: Aclara-Facilitated November SEU Paper Report(Back)



Your Usage On a **Normal Day vs. Cold Day**, Last Winter

Normal Day — 1 Therm*

Cold Day — 5 Therms*

5X

You used nearly 5X more on a cold day compared to a normal day.

* Your average daily natural gas usage

What is a Therm? A standard unit of measuring heat energy. One therm equals approximately 100 cubic feet of natural gas.

- **Normal Day:** Your average daily gas usage during the cold months.
- **Cold Day:** Your average daily gas usage on the 5 coldest days.

Here are some simple ways to keep your costs down this winter:

Lower your Thermostat to 68 degrees

Bundle up!

Close Windows and Doors on the Coldest Days

Need help?

Get more details on how your home uses natural gas and the steps you can take to lower your bills. Visit "Ways to Save" at **myaccount.socalgas.com.**

Get started today... lower your Thermostat!

Data, analysis and recommendations in this report are based on estimates and projections, and are provided for informational purposes only.

For questions regarding this report, please call 888-873-4894, 24/7 or refer to the enclosed "Frequently Asked Questions and Reference Guide".

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Figure E - 7: Aclara-Facilitated SEU January Paper Report (Front)

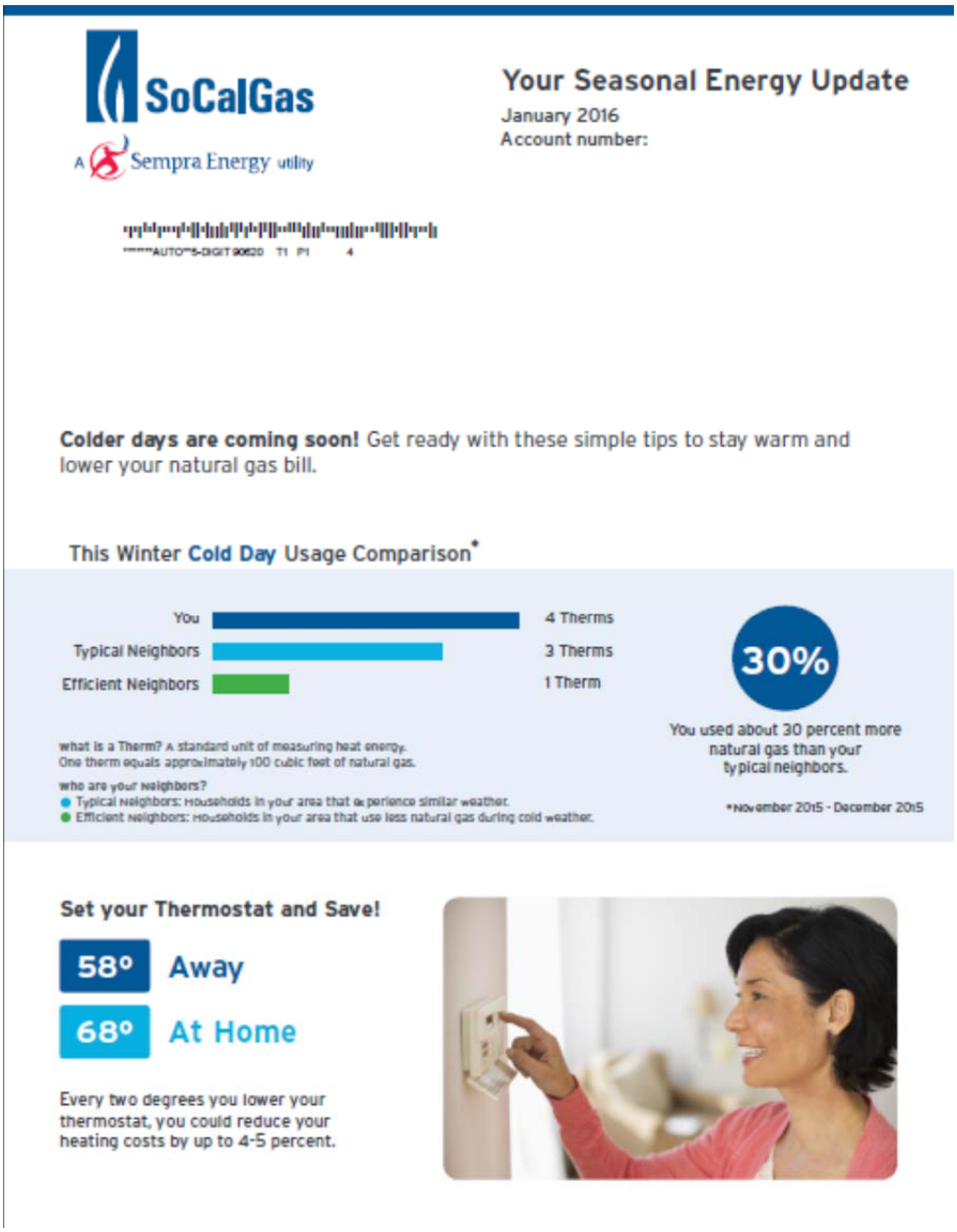


Figure E - 8: Aclara-Facilitated SEU January Paper Report (Back)



Your Usage On a **Normal Day vs. Cold Day**, This Winter

Normal Day — 2 Therms*

Cold Day — 4 Therms*

2X

You used nearly 2X more on a cold day compared to a normal day.

* Your average daily natural gas usage

What is a Therm? A standard unit of measuring heat energy. One therm equals approximately 100 cubic feet of natural gas.

- Normal Day: Your average daily gas usage during the cold months.
- Cold Day: Your average daily gas usage on the 5 coldest days.

Here are some simple ways to keep your costs down this winter:

Seal out the Cold by Caulking and Weather-stripping

Add Insulation

Avoid Heating Unoccupied Areas

Need help?

Get more details on how your home uses natural gas and the steps you can take to lower your bills. Visit "Ways to Save" at **myaccount.socalgas.com.**

Get started today... lower your Thermostat!

Data, analysis and recommendations in this report are based on estimates and projections, and are provided for informational purposes only.
For questions regarding this report, please call 888-873-4894, 24/7 or refer to the enclosed "Frequently Asked Questions and Reference Guide".

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Figure E - 9: Aclara-Facilitated SEU Email Update – Cold Weather Alert



This message contains graphics. If you do not see the graphics, click here to view

SoCalGas
A Sempra Energy utility

Cold Weather Alert

Tips to keep you warm

This Winter Cold Day Usage Comparison*

Account Number: *****00010

What is a Therm? A standard unit of measuring heat energy. One therm equals approximately 100 cubic feet of natural gas.

Who are your Neighbors?

- Typical Neighbors: Households in your area that experience similar weather.
- Efficient Neighbors: Households in your area that use less natural gas during cold weather.

December 2015 - January 2016

Here are some simple ways to keep your costs down this winter:

Lower your Thermostat to 68 Degrees

Let the Sun in

Seal out the Cold by Caulking and Weather-stripping

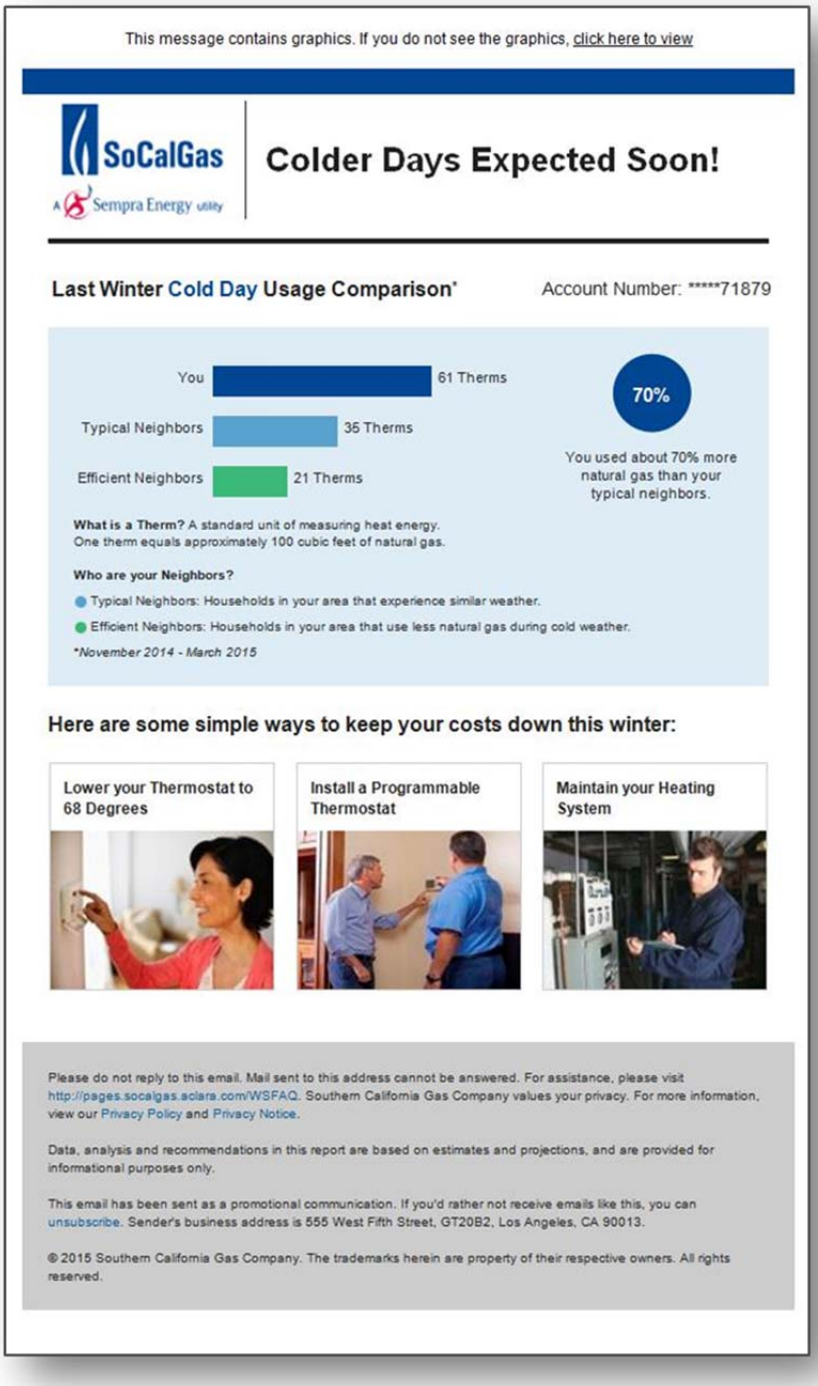
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Figure E - 10: Aclara-Facilitated SEU Email Update – No Cold Weather Email



This message contains graphics. If you do not see the graphics, click here to view

SoCalGas
A Sempra Energy utility

Colder Days Expected Soon!

Last Winter Cold Day Usage Comparison*

Account Number: *****71879

What is a Therm? A standard unit of measuring heat energy.
One therm equals approximately 100 cubic feet of natural gas.

Who are your Neighbors?

- Typical Neighbors: Households in your area that experience similar weather.
- Efficient Neighbors: Households in your area that use less natural gas during cold weather.

November 2014 - March 2015

Here are some simple ways to keep your costs down this winter:

Lower your Thermostat to 68 Degrees

Install a Programmable Thermostat

Maintain your Heating System

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Attachment N

SoCalGas Advance Meter Semiannual Report (August 2017)

SOUTHERN CALIFORNIA GAS COMPANY
ADVANCED METER
SEMIANNUAL REPORT

August 31, 2017

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Southern California Gas Company
Advanced Meter Semiannual Report

Introduction

This is the ninth Semiannual Report ("Report") regarding the progress of Southern California Gas Company's ("SoCalGas") Advanced Meter project. In Decision ("D.") 10-04-027, the California Public Utilities Commission ("CPUC" or "Commission") authorized the project. Ordering Paragraph 5 required the following reporting requirements for SoCalGas:

> "Southern California Gas Company shall establish a system to track and attribute program costs and projected savings from conservation. Based on this tracking system, Southern California Gas Company shall submit a report to the Director of the Commission's Energy Division semiannually, tracking the gas conservation impacts of the advanced metering infrastructure project to date. These reports shall serve as a forum to adjust, as necessary the elements laid out in the final outreach plan described above. We expect that customer outreach, education and communications will continue to evolve and improve as SoCalGas conducts customer research, monitors customer reaction to new AMI technology and various customer usage presentation tools, and incorporates feedback from these activities into its AMI outreach and education activities. If the report shows that the company is falling short of its projections, it shall submit revisions to its conservation plan to increase awareness, participation, and durability of conservation actions among its customers. The semiannual reports and any revisions to the advanced metering infrastructure outreach and conservation plan shall be submitted to the director of the Commission's Energy Division and served on the most recent service list for this proceeding. Additional costs incurred in order to improve conservation response will be funded out of contingency funds, or otherwise subject to the risk sharing mechanism authorized in Ordering Paragraph 2."

Chapter 1 - Project Overview and Summary

In addition to the specific requirements identified in D.10-04-027, this Report provides overall status of SoCalGas' Advanced Meter project through June 30, 2017 and builds upon previous Reports by highlighting project changes and activities that have taken place since January 1, 2017. Previous Report filings may be accessed on SoCalGas' website.[1]

The Advanced Meter infrastructure consists of two primary components – a meter transmission unit ("MTU" or "module") attached to SoCalGas meters, and a communications network consisting of data collection units ("DCU") installed across the SoCalGas service territory. Data from the modules is communicated to the DCUs and then transmitted to SoCalGas' back-office systems. Operational highlights as of June 30, 2017 include:

[1] http://www.socalgas.com/regulatory/A0809023.shtml.

- Over 5.8 million meter modules installed representing 99% of the total meters to be upgraded.
- 4,201 data collector units (DCUs) installed and functioning On-Air representing 91 percent of the estimated 4,600 DCUs planned. These DCUs are fully installed in 178 of the 221 cities and counties located within SoCalGas' service territory (80 percent of total).
- Approximately 99 percent of the installed modules have been deemed 'Billing Ready' and are now used or ready for billing customers.

SoCalGas also completed its fourth targeted heating season conservation campaign leveraging Advanced Meter-enabled usage data. The conservation campaign launched in late November 2016 and extended through the heating season, with most treatments concluding in March 2017. It was the final campaign in the series of four conservation "Test and Learn" campaigns conducted over the course of the Advanced Meter project.

The goals of these consecutive conservation campaigns were to demonstrate how to best meet the one percent energy savings goal[2] associated with the Advanced Meter rollout and to track the resulting conservation savings. In accordance with Ordering Paragraph 5, each of SoCalGas' successive heating season conservation campaigns incorporated the lessons learned and key findings from the prior campaigns.

As with the prior year's campaign, every one of the eleven new residential conservation treatments tested during the 2016-2017 campaign produced statistically significant gas savings.[3] These new treatments resulted in average savings of over 1.7 percent during the 2016-2017 fall/winter period. This is an increase in savings vs. average first year savings rates for the successful[4] treatments tested in the three prior heating season campaigns, and shows continued progress towards the conservation goal. Also of note for the 2016-2017 treatments tested was that one treatment – a "Seasonal Energy Update" energy report based on advanced meter analytics developed by SoCalGas – achieved the highest savings rate for all four years' campaigns of 3.43 percent.

Continued savings effects were also realized for ten of the treatments initially tested during the 2014-2015 and 2015-2016 campaigns. Overall, the new and continued successful treatments produced gas savings of 1.6 percent during the 2016-2017 fall/winter period. The persistence and sustainability of these conservation results demonstrates the durability of conservation actions as outlined in Ordering Paragraph 5 above.

[2] This energy savings goal specifically refers to one percent of total *residential* gas usage.

[3] Four out of eleven treatments tested during the 2013-2014 heating season campaign generated average savings of about 1.3 percent. Four out of seven residential treatments tested during the 2014-2015 heating season campaign generated average savings of about one percent. Fourteen out of fourteen residential treatments tested during the 2015-2016 campaign generated average savings of over 1.4 percent.

[4] Successful treatments are comprised of the subset of treatments tested that were successful in producing statistically significant usage reductions.

The Advanced Meter project is currently meeting its schedule, budget and major project milestones; however, continued permitting and construction challenges may impede completing the network in accordance with D.10-04-027. SoCalGas has implemented a proactive public outreach strategy to educate and inform impacted residents, businesses, and municipalities of network installation to help mitigate potential concerns. As noted in previous Reports, despite extensive engagement, select municipalities continue to require SoCalGas to secure discretionary permits. Because discretionary permitting processes are contrary to SoCalGas' understanding of the CPUC's overarching authority over utility facilities, and because acquiescing to discretionary permitting processes could result in DCUs being rejected or removed by the jurisdiction at any time, SoCalGas has refrained from completing applications in these jurisdictions.

Although there has been progress in select areas, by continuing to assert their position these municipalities are considerably delaying or preventing the network installation timeline for over 90 DCUs or two percent of the 4,600 planned DCUs. The inability to deploy the necessary infrastructure in these jurisdictions will likely result in SoCalGas having to maintain separate meter reading, communications, data processing and billing systems functions for longer than was anticipated in D.10-04-027 and may negatively impact expected customer operational and conservation benefits pursuant to Sections 3.C, 3.D and 9 of this report.

As previously communicated to the Commission, SoCalGas discovered a small percentage of Advanced Meter modules producing inaccurate digital reads of gas usage. The problem was limited to approximately 0.15 percent of the installed population of MTUs. These devices were issuing multiple false alarms. SoCalGas has implemented a plan to replace all defective MTUs, address any authorized billing corrections, and communicate with regulators, customers and stakeholders. During the course of remediation a subsequent issue was identified with MTUs in curb meter vaults. SoCalGas is working with the manufacturer to resolve the issue; until then, these meters will be manually read to minimize any billing impacts to customers. Additionally, SoCalGas is working with the vendor on the feasibility of diagnostic tools to identify malfunctioning modules prior to or at installation. The total financial impact of the issue is unknown at this time, but SoCalGas is seeking full-financial recovery from the vendor for the costs associated with the curb meter MTU issue, including the costs for replacement product, for temporary manual meter reading of the affected curb meters and for the labor costs associated with replacing those that have been installed.

Chapter 2 - Module Installation and Network Construction Status

2.A Module Installation Status

SoCalGas has installed 5,893,785 modules through the end of June 2017, with its first installation dating back to October 2012. Table 1 displays the installations performed by Advanced Meter Mass Install personnel and identifies installations completed by other SoCalGas personnel.

Table 1
Module Installations by Personnel Group

	Module Only	Meter Change w/Module	Total
Advanced Meter Installations	4,231,142	1,226,172	5,457,314
Other SoCalGas Personnel		436,471	436,471
Total Installations	**4,231,142**	**1,662,643**	**5,893,785**

About 93 percent of the modules are being installed by Advanced Meter personnel, with approximately seven percent being installed by other SoCalGas personnel. Other SoCalGas personnel are involved when the installation requires extensive modifications to the existing meter configuration, such as installing the modules on complex industrial and commercial meters; replacing existing curb meters with new curb meters containing a pre-installed module; and when meters are changed through the normal course of business.

As Table 1 displays, over 72 percent of the modules were installed on existing meters, while nearly 28 percent of the time, the meter was replaced with a new meter with a module already installed.

Installation teams generally performed work out of warehouses leased specifically for the Advanced Meter project. As part of the planned project shut down, operations at all warehouses have completed as of June 30, 2017.

Throughout the project, the Advanced Meter team has experienced some injuries and incidents. Table 2 displays safety results from January through June 2017. SoCalGas aspires to have zero incidents and has taken a proactive approach in providing its Advanced Meter team with additional safety and training resources. SoCalGas included an additional day dedicated to safety in the installer training curriculum and as part of its “Safe and Sound” Safety Campaign, SoCalGas created and shared short safety films to promote safe behavior at the workplace and at home.

Table 2
Advanced Meter Safety Incidents
January 1, 2017 through June 30, 2017

	Number of Incidents	Rate*
Occupational Safety & Health Administration ("OSHA")	5	4.5
Controllable Motor Vehicle Incidents ("CMVI")	6	5.8
Lost Time Incidents ("LTI")	1	0.9

*OSHA Rate is the number of incidents per 200,000 hours worked
*CMVI Rate is the number of incidents per million miles driven
*LTI Rate is per 100 workers

2.B Communication Network Construction Status

The communications network of the Advanced Meter system is designed to ensure that SoCalGas customers receive their hourly consumption data. It consists of DCUs deployed across the SoCalGas service territory that receive the meter reading data from the modules installed on each meter. Most modules transmit twelve hourly meter reads four times a day to at least three DCUs. Each module communicates for less than two minutes per year. The data is encrypted and transmitted across a licensed frequency from the module to the DCU.

SoCalGas continues to refine the network to improve system performance and based on the latest propagation study provided by Aclara, the technology vendor, the project plans to install 4,600 DCUs. The actual number of DCUs to be installed is determined by a two-step process:

1. The specific DCU locations, referred to as design points, are determined based on the propagation study which takes into account the location of the modules on the six million meters, the topography of the surrounding area, and the influence of the environment on the transmission of the radio signal. The DCUs can be placed within a 500 foot radius of the design point.
2. After these DCUs are installed, SoCalGas evaluates the performance of the network and identifies gaps in the network. SoCalGas then installs additional DCUs to remediate these deficiencies in performance.

SoCalGas' plan is to install DCUs prior to the scheduled module installation so that data can be received soon after the module is installed. Overall, SoCalGas has achieved this goal. Table 3 displays the status of the SoCalGas network as of June 30, 2017.

Table 3
Status of DCUs through June 30, 2017

DCU Status	Number of DCUs	Percent of DCUs
Installed	4,201	91.3%
On – Air	*4,201*	*91.3%*
Ready to Construct	17	0.4%
Negotiating with Local Governments/Other Third Parties[5]	229	5.0%
Not Started	153	3.3%
Total Planned Installations	4,600	**100%**

Ninety-one percent of the network has been constructed or is ready to construct. By June 30, 2017, SoCalGas has installed 4,201 DCUs with an additional 17 DCUs ready for construction. Of the 4,201 installed, all have been commissioned on-air and are receiving reads from installed MTUs. SoCalGas continues to negotiate with local governments and third parties to install the remaining DCUs in the network. Table 4 displays the locations of installed DCUs to date.

Table 4
Location of Installed DCUs

DCU Location	Installed DCUs
SoCalGas Owned Poles in	
SoCalGas Facilities	65
Public Right of Way	2,625
Caltrans Right of Way	38
Private Easement	24
Total	2,752
Attached to Third Party Assets	
Los Angeles Bureau of Street Lighting	637
SCE Street Lights	366
PG&E Street Lights	27
SDG&E Street Lights	43
Other Cities Street Lights	304
Other Public/Private Assets	72
Total	1,449
Total DCUs Installed	**4,201**

[5] Includes municipalities refuting the CPUC's preemptory jurisdiction over utility facilities.

To date SoCalGas has installed DCUs on a SoCalGas owned pole in the public right of way under its franchise 62 percent of the time. The second most common method has been to install DCUs on local government-owned street lights.

When a DCU is attached to a third party owned asset, SoCalGas negotiates a contract with the asset owner which usually includes:

- Fees to lease the space on the asset; and,
- Energy rates for the electricity to power the DCU.

SoCalGas has executed contracts with the City of Los Angeles Bureau of Street Lights ("BSL"), Pacific Gas & Electric Company ("PG&E"), Southern California Edison Company ("SCE"), San Diego Gas & Electric Company ("SDG&E"), and has reached contract agreements with 143 cities and six counties.[6]

Of the 12 counties and 211 cities in the SoCalGas service territory, SoCalGas has finished installing DCUs in seven counties and in 178 cities/communities.[7] SoCalGas is in active negotiations with several cities and counties to continue installing the remaining DCUs. A limited number of cities and counties have been reopened due to network optimization.[8] To ensure area coverage, the project has reassessed cities and counties that have been completed with the original design and added DCUs where necessary.

With 4,201 DCUs constructed, SoCalGas has received 188 complaints and 92 inquiries, including concerns about the DCUs aesthetics, glare, or location. In each case, SoCalGas contacted the complaining party to resolve the complaint. As a result of customer concerns, SoCalGas has relocated 89 DCUs. Otherwise, the concerns have been resolved without relocating the DCU.

Where the DCU design point falls entirely within private property, SoCalGas negotiates easements with the private property owner(s). Installations of this type usually require a contract to secure the right to locate on the third party property.

When SoCalGas installs a DCU on its own pole, the DCU is solar-powered. When installed on a street light, the DCU is most often powered by electricity from the street light. Given the preponderance of new poles, most of the DCUs are solar powered. Table 5 shows the breakdown between solar and A/C powered DCUs.

[6] Pursuant to Commission Resolution ESRB-1 dated May 10, 2013 (SCE), Resolution ESRB-2 dated June 27, 2013 (SDG&E) and Resolution ESRB-3 dated June 27, 2013 (PG&E) SoCalGas is able to permanently attach the DCUs to these electric utilities' street lights.

[7] Appendix A provides a list of the counties and cities with fully installed DCUs.

[8] Appendix B provides a list of the counties and cities that have been reopened.

Table 5
Power Source for DCUs

Installed DCUs	Solar Powered	AC Powered
4,201	2,845	1,356

Chapter 3 - System Performance

Two key indicators of the overall Advanced Meter system performance are the performance of the network with respect to the delivery of hourly data for billing and online presentation purposes, and the resulting billing data-related performance. Additional improvements to SoCalGas' service delivery are also being realized as a result of meter read automation and enhanced data analytics capabilities enabled by the Advanced Meter system. Extended uses of the Advanced Meter system through a network sharing capability also have the potential to provide additional operational and conservation benefits to water agencies and their customers within SoCalGas' service territory.

3.A Network Performance

The most basic measure of system performance is to measure the data delivered as a percentage of the expected data to be delivered. This has direct impacts to both billing and the presentment of hourly gas consumption data to customers. In a perfect system, SoCalGas would receive data for every customer for every hour, each day of the year. To provide this data, the modules must communicate with the DCUs and the DCUs must transmit the data to SoCalGas back office systems 100 percent of the time.

Table 6 displays the breakdown of modules that have successfully communicated with SoCalGas' back office systems.

Table 6
Module Communication Status

Module Communication Status	Modules Installed	Percent Installed With Network
Total Modules Installed	5,893,785	-
Modules installed but not yet communicating with HE systems[9]	16,942	-
Delivering 100 Percent of Expected Reads	5,582,447	94.7%
Missing 1-12 Reads	172,751	3.1%
Missing More Than 12 Reads[10]	105,775	1.9%
Missing All Reads	15,870	0.3%

[9] Installed MTUs that have not yet established communication with a DCU and transmitted 24 hours of reads

[10] Missing more than 12 reads but at least one read has been communicated.

SoCalGas generally installs modules where the network is available; however, some exceptions to installing outside of an available network include instances when new business meters are connected and routine meter changes are being performed. Additionally, when a meter fails in the field, it is replaced with an integrated meter and module, regardless of whether the network is installed or not.

As illustrated in Table 6, approximately 95 percent of the installed modules are successfully communicating all of a customer's hourly data on a monthly basis. About three percent of the modules are missing 1-12 reads, which means that they have had only one or two unsuccessful communications per month. That is, one or two six-hour periods have not been successfully communicated to the SoCalGas back office systems. SoCalGas does not consider a module performing at this level to be problematic for billing as enough hourly data is being received for these purposes.

About two percent of the modules are missing more than 12 reads but have communicated at least one read. SoCalGas continues to examine module modifications and network enhancements to improve the performance of these modules.

3.B Billing Data Performance

The Advanced Meter modules replace the manual reads with an automated read, with the expectation that the system will produce more accurate reads (no data entry mistakes) and fewer estimated reads (meter access problems are largely eliminated).

Table 7 displays the progression of modules from installation to actual use for billing.

Table 7
Advanced Meters Utilized for Billing

Modules Installed as of June 30, 2017	5,893,785
Modules in 'Billing Ready' Status	5,849,741
Advanced Meter Reads Requested for Billing	5,815,886
Billing Data Provided by Advanced Meter	5,810,226
Billing Data Not Provided by Advanced Meter	5,660
Percent Provided by Advanced Meter – Actual Read	99.86%
Percent Provided by Advanced Meter – Estimated Read	0.04%
Percent Not Provided by Advanced Meter	0.1%

Approximately 99 percent of the installed modules have been deemed 'Billing Ready' and are now used or ready for billing customers. Of the remaining one percent, most are still in the process of completing one of the test elements needed to become 'Billing Ready.' Others are located in areas with incomplete DCU coverage, or are located in areas with insufficient module density to support conversion to Advanced Meter billing.

Modules in areas with network coverage which do not pass the 'Billing Ready' tests are monitored and, if necessary, replaced. They may also point to insufficient network coverage or DCU problems, which are then remediated.[11]

For the Billing Ready modules, the system provides a high percentage of actual reads. The system also provided 0.04 percent of reads which were 'estimated reads' based substantially on reads received earlier in the month, rather than on a particular designated day. Only about 0.1 percent of the reads could not be provided by the Advanced Meter system.

In July 2013, SoCalGas implemented software that enabled the utilization of automated reads for the initiation of new service and generation of closing bills. With Advanced Meter automation, a field visit to collect a customer's starting read was no longer necessary for turn-on orders that did not require entry into the home. SoCalGas' Customer Service Field organization has seen a reduction of over 2,726,064 orders since the implementation of the automated reads.

3.C Service Delivery Enhancements resulting from Enhanced Data Analytics

As the Commission articulated in the AMI decision,[12] the Advanced Meter system "provides [a] system-wide technology platform with the ability to expand operating benefits as new applications emerge." In areas where the communications network is fully deployed, SoCalGas is leveraging Advanced Meter-enabled data analytics and technology by integrating data to develop algorithms that support the continued safe and reliable delivery of natural gas to its customers. These enhanced data analytics enable identification of unusual gas consumption patterns at customer facilities.

Though in the exploratory phase, this new and more granular awareness of energy data utilization is uncovering new opportunities and benefits potential. Leveraging the Advanced Meter network could result in faster identification of abnormally high gas usage, which enables SoCalGas to identify, investigate, and respond to potential safety situations quicker. By discovering abnormally high gas usage and notifying customers, SoCalGas can reduce methane emissions at customer facilities saving energy and improving air quality while also reducing the financial burden on customers from higher usage.

The Advanced Meter team assesses unusual consumption patterns on closed accounts using a Per Day Average and in some cases will look at the hourly reads to conduct further research. During the exploratory phase of SoCalGas' enhanced data analytics, the following results have been achieved. Table 8 summarizes the results of the 5,909 exploratory service orders fielded through June 30, 2017.

[11] As referenced in Chapter 2, additional DCUs may have to be added to improve system performance.
[12] D.10-04-027, page 40.

Table 8
Gas consumption data analytics results through June 30, 2017

Findings from completed field visits (project to date)	Number of field visits	Percent
Total field visits generated by consumption analytics awareness	**5,909**	
Gas services closed by SoCalGas field technician due to excessive registration, awaiting resolution. Resolution takes place at the time of the follow-up field visit to reinstate gas service.	2,561	43.34%
Gas leak found by SoCalGas field technician	1,120	18.95%
Gas or hot water leaks corrected by the customer as a result of SoCalGas field visit	878	14.86%
Hot water leaks where the hot water heater was in continuous demand	835	14.13%
Abnormal gas usage resulting from an appliance in use for an extended period of time (e.g., appliances unintentionally left on).	515	8.72%

Leveraging Advanced Meter consumption analytics is a component of a more comprehensive set of processes and inspections aimed at ensuring public safety and SoCalGas expects that, as it continues to build out enhanced analytics capabilities enabled by the Advanced Meter system, further customer service and safety benefits will accrue to its customers. More rapid detection and resolution of gas and hot water leaks provides enhanced safety for customers and their communities, as well as provides energy and financial savings, reduced greenhouse gas emissions, and conservation of our scarce water supplies.

3.D Extending the Use of the Advanced Meter Network

As articulated in our AMI Application, SoCalGas recognizes the State's priority and urgency in encouraging and enabling water conservation and as such included the requirement for an AMI technology capable of reading water meters. This network sharing capability has the potential to provide significant operational and conservation benefits to water agencies and their customers within SoCalGas' service territory.

In order to operationally evaluate the feasibility of the "Shared Network" concept, SoCalGas has established pilots to be conducted by Aclara and SoCalGas with a limited number of water utilities. Three municipal water utilities are participating in this pilot, and as of June 30, 2017 each of the municipal water utilities has renewed their pilot term for an additional one year period. There continue to be approximately 2,000 municipal water utility MTUs successfully transmitting data over the SoCalGas Advanced Meter network.

SoCalGas continues to work with the technology vendor (Aclara), a 3rd party analytics vendor (Valor Water Analytics), and two separate Commission-regulated water utilities (San Gabriel Valley Water Company, California American Water) for the SoCalGas Water Energy Nexus (WEN) AMI Pilots which were approved by the CPUC on June 9, 2016 with D.16-06-010. As of June 30, 2017, there are approximately 1,800 Commission-regulated water utility MTUs successfully transmitting data over the SoCalGas Advanced Meter network. The year-long analytics period for California American Water kicked off in April 2017, and the San Gabriel Valley analytics period will conclude in October of 2017.

In addition to the Advanced Meter network being shared by external water utilities, other groups within SoCalGas are leveraging the network. As part of a pilot project by the Pipeline Safety Enhancement Plan (PSEP) group, data from a sensor device to detect, measure and monitor methane in the area near a transmission pipeline is being transmitted over the Advanced Meter network. Eleven of these methane sensor devices, installed in 2016, continue to successfully communicate over the Advanced Meter network and provide SoCalGas with remote alarm registration and processing when the methane-in-air concentration, as measured by the sensors, exceeds limits established for our testing period.

Chapter 4 - Financial Status

To track expenses during the project, Ordering Paragraph 7 of the D.10-04-027, stated:

> "Southern California Gas Company shall file an advice letter no later than 30 days from the effective date of this decision, establishing a balancing account and detailing the cost recovery mechanism in conformance with this decision. Southern California Gas Company is authorized to recover deployment costs up to $1.0507 billion in this account, plus additional amounts, if any, consistent with the terms and conditions of the Risk Sharing Mechanism approved in Ordering Paragraph 2."

On August 4, 2010, the CPUC approved AL 4110, effective April 8, 2010, which established the Advanced Meter Infrastructure Balancing Account.

The CPUC approved budget of $1,050 million for the SoCalGas Advanced Meter project was augmented by re-directing $13.5 million of previously approved General Rate Case funding for a Remote Automated Meter Reading ("RAMR") project. SoCalGas halted the implementation of its RAMR project, a drive-by meter reading system, when its Advanced Metering Infrastructure ("AMI") application was submitted, and in the AMI application requested that this funding be re-directed to the Advanced Meter project. In D.10-04-027, the CPUC approved this request.[13] Due to the timing of the AMI application and Decision, the project deployment period overlapped with SoCalGas' TY 2012 and TY 2016 General Rate Case (GRC) schedules. Since AMI deployment costs and benefits are recorded in the AMIBA, AMI impacts could not be

[13] A.08-09-023, Prepared Direct Testimony of Edward Fong, page 15.

integrated into GRC forecasts until TY 2019. As a result, SoCalGas requested authorization in the TY 2016 to establish a 2018 "bridge-year" period – the year between the end of deployment in 2017 and the TY 2019 GRC. Subsequently, on May 5th, 2017, SoCalGas filed Advice Letter 5134 to request the 2018 bridge-year period, referred to in the Advice Letter as the "post-deployment phase cost sub-account."[14] The total budget for the SoCalGas Advanced Meter project is $1,064 million, which includes a contingency fund of $68.7 million.

The sequencing of the spending to date is typical of the pattern for many major projects. The early years of the project were spent organizing the large project team; developing new business processes; and building and implementing the information systems that support the construction of the DCUs and installation of the modules. SoCalGas' plan contemplated that the DCUs would be constructed prior to the installation of the modules so that the modules would be effective in delivering benefits to customers. As indicated in Chapter Two, SoCalGas began installing its DCUs in June 2012 and its modules in October 2012.

Table 9
Financial Results (in $Thousands)
Recorded 2010 through June 2017

	2010	2011	2012	2013	2014	2015	2016	2017	Project to Date
Project Management Office	2,719	6,477	6,634	4,945	4,027	3,415	3,006	1,409	**32,632**
Meters, Modules & Installation	120	3,718	28,410	115,516	183,117	170,078	58,829	10,623	**570,411**
Network	877	3,743	14,429	23,805	18,796	15,306	14,572	4,563	**96,091**
Information Technology	6,011	16,873	21,931	16,015	10,469	11,109	6,248	2,425	**91,081**
Customer Outreach	324	1,026	2,088	5,502	5,190	4,786	3,999	1,572	**24,486**
Employee Awareness	65	3,078	3,732	2,088	1,046	1,087	752	213	**12,062**
Support Organizations[15]	-	-	707	3,500	4,517	4,684	11,512	7,311	**32,231**
Overheads & AFUDC[16]	2,222	9,471	21,291	32,577	38,311	32,268	29,433	8,742	**174,314**
Total	**12,338**	**44,386**	**99,223**	**203,947**	**265,472**	**242,732**	**128,350**	**36,859**	**1,033,308**

Table 9 displays the Advanced Meter spending through June 30, 2017, by the major project activities. The purchase and installation of meters and modules continue to be the primary source of spending at approximately $570 million project to date. The next large areas of spend are in information systems and the construction of the communication network with approximately $91 and $96 million in spend, respectively. Although the project has fully

[14] AL 5134 with sub-account details is available at the following site:
https://www.socalgas.com/regulatory/tariffs/tm2/pdf/5134.pdf
[15] Support organizations are comprised of SoCalGas departments outside of Advanced Meter that are funded by the project for project-related work or for work identified in the business case. This includes field work related to advancing our larger meters (primarily commercial and industrial).
[16] Updated to exclude the Pension & Benefits refundable portion that is balanced separately from the AMI project.

allocated the authorized contingency, SoCalGas believes the project will be delivered within the approved budget.

Chapter 5 - Meter Reading Work Force Impacts

The Meter Reading work force is the most significantly impacted by the Advanced Meter project as Meter Reading positions will all but be eliminated by the project.[17] Both SoCalGas and the CPUC are concerned about these impacts. The Commission specifically addressed this concern. Ordering Paragraph 1 of the D.10-04-027 states:

> "Southern California Gas Company shall supplement by $1 million, its funding for workforce retention and retraining. This fund is established to better protect the employment interests of Southern California Gas Company's meter reading workforce and should be used to extend severance, vocational training, and other transitional opportunities to employees affected by the decision to pursue advanced metering infrastructure."

In response to this direction, SoCalGas set aside funding in its Enhanced Educational Assistance Fund specifically to support the Meter Reading personnel in place in April 2010. As of June 30, 2017 meter readers had been reimbursed approximately $104,000 through this fund.

While meter readers have been active in seeking employment opportunities within SoCalGas the fund has not been heavily utilized, so as part of continuing efforts to support our employees' transition to potential job opportunities, SoCalGas expanded the retention and retraining efforts to include skills orientation workshops. These workshops are designed to familiarize employees with the mechanical and technical skills associated with piping, tools usage, natural gas appliance and distribution system construction work. The orientation workshops offered transitional skills that could be applied toward job opportunities within and outside of SoCalGas. The target employee group was expanded to include all current meter reading employees as well as AMI Field Representatives. All of these employees will be affected when Advanced Meter implementation is completed.

SoCalGas has allocated $42,400 from the authorized funding from 4th Quarter 2014 through 2017 to provide these workshops for employees. SoCalGas will continue to offer enhanced educational assistance reimbursement to the remaining eligible meter reading employees.

Table 10 displays the current status of those Meter Reading personnel who were employed in April 2010, when the project was approved by the CPUC.

[17] Some personnel may continue to manually read meters in support of the CPUC authorized Opt-Out program.

Table 10
Status of Meter Reading Personnel Employed in April 2010

Meter Reading Personnel	Work Force in April 2010	Remain in Meter Reading June 30, 2017	Left Company	Transition Within Company
Full-time	166	2	24	741
Part-time	818	26	191	
Management	46	4	14	28
Total	1,030	32	229	769
Percent of Work Force	100%	3.10%	22.23%	74.66%

As Table 10 shows, 741 employees (over 74 percent of the Meter Reading personnel from April 2010) have transitioned to another position within SoCalGas. Twenty-two percent of those employed in 2010 have left SoCalGas and 32 employees (3.10 percent) remain in the Meter Reading organization.

SoCalGas continues to encourage Meter Reading employees to explore all company opportunities outside of the Meter Reading organization.

Chapter 6 – Community Education and Outreach

SoCalGas personnel perform an array of outreach activities to inform customers about Advanced Meter project activity. SoCalGas developed a local stakeholder education and community outreach program to ensure every city and county SoCalGas serves is addressed. During the network construction process, outreach is done at the city level with initial city briefings to the city manager and staff including informational presentations to city councils as well as any other sub-committees as necessary. Outreach to the community includes, but is not limited to: one-on-one customer meetings, door knocking, and meetings with homeowner associations, community/neighborhood councils, community groups, and mailings. These efforts include briefing local elected officials, media outreach, community town hall events and local speaking engagements. During the first half of the year 2017, SoCalGas worked closely with the community and cities to support the construction of DCUs in the cities of Burbank, Santa Clarita, Diamond Bar, Orange Coast, Santa Paula, Oak View, San Marino, Norwalk, Santa Barbara, Bellflower, Glendale, Garden Grove, Pasadena, Ontario, Gardena, Riverside, Malibu, Hermosa Beach, Manhattan Beach, Burbank, Thousand Oaks, Newport Beach, Ventura, Goleta and Torrance.

6.A Outreach Organizations and Events

To date, SoCalGas has participated in over 3,093 events. In the time frame of January 1, 2017 through June 30, 2017, SoCalGas completed over 700 public outreach activities, including briefings, presentations, exhibit booths, door-to-door, public service announcements, etc.

As of June 30, 2017, nearly 165 organizations were contracted to support community outreach activities. Due to the Advanced Meter project ramping down, SoCalGas will no longer be partnering with GeM Communications to manage the solicitation and implementation for local organizations to perform community outreach on behalf of SoCalGas. GeM managed the request for proposal (RFP) process and contracts with community- and faith-based organizations (CBOs, FBOs), disability agencies, Chambers of Commerce, and business organizations that conducted outreach to sensitive communities and customers in specific Advanced Meter installation areas.

Chapter 7 - Customer Awareness and Satisfaction

From 2010 through 2016, SoCalGas monitored the impact of its outreach activities in the areas of customer awareness and customer satisfaction. SoCalGas utilized a variety of market research diagnostics to monitor the "pulse" of customers pertaining to the Advanced Meter installation process, customer communications, new programs and services, and customer attitudes and motivational drivers to behavioral change.

For purposes of monitoring overall customer awareness and perceptions, SoCalGas used the Customer Insight Study ("CIS")[18] which is administered by Davis Research. CIS is SoCalGas' public opinion tracking study. Starting in the fourth quarter of 2010, SoCalGas added three Advanced Meter related questions to this tracking survey. The questions were then updated slightly in the fourth quarter of 2012, commensurate with the initial deployment of Advanced Meters. These questions were fielded through the fourth quarter of 2016, and then discontinued going forward given that 96 percent of the installations were completed by the end of 2016.

A consistent finding of the quarterly CIS results was that awareness levels amongst residential and business customers increased gradually over the course of the project rollout. The general upward trend seems to reflect the increased volume of customer communications about the project as well as an increase in installations.[19]

Chapter 8 – Elevated Customer Inquiries and Deferral/Opt-Out Program Enrollments

SoCalGas customers may inquire about the Advanced Meter project by contacting either the SoCalGas Customer Contact Center ("CCC") or the Advanced Meter Customer Information Center ("CIC"). The CCC addresses customer inquiries about any subject while the CIC typically makes appointment arrangements with customers to have their Advanced Meter installed. Advanced Meter "opt-out" requests are processed by the CCC.

[18] Formerly called iTracker Customer Perception Study.

[19] Please refer to prior years' Reports for further details regarding Customer Awareness and Satisfaction research conducted over the course of the Advanced Meter project.

Some customer inquiries were not routinely resolved and were escalated to Advanced Meter Customer Experience staff. There have been about 8,537 inquiries since the project's inception. The number of escalated customer inquiries is very low, considering the volume of Advanced Meter communications that have been distributed to SoCalGas customers. The most common cause of the escalated inquiries is requests to defer/opt-out of the installation of the Advanced Meter communications module.

Although customers can call either the CCC or the CIC to have their deferral/opt-out requests recorded, some ask to speak to the Advanced Meter Customer Experience staff. Their questions usually revolve around safety and privacy concerns, as well as comments on the Advanced Meter Opt-Out Program fees.

Table 11 displays a breakdown of enrollment status for the Advanced Meter Opt-Out Program as of June 30, 2017.

Table 11
Advanced Meter Opt-Out Program Enrollment

Inquiry Type	Number Received	Explanation
Active customer-requested Opt-Out Program enrollments[20]	7,737	The number of customers actively enrolled and being billed for Opt-Out Program fees and charges.[21]
Active customers defaulted in to the Opt-Out Program	19,291	The number of customers that have been default enrolled[22] and are being billed for Opt-Out Program fees and charges.
Total Active Opt-Out Program enrollments	**27,028 (0.46%)**	
Customer Opt-Out Program requests to "opt back in" to Advanced Meter installation	50,802	The number of customers that requested to be removed from the Opt-Out Program (includes customers in both an "Active" and "Pending Enrollment" Opt-Out Program status).

[20] "Active" includes only those customers who are enrolled in the Opt-Out Program and are currently being billed associated Opt-Out Program fees. Many customers in a "Pending" status, once presented with final communications regarding Opt-Out Program fees, elect to terminate their prior request for enrollment in the Opt-Out Program. Similarly, customers about to be default-enrolled due to repeated installation/access attempts sometimes contact SoCalGas to schedule an installation prior to being actively enrolled.
[21] SoCalGas implemented its Advanced Meter Opt-Out Program effective March 19, 2014, pursuant to D.14-02-019. These customers either requested to defer from an Advanced Meter module installation prior to March 19, 2014, or subsequent to March 19, 2014, requested to enroll in the Advanced Meter Opt-Out Program.
[22] These customers were defaulted (automatically enrolled) into the Opt-Out Program due to several unsuccessful attempts by SoCalGas to contact the customers to provide access for the installation of the Advanced Meter.

In March 2014, SoCalGas' Opt-Out Program became effective and the project team initiated efforts to inform employees of the Opt-Out Program and revised any impacted company communication materials. The interim opt-out fees approved by the Commission were consistent with those previously adopted for the other California Investor-Owned Utilities ("IOUs").[23] SoCalGas' Advanced Meter Opt-Out Program interim fees for residential customers were as follows:

- Non-CARE Customers: Initial fee of $75.00 and $10.00/month ongoing cost
- CARE Customers: Initial fee of $10.00 and $5.00/month ongoing cost

In December 2014, the Commission issued D.14-12-078 regarding the Smart Meter Opt-Out Phase 2 proceeding; this decision reiterated approval of the interim opt-out fees and charges and adopted them as permanent opt-out fees and charges for residential customers for each of the California IOUs.

In April 2015, pursuant to the Commission's Phase 1 and Phase 2 Opt-Out decisions, SoCalGas implemented modifications to its billing system to begin charging opt-out fees to Opt-Out Program participants, including customers who were defaulted into the program. Additionally, information regarding key new features introduced in the Phase 2 decision was incorporated into existing customer talking points and all relevant Advanced Meter customer and external communications materials.

SoCalGas still expects the total percentage of customers who will eventually opt-out to be within the planning assumption of 0.5 percent.

Chapter 9 - Conservation Outreach Campaigns

D.10-04-027 set a goal for SoCalGas to reduce residential gas consumption by one percent and placed reporting requirements on SoCalGas which are referenced in the introduction to this report.[24]

In late November 2016, SoCalGas initiated the fourth and final targeted heating season campaign of a multi-year outreach campaign aimed at demonstrating how to best drive behavior change to reach the Advanced Meter one percent conservation goal. This campaign followed a "Test and Learn" approach and generally ran through March 2017.[25] The overall strategy for the 2016-2017 conservation campaign design was to incorporate lessons learned and key findings from the prior three heating season campaigns conducted in 2013-2014, 2014-2015 and 2015-2016, with a goal towards increasing engagement levels in order to achieve behavioral change that would drive energy conservation of one percent or more. Lessons

[23] D.12-02-014 (PG&E), D.12-04-018 (SCE), and D.12-04-019 (SDG&E).
[24] This energy savings goal specifically refers to 1% of total *residential* gas usage.
[25] A few treatments tested also included year-round elements.

learned from the four Advanced Meter conservation campaigns will be carried forward into SoCalGas energy efficiency behavior programs in the future.[26]

Through 2017, SoCalGas continued to team with Nexant on several aspects of its conservation campaign implementations and post-campaign evaluations. The primary objectives were as follows:

1) Development of comprehensive outreach plans incorporating a Test and Learn program development strategy in which continuous assessment and improvement in the performance of feedback programs was the objective;
2) Evaluation of the four years' conservation campaign results, as well as of continued conservation effects resulting from prior years' campaigns; and,
3) Recommendations and guidance for future years' program plans.

9.A Conservation Customer Engagement and Results

The major features of the 2016-2017 conservation campaign were:

- Continued exploration of ways to improve the Bill Tracker Alert (BTA), as it has proven to be one of the most cost effective conservation treatments for My Account customers. This included testing BTAs with and without seasonal energy-savings tips in comparable populations to determine whether these tips increased savings;
- Continued testing of innovative behavioral methods that fully leverage AM data, such as weather sensitivity-based "Seasonal Energy Update" reports (SEU), targeted to customers identified through AM-enabled analytics as those with gas usage habits most sensitive to colder weather;
- Exploration of how the SEU reports performed with CARE customers;
- Testing of a new weatherization-focused SEU with Non-CARE customers;
- Comparison of the Paper SEU treatments against the Opower Paper-only Home Energy Report (HER) and other "HERs," ensuring that the treatments were tested on comparable populations;
- Retesting of new and simplified Aclara Paper "Home Energy Update" (HEU) reports (originally tested in the 2014-2015 campaign);
- Development of an "in-house"-developed paper "SoCalGas Usage Report" that not only tested the effectiveness of a SoCalGas-developed "peer comparison" algorithm, but also helped to cultivate SoCalGas' internal behavioral change analytics and personalized messaging capabilities;

[26] As outlined in its Program Implementation Plan for the 2013-2014 California Statewide Program for Residential Energy Efficiency, Energy Advisor Program: "Upon completion of the Advanced Meter project, SoCalGas will incorporate successful behavioral programs and techniques into the energy efficiency portfolio." Behavioral programs are outlined as a key element of the SoCalGas Energy Efficiency Business Plan filed with the Commission on January 17, 2017.

- Testing of the impacts of providing a Bilingual English-Spanish language paper energy report and welcome materials in lieu of either a single language English or Spanish report for customers in areas with high rates of Latino population;
- Continued treatment in 2016-2017 for several Opower HER treatments that initiated in the 2015-2016 campaign, but with a decrease from four monthly paper reports and 12 email HERs (eHERs) to one paper HER supplemented with 12 eHERs. These continued treatments received the "Thermostat" version of the HER first tested in 2015-2016 campaign, or Opower's new version of their standard HER;
- Development of new Opower paper HER treatments for the 2016-2017 campaign for CARE customers. These HER treatments included cross-promotional messaging targeted specifically to CARE customers in the treatment group who had already enrolled in the SoCalGas Energy Savings Assistance Program (ESAP), as well as to those who had not yet signed up for ESAP;
- Testing of a combination of two information feedback options -- BTA with seasonal tips supplemented with an Opower Paper HER -- to see if there are incremental savings relative to other populations that only received the BTA or HER treatments alone;
- Continued testing of treatments within the top two usage quartiles, since they both produce measurable therm savings; and
- Re-testing of the BTA that was enhanced in the 2015-2016 campaign on small and medium business (SMB) customers.

As with the prior year's campaign, **every one of the eleven new residential conservation treatments tested during the 2016-2017 campaign produced statistically significant gas savings.**[27] As shown in Table 12, **these new treatments resulted in average savings of over 1.7% during the 2016-2017 fall/winter period.** This is an increase in savings vs. average first year savings rates for the successful[28] treatments tested in the three prior heating season campaigns, and shows continued progress towards the conservation goal. Also of note for the 2016-2017 treatments tested was that one treatment – a "Seasonal Energy Update" energy report based on advanced meter analytics developed by SoCalGas – achieved the highest savings rate for all four years' campaigns of 3.43 percent.

[27] Four out of eleven treatments tested during the 2013-2014 heating season campaign generated average savings of about 1.3 percent. Four out of seven residential treatments tested during the 2014-2015 heating season campaign generated average savings of about one percent. Fourteen out of fourteen residential treatments tested during the 2015-2016 campaign generated average savings of over 1.4 percent.

[28] Successful treatments are comprised of the subset of treatments tested that were successful in producing statistically significant usage reductions.

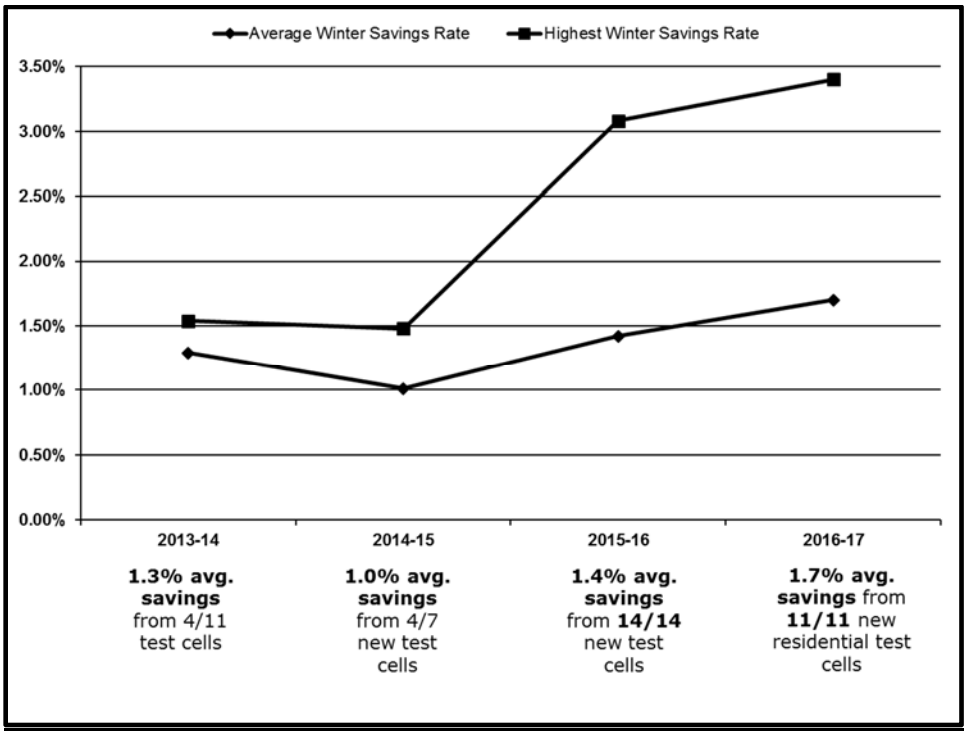
Table 12
Percent Reduction in Fall/Winter 2016-2017 Gas Usage
for Residential Conservation Treatments

Treatment	Percentage Reduction
11 New Treatments	**1.74%**
9 2015-2016 Treatments	1.42%
1 2014-2015 Treatment	1.31%
Overall % Reduction	**1.60%**

Continued savings effects were also realized for ten of the treatments initially tested during the 2014-2015 and 2015-2016 campaigns. **Overall, the new and continued successful treatments produced average gas savings of 1.6 percent during the 2016-2017 fall/winter period.** The persistence and sustainability of these conservation results demonstrates the durability of conservation actions as outlined in Ordering Paragraph 5 included on page 4 of this Report.

Please refer to Appendix C, "Evaluation of Southern California Gas Company's 2016-2017 Conservation Campaign, August 31, 2017" provided by Nexant for a comprehensive evaluation of the results of this conservation campaign, as well as a further summary of the campaign results (as shown in Figure 1 below) for the four Test and Learn heating season campaigns conducted over the course of the Advanced Meter rollout.

Figure 1
Average and Highest Savings Rates for Conservation Test and Learn Campaigns



In addition to the conservation Test and Learn campaign treatments and outcomes described above, following is an update regarding related customer engagement metrics and indicators for the 2016-2017 customer conservation campaign pilot programs and associated Advanced Meter-enabled energy presentation and analysis tools.

9.B Conservation Campaign Update

9.B.1 Opower Home Energy Reports

As outlined above, given the success of Opower's Home Energy Reports (HERs) in generating conservation savings in prior years, SoCalGas contracted with Opower to implement numerous treatments for the 2016-2017 campaign. This included continuation into a second heating season for five Opower treatments that were initiated during the 2015-2016 campaign. For treatments that were repeated for a second year, the number of monthly paper HERs delivered was reduced from four to one. Aside from this, any customers with email addresses within the Opower treatment groups received an electronic version of the HER (emailed HERs or "eHERs") beginning in December.

The Opower HER contained personalized usage information that was designed to help customers save energy and money. This report engaged customers primarily through the "Neighbor Comparison" information. A customer's current natural gas usage was compared to approximately 100 nearby occupied homes with similar characteristics - such as square footage

and heating system. These comparisons, along with personalized energy saving tips, can help customers understand how they can conserve natural gas.

A total of 652,875 paper HERs and 1,114,750 eHERs (emailed HERs) have been sent from December 2016 through June 2017. Another 955,500 remaining eHERs are scheduled to be sent from July to December 2017.

Table 13
December 2016 - June 2017 New and Continuing Opower Home Energy Reports

	2016	2017					
	Dec	Jan	Feb	Mar	Apr	May	Jun
Paper HERs							
Continuing	66,659	0	0	0	0	0	0
New Treatments	293,108	146,554	146,554	0	0	0	0
Total Paper Reports Sent	**359,767**	**146,554**	**146,554**	**0**	**0**	**0**	**0**
eHERs							
Continuing	66,750	66,750	66,750	66,750	66,750	66,750	66,750
New Treatments	92,500	92,500	92,500	92,500	92,500	92,500	92,500
Total eHERs Sent	**159,250**	**159,250**	**159,250**	**159,250**	**159,250**	**159,250**	**159,250**
Total Opower Reports Sent	**519,017**	**305,804**	**305,804**	**159,250**	**159,250**	**159,250**	**159,250**

As of June 30, 2017, 684 (0.2 percent) of Opower HER program enrollees opted-out of receiving further Opower HERs during the current campaign. EHERs delivered an average open rate of about 44.84 percent and a click-through rate of 0.96 percent.

Customer acceptance of the Opower treatments remains strong as indicated by both the low opt-out rate for recipients of these reports, coupled with the findings of customer satisfaction research performed with a sampling of the recipients of the reports from the 2014-2015 campaign as reported in the August 2015 Report.

9.B.2 SoCalGas (Aclara-facilitated) "Seasonal Energy Update" Reports

As outlined in section 9.A, in the 2016-2017 campaign, SoCalGas tested innovative behavioral methods that more fully leverage AM data. In collaboration with Aclara, SoCalGas developed energy reports targeted to customers based on their individual weather sensitivity, called "Seasonal Energy Update" reports. The Seasonal Energy Update report campaign included paper reports targeted to customers identified through AM-enabled analytics as those with gas usage habits most sensitive to colder weather.

Three test cells were assigned to these Aclara-facilitated treatments. Two treatment groups received a slightly enhanced version of the report tested in the prior year, with one CARE (low income) customer segment test cell and one Non-CARE customer segment test cell. The third

Non-CARE test cell received a new version of the report that focused on building envelope/weatherization-related messaging. Customers in all three test cells received the following: four paper reports; one Welcome Letter/Frequently Asked Questions; three Frequently Asked Questions inserts; and one Repositionable Thermostat Setting Reminder Decal.

The Aclara-facilitated Seasonal Energy Update reports contained personalized usage information to help customers understand their home energy usage when temperatures get cold and to offer tips on how to save energy. Each monthly report provided three pieces of information: 1) Comparison to Neighbors during cold weather; 2) Normal Day vs Cold Day Usage Comparison; and 3) Savings Tips. Customers were also encouraged to lower their thermostat settings to 58 degrees or lower when they're asleep, 68 degrees or lower when they're at home, and 50 degrees or off when away.

A total of 233,719 paper Seasonal Energy Update reports were mailed from November 2016 through February 2017.

Table 14
"Seasonal Energy Update" Reports

	Nov	Dec	Jan	Feb
Paper Seasonal Energy Updates	58,837	58,731	58,195	57,956

As of June 30, 2017, 530 (0.9 percent) of program enrollees opted-out of receiving further Seasonal Energy Update reports.

Customer acceptance of the Seasonal Energy Update report treatments was also strong as indicated by both the very low opt-out rate for recipients of these reports, coupled with the findings of customer satisfaction research performed with a sampling of the recipients of the reports from the 2016-2017 campaign as reported in Appendix C.

9.B.3 Aclara Home Energy Update Reports

As outlined in section 9.A, for the 2016-2017 conservation campaign, SoCalGas also contracted with Aclara to re-test newly enhanced and modified Aclara Home Energy Update (HEU) reports. Aclara HEUs were originally tested in the 2014-2015 campaign. The updated Aclara HEU includes streamlined messaging focused on providing customers with insights around their energy consumption, including AM usage data highlights, and personalized tips for lowering energy consumption. One test cell was assigned to this Aclara HEU treatment. Customers in this test cell received the paper HEU four times over the winter months, as well as an initial Welcome Letter and Repositionable Thermostat Setting Reminder Decal.

The Aclara HEU contains personalized usage information to help customers understand their home energy usage and to offer recommendations on how to save energy and reduce waste. Each monthly report provides three pieces of information: 1) Usage comparison to similar homes; 2) Natural gas usage breakdown; and 3) Personalized savings tips.

A total of 127,616 paper Home Energy Update reports were mailed from December 2016 through February 2017.

Table 15
Aclara Home Energy Update Reports

	Dec (2 Reports)	Jan	Feb
Paper Home Energy Updates	64,182	31,918	31,516

As of June 30, 2017, 41 (0.1 percent) of program enrollees opted-out of receiving further Home Energy Update reports.

Customer acceptance of the Home Energy Update report treatments was also strong as indicated by both the very low opt-out rate for recipients of these reports, coupled with the findings of customer satisfaction research performed with a sampling of the recipients of the reports from the 2016-2017 campaign as reported in Appendix C.

9.B.4 SoCalGas-developed "SoCalGas Usage Report"

As outlined in section 9.A, for the current campaign, SoCalGas developed a new paper "SoCalGas Usage Report" to test against Aclara and Opower paper energy reports. The SoCalGas Usage Report was developed completely in-house leveraging SoCalGas internal analytics capabilities to develop the "similar home comparison" information contained the reports. The report also incorporates customized messaging for homeowners and renters.

A key goal for testing this report was to determine if an in-house developed energy report could offer a potentially more cost-effective alternative to energy report programs outsourced to external vendors. Another key goal for the SoCalGas Usage Report was to test the impact of providing a Bilingual English-Spanish language paper energy report and welcome materials in lieu of either a single-language English or Spanish report for customers in areas with high rates of Latino population. (Bi-lingual energy reports are not currently offered by external providers.)

A total of 55,000 paper English-only and another 55,000 Bi-lingual English-Spanish SoCalGas Usage Reports were mailed from December 2016 through March 2017.

Table 16
"SoCalGas Usage Report" English and Bi-lingual Reports

	Dec	Jan	Feb	March
SoCalGas Usage Report (English Only)	13,750	13,750	13,750	13,750
SoCalGas Usage Report (Bi-lingual English-Spanish)	13,750	13,750	13,750	13,750

As of June 30, 2017, 57 customers had opted out of receiving the SoCalGas Usage Reports, or 0.2 percent.

9.B.5 Bill Tracker Alerts Enrollment

SoCalGas Bill Tracker Alerts (BTAs) offer several key features to help customers maintain a high level of energy usage awareness and engagement with SoCalGas. They help customers maintain "top of mind" awareness of their natural gas consumption which is critical to creating the ongoing behavioral change necessary to achieve energy conservation.

Bill Tracker Alerts provide "Advanced Meter Billed" customers with the following information on a weekly basis and are sent alerts via email and/or mobile phone SMS text message:

- Bill-to-Date ($)
- Projected Next Bill ($)
- Last year, Same Month Bill Amount ($) [Seasonal comparison]
- Days Remaining in the Current Billing Cycle (#)
- Last Month's Bill Amount ($)*
- Days Elapsed in the Current Billing Cycle (#)*
- Choice of weekly email and/or SMS text messages

** provided via email only, due to 160 character text limitation*

As outlined in section 9.A, given continued proven savings results coupled with the cost-effectiveness of BTA delivery via electronic channels (email and text), the SoCalGas 2016-2017 Test and Learn campaign treatments include continued testing of different BTA options and approaches, including a treatment group with small to medium business customers. Samples of the various enhanced weekly Bill Tracker Alert emails being tested in the 2016-2017 campaign may be found in Appendix C, "Evaluation of Southern California Gas Company's 2016-2017 Conservation Campaign, August 31, 2017."

Through June 30, 2017, 439,599 SoCalGas customers were actively enrolled in Bill Tracker Alerts (see Table 17 below, which provides cumulative enrollments-to-date). These enrollments support the Advanced Meter project conservation savings goal as well as SoCalGas' 2013-2016

Energy Efficiency behavior change program household participation goals.[29]

Table 17
SoCalGas Bill Tracker Alerts Enrollment

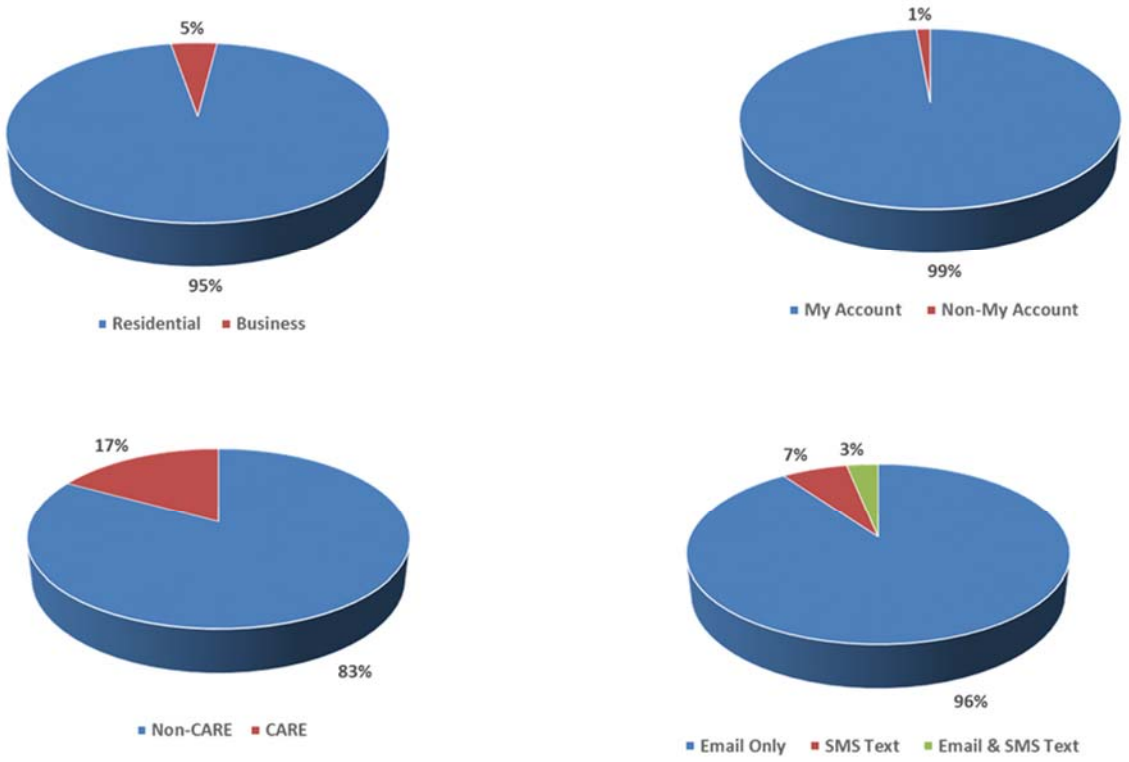
Item	Count through June 30, 2017
Total Subscriptions	**553,067**
Auto Enrollment	452,647
Microsite – Online @ billtracker.socalgas.com	13,516
Microsite – Business Response Cards	7,611
Microsite – Hard-to-Reach Events	724
My Account/CSR – "Manage Alerts"	78,569
Total Unsubscriptions[30]	**113,468**
By Customer (subscribed via Microsite/Auto Enrollment)	35,018
By Customer (subscribed via My Account)	5,498
By System (i.e., Account Closed)	72,952
Total Active Subscriptions	**439,599**

The BTAs retention rate continues to remain high at 79 percent. Sixty-four percent of the "unsubscribes" are due to system factors, such as customer account closures, which results in a customer-initiated unsubscribe rate of approximately seven percent since the program's inception. This is a strong indicator that customers value weekly email and/or SMS text messages that keep them apprised of their bill-to-date, projected next bill, last month's bill, last year's same month bill, and the number of days remaining in their current billing cycle.

[29] Pursuant to D.12-11-015, SoCalGas is also utilizing its Advanced Meter project to support its Energy Efficiency non-resource behavior goals, which contain a 5% behavioral target for residential households. This five percent behavioral target remains in place through current Energy Efficiency program cycles as outlined in D.14-10-046.
[30] The majority of cancelled subscriptions are system-related (e.g., Account closures); currently 7% are due to customers unsubscribing.

Figure 2 displays some of the customer characteristics of customers enrolled in Bill Tracker Alerts as of June 30, 2017.

Figure 2
SoCalGas Bill Tracker Alert Characteristics as of June 30, 2017



* As of June 30, 2017, California Alternative Rates for Energy ("CARE") customers accounted for approximately 27.62% of percent of SoCalGas' residential customer base.

9.C My Account "Ways to Save" Tool Utilization

Another key indicator of enhanced customer engagement enabled or stimulated by Advanced Meter includes customer utilization of the SoCalGas.com, My Account-based "Ways to Save" online tools.

As described in prior Reports, SoCalGas has implemented energy presentation and analysis tools within its My Account customer portal, as well as within the SoCalGas Mobile App. Through June 30, 2017, a total of 512,642 residential My Account users (both new and returning users) have engaged with the Ways to Save tool "My Savings Plan" web page from which users could view their personal energy use profile and initiate a savings plan, as well as navigate to view their hourly and daily gas usage and other energy usage and bill-related information.

For further details regarding the Advanced Meter-enabled online energy information feedback options rolled out to customers, please refer to prior Reports.

Appendices

Appendix A - List of Cities and Counties with Fully Installed DCUs

Adelanto	Compton	Indio	Murrieta	Santa Ana
Agoura Hills	Corcoran	Industry	Norco	Santa Clarita
Alhambra	Corona	Irwindale	Norwalk	Santa Fe Springs
Aliso Viejo	Costa Mesa	Jurupa Valley	Ontario	Santa Maria
Anaheim	Covina	Kern County	Orange	Santa Monica
Arcadia	Cudahy	Kings County	Oxnard	Santa Paula
Arroyo Grande	Culver City	La Canada Flintridge	Palm Desert	Shafter
Artesia	Cypress	La Habra	Palm Springs	Simi Valley
Atascadero	Dana Point	La Habra Heights	Palmdale	Solvang
Azusa	Delano	La Mirada	Paramount	South El Monte
Bakersfield	Desert Hot Springs	La Palma	Pasadena	South Gate
Baldwin Park	Diamond Bar	La Puente	Paso Robles	South Pasadena
Banning	Dinuba	La Quinta	Perris	Stanton
Beaumont	Downey	La Verne	Pico Rivera	Taft
Bell	Duarte	Laguna Hills	Pismo Beach	Temecula
Bell Gardens	Eastvale	Laguna Niguel	Placentia	Temple City
Blythe	El Centro	Lake Elsinore	Pomona	Torrance
Bradbury	El Monte	Lake Forest	Port Hueneme	Tulare
Brawley	El Segundo	Lakewood	Porterville	Tulare County
Brea	Fillmore	Lancaster	Rancho Cucamonga	Tustin
Buellton	Fontana	Lawndale	Rancho Mirage	Twentynine Palms
Buena Park	Fresno County	Lemoore	Rancho Santa Margarita	Upland
Calexico	Fullerton	Loma Linda	Redlands	Ventura
California City	Garden Grove	Lomita	Reedley	Vernon
Calimesa	Glendora	Lompoc	Rialto	Villa Park
Calipatria	Goleta	Los Alamitos	Riverside County	Visalia
Camarillo	Grand Terrace	Lynwood	Rolling Hills Estates	Walnut
Carpinteria	Grover Beach	Manhattan Beach	Rosemead	Wasco
Carson	Hanford	Maywood	San Bernardino	West Covina
Cathedral City	Hawaiian Gardens	Menifee	San Bernardino County	West Hollywood
Cerritos	Hawthorne	Mission Viejo	San Clemente	Westmorland
Chino	Hemet	Monrovia	San Dimas	Whittier
Chino Hills	Highland	Montclair	San Fernando	Wildomar
Claremont	Holtville	Montebello	San Gabriel	Yorba Linda
Coachella	Imperial	Monterey Park	San Jacinto	Yucaipa
Colton	Imperial County	Moorpark	San Luis Obispo	Yucca Valley
Commerce	Indian Wells	Moreno Valley		

Appendix B - List of Cities and Counties that are no longer Fully Installed due to increased number of sites needed for Network Optimization

Beverly Hills
Gardena
Guadalupe
Hermosa Beach
Seal Beach
Westminster

Appendix C - Evaluation of Southern California Gas Company's
2016-2017 Conservation Campaign, August 31, 2017
Prepared by Nexant

REPORT



Evaluation of Southern California Gas Company's 2016–2017 Conservation Campaign

August 31, 2017

Prepared for
Southern California Gas Company

Prepared by
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1 Executive Summary

Southern California Gas Company (SoCalGas®) began deploying "Advanced Meters"[1] (AM) in its service territory in late 2012, pursuant to California Public Utilities Commission (CPUC) Decision (D.)10-04-027. These meters are capable of providing enhanced information services that can help customers better manage and control their energy costs. By rigorously evaluating these types of information services, SoCalGas can demonstrate how to meet its 1% energy savings goal that is associated with its AM rollout.[2] Each year of the AM rollout, SoCalGas implements a Conservation Campaign that is designed to test various enhanced information programs. This document summarizes the evaluation of the fourth and final Conservation Campaign, which primarily ran from December 2016 through March 2017.[3][4] This document also includes results on continuation and persistence of energy savings from the first three Campaigns that occurred during the previous three years.

Similar to the third Campaign, the 2016–2017 Conservation Campaign (fourth Campaign) tested three information feedback options—Bill Tracker Alerts (BTAs), Seasonal Energy Update reports (SEUs), and Home Energy Reports (HERs), including several types of HERs developed by Opower, Aclara and SoCalGas. These three information feedback options were chosen because they have the potential to reach large numbers of customers and demonstrate how to meet the 1% energy savings goal in a cost-effective manner. SEUs were introduced for the first time in the third Campaign. They were designed by SoCalGas specifically for residential customers with natural gas usage that is highly weather sensitive, which means that their usage increases substantially under cold weather conditions. This information feedback option leveraged AM data to target the most weather sensitive customers and also to present cold day usage patterns to customers.

Table 1-1 summarizes the estimated natural gas savings for the 2016–2017 SoCalGas Conservation Campaign. As with the three prior Campaigns, energy savings for the fourth Campaign were found to be in line with the 1% savings goal. Overall, the new and continued residential customer treatments produced gas savings of almost 2.68 million therms, or almost 1.5% from April 2016 – March 2017 for the subset of treatments tested that were successful in producing statistically significant usage reductions.[5] During the winter period from December 2016 – March 2017, a total of 2.3 million therms were saved by the new and continued treatments. Of the 2.3 million therm savings, nearly 1.62 million therms were conserved as a result of the new treatments for the 2016–2017 Conservation Campaign, representing a savings of over 1.7%.

[1] The Advanced Meter infrastructure consists of two primary components—a meter transmission unit (communications module) attached to SoCalGas meters and a communications network consisting of data collection units installed across the SoCalGas service territory.

[2] This energy savings goal specifically refers to 1% of total residential gas usage.

[3] In previous years, treatments began in November. This year all of the treatments started in December. The 2016-2017 winter period referred to for the remainder of the report will represent December – March.

[4] A few programs included a year-round email element that continued after March 2017.

[5] Gas savings are only calculated for the treatments that produced statistically significant usage reductions for that time period. As discussed in Section 5.2, treatments tested with small and medium businesses (SMB) during the 2016-2017 Campaign did not produce statistically significant usage reductions.

Roughly 718,000 therms of energy savings conserved from April 2016 to March 2017 were the result of continued effects of the treatments in the 2015–2016 Conservation Campaign (third Campaign). The continuation of the effects of these treatments over spring and summer 2016 (April through November) were found to be about 200,000 therms.

Approximately 333,000 therms of energy savings conserved from April 2016 to March 2017 were the result of continued effects of the treatments in the 2014–2015 Conservation Campaign (second Campaign). The continuation of the effects of these treatments over spring and summer 2016 (April through November) were found to be about 160,000 therms.

The first 2013-2014 Campaign treatments did not produce measurable savings during this time period. In all, the effects of the new 2016–2017 treatments and the continued effects of the 2015–2016 and 2014–2015 treatments resulted in savings of about 2.67 million therms over the 12 month period from April 2016 to March 2017.

Table 1-1: Estimated Gas Savings for the 2016–2017 SoCalGas Conservation Campaign

Initial Treat-ment Year	Treatment	Group	Number of Treatment Customers	% Reduction	Aggregate Therms Saved (Nov-Mar)
2016-2017	BTA w/Tips + Paper & Email Opower HER	T-31	38,700	2.21%	255,322
	BTA w/o Tips	T-36	30,906	0.77%	70,435
	BTA w/ Tips	T-37	30,649	0.88%	83,103
	Paper-only Opower HER	T-32	51,508	1.37%	209,944
	Paper Aclara Home Energy Update report (HEU)	T-40	31,772	1.47%	143,375
	Paper In-House HER	T-39	13,414	1.25%	53,596
	Paper SEU	T-34	19,612	3.18%	211,926
	Paper SEU (Weatherize)	T-35	19,625	3.43%	223,203
	Paper & Email Opower HER - CARE	T-30	49,995	1.78%	236,316
	Paper SEU - CARE	T-33	18,364	2.24%	123,932
	Paper Bi-lingual HER	T-41	13,453	0.60%	12,616
Overall for 2016-2017 treatments (fall / winter)			**317,997**	**1.74%**	**1,623,768**
2015-2016	Opower Email HER[7]	T-16	12,008	1.12%	38,447
	Opower Email Thermostat HER[6]	T-19	11,950	1.58%	56,261
	Old BTA, w/materials	T-26	17,452	1.04%	51,561
	New BTA, w/materials	T-28	17,392	1.46%	72,103
	New BTA, w/o materials	T-29	17,465	1.18%	59,103
	Opower Paper-only HER[6]	T-17	12,609	1.02%	35,966
	Opower Paper-only Thermostat HER[6]	T-20	12,580	1.57%	56,434
	Opower Paper & Email HER[7]	T-15	11,987	1.01%	30,326
	Opower Thermostat Email HER (ESA & Non-ESA[6]	T-18	24,146	1.84%	117,747
Overall for 2015-2016 treatments (fall / winter)			**137,588**	**1.42%**	**517,947**
2014-2015	Opower Paper-only HER[7]	T-13	47,910	1.31%	173,041
Overall for 2014-2015 treatments (fall / winter)			**47,910**	**1.31%**	**173,041**
Overall for December 2016-March 2017			**503,494**	**1.60%**	**2,314,756**
2015-2016	Opower Email HER	T-16	12,024	0.80%	21,887
	Opower Email Thermostat HER	T-19	11,980	0.87%	23,602
	Old BTA, w/materials	T-26	17,500	0.81%	30,076
	Old BTA, w/o materials	T-27	17,499	0.85%	31,829
	Opower Paper & Email HER	T-15	12,028	0.62%	29,866

[6] This treatment cell received continued treatment including only one paper report in 2016-2017 compared to the standard four reports received the prior heating season.

[7] This treatment cell did not continue to receive treatment during the 2016-2017 campaign.

Initial Treat-ment Year	Treatment	Group	Number of Treatment Customers	% Reduction	Aggregate Therms Saved (Nov-Mar)
	Opower Paper & Email Thermostat HER (ESA & Non-ESA)	T-18	24,209	1.09%	62,632
Overall for 2015-2016 treatments (spring / summer)			**95,241**	**0.94%**	**199,893**
2014-2015	Opower Paper & Email HER[7]	T-10	11,658	1.43%	40,022
	Opower Paper-only HER[7]	T-13	46,764	1.15%	119,788
Overall for 2014-2015 treatments (spring / summer)			**35,000**	**1.21%**	**159,809**
Overall for April 2016-November 2016			**130,240**	**1.04%**	**359,702**
Overall for April 2016-March 2017			**657,698**	**1.49%**	**2,674,458**

1.1 Key Research Questions and Lessons Learned

Lessons learned from the first three Campaigns were incorporated into the program designs tested during the fourth Campaign, with the goal of answering nine key research questions related to cost-effectiveness for information feedback programs. Table 1-2 summarizes the key research questions explored in the 2016–2017 Conservation Campaign as well as the findings identified.

Table 1-2: Key Research Questions and Lessons Learned from the 2016–2017 Conservation Campaign

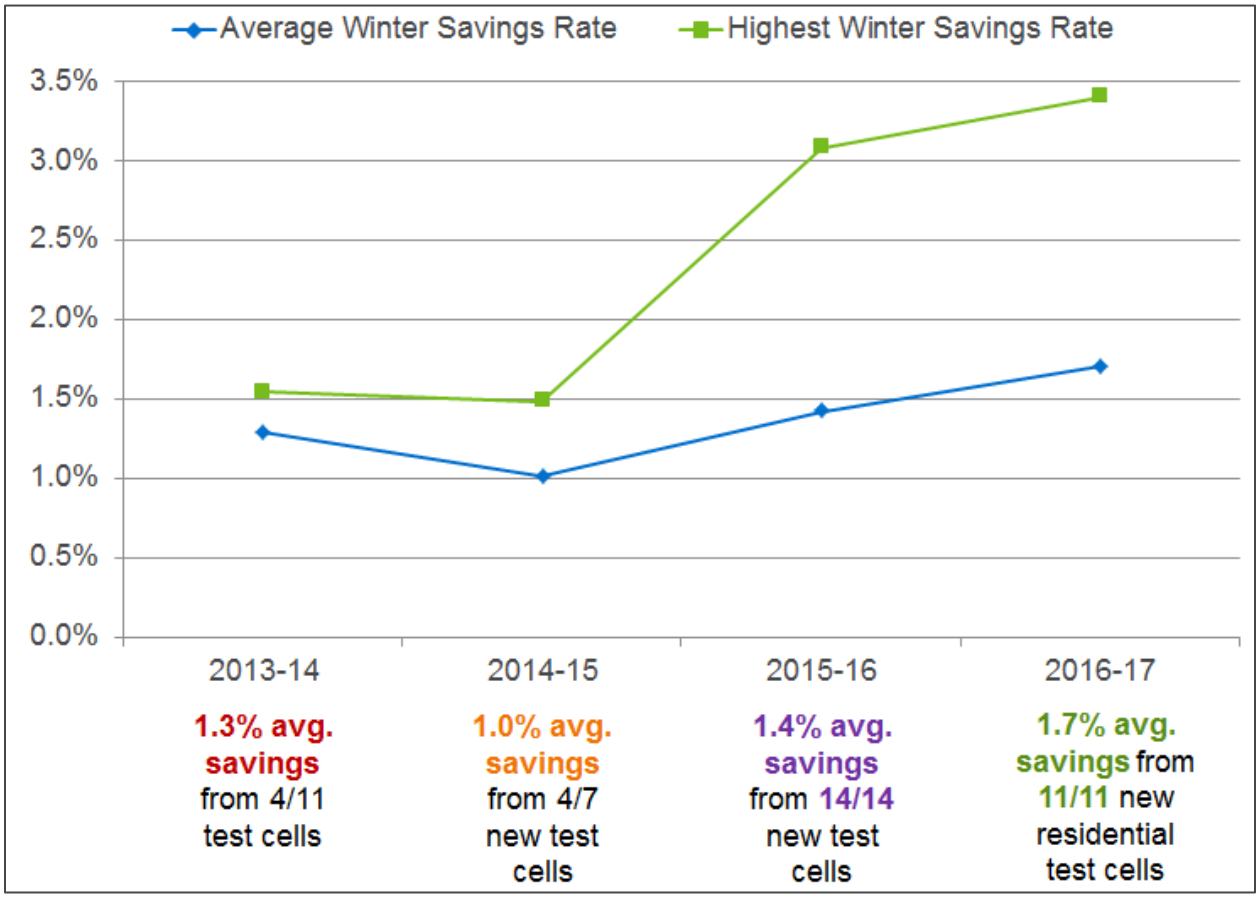
Key Research Question	Key Lessons Learned
Which variations of BTAs appear to be most effective at generating savings for residential customers on an initial and ongoing basis?	In the 2015-2016 campaign it was shown that the **New [more graphical] BTA outperformed the Old BTA**. Of the different new BTA treatments tested, the New BTA with promotional materials had the highest percent reduction in the first year of treatment. All of the New BTA variations achieved **at least .75% savings in the first year**. Both new BTA treatments that originated in the 2015-2016 campaign had savings rates that grew to over 1% in their second year.
How does the Opower HER + BTA combined information feedback treatment compare to the other BTA-only treatments?	The Opower HER + BTA w/Tips treatment achieved higher percent reductions than either of the other BTA treatments. The Opower HER + BTA w/Tips had a percent reduction of 2.21% while the other BTA treatments had savings below 1%. **The combination of the two information feedback options produced higher savings.**
Can SEUs with a stronger focus on home weatherization generate higher savings rates?	The SEU (Weatherize) version had a higher percent savings of 3.4%, while the standard SEU had a percent reduction of 3.2%. However, the difference between the two treatments is not statistically significant.
Do the strong savings rates from SEUs in year one persist when the treatment is not continued in the following winter?	Both SEU treatments from the third campaign had percent reductions of approximately 1.1% in the first year after stopping treatment, but the savings is not statistically significant. The results are likely insignificant due to the RED design being used to evaluate these treatments. It would be worthwhile to test the persistence of the SEUs again with the RCT design from the fourth campaign.

How do the Non-My Account SEU treatments compare to other information feedback types tested with weather sensitive customers in that segment?	This year the treatment assignment was done so that the SEU treatments could be compared against other Non-My Account paper energy report treatments. In order to compare the results of the other treatments, it is necessary to use only the top 25% most weather sensitive customers in the comparison. Both the SEU and SEU (weatherize) had percent reductions above 3% while the weather sensitive Opower HER and Aclara HEU customers had percent reductions of 1.5% and 1.8% respectively. **This confirms that the SEU treatment is more effective in getting weather sensitive customers to reduce their usage.**
How do CARE customers identified as highly weather sensitive respond to the SEU treatment?	The CARE weather sensitive customers that received the SEU treatment produced a percent reduction of 2.24%. This treatment is not directly comparable to the other CARE treatment as the SEU treatment contains the top 25% most weather sensitive CARE customers. The CARE Opower HER produced a savings rate of 1.78%.
How do the Opower HERs, Aclara HEUs, and SoCalGas In-house HERs compare?	The Aclara Paper HEU had the highest percent reduction compared to the SoCalGas In-House Paper HER and the Opower Paper HER. The Aclara Paper HEU had a percent reduction of 1.47% while the Opower Paper HER had a percent reduction of 1.37% and the SoCalGas In-house Paper HER had a savings rate of 1.25%. However, **the difference between the three treatments is not statistically significant**.
How do the impacts of a Bilingual English-Spanish language paper energy report and welcome materials in lieu of either a single language English or Spanish report compare for customers in areas with high rates of Latino population?	The percent reductions of the Bi-lingual English-Spanish report, Spanish report, and English report for this customer segment **were all less than 1%.** The Bi-lingual HER and Spanish HER were both tested on customers residing in an area with high concentrations of Latino households based on census block data. A possible conclusion is that neighborhood comparison is not effective with this population.
Does the small and medium business (SMB) BTA treatment produce statistically significant results?	**The SMB BTA treatment did not produce measurable savings.** The percent reduction was -.39% and the p-value was .58. Therefore, the savings are essentially zero and not statistically significant. This is not surprising given the historical treatments tested by other utilities on SMB customers.

1.2 Four Year Summary of Gas Savings and Key Findings

The 2016-2017 Conservation Campaign serves as the culmination of a highly successful multi-year "test and learn" process involving over 1.2 million participants. Figure 1-1 presents the average winter savings rate and highest winter savings rate for each campaign's first year, showing how two years of testing various options and iterating toward the effective ones has led to impressive results in the last two years. Importantly, these savings rates only include treatments that produced statistically significant savings during the time period analyzed. Only 8 of 18 treatments in the first two campaigns produced measurable savings, whereas all 25 residential treatments in the final two campaigns were successful. The fourth and final campaign had an average savings rate of 1.7%, which was the highest of the four campaigns. The fourth campaign also achieved the highest percent reduction for any individual treatment, which was the SEU savings of 3.4%. This rate of savings was more than double the rate of the most effective treatments from the first two campaigns. It is clear that over the course of the four campaigns, this deliberate test and learn process produced significantly higher savings and identified innovative offerings as different treatments were tested and informed the decisions of the following campaigns.

Figure 1-1: Comparison of Percent Reductions in Gas Energy Consumption for the Four Conservation Campaigns



The four campaigns also generated four years of key findings that are applicable to SoCalGas and other utilities going forward, including:

- BTAs and HERs consistently produce savings of around .75% to 1.5%;
- SEUs and BTA+HER, which were developed in part by SoCalGas and leveraged AM data, were the only treatments to produce savings over 2%, including savings over 3% in all four non-CARE SEU treatments;
- These types of behavioral interventions consistently produce energy savings for default (auto-enrolled) participants, residential customers, and top two usage quartiles (highest in top quartile);
- Little to no savings measured for treatments involving opt-in participants, small/medium business customers, bottom two usage quartiles, and customers in highest density Hispanic neighborhoods (78%+ of population);
- Treatments targeted at CARE customers can be successful, but they cannot be solely based on email communications (BTAs or e-HERs) – paper-based communications through direct mail is required for success; and
- Energy savings generally persist if treatment continues, and in some cases, savings persist for more than one year if treatment is reduced/discontinued.

2 Introduction

SoCalGas began deploying AM in its service territory in late 2012. AM will be almost fully deployed to SoCalGas' approximately 6 million customers by the end of 2017. These meters are capable of providing enhanced information services that can help customers better manage and control their energy costs. By rigorously evaluating these types of information services, SoCalGas can develop cost effective information feedback programs designed to meet its 1% energy savings goal that is associated with its AM rollout.[8] Each year of the AM rollout, SoCalGas has conducted a Conservation Campaign designed to test various enhanced information programs, primarily during the heating season from November through March.[9] In approving SoCalGas' AM application in D.10-04-027, the CPUC directed SoCalGas "to establish a system to track and attribute the conservation impacts of its AM rollout" and to report the measured savings every six months. This document is the fourth of the biannual reports to include impact results of the Conservation Campaigns, which were implemented as outlined in this and prior semiannual reports.

2.1 Research Objectives and Design

This report addresses the following primary objectives:

- Meet the requirements of D.10-04-027 to track and attribute the conservation impacts of the AM rollout and to report measured savings every six months;
- Help demonstrate how SoCalGas can achieve its 1% energy savings goal in a cost-effective manner; and
- Carry forward lessons learned from the four campaigns into Energy Efficiency behavior programs.[10]

Meeting the first objective requires a rigorous research strategy that conclusively determines whether or not information feedback provided by SoCalGas through various programs caused changes in gas usage. Usage varies significantly across months, seasons, and years. As a result, comparing usage before and after customers receive information treatments is not a suitable approach to estimating conservation effects. Instead, impacts must be estimated by comparing usage for two groups of customers that are identical except for the fact that one group receives information feedback (the treatment group) and the other does not (the control group).

Meeting the second objective requires adherence to a "test and learn" strategy that quickly identifies the marketing strategies and service options that are most cost-effective for achieving energy savings through information services. This strategy was envisioned by D.10-04-027,

[8] This energy savings goal specifically refers to 1% of total *residential* gas usage.

[9] Some treatments, such as the alert component of the default BTAs and the email HER component of the Opower treatments from the last three Campaigns are continued into the spring and summer months.

[10] Pursuant to D.12-11-015, SoCalGas has been utilizing its Advanced Meter project to support its Energy Efficiency non-resource behavior goals, which contain a 5% behavioral target for residential households. As SoCalGas outlined in its Program Implementation Plan for the 2013-2014 California Statewide Program for Residential Energy Efficiency, Energy Advisor Program: "Upon completion of the Advanced Meter project, SoCalGas will incorporate successful behavioral programs and techniques into the energy efficiency portfolio."

which stated, “we expect that customer outreach, education and communications will continue to evolve and improve as SoCalGas conducts customer research, monitors customer reaction to new AM technology and various customer usage presentation tools, and incorporates feedback from these activities into its AM outreach and education activities.”

Meeting the third objective requires that the information gained from the four campaigns be used to inform decisions made for SoCalGas Energy Efficiency behavior programs moving forward.

2.2 Overview of Information Services Tested

The 2016–2017 Campaign tested three information feedback options—Bill Tracker Alerts (BTAs), Home Energy Reports (HERs)[11], and Seasonal Energy Update reports (SEUs). The BTAs and HERs were tested in all four year’s campaigns while the SEUs were tested for the first time in the third campaign. For the first time during the four years of the campaigns, a single treatment cell received two different information feedback options. This treatment received both the Paper Opower HER and the BTA with tips. These three information feedback options were chosen because they have the potential to reach large numbers of customers and demonstrate how to cost effectively meet the 1% energy savings goal. As outlined in sections 2 and 2.1, variations to the segmentation, targeting, and messaging for each of these information feedback approaches were refined based on the findings and associated learnings from the previous three campaigns.

2.2.1 Home Energy Reports

Unlike the previous three campaigns, the 2016-2017 campaign tested HERs created by three different providers. In addition to the Opower-generated HER, Aclara introduced a new version of their “Home Energy Update” (HEU) report. The Aclara HEU is different from the Aclara HER tested in the 2014-2015 campaign. Additionally, SoCalGas tested an in-house developed HER (In-house HER) called a “SoCalGas Usage Report”. Along with the standard HERs, a bi-lingual HER developed by SoCalGas was tested in the fourth Campaign. Approximately 146,554 customers received standard Opower HERs, 33,000 received Aclara HEUs, 13,750 received SoCalGas In-house HERs, and 13,750 received Bi-lingual HERs throughout the winter months. When referring to HERs and HEUs in general, the blanket term of HER will be used in this report to simplify naming conventions. All customers receiving HERs were defaulted onto the service and received HERs either through direct mail, email, or a combination of direct mail and email (with varying frequencies of each in the different treatments tested). In addition to displaying comparisons of households’ natural gas consumption with that of neighbors, and other self-comparative information, the HERs provided tips on how to reduce gas consumption.

The features and timeline of the residential HER treatments that Opower, Aclara, and SoCalGas began implementing are shown in the sections below. Unlike previous campaigns, the first report was sent in December[12] instead of November. In total, 207,554 customers were sampled for HER treatments, split between the different types of HERs. Of the 146,554

[11] As outlined further below, several variations of monthly energy reports or HERs were evaluated, including HERs developed by Opower, Aclara and SoCalGas.

[12] The Aclara HEU was sent on November 30, 2016.

customers treated with Opower HERs, 52,500 CARE customers received the Paper & Email HER;[13] 40,554 My Account customers received the Paper HER + the BTA w/Tips; and 53,500 Non-My Account customers received the Paper HERs. 33,000 Non-My Account customers were treated with the Aclara Paper HEU. Of the 27,500 customers treated with SoCalGas-developed HERs, half (13,750) received the In-house HER and half received the Bi-lingual HER.

Opower Standard HER treatment overview for new 2016-2017 treatments

Figure 2-1 and Figure 2-2 provide examples of the front and back sides of the Opower paper HER sent in January (additional HER materials are shown in Appendix A). These paper HERs were similar but not identical from month to month. They featured the following four sections that were for the most part consistently shown in each monthly report:

- Previous winter's natural gas usage (in initial HER) or previous month's gas usage compared with usage by similar neighbors, including an emoticon rating;
- Historical monthly gas usage compared with usage by similar neighbors (except January);
- Neighbor efficiency rank (except the initial December HER); and
- Personalized energy-saving tips.

[13] Only CARE customers registered for My Account received the Email HER in addition to the Paper HER report.

Figure 2-1: Opower Paper January HER Example (Front)

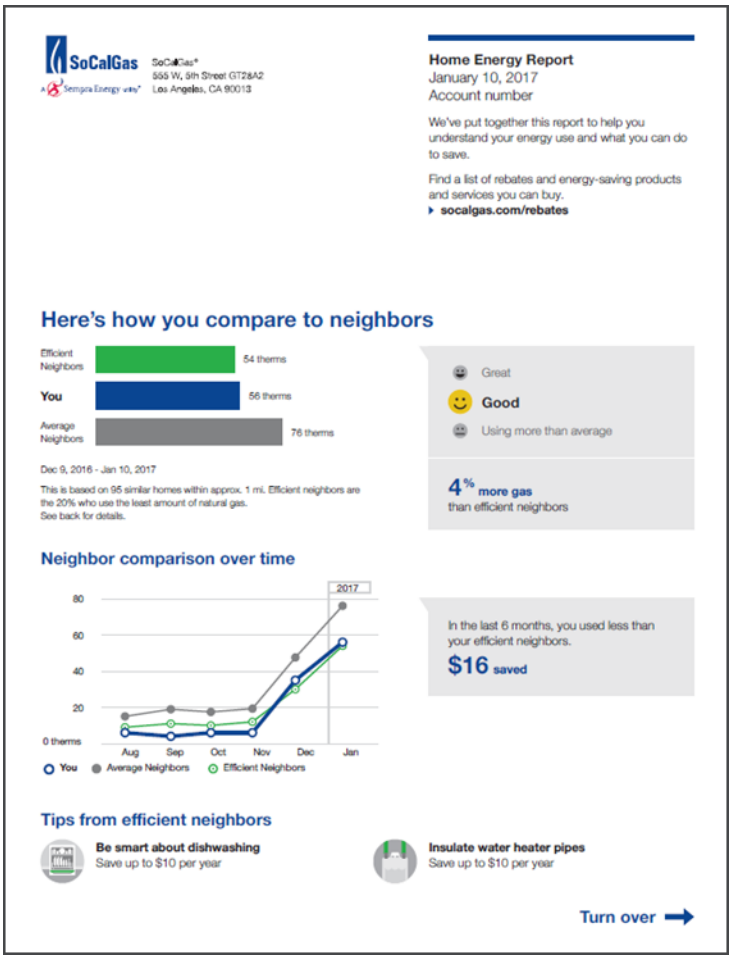


Figure 2-2: Opower January Paper HER Example (Back)

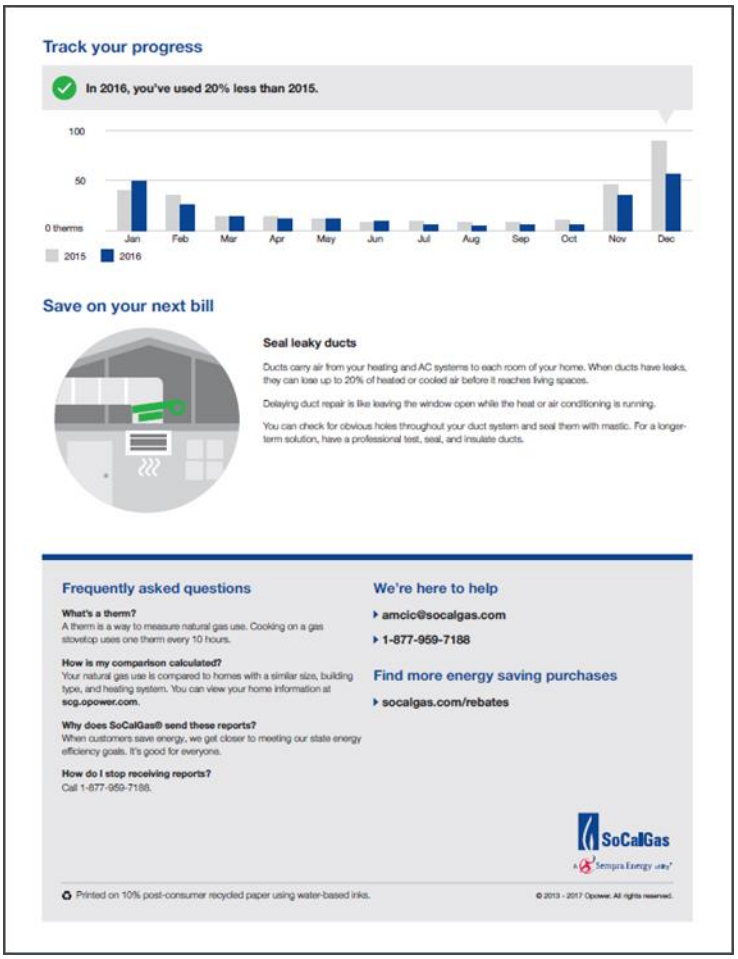
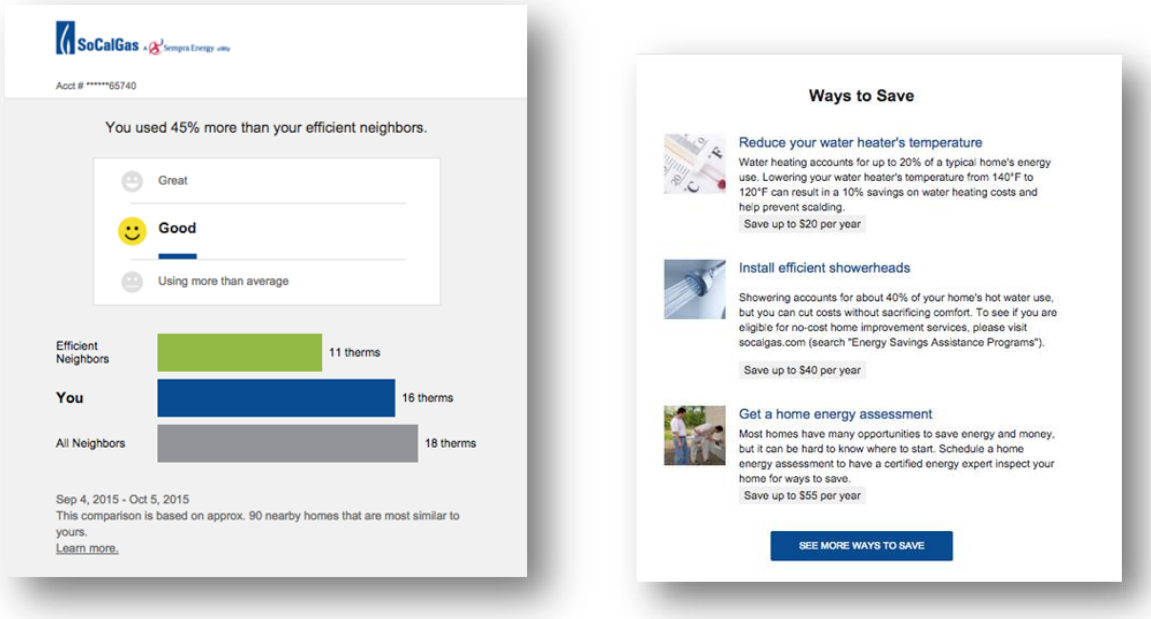


Figure 2-3 provides an example of the Opower email HER that was sent starting in December. The email HER was simpler than the paper HER and included just one main section—previous month's/winter's natural gas usage compared with similar neighbors—followed by several conservation tips. This comparison section is similar to the first section of the paper HER and was consistently shown in each monthly report. Examples of both HERs and the remaining materials that Opower sent are provided in Appendix A.

Figure 2-3: Opower Email HER Example, December and Subsequent Months



Opower Treatment Schedule

The features and timeline of the 2016-2017 new residential Opower HER treatments are shown in Table 2-1. All paper reports began around the first week of December 2016 with an initial paper HER. The Paper-only and Paper & Email HER then included another three monthly paper HERs sent via direct mail between January 2016 and March 2017. In addition, the Paper & Email HER treatment included a total of 12 monthly HERs sent via email.

Table 2-1: Features and Timeline of New Residential Opower HER Treatments (November 2016[14] through November 2017)

		Opower HERs					
		Nov	Dec	Jan	Feb	Mar	Apr-Nov
Paper Reports	Paper HER		✓	✓	✓	✓	
Paper & Email	Paper HER		✓	✓	✓	✓	
	Email HER	✓	✓	✓	✓	✓	✓

Several of the Opower HER treatments implemented in the 2015-2016 campaign were also continued for a second year in the 2016-2017 campaign. These treatments followed the same treatment timeline as shown above, however all treatments only included one Paper report in December, whereas they may have included four monthly Paper reports in the first year of treatment.[15] Similarly, the Opower HER treatments implemented in the 2014-2015 campaign were also continued for a second year in the 2015-2016 campaign. However, these treatments were not continued in the 2016-2017 campaign.

Aclara HEU treatment overview

Figure 2-4 and Figure 2-5 provides an example of the front and back sides of the December Aclara paper HEU (all additional materials can be found in Appendix B). These paper HEUs were similar but not identical from month to month. The Aclara paper HEUs featured the following three sections that were for the most part consistently shown in each monthly report:

- Historical monthly gas usage compared with usage by similar neighbors;
- Previous winter gas usage breakdown (amount of gas used for heating); and
- Personalized energy-saving tips.

[14] The November email HER was sent on at the end of the month on November 25, 2016.

[15] Additional information regarding the treatments implemented in the 2015-2016 campaign can be found in the SoCalGas 2015-2016 Conservation Campaign Evaluation – Final dated August 31 2016.

Figure 2-4: Aclara Paper HEU Example (Front)

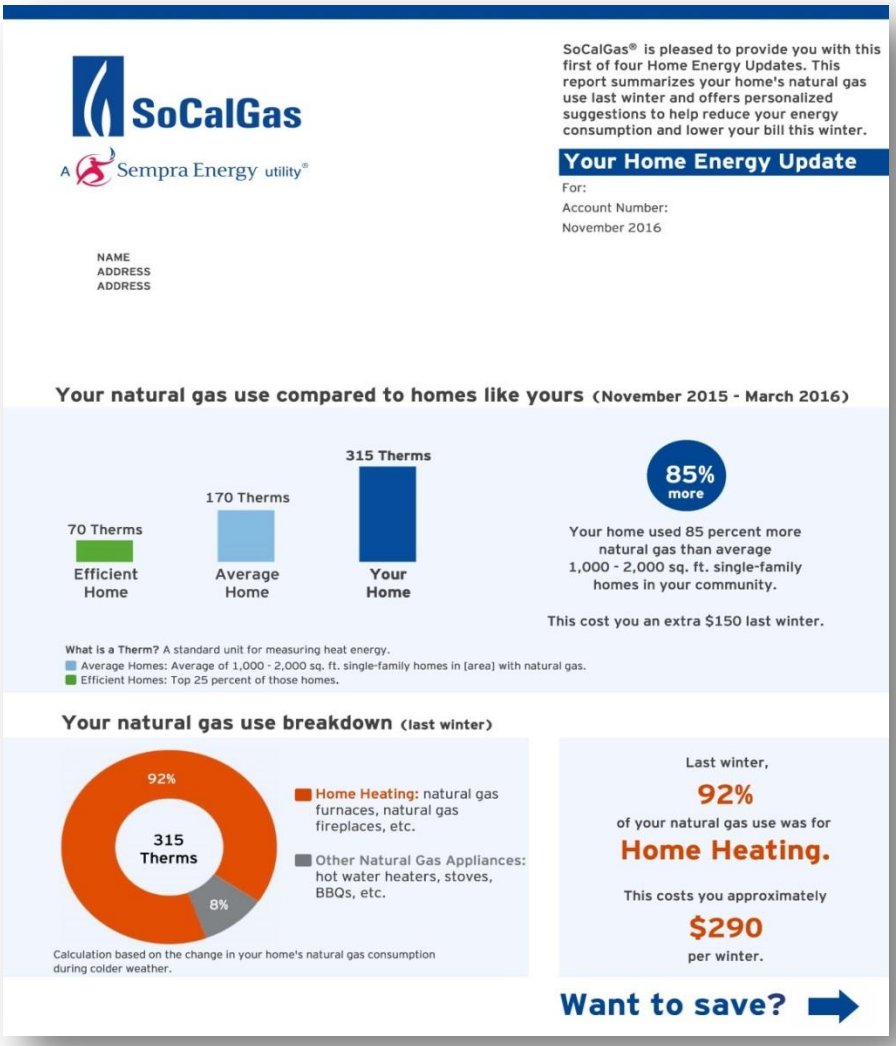


Figure 2-5: Aclara Paper HEU Example (Back)



Aclara Treatment Schedule

The features and timeline of the residential Aclara HEU treatment are shown in Table 2-2. All paper reports began around the first week of December 2016 with an initial paper HEU. Two paper reports were sent in December instead of one being sent in November. A welcome insert was sent in December as well. The thermostat decal was sent to customers in January.

Table 2-2: Features and Timeline of Residential Aclara HEU Treatment (December 2016 through November 2017)

		Aclara HEU					
		Nov	Dec	Jan	Feb	Mar	Apr-Nov
Paper Reports	Paper Report						
	Welcome Insert						
	Thermostat Decal						

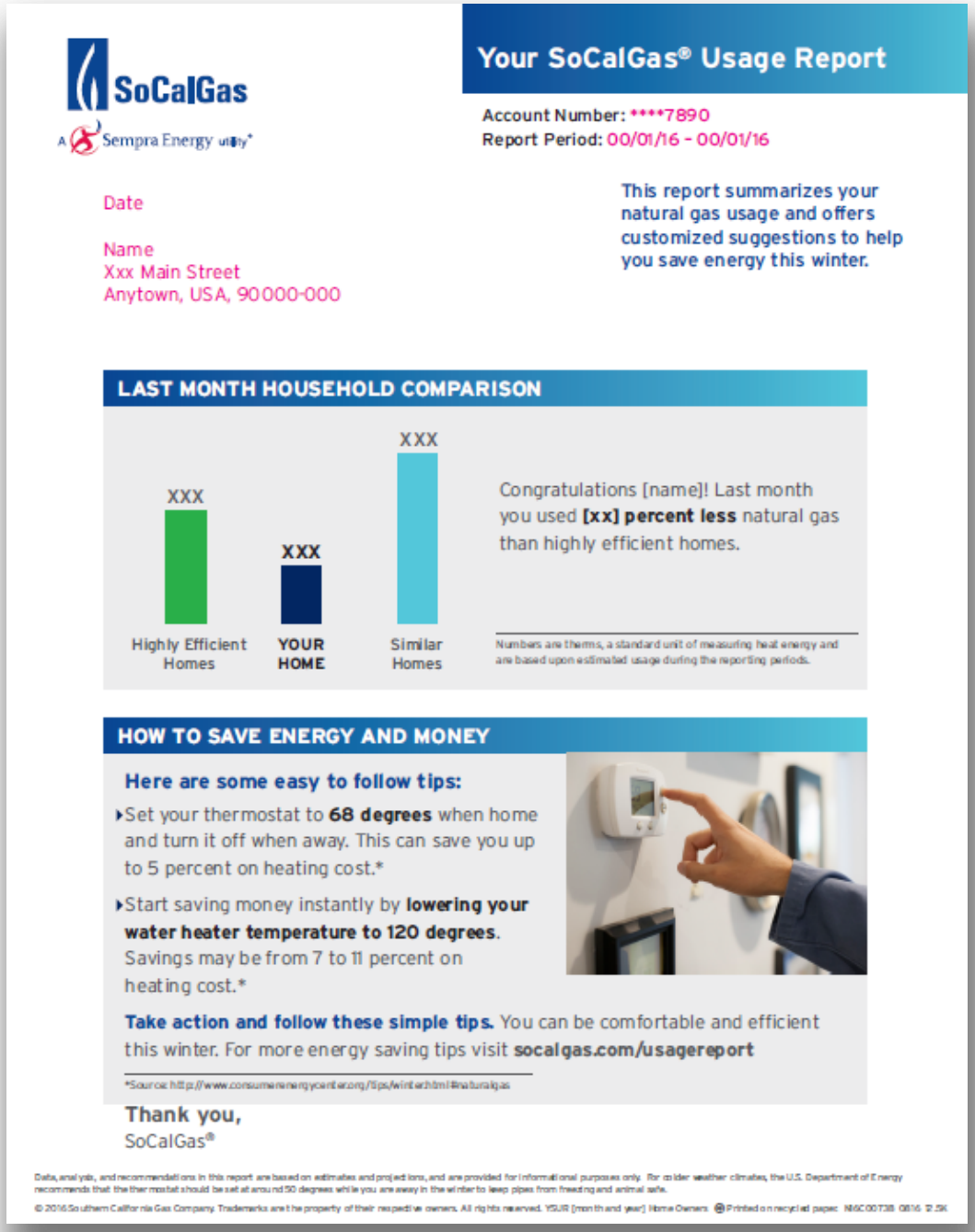
SoCalGas Usage Report In-House HER treatment overview

The In-house "SoCalGas Usage Report" HER treatment featured two different paper reports; one for homeowners and the second for renters. The only difference between the renters' and homeowners' versions of these reports is the tips containing actions that a renter could take compared to a homeowner. For example, the homeowner could lower the water heater temperature while a renter might not have access to do this.

Figure 2-6 and Figure 2-7 provide an example of the homeowners and renters In-house paper HERs sent in December (all additional materials can be found in Appendix C). The In-house HERs were only sent in paper form (there were no email In-house HERs). These paper HERs were similar but not identical from month to month. In-house HERs featured the following sections that were for the most part consistently shown in each monthly report:

- Historical monthly gas usage compared with usage by similar neighbors; and
- Personalized energy-saving tips.

Figure 2-6: SoCalGas Usage Report Paper Homeowners In-house HER Example



SoCalGas
A Sempra Energy utility*

Your SoCalGas® Usage Report

Account Number: ****7890
Report Period: 00/01/16 - 00/01/16

Date

Name
Xxx Main Street
Anytown, USA, 90000-000

This report summarizes your natural gas usage and offers customized suggestions to help you save energy this winter.

LAST MONTH HOUSEHOLD COMPARISON

Congratulations [name]! Last month you used **[xx] percent less** natural gas than highly efficient homes.

Numbers are therms, a standard unit of measuring heat energy and are based upon estimated usage during the reporting periods.

HOW TO SAVE ENERGY AND MONEY

Here are some easy to follow tips:

- Set your thermostat to **68 degrees** when home and turn it off when away. This can save you up to 5 percent on heating cost.*
- Start saving money instantly by **lowering your water heater temperature to 120 degrees**. Savings may be from 7 to 11 percent on heating cost.*

Take action and follow these simple tips. You can be comfortable and efficient this winter. For more energy saving tips visit **socalgas.com/usagereport**

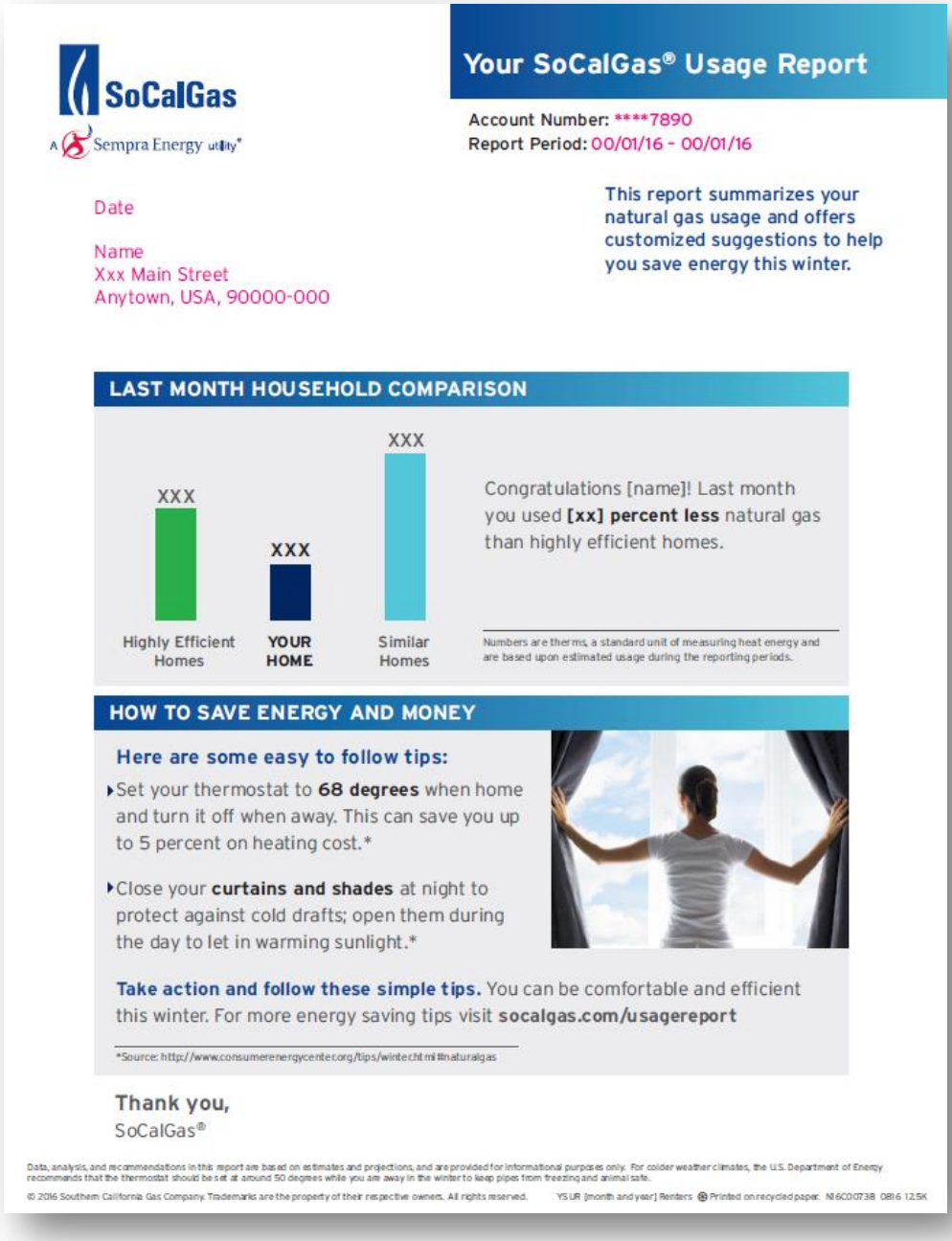
*Source: http://www.consumerenergycenter.org/tips/winter.html#naturalgas

Thank you,
SoCalGas®

Data, analysis, and recommendations in this report are based on estimates and projections, and are provided for informational purposes only. For colder weather climates, the U.S. Department of Energy recommends that the thermostat should be set at around 50 degrees while you are away in the winter to keep pipes from freezing and animal safe.

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Figure 2-7: SoCalGas Usage Report Paper Renters In-house HER Example



SoCalGas Bi-lingual HER treatment overview

Figure 2-8 and Figure 2-9 provide an example of the front and back sides of the Bi-lingual paper HER sent in December (all additional materials can be found in Appendix D). The front side displays the messaging in English, while the backside displays the same messaging in Spanish. The Bi-lingual HERs were only sent in paper form (there were no email Bi-lingual HERs). These paper HERs were similar but not identical from month to month. Spanish paper HERs featured the following two sections that were for the most part consistently shown in each monthly report:

- Historical monthly gas usage compared with usage by similar neighbors; and
- Personalized energy-saving tips.

Figure 2-8: SoCalGas December Bi-lingual Paper HER Example (Front)

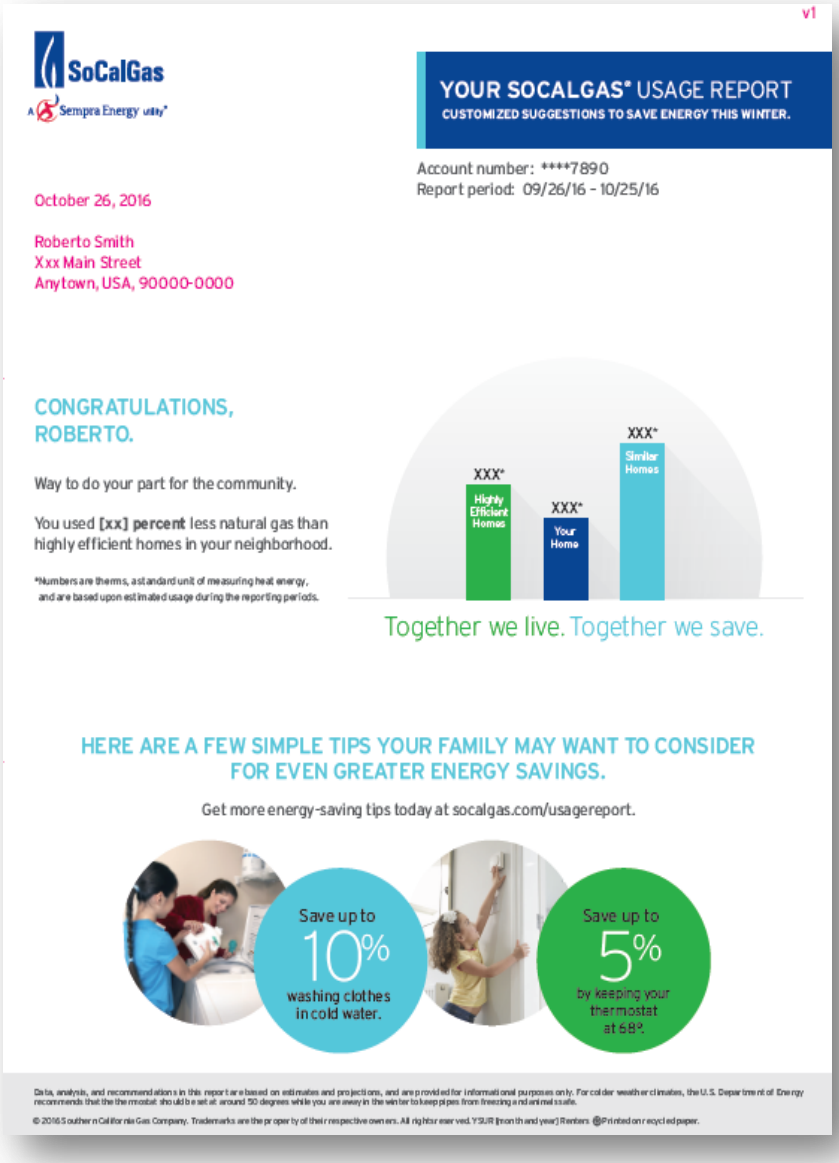
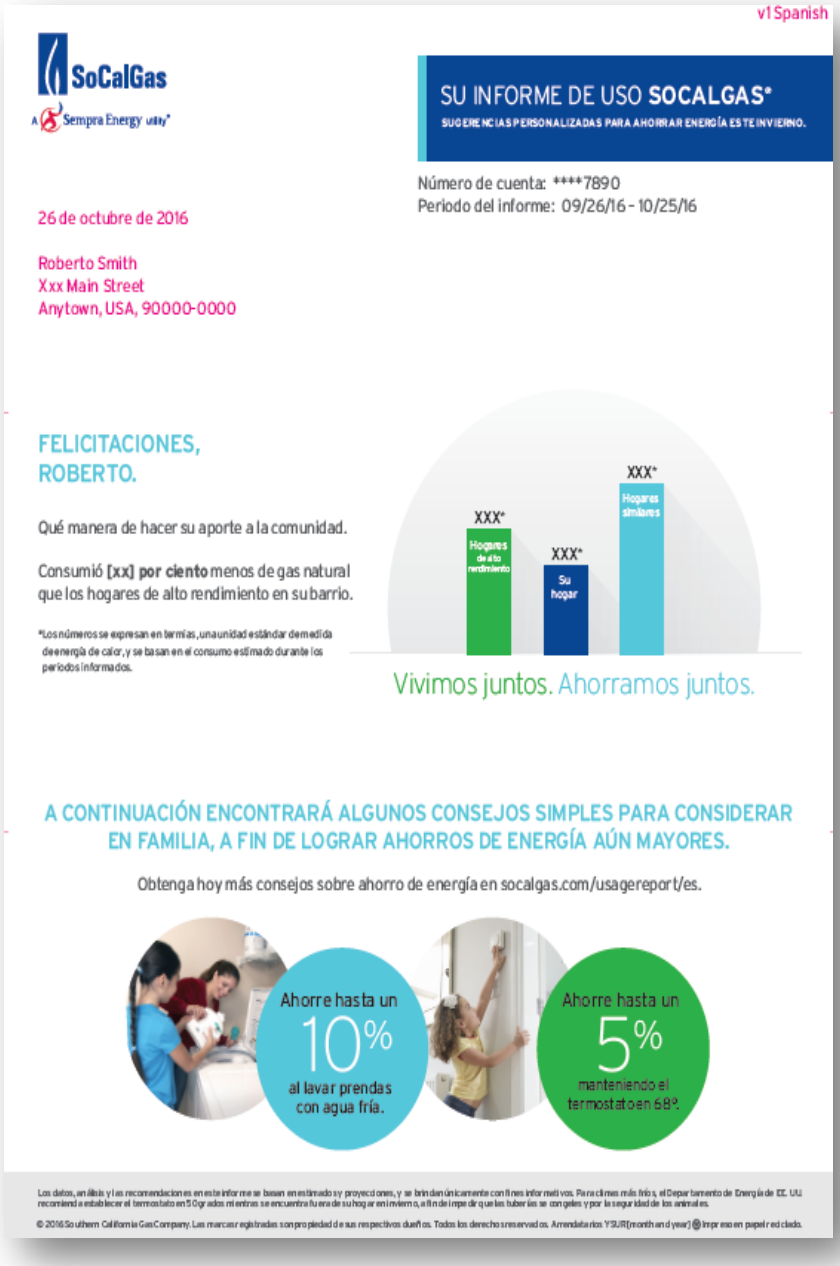


Figure 2-9: SoCalGas December Bi-lingual Paper HER Example (Back)



SoCalGas HER Treatment Schedule

The features and timeline of the residential SoCalGas HER treatments including the Bi-lingual and In-house HERs are shown in Table 2-3. All paper reports began around the first week of December 2016 with an initial paper HER. Both treatments received four paper reports.

Table 2-3: Features and Timeline of Residential SoCalGas HER Treatments (December 2016 through November 2017)

		SoCalGas HERs					
		Nov	Dec	Jan	Feb	Mar	Apr-Nov
Paper Reports	Paper HER						

2.2.2 Bill Tracker Alerts (BTA)

BTAs are weekly reports developed and provided by SoCalGas to customers by email and/or text message. The reports describe the cost of the natural gas that customers have consumed since receiving their last bill. BTAs also provide a forecast of what a customer's gas bill will be at the end of the billing period if they continue to consume gas at the same rate. Customers are not able to set specific goals for daily or weekly gas consumption. BTAs are designed to raise customers' awareness of the amount of gas they are using and its impact on their bill.

During the first 2013-2014 Campaign, the BTA service was tested on an opt-in and default enrollment basis for residential and small/medium business (SMB) customers. This service was also initially accompanied by a welcome letter and three monthly informational letters with various supporting materials sent via direct mail[16] and email.[17] All BTA customers from the first Campaign who did not opt out or otherwise choose to discontinue the BTA service continued to receive BTAs throughout year two and beyond but no longer received the additional informational materials.

However, in the second Campaign in 2014–2015, SoCalGas decided to forgo the supplemental direct mail and email communications that accompanied the BTAs in 2013–2014. This reduction in communications was meant to test whether comparable energy savings could be achieved without these additional communications, thereby improving cost-effectiveness. For this Campaign, enrollment in weekly BTAs was expanded to an additional 55,346 residential My Account customers on a default enrollment basis only.[18] These default BTA customers received an initial Welcome email followed by the weekly email BTA notifications, which included a link to SoCalGas.com My Account-based *Ways to Save* online tools.

[16] A Welcome letter was sent in October; a letter with "3 Easy Ways to Save" insert was sent in November; a letter with a "Winter Savings Checklist" in January; and a letter with links to My Account *Ways to Save* in February. These materials were sent to all BTA participants in the first Campaign, both default and opt-in.

[17] A Welcome email was sent in October (to default customers only); an email titled "Save More This Winter" including links to My Account *Ways to Save* was sent in November; an email titled "How much more can you save" including links to My Account *Ways to Save* was sent in January; an email titled "Tools and Tips to help you save energy and money" including links to My Account *Ways to Save* was sent in February; and an email titled "Helping you save more" including links to My Account *Ways to Save* was sent in March.

[18] Of these 55,346 accounts selected for default enrollment into BTAs, 1,229 were suppressed from receiving BTAs because the accounts were in a collections status due to payments significantly past due. It is SoCalGas' procedure to not send BTAs to accounts undergoing collections activity.

In the third Campaign (2015–2016), SoCalGas introduced a new, graphically enhanced version of the BTA email. Moving forward, only the new version of the BTA will be sent to customers after it was proven that achieve higher savings results than the old version of the BTA.

In the fourth campaign, enrollment in weekly BTAs was split into three different treatment groups, including a total of approximately 105,000 residential My Account customers enrolled on a default basis only. The 105,000 customers were split between three different treatment categories: BTA with tips and Paper Opower HER; BTA without tips; and BTA with tips. The BTA with tips included seasonal energy-savings tips in each weekly BTA email sent. This treatment design was meant to test if the addition of tips in the design of the BTA produced additional energy savings and whether combining the Opower Paper HER with the BTA with tips provided even greater energy savings than either of the treatments alone.

Additionally, in the 2016-2017 Campaign, the new version of the BTA was sent to approximately 21,000 SMB customers enrolled on a default basis only.

Figure 2-10 shows the template for the residential New BTA email notification. The New BTA emails featured the following information along with several graphic representations of these numbers:

- Bill amount ($) to date;
- Projected amount ($) for next bill;
- Days remaining and days elapsed in the current bill cycle;
- Last month's bill amount ($);
- Bill amount ($) for same month in the prior year; and
- Links to the SoCalGas *Ways to Save* tool and rebate programs.

Figure 2-10: Template for SoCalGas Residential New BTA Email Notification without Tips

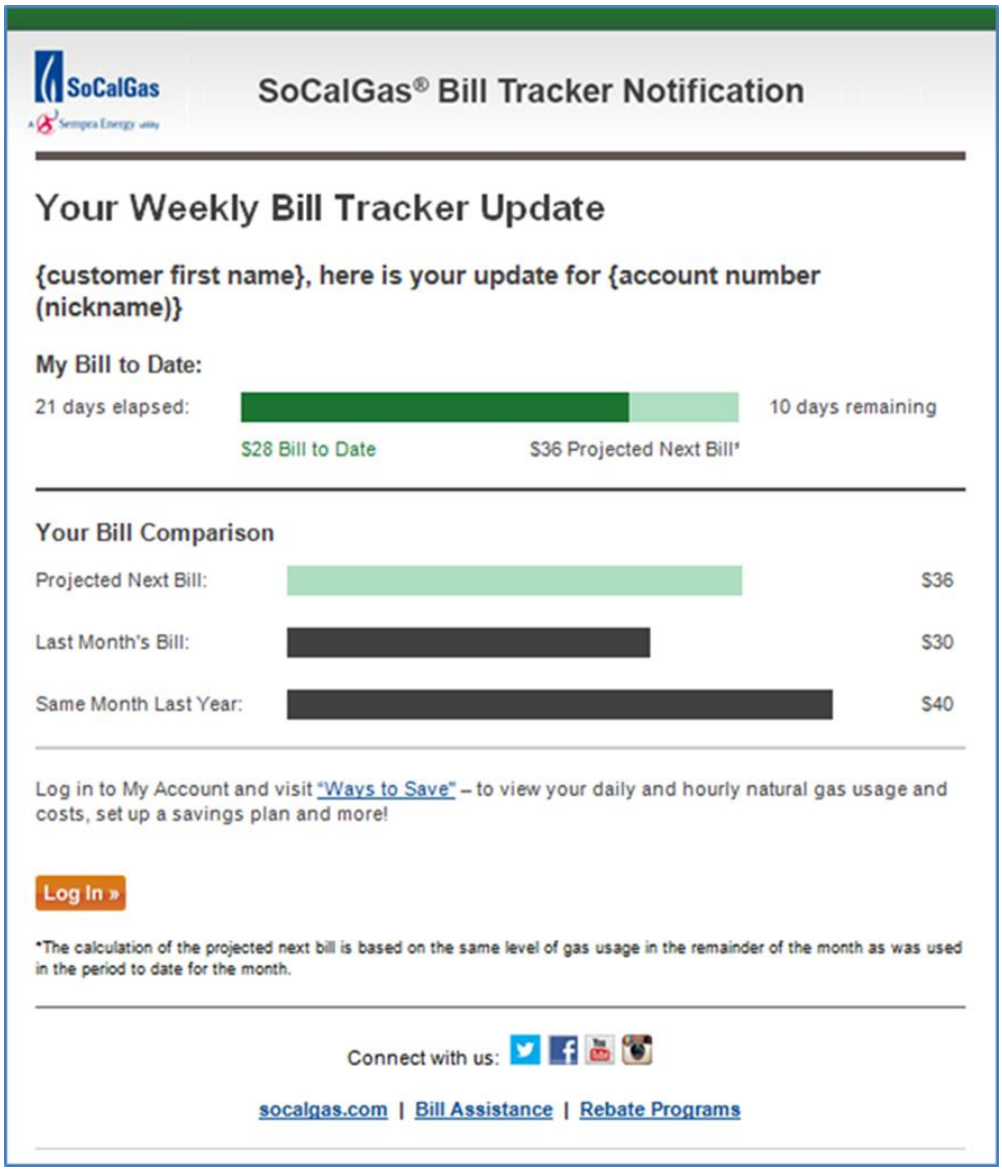
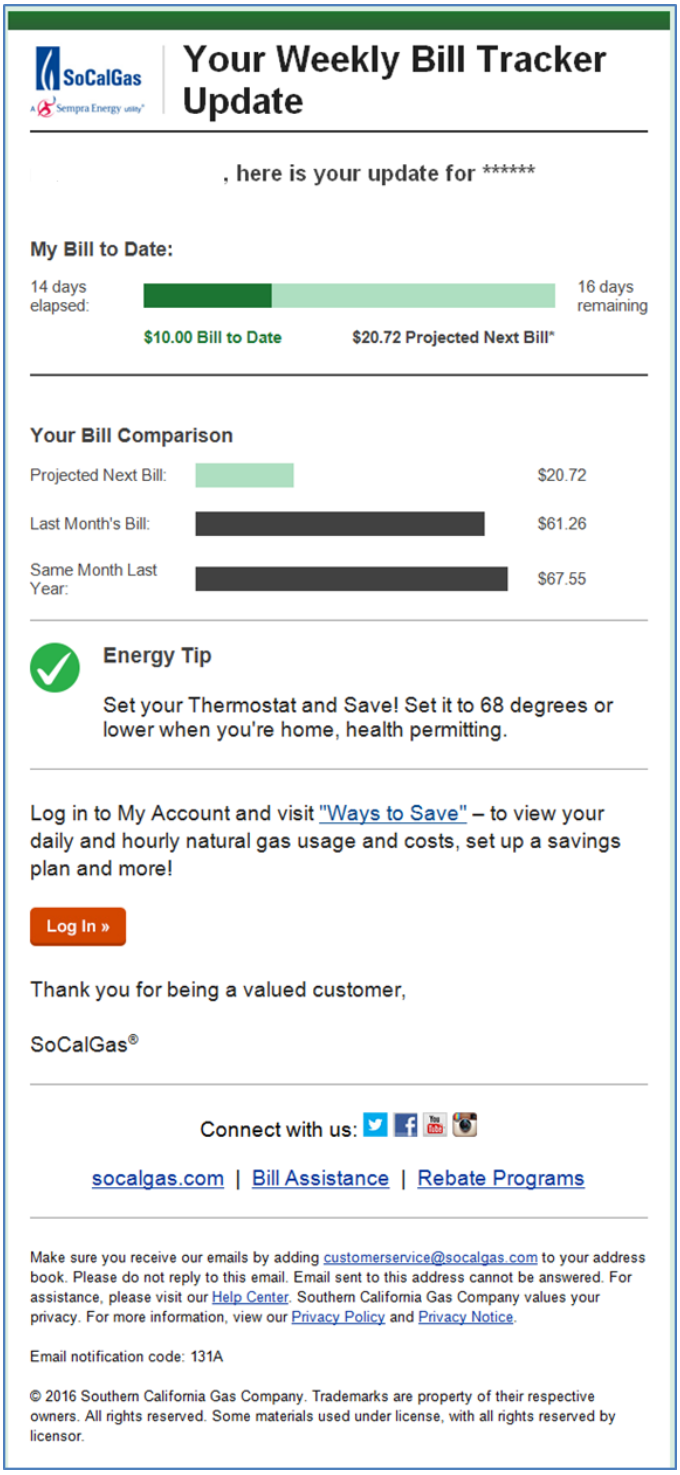


Figure 2-11 shows the template for the New BTA email notification with tips. These BTAs included a rotating energy-savings tip at the end of each email notification.

Figure 2-11: Template for SoCalGas Residential New BTA Email Notification with Tips



SoCalGas
A Sempra Energy utility

Your Weekly Bill Tracker Update

, here is your update for ******

My Bill to Date:

14 days elapsed: 16 days remaining

$10.00 Bill to Date $20.72 Projected Next Bill*

Your Bill Comparison

Projected Next Bill: $20.72

Last Month's Bill: $61.26

Same Month Last Year: $67.55

Energy Tip

Set your Thermostat and Save! Set it to 68 degrees or lower when you're home, health permitting.

Log in to My Account and visit "Ways to Save" – to view your daily and hourly natural gas usage and costs, set up a savings plan and more!

Log In »

Thank you for being a valued customer,

SoCalGas®

Connect with us:

socalgas.com | Bill Assistance | Rebate Programs

Make sure you receive our emails by adding customerservice@socalgas.com to your address book. Please do not reply to this email. Email sent to this address cannot be answered. For assistance, please visit our Help Center. Southern California Gas Company values your privacy. For more information, view our Privacy Policy and Privacy Notice.

Email notification code: 131A

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Figure 2-12 provides an example of a text message BTA notification, which is similar to the email BTA notification. However, due to limits on the number of characters that can be included in a single text message, links to the *Ways to Save* tool and rebate programs were not provided in the text message BTAs.

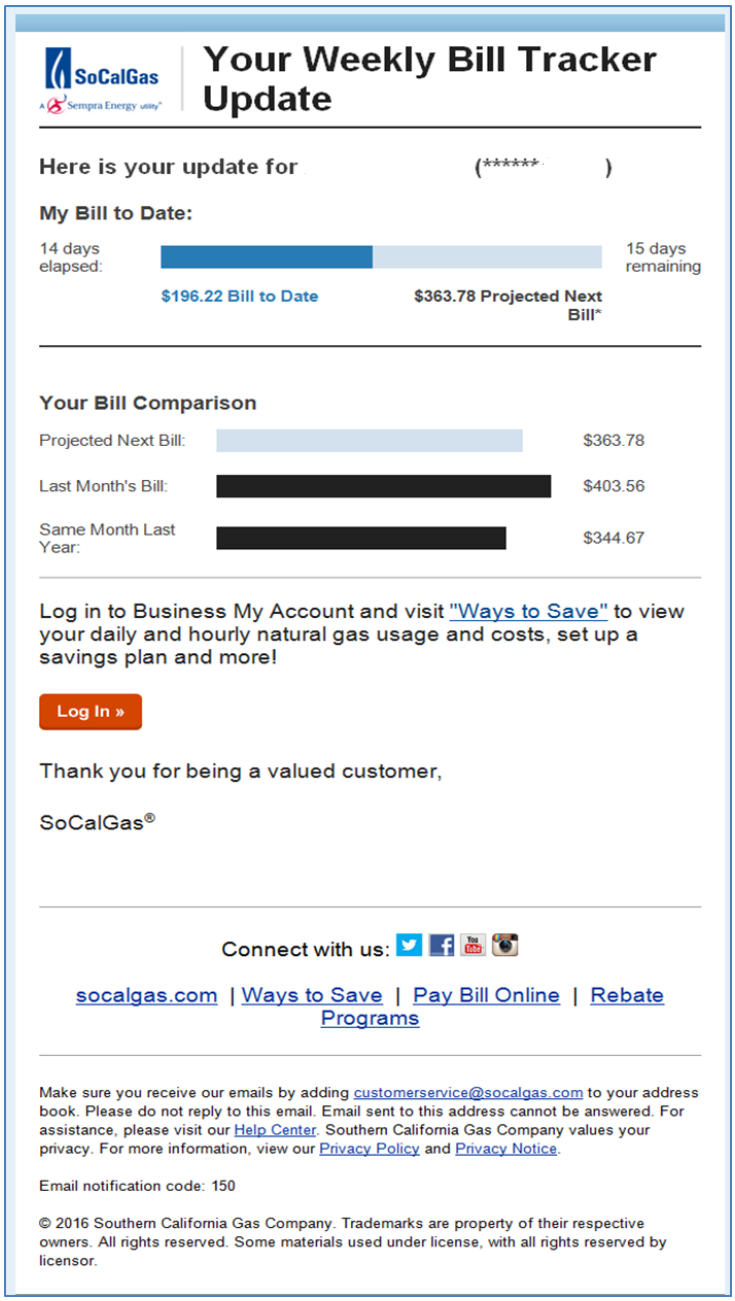
Figure 2-12: Example SoCalGas Residential Text Message BTA Notification



Figure 2-13 shows the template for the New BTA email notification sent to SMB Customers. Similar to the residential New BTA emails, the SMB BTA emails featured the following information along with several graphic representations of these numbers:

- Bill amount ($) to date;
- Projected amount ($) for next bill;
- Days remaining and days elapsed in the current bill cycle;
- Last month's bill amount ($);
- Bill amount ($) for same month in the prior year; and
- Links to the SoCalGas *Ways to Save* tool and rebate programs.

Figure 2-13: Template for SoCalGas SMB New BTA Email Notification



SoCalGas
A Sempra Energy utility

Your Weekly Bill Tracker Update

Here is your update for (******)

My Bill to Date:

14 days elapsed: 15 days remaining

$196.22 Bill to Date

$363.78 Projected Next Bill*

Your Bill Comparison

Projected Next Bill:	$363.78
Last Month's Bill:	$403.56
Same Month Last Year:	$344.67

Log in to Business My Account and visit "Ways to Save" to view your daily and hourly natural gas usage and costs, set up a savings plan and more!

Log In »

Thank you for being a valued customer,

SoCalGas®

Connect with us:

socalgas.com | Ways to Save | Pay Bill Online | Rebate Programs

Make sure you receive our emails by adding customerservice@socalgas.com to your address book. Please do not reply to this email. Email sent to this address cannot be answered. For assistance, please visit our Help Center. Southern California Gas Company values your privacy. For more information, view our Privacy Policy and Privacy Notice.

Email notification code: 150

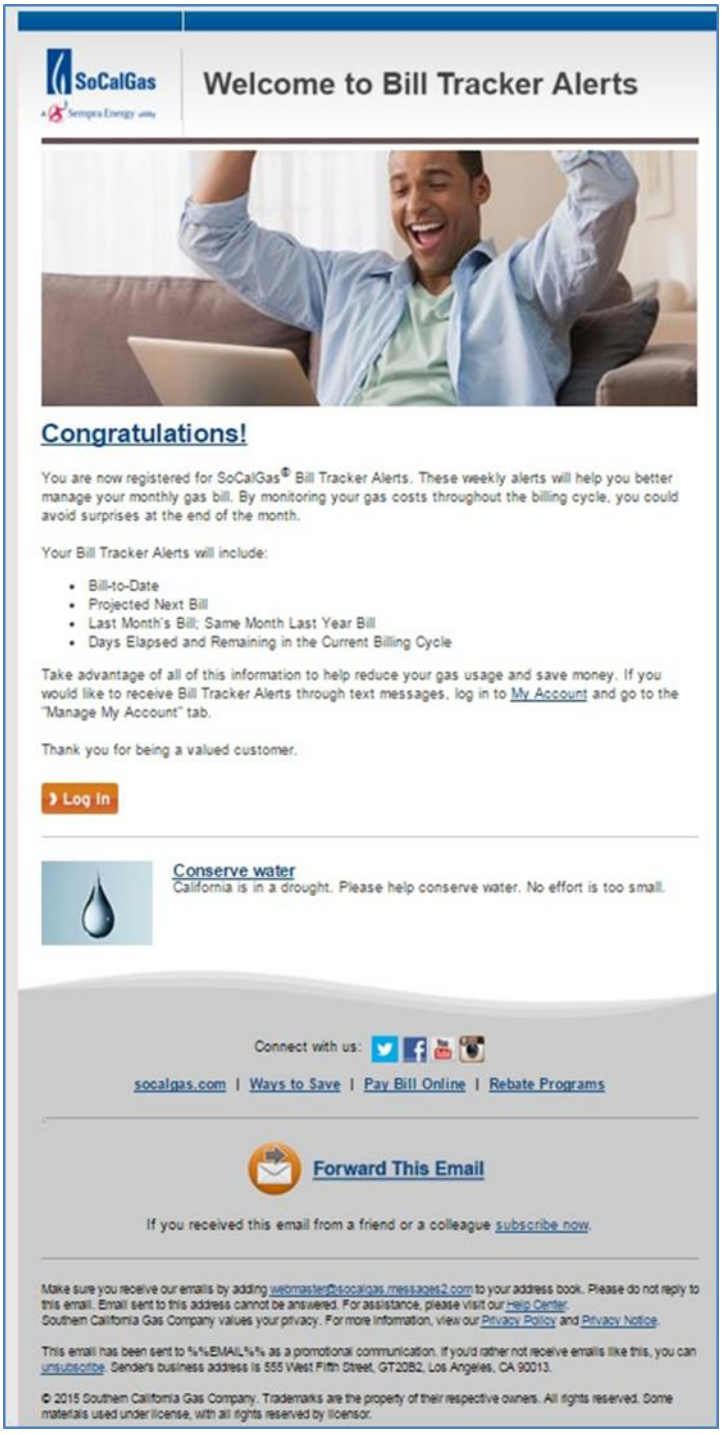
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Communications Sent to Default Residential BTA Customers

In mid-October 2016, approximately 105,000 residential customers were defaulted onto BTA and started automatically receiving BTAs through their primary My Account email address (non-My Account customers could not be defaulted onto BTA because SoCalGas does not have their email address). The default customers could also log into My Account and change their notification preferences to receive BTAs through text message, but the vast majority remained with the BTAs through email alone. In addition to the 15 or more weekly BTAs that

these customers received throughout the 2016–2017 Conservation Campaign, SoCalGas sent an initial Welcome email as shown in Figure 2-14.

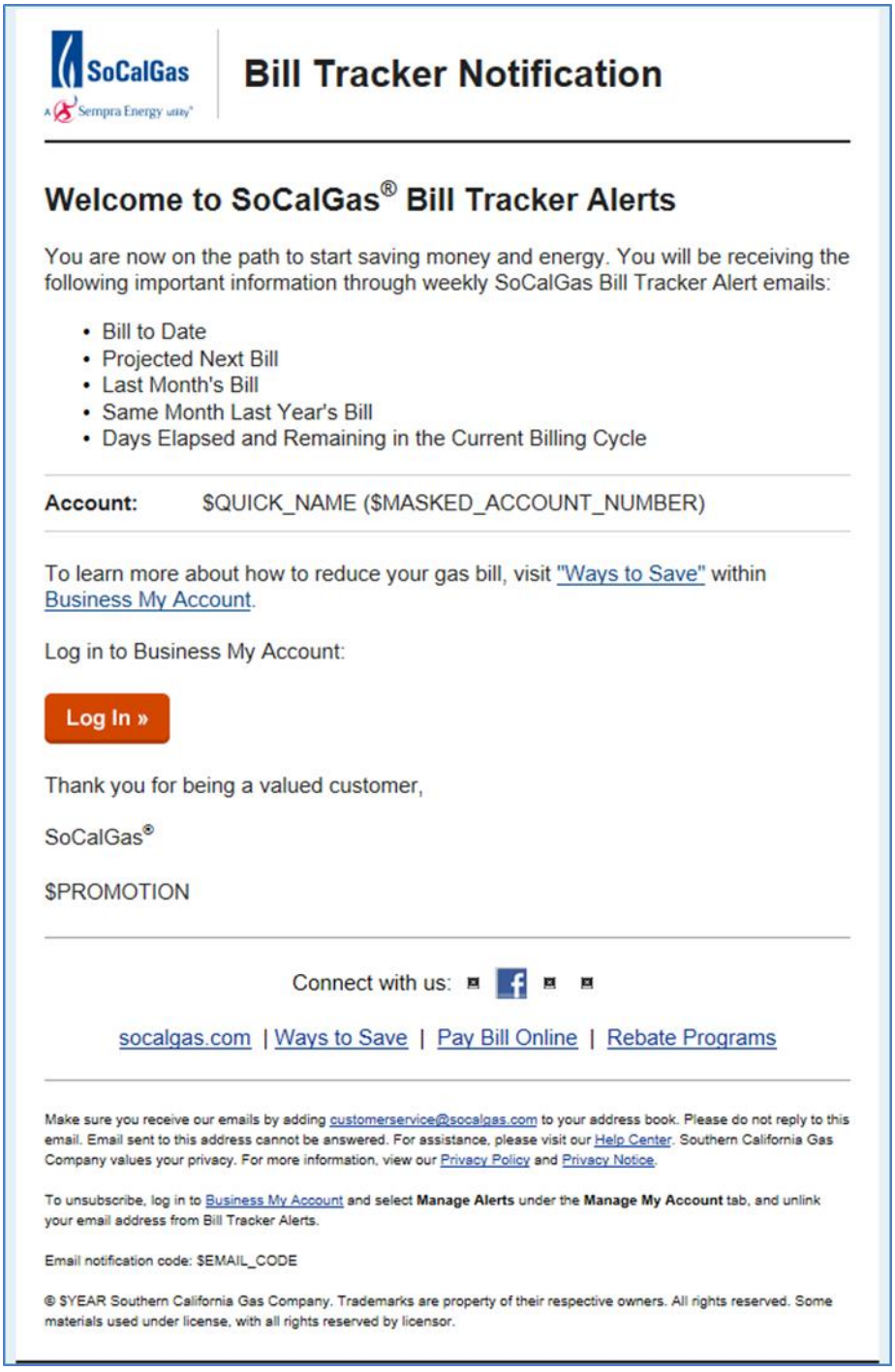
Figure 2-14: SoCalGas – November Residential Bill Tracker Alert Welcome Email



Communications sent to Default SMB BTA Customers

In mid-October 2016, approximately 21,000 SMB customers were defaulted onto BTA and started automatically receiving BTAs through their primary My Account email address. In addition to the 15 or more weekly BTAs that these customers received throughout the 2016–2017 Conservation Campaign, SoCalGas sent a Welcome email as shown in Figure 2-15.

Figure 2-15: SoCalGas – November SMB Bill Tracker Alert Welcome Email



SoCalGas
A Sempra Energy utility

Bill Tracker Notification

Welcome to SoCalGas® Bill Tracker Alerts

You are now on the path to start saving money and energy. You will be receiving the following important information through weekly SoCalGas Bill Tracker Alert emails:

- Bill to Date
- Projected Next Bill
- Last Month's Bill
- Same Month Last Year's Bill
- Days Elapsed and Remaining in the Current Billing Cycle

Account: $QUICK_NAME ($MASKED_ACCOUNT_NUMBER)

To learn more about how to reduce your gas bill, visit "Ways to Save" within Business My Account.

Log in to Business My Account:

Log In »

Thank you for being a valued customer,

SoCalGas®

$PROMOTION

Connect with us:

socalgas.com | Ways to Save | Pay Bill Online | Rebate Programs

Make sure you receive our emails by adding customerservice@socalgas.com to your address book. Please do not reply to this email. Email sent to this address cannot be answered. For assistance, please visit our Help Center. Southern California Gas Company values your privacy. For more information, view our Privacy Policy and Privacy Notice.

To unsubscribe, log in to Business My Account and select **Manage Alerts** under the **Manage My Account** tab, and unlink your email address from Bill Tracker Alerts.

Email notification code: $EMAIL_CODE

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2.2.3 Seasonal Energy Update reports (SEU)

SEUs are monthly energy reports that were developed based on data analytics provided by SoCalGas and implementation facilitated by Aclara. These reports are targeted to customers based on their individual sensitivity to colder weather as determined by their historical AM usage data. Using AM data, SoCalGas is able to measure how customers react to changes in temperature. SoCalGas refers to customers whose natural gas consumption is highly responsive to cold weather as "weather sensitive" customers. The SEU treatment included four monthly paper reports. SEUs are designed to target these weather sensitive customers and inform them on how to change their habits to reduce energy during colder weather periods.

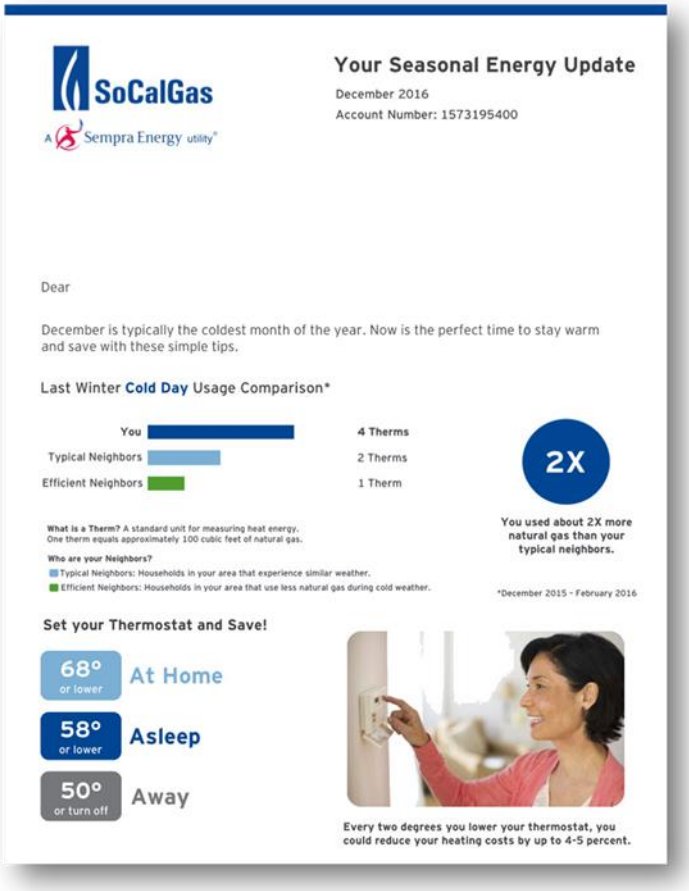
SoCalGas developed SEUs based on learnings, insights, and hypotheses arising from the first two Campaigns and first tested SEUs in the third Campaign. In the fourth campaign, the SEU was tested on CARE and Non-My Account customers. A new version of the SEU was tested that focused on home building envelope and weatherization-related messaging. The treatment groups in the Non-My Account segment contained a large number of customers in comparison to the other treatment cells. However, only 25% of the customers in the treatment group received treatment (SEU reports). In the SEU and SEU (Weatherize) treatments there were 81,400 total customers, but only the top 25% most weather sensitive customers received reports (20,350). In the CARE SEU treatment group, which was comprised of only the top 25% most weather sensitive customers amongst treated CARE customers, all of the customers in the treatment group received reports (19,250).

All SEU treatment customers received the following: four paper reports; one welcome letter/frequently asked questions; three frequently asked questions inserts; and one repositionable thermostat setting reminder decal.

Figure 2-16 and Figure 2-17 provide examples of the front and back sides of the standard paper SEU sent in December (all additional materials can be found in Appendix E). The paper SEU featured the following information:

- Comparison to Neighbors during cold weather days;
- Normal Day vs. Cold Day Usage [self] Comparison; and
- Savings tips.

Figure 2-16: Aclara/SoCalGas Paper SEU (Front)



SoCalGas
A Sempra Energy utility

Your Seasonal Energy Update
December 2016
Account Number: 1573195400

Dear

December is typically the coldest month of the year. Now is the perfect time to stay warm and save with these simple tips.

Last Winter **Cold Day** Usage Comparison*

You	4 Therms
Typical Neighbors	2 Therms
Efficient Neighbors	1 Therm

2X

You used about 2X more natural gas than your typical neighbors.

*December 2015 - February 2016

What is a Therm? A standard unit for measuring heat energy. One therm equals approximately 100 cubic feet of natural gas.

Who are your Neighbors?
Typical Neighbors: Households in your area that experience similar weather.
Efficient Neighbors: Households in your area that use less natural gas during cold weather.

Set your Thermostat and Save!

68° or lower At Home
58° or lower Asleep
50° or turn off Away

Every two degrees you lower your thermostat, you could reduce your heating costs by up to 4-5 percent.

Figure 2-17: Aclara/SoCalGas Paper SEU (Back)

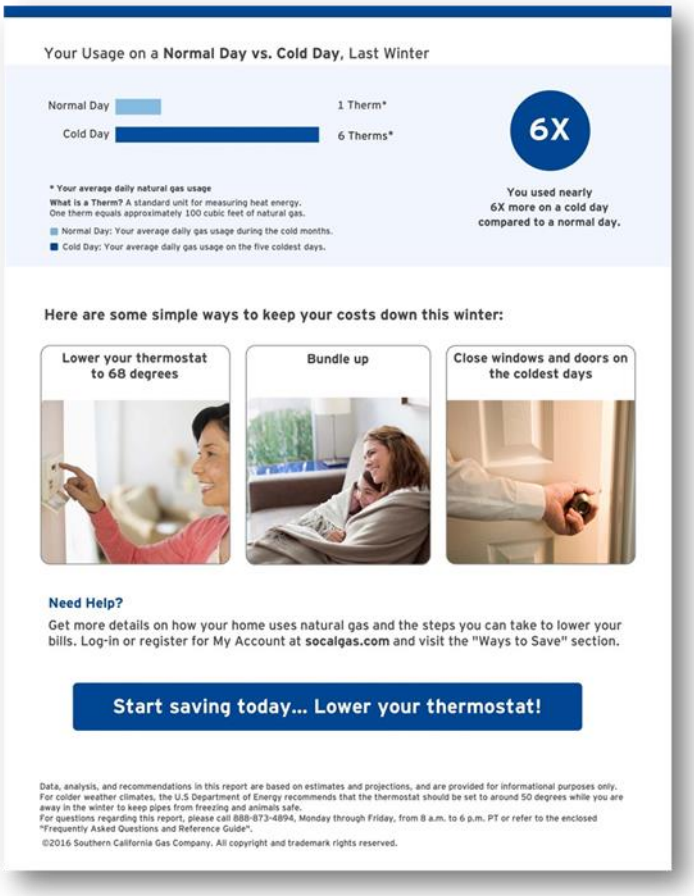


Figure 2-18 and Figure 2-19 and provide examples of the front and back sides of the paper SEU (Weatherize) sent in December (all additional materials can be found in Appendix E). The paper SEU (Weatherize) featured the following information:

- Comparison to Neighbors during cold weather days;
- Normal Day vs. Cold Day Usage [self] Comparison; and
- Savings tips.

Figure 2-18: Aclara/SoCalGas Paper SEU Weatherize (Front)

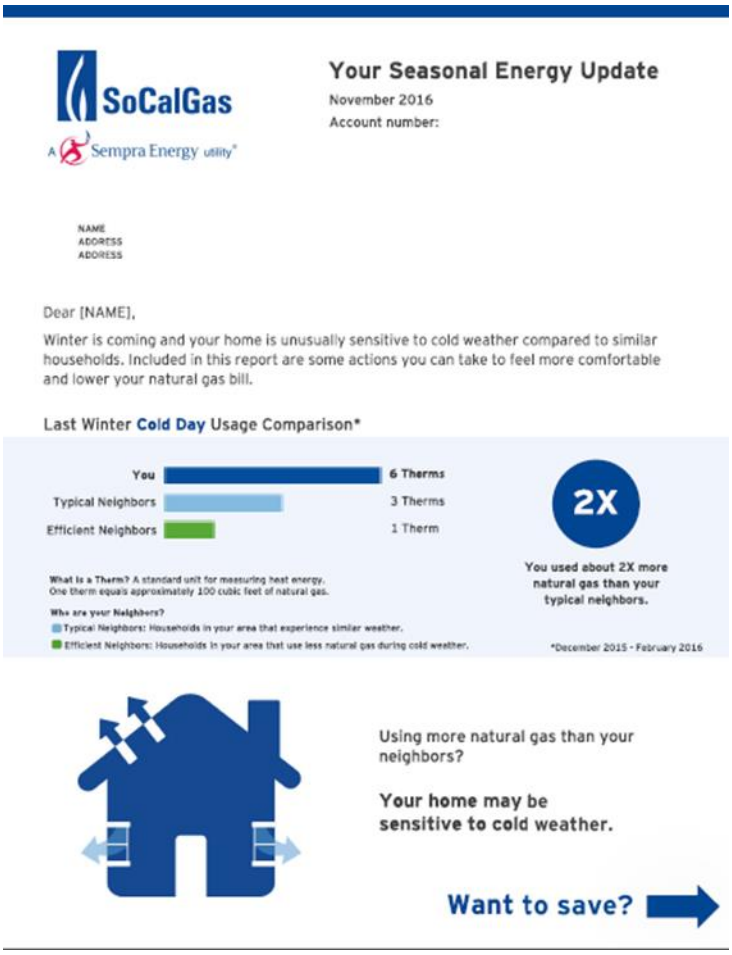
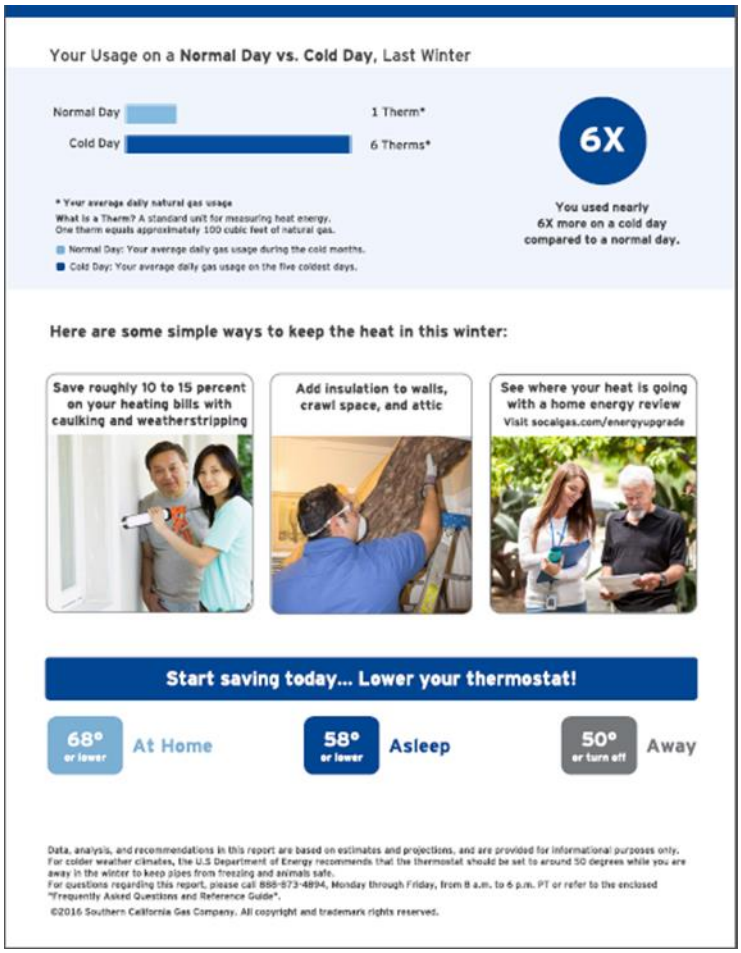


Figure 2-19: Aclara/SoCalGas Paper SEU Weatherize (Back)



2.3 Customer Acceptance of Information Services

This report focuses primarily on the energy savings impact of the information services described above. A related aspect of these services is customer experience. Two gauges of customer acceptance are available: participant opt-out rates and customer experience surveys. For the fourth Campaign, SoCalGas administered customer experience surveys for SEU and Aclara HEU toward the end of the winter treatments in 2016–2017.

All treatments in the fourth Campaign were administered on a default basis but participants were able to opt-out of the service. For the 2016–2017 HER treatments, as of June 30, 2017, a total of 684 (0.2 percent) of Opower HER initial program enrollees opted-out of receiving further Opower HERs. For the Aclara HEU treatment, approximately 41 (.1 percent) enrollees opted-out of receiving further Aclara HEUs. For the same time period, a total of 530 (0.9 percent) of SEU initial program enrollees opted-out of receiving further SEUs. For the SoCalGas In-house HER (English-only and Bi-lingual), only 57 enrollees opted-out during this time (.2 percent). Additionally, since the inception of the Bill Tracker Alert offering in fall 2013, about 7

percent of enrollees have unsubscribed. This implies that customer acceptance rates were quite high for all treatments.

The customer experience survey for the Aclara HEU and SEU treatment[19] reflected general customer satisfaction with SoCalGas. However, both the SEUs and Aclara HEU did not change most customers' opinions of SoCalGas.

Other key findings included:

- Approximately three-quarters of customers in the HEU treatment group and control group were satisfied with SoCalGas. There was not a statistically significant difference between the two groups.
- Almost half of the HEU treatment group customers and control group customers set their thermostat higher than the recommended setting of 68 degrees. There was not a statistically significant difference between the two groups;
- Approximately half of the SEU treatment and control customers set their thermostat above the recommended setting of 68 degrees. There was no difference between treatment and control customers; and
- CARE customers are more likely than non-CARE customers to turn off their thermostat while they are away. They are also significantly more likely to say they had sealed with caulking and weather-stripping or checked air ducts for leaks.

2.4 2016–2017 Winter Weather Conditions

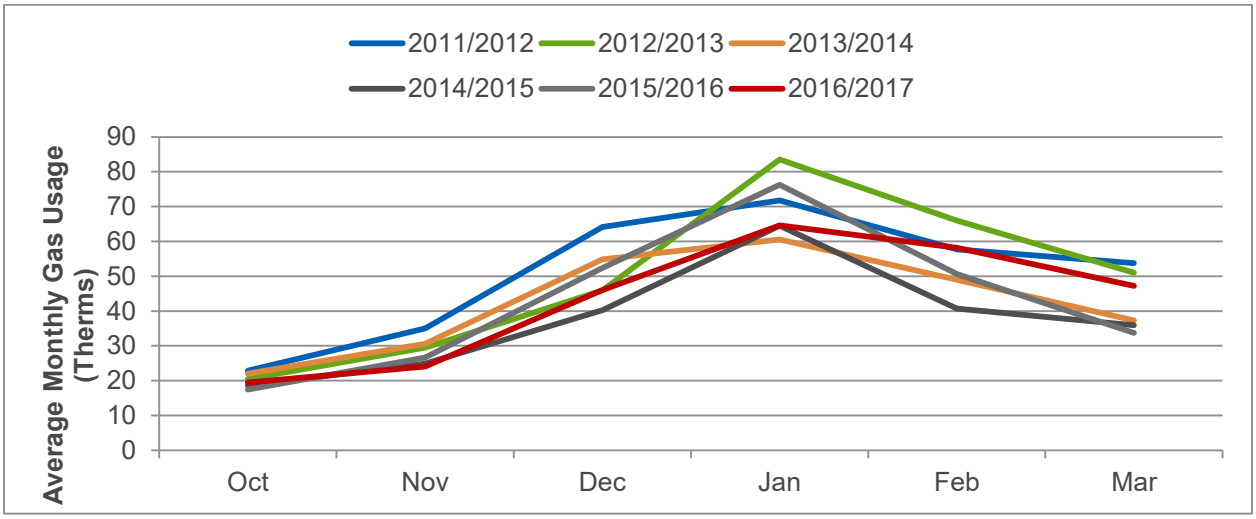
To fully interpret the energy savings that resulted from the 2016–2017 Conservation Campaign, it is important to consider the winter weather conditions. The winters of 2013–2014 and 2014–2015 were in turn the warmest on record in California.[20,21] The winter of 2015–2016 was not the record warmest but it was still above average. The winter of 2016-2017 was close to average, making it the coldest winter of the four campaigns. This is particularly relevant for all of the Campaign winters as the analysis uses each year prior to the start of the Campaign as pretreatment data. This unseasonably warm weather for the first and second Campaign winters was reflected in the overall gas usage for residential SoCalGas customers in both years, as shown in Figure 2-20, which provides a comparison of residential gas usage over the past five winters. From October 2013 through December 2014, residential gas usage in the 2013 heating season was similar to gas usage in the prior two years. However, in January through March 2014, residential gas usage was substantially lower in 2014 than it was in the prior two years. Further, gas usage for the 2014–2015 heating season was the lowest in four years for all months except January 2015. Surprisingly, the residential gas usage for the 2016-2017 heating season was lower than the 2015-2016 heating season even though it was slightly colder in the 2016-2017 winter. The residential gas usage for the 2015–2016 heating season was substantially higher than the prior two years due to the relatively colder temperatures. Based on the weather and results observed to date, it would be reasonable to expect that in warmer years the conservation savings may be lower compared to years with relatively colder weather.

[19] Opinion Dynamics, SoCalGas Customer Survey: Summary Results, March 2017.

[20] http://www.ncdc.noaa.gov/sotc/service/national/statewidetavgrank/201312-201402.gif

[21] http://www.ncdc.noaa.gov/sotc/service/national/statewidetavgrank/201412-201502.gif

Figure 2-20: Comparison of SoCalGas Residential Gas Usage over the Past Six Winters



2.5 Geographic Distribution of all the Conservation Campaigns

The customer populations for the all four Campaigns were significantly influenced by the geographic distribution of the SoCalGas advanced meter rollout. At this point the four Campaigns contain a majority of overlap in geographic regions as the advanced meter rollout is almost complete and as past control/treatment customers have been recycled into new treatment cells. While populations from the two Campaigns were geographically diverse, the first Campaign was more concentrated in denser urban areas—Glendale, areas along the 605 corridor, central areas of Bakersfield and Palm Springs—while the second campaign was more of a mix of urban, suburban, and rural areas—the San Fernando Valley, outer edges of Riverside County, towns along I-5 near the Grapevine, etc.). The third Campaign was also more of a mix of urban, suburban, and rural areas—the Inland Empire, Northern Orange County, Eastern Los Angeles, the San Fernando Valley, and California's Central Valley.

The census block data was also used to analyze the extent to which populations for the three Campaigns varied demographically.

Table 2-4 summarizes certain customer characteristics and demographics for the populations included in the original sample for the four Campaigns. Similar to the previous two years, there is a decline in the representation of customer from areas with high concentrations of renters and high population density. Similar to the second Campaign, the customers in the third Campaign show a lower representation from areas with high concentrations of renters [22] and a lower representation from areas with high population density.[23] The lower representation of areas with high concentrations of Latino households is mainly due to the initial segmentation that occurred during the sampling process to separate the customers into English-only and English + Spanish

[22] "High" defined as census block with rental rates above the 75th percentile among census blocks included in the first, second, or third campaign

[23] "High" defined as census block with densities above the 75th percentile among census blocks included in the first, second, or third campaign

groups.[24] The focus on specifically researching the customers identified by census blocks with high concentrations of Latino households ultimately resulted in a smaller overall number of Latino households being included in the Third and Fourth Campaigns.

Table 2-4: Comparison of Select Demographics for Customer Populations in the four Campaigns[25]

Segment	First Campaign (2013–2014)	Second Campaign (2014–2015)	Third Campaign (2015–2016)	Fourth Campaign (2016–2017)
% Areas with high concentrations of renters	34%	17%	18%	14%
% Areas with high population density	35%	23%	19%	16%
% Areas with high concentrations of Latino households	27%	16%	4%	10%

These are all characteristics that may affect both the ability and the propensity of participants to respond to conservation efforts such as the SoCalGas Conservation Campaign. As such, one should not necessarily expect to find similar overall impacts from similar treatments in the four different campaigns. One may expect, however, for impacts from similar treatments within each demographic group to be more similar.

[24] The English + Spanish group was formed with customers who resided in a census blocks with high concentrations of Latino households

[25] Based on 2010 Census Block demographics

2.6 Report Organization

The remainder of this report proceeds as follows:

- Section 3 describes the research design, including the treatment and control group assignments for residential customers;
- Section 4 summarizes the methodology used to evaluate energy conservation;
- Section 5 summarizes the energy conservation estimates for all of the treatments;
- Section 6 provides recommendations and conclusions from the four Campaigns; and
- Appendix A through Appendix E include additional example communications and informational materials for the treatments.

3 Research Design

In order to determine if the new information services made available by SoCalGas change energy use for consumers who have access to them, it is necessary to estimate what energy use would have been for those customers if they did not have access to the information. Conceptually, this can be accomplished by comparing usage before and after a group of customers receives the information, but other factors such as differences in weather or economic conditions can make such comparisons highly inaccurate. Side-by-side comparisons of customers that do (the treatment group) and don't (the control group) have access to the service of interest is the most robust approach, but only if the two groups of customers are identical except for the fact that one gets the information service and the other doesn't. Obtaining well matched treatment and control groups is the fundamental challenge to getting accurate impact estimates.

In the evaluation plan[26] for its 2013–2014 Conservation Campaign, SoCalGas considered the full spectrum of options before determining that a randomized control trial (RCT) design was the preferred option for these default programs. The evaluation plan provides a summary of the reasons why other options were rejected.

Finally, an important input into development of the evaluation plan was the size of the participant population and control groups required to estimate the effects of the planned information/behavioral treatments. The evaluation plan provided a detailed description of the process used for sample size determination and this will not be repeated here. However, it is relevant to note that sample sizes were adjusted upward in the last three Campaigns to control for the effects of anticipated customer attrition.

3.1 Residential Treatment and Control Group Assignments

Several factors were taken into consideration in assigning customers to test cells in the 2016–2017 Conservation Campaign and how the target market should be segmented.

The first important consideration is usage. Experience has shown that customers with low annual usage may not be interested in or respond to information feedback since their bills are so low that even significant percent changes in energy use would produce only very small economic benefit in the form of bill savings. Even if these customers produced above average savings relative to other customers (which, for reasons just mentioned, may be unlikely), their contribution to the target of 1% savings in aggregate for the overall population would be small and the implementation costs for these customers per therm conserved would be relatively high. In short, it is highly unlikely that low usage customers are cost-effective and almost certain that they would be less cost-effective than customers with larger usage. In fact, the 2013–2014 Campaign found that customers in the second usage quartile (the first quartile was excluded from default treatments in that testing cycle) delivered the lowest absolute and percent gas savings, relative to high users in the third and fourth usage quartiles. Therefore, considering that the 2016–2017 Conservation Campaign was able to take advantage of an expanded

[26] Southern California Gas Company's Evaluation Plan for Estimating Conservation Effects from Information Feedback Services. August 9, 2013. (Included as Appendix O in the "Southern California Gas Company Advanced Meter Semi-Annual Report" dated August 30, 2013).

footprint in terms of AM installations, SoCalGas had a sufficient amount of customers to improve its targeting strategy for the fourth Campaign as follows:

- Continued focus on the top two usage quartiles;
- Continue to include customers who have passed the Opower eligibility screen;
- Delineation of top most "weather sensitive" vs. bottom most weather sensitive customers within most residential treatment groups; and
- Only include customers who have pretreatment data from October 2015 through March 2016.

Another important segmentation factor is whether customers are My Account users. My Account customers register with SoCalGas to receive a variety of online services, including receiving, viewing, and paying their bills online, accessing historical usage data, making payment arrangements, and service scheduling changes such as starting or stopping service. Given their demonstrated interest in online transactions, My Account customers may be more likely than non-My Account customers to take advantage of the new information available through BTAs or HERs. They also are a population for whom SoCalGas has email addresses and, thus, can receive email solicitations and information feedback through this inexpensive channel. For all of these reasons, the population of customers targeted for both BTAs and HERs was segmented into My Account and non-My Account customers in the all four Campaigns.

Similar to the 2015-2016 Campaign, a segmentation used was whether customers were English-only speaking customers or English and Spanish speaking customers. This segmentation was done to test how customers who preferred using Spanish performed when receiving a Bi-lingual HER.

An additional segmentation was between CARE (low income) and Non-CARE customers. The CARE population of customers may behave differently after receiving new information available through HERs or SEUs. This segmentation was used for the first time in the 2015-2016 Campaign. Additionally within this segment, the top 25% most weather sensitive customers were segmented into a treatment and control group, leaving the bottom 75% most weather sensitive customers to be split between a treatment and control group.

An important distinction to note about the residential and control group assignments for the 2016–2017 campaign is that this population included carryover/leftover customers from the previous three campaigns. These included customers from treatment groups no longer receiving treatments, treatment groups that had consistently insignificant and close to zero savings, and control group customers that were no longer needed. The C-10 control group was reduced to 27,500 customers and the C-12 control group was reduced to 63,194 customers.

Figure 3-1 provides a summary of the population segmentation and treatment and control group assignments for residential and commercial customers in the 2016–2017 Conservation Campaign. The research sample for the fourth Campaign excluded customers in the lower two usage quartiles: customers who did not have 2015–2016 pretreatment data and who did not pass the Opower screen. About 915,000 customers remained after removing customers in these three groups.

The remaining customers were then split into English Only and English + Spanish groups based on census block data. The 63,462 customers in the English + Spanish group that had data available to SoCalGas for the neighborhood algorithm were assigned to the SoCalGas Bi-lingual HER treatment (13,750) and its corresponding control group (49,712). The remaining 49,995 customers who did not have data available to SoCalGas for the neighborhood algorithm were not used in the campaign.

Among the roughly 802,000 customers in the English Only segment, about 131,000 were CARE customers and about 671,000 were Non-CARE customers. In the CARE segment, the customers were split into the top 25% most weather sensitive customers and the bottom 75% weather sensitive customers. Within the bottom 75% most weather sensitive customers, 52,500 customers were assigned to the Opower Paper and Email HER and the remaining 46,084 were assigned to the control group. In the top 25% weather sensitive segment, 19,250 customers were assigned to the Aclara/SoCalGas SEU treatment and the remaining 13,612 were assigned to the control group.

The 670,561 Non-CARE customers were divided into the My Account or Non-My Account groups. Since SoCalGas did not have email addresses for the non-My Account customers, this group was assigned to test the paper-only treatments. The Opower standard Paper HER treatment contained 53,500 customers. The Aclara Paper HEU was sampled for 33,000 customers. The SoCalGas HER was sampled for 13,750 customers. The paper SEU and paper SEU (weatherize) both contained 81,400 customers but only the top 25% most weather sensitive customers received treatment.

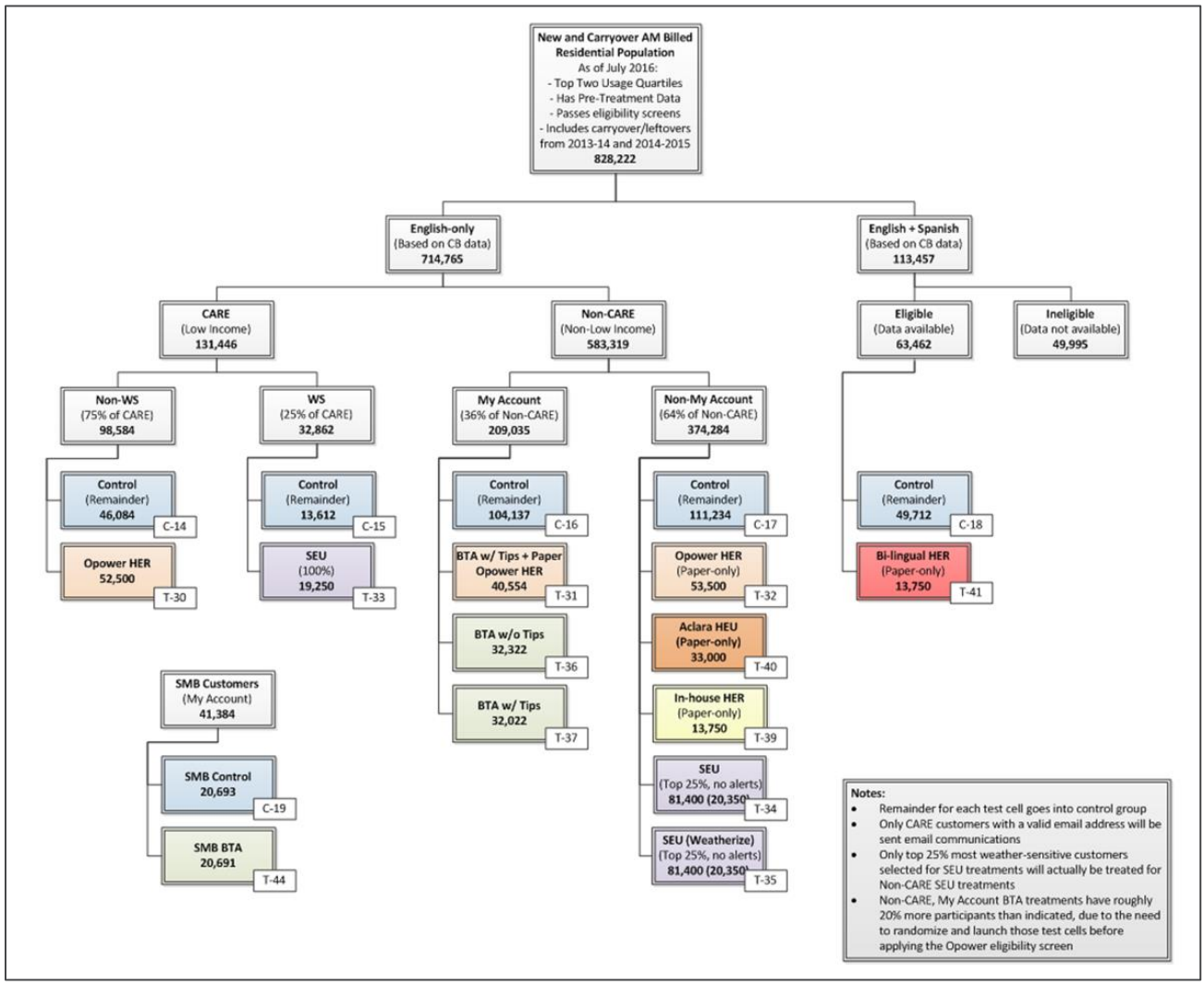
Since SoCalGas had email addresses for the roughly 259,000 My Account customers, it used this group to test default BTAs and the default BTA + Paper Opower HER treatment. The BTA w/Tips + Paper Opower HER was sampled for 40,554 customers. Both the BTA w/o Tips and BTA with Tips contained approximately 32,000 customers each.

In summary, the 828,222 residential customers in the eligible AM population were allocated to the new 2016-2017 treatments as follows:

1. **Default BTA:** 64,344 customers;
2. **Default BTA & Opower Paper-only HERs**: 40,554 customers;
3. **Paper-only HERs:** 100,250 customers (53% Opower, 33% Aclara, 14% SoCalGas);
4. **Opower Paper & Email HERs:** 52,500 customers[27];
5. **Bi-lingual HERs**: 13,750 customers;
6. **SEUs:** 59,950 customers (66% paper SEU, 34% paper “Weatherize” SEU); and
7. **Control Group:** 324,799 customers.

[27] The monthly Email HER was only sent to those CARE customers within the treatment group registered for SoCalGas My Account customer portal and with a valid Email address.

Figure 3-1: New Treatment and Control Group Assignments for the 2016–2017 Conservation Campaign



3.2 SMB Treatment and Control Group Assignments

For the first time since the 2013-2014 campaign, a treatment was tested again on SMB customers. This treatment was not tested in the prior two years as a sufficient number of AM-enabled SMB customers was first needed to conduct rigorous impact analyses with a RCT design. SMB customers were included in the assignment population if they had sufficient pretreatment data from October 2015 through March 2016 and if they were My Account customers. Only one treatment was tested in the population. In order to detect a potentially very small effect from the treatment, a randomized block design was used to select the treatment and control group.

A randomized block design is an approach to assigning treatment and control in which like units are grouped together into blocks first, then the same proportion of each block is randomly assigned to each treatment regime. This results in groups that are much more similar in terms of the variables used to create the blocks. Since the probability that any unit is assigned to any

particular treatment regime is equal for all units, the only thing different about the treatment and control groups on average is the treatment.

The randomized block design can be generalized to correct imbalance on a large number of continuous and discrete variables using clustering algorithms. Historically, blocking was conducted by dividing units into coarse categories, such as decile or quartile of a particular continuous variable and proceeding through each blocking variable, shrinking the size of the blocks with the addition of more and more variables. Further work in statistics and computer science has developed algorithms that improve on this approach. These algorithms all begin by determining how different each experimental unit is from each other unit in terms of the chosen variables. The numerical measures of difference, known as distance metrics, are then put together in a distance matrix. The most popular of these distance metrics, called Mahalanobis distance, is preferred for this task because unlike some distance metrics it is not sensitive to the means of the variables included and weights noisier variables less than quieter ones. Mahalanobis distance also accounts for the correlations between variables, making variables that are highly correlated with other included variables contribute less to the distance.

The next step in the algorithm is to group like units. These algorithms are known as nonbipartite (pair blocking) matching algorithms and attempt to minimize the sum of the distances between pairs, therefore finding the best blocks of two units.

The research sample for the fourth Campaign excluded SMB customers who did not have 2015–2016 pretreatment data and customers who belonged to the Non-My Account segment. About 41,384 SMB customers remained after removing customers in these two groups. The treatment group contained 20,691 customers while the remaining customers were placed in the control group.

3.3 Residential Data Sources

In the analysis, Nexant used daily gas usage data in therms for the post-treatment period from December 1, 2016 through March 31, 2017. Monthly billing data from the same months a year prior was used as the pretreatment data because daily AM data was largely not available for customers in the sample.[28] These data sources yielded 8 months of gas usage data for the study period of interest—spanning from December 1, 2015 through March 31, 2017—with the 2015 non-heating months—April through November—omitted. For estimation purposes, November was dropped from the pre- and post-treatment period both because almost all the treatment started in early December rather than November like in previous years. Thus, the impact estimates discussed in Section 5 span the four month period from December 1, 2016 through March 31, 2017.

In an RCT design that uses difference-in-differences to estimate the energy savings, customers must have a full panel of pre- and post-treatment usage data in order to be included in the analysis that assesses impacts and statistical significance across all months. Basically,

[28] As previously stated, only customers with pretreatment data were included, but this simply means that the sample was limited to customers who had active SoCalGas accounts in the pretreatment period, not explicitly limited to customers with pretreatment AMI data.

customers that were not active SoCalGas accounts from December 1, 2015 through March 31, 2017 were excluded from the analysis of the overall impacts of the fourth Campaign. As long as the percentage of customers dropped is consistent between each treatment group and associated control group, this exclusion of customers from the analysis does not produce bias in the conservation estimates. To verify that the percentage of customers dropped is consistent within each segment, Table 3-1 shows the number of customers that were included in the analysis by treatment/control group, compared to the original number of customers that was sampled. All treatment and control groups retained almost 95% of the customers that were originally sampled. Most importantly, the percentage of customers retained is highly consistent within each statistically equivalent group, which ensures that the integrity of the original sample design is held intact even though some customers had to be dropped from the analysis that assesses impacts and statistical significance across all months.[29]

[29] For the purposes of estimating whether the treatments produced a statistically significant reduction in overall gas usage throughout the 2016-2017 Conservation Campaign, these customers were dropped. However, once Nexant identifies a statistically significant usage reduction within a given test cell, the analysis can be done at the monthly level, which allows for the re-inclusion of some customers that may not have had usage data for every month, but do have data for some pre- and post-treatment months. Basically, when the analysis is conducted at the monthly level, as long as a customer has data for an individual pre- and post-treatment month, that customer can be included in the analysis for that month.

Table 3-1: Residential Customers Included in Analysis by Treatment/Control Group

Segment	My Account	Group	Number of Customers in Original Sample	Number of Customers in Analysis	% of Original Sample in Analysis
Non-CARE	Yes	C-16	104,137	97,944	94.05%
		T-31	40,554	38,060	93.85%
		T-36	32,322	30,398	94.05%
		T-37	32,022	30,150	94.15%
	No	C-17	111,234	105,649	94.98%
		T-32	53,500	50,784	94.92%
		T-40	33,000	31,333	94.95%
		T-39	13,750	13,218	96.13%
		T-34	20,350	19,331	94.99%
		T-35	20,350	19,338	95.03%
CARE	Yes/No	C-14	46,084	43,248	93.85%
		T-30	52,500	49,177	93.67%
		C-15	13,612	12,815	94.14%
		T-33	19,250	18,077	93.91%
Bi-lingual		C-18	49,712	48,011	96.58%
		T-41	13,750	13,277	96.56%
All		**Total**	**551,990**	**522,866**	**94.72%**

3.4 SMB Data Sources

Similar to the residential analysis, Nexant used daily gas usage data in therms for the post-treatment period from December 1, 2016 through March 31, 2017. Monthly billing data from the same months a year prior was used as the pretreatment data because daily AM data was largely not available for customers in the sample.[30] These data sources yielded 8 months of gas usage data for the study period of interest—spanning from December 1, 2015 through March 31, 2017—with the 2016 non-heating months—April through November—omitted. Thus, the impact estimates discussed in Section 5 span the four month period from December 1, 2016 through March 31, 2017.

In an RCT design that uses difference-in-differences to estimate the energy savings, customers must have a full panel of pre- and post-treatment usage data in order to be included in the analysis that assesses impacts and statistical significance across all months. Basically, customers that were not active SoCalGas accounts from December 1, 2015 through March 31, 2017 were excluded from the analysis of the analysis. As long as the percentage of customers dropped is consistent between the treatment group and the control group, this exclusion of customers from the analysis does not produce bias in the conservation estimates. To verify that the percentage of customers dropped is consistent for the SMB treatment and control group, Table 3-2 shows the number of customers that were included in the analysis by treatment/control group, compared to the original number of customers that was sampled. The treatment group retained about 88% of what was additionally sampled. Most importantly, the percentage of customers retained is highly consistent within each statistically equivalent group, which ensures that the integrity of the original sample design is held intact even though some customers had to be dropped from the analysis that assesses impacts and statistical significance across all months.[31]

Table 3-2: SMB Customers Included in Analysis

Group	Number of Customers in Original Sample	Number of Customers in Analysis	% of Original Sample in Analysis
C-19	20,693	18,329	88.58%
T-44	20,691	18,291	88.40%
All	**41,384**	**36,620**	**88.49%**

[30] As previously stated, only customers with pretreatment data were included, but this simply means that the sample was limited to customers who had active SoCalGas accounts in the pretreatment period, not explicitly limited to customers with pretreatment AMI data.

[31] For the purposes of estimating whether the treatments produced a statistically significant reduction in overall gas usage throughout the 2016-2017 Conservation Campaign, these customers were dropped. However, once Nexant identifies a statistically significant usage reduction within a given test cell, the analysis can be done at the monthly level, which allows for the re-inclusion of some customers that may not have had usage data for every month, but do have data for some pre- and post-treatment months. Basically, when the analysis is conducted at the monthly level, as long as a customer has data for an individual pre- and post-treatment month, that customer can be included in the analysis for that month.

4 Gas Savings Impact Estimation Methodology

Nexant estimated models using panel data to determine energy savings. Panel data is a data structure in which multiple observations over time are present for multiple individuals. In the evaluation[32] for the 2013–2014 Conservation Campaign, Nexant took the opportunity to test three different model specifications for using panel data to estimate energy savings—a fixed-effects (FE) model, a random-effects (RE) model, and a lagged dependent variable (LDV) model. All models featured time-effect variables as well as error estimates clustered at the customer level. Each of these model specifications has merit under the appropriate circumstances, but they are fundamentally different approaches to estimating treatment effects. All three model specifications were carefully considered before determining that a LDV model was the preferred evaluation model. The evaluation of the first Campaign provides a summary of the reasons why the LDV model was chosen as the appropriate model for this evaluation.

The LDV model incorporates individual heterogeneity by explicitly including past values of an individual's energy consumption as control variables on the right-hand side of the regression equation. The LDV regression model as used in this evaluation is specified in this equation:

$$therms_{i,t} = a + b \cdot T_i + c \cdot u_t + d \cdot therms_{i,t-12} + \varepsilon_{it}$$

In this equation, *t* indexes months December 2016 through March 2017 and *i* indexes individuals. The intercept is the same for everyone and the term $therms_{i,t-12}$ represents the energy consumption for individual i in a previous period (in this case, the same month from the prior year). This is akin to saying that what makes consumers unique is captured entirely by their past levels of consumption. The model variables are defined in Table 4-1. This model can be estimated using pooled OLS, provided that there is no serial correlation in the error term and that there are no omitted variables that are correlated with the treatment. The underlying identification assumption is that average consumption without the treatment would be the same for both treatment and control customers. Given that the research design features an RCT with random assignment to large treatment and control groups, this assumption is clearly valid in this case.

[32] Southern California Gas Company's Evaluation Plan for Estimating Conservation Effects from Information Feedback Services. August 9, 2013. (Included as Appendix O in the "Southern California Gas Company Advanced Meter Semi-Annual Report" dated August 30, 2013).

Table 4-1: Definition of Lagged Dependent Variable Model Variables

Variable	Definition
$therms_{i,t}$	average daily gas consumption of participant i during month t
a	estimated intercept
b	estimated treatment effect
c	estimated monthly time effect on treatment and control group
d	estimated effect of an individual's consumption in month $t-12$
T_i	indicator of whether or not the participant is assigned to the treatment condition
$therms_{i,t-12}$	average daily gas consumption of participant i during month $t-12$
u_t	Time effects for each month that control for unobserved factors that are common to all treatment and control customers but unique to month t
$\varepsilon_{i.t}$	error for each participant and month

Nexant conducted an evaluation of impacts for the fourth Campaign using winter 2015–2016 as the pretreatment period ($t-12$). In addition, Nexant estimated the impacts for all the different treatments from the third Campaign. Nexant also estimated the impacts for the second Campaign including the Opower HER and Default BTA customers still receiving treatment. In addition to these ongoing treatments, Nexant estimated the persistence of energy savings for customers from the first Campaign—the Opower HER customers who no longer received HERs and the BTA customers who continued to receive BTAs in the absence of any promotional materials. For the first Campaign customers, the treatment period (*t*) was 2016–2017 and pretreatment period was still 2012–2013 so that energy savings in the fourth year could be compared to energy savings in the first year. For the second Campaign customers, the treatment period (*t*) was 2016–2017 and pretreatment period was still 2013–2014 so that energy savings in the third year could be compared to energy savings in the first year. For the third Campaign customers, the treatment period (*t*) was 2016–2017 and pretreatment period was still 2014–2015 so that energy savings in the second year could be compared to energy savings in the first year. Similar to last year's evaluation, the SEU treatments in the 2015-2016 Campaign are evaluated differently from the other treatments.[33]

This analysis also reflects the same data management protocols developed during the 2013–2014 and used in the 2014-2015 and 2015-2016 Campaigns and agreed upon during a knowledge sharing meeting with SoCalGas and other stakeholders.

[33] For more information on this analysis see SoCalGas 2015-2016 Conservation Campaign Evaluation – Final dated August 31 2016.

5 Energy Conservation Estimates

This section begins with a summary of the results and conclusions for the 2016–2017 SoCalGas Conservation Campaign new residential treatments and the SMB treatment, followed by a detailed assessment of how gas savings vary by customer segment and a summary of the fourth year savings results for customers from the 2013–2014, 2014-2015, and 2015-2016 Conservation Campaigns. At the end of the section, an estimate of the total 2016–2017 gas savings for all four groups is provided.

5.1 Percent Reductions for 2016–2017 Conservation Campaign Residential Treatments

Table 5-1 shows the estimated percent reductions in gas consumption for the 11 new residential treatments deployed for the 2016–2017 Conservation Campaign. Percent reductions were derived using the LDV regression model. P-values for the coefficient estimates from the regression models are also displayed. The data used for model estimation covers the months of December 2016 through March 2017 as compared to the pretreatment period (the months of December 2015 through March 2016). It only includes customers who were active for the full period.

All of the 11 residential treatments yielded statistically significant impacts. This is the second year in a row that all the treatments provided statistically significant impacts. This reflects the value of the adaptive design process being utilized within the “test and learn” approach. The Non-My Account SEU treatments both produced the highest percent reductions—approximately 3%—for both the standard and weatherize versions. However, it is important to note that the SEU treatments are not directly comparable to the other treatments as they only include customers identified as being highly sensitive to cold weather. In order to compare the SEU treatments to other treatments it is necessary to look at the top 25% most weather sensitive customers in those treatments. The Bi-lingual HER produced the lowest savings rate of the treatments.

The BTA w/Tips + Paper Opower HER treatment had a percent reduction of 2.21% which was greater than both the BTA w/Tips (.88%) and the BTA w/o Tips (.77%). The Aclara HEU had the highest savings rate of the three HERs; however the difference between them is not statistically significant.

Table 5-1: Estimates of Percent Reductions in Gas Energy Consumption for the 2016–2017 Conservation Campaign New Residential Treatments, December 2016 through March 2017

CARE	My Account	Treatment	Group	Number of Treatment Customers	% Reduction	P-value
No	Yes	BTA w/Tips + Paper Opower HER	T-31	38,060	2.21%	0.00
		BTA w/o Tips	T-36	30,398	0.77%	0.00
		BTA w/ Tips	T-37	30,150	0.88%	0.00
	No	Paper Opower HER	T-32	50,784	1.37%	0.00
		Paper Aclara HEU	T-40	31,333	1.47%	0.00
		Paper In-House HER	T-39	13,218	1.25%	0.00
		SEU	T-34	19,331	3.18%	0.00
		SEU (Weatherize)	T-35	19,338	3.43%	0.00
Yes	Yes/No	Opower HER	T-30	49,177	1.78%	0.00
		SEU	T-33	18,077	2.24%	0.00
Yes/No	Yes/No	Bi-lingual HER	T-41	13,277	0.60%	0.01

Figure 5-1 shows the estimated percent reductions in gas consumption for top 25% most weather sensitive customers for the Non-My Account SEU treatments, the Paper Aclara HEU, and the Paper Opower HER. Applying the weather sensitive filter increases the percent reduction as compared to the full treatment population for the Aclara and Opower HERs. However, the SEU still has the highest percent reduction. The In-house HER was not included in this comparison because an additional filter was applied for these customers so they are not directly comparable.

Figure 5-1: Comparison of Weather Sensitive Customers for Non-My Account Treatments

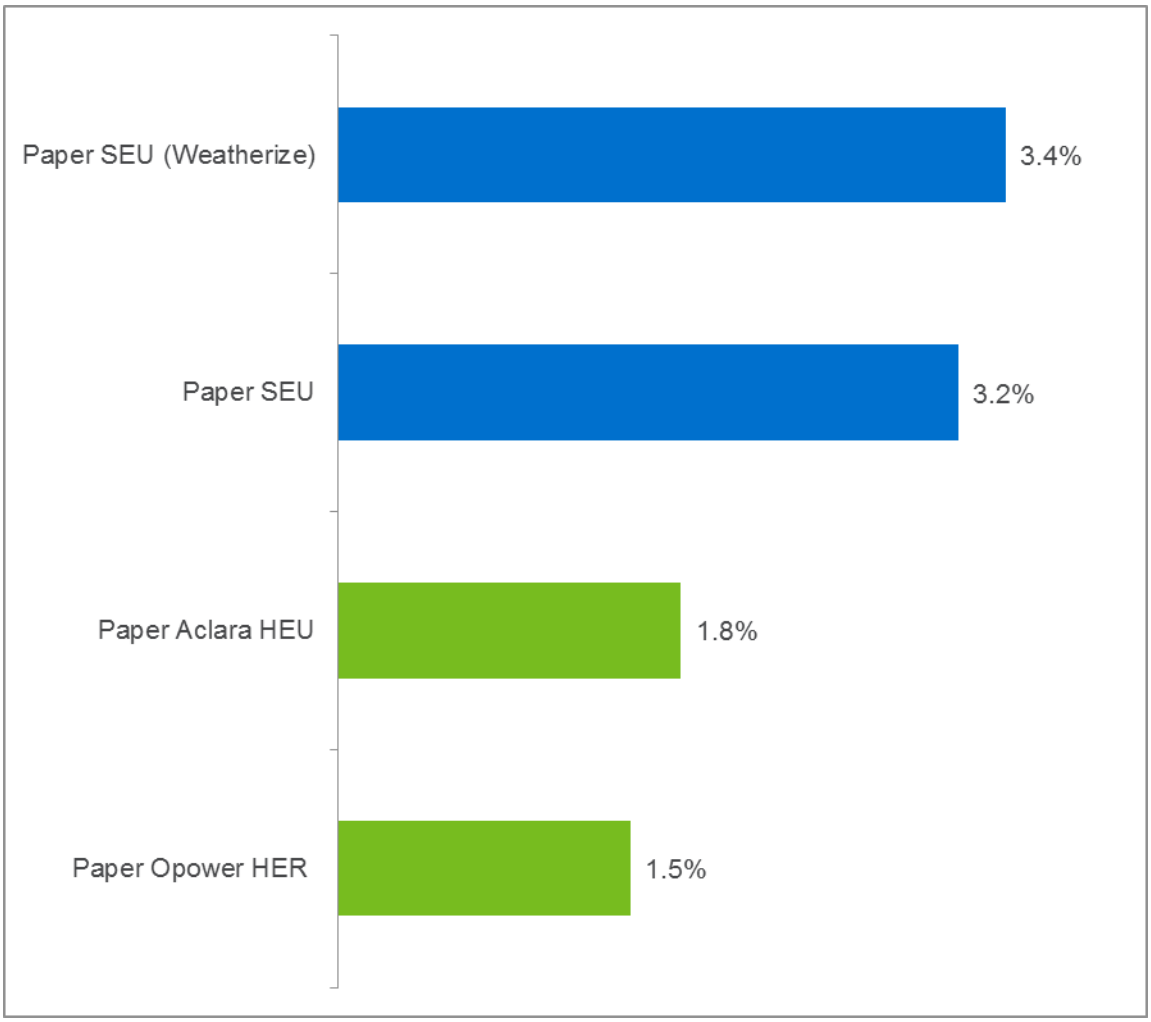
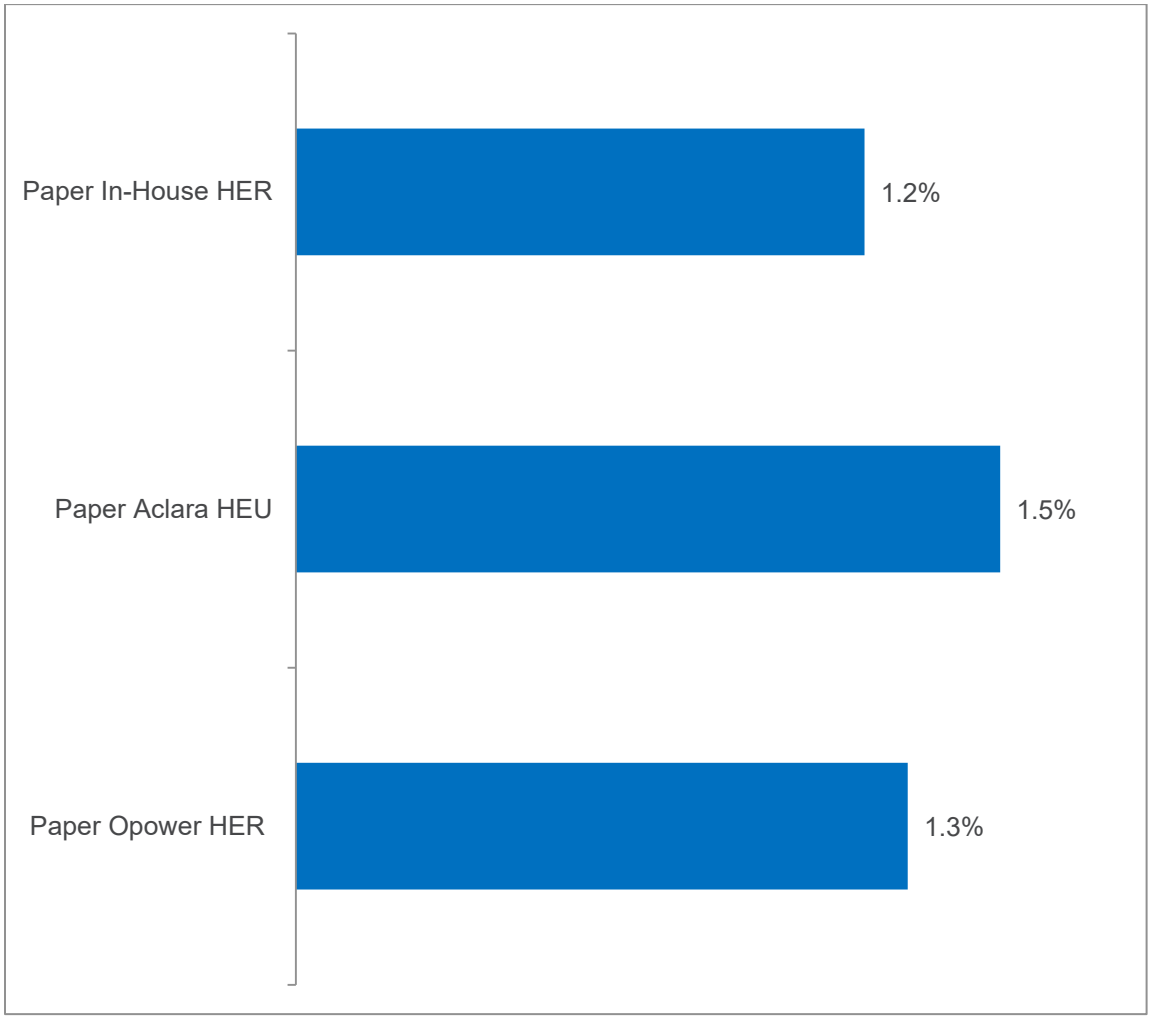


Figure 5-2 shows the estimated percent reductions in gas consumption for the customers who pass the SoCalGas “neighborhood algorithm” filter for the In-house HER, the Paper Aclara HEU, and the Paper Opower HER. This filter allows the Aclara and Opower HER treatments to be compared to the In-house HER. Applying the neighborhood algorithm filter does not significantly change the Aclara and Opower HER percent reductions. The Aclara HEU has the highest percent reduction, but the difference between the three treatments is not statistically significant.

Figure 5-2: Comparison of "Neighborhood Algorithm Customers" for Non-My Account HER Treatments



5.2 Percent Reductions for 2016–2017 Conservation Campaign SMB Treatment

Table 5-2 shows the estimated percent reductions in gas energy consumption for the SMB treatment deployed for the 2016-2017 Conservation Campaign. Percent reductions were derived using the LDV regression model. P-values for the coefficient estimates from the regression models are also displayed. The data used for model estimation covers the months of November 2016 through March 2017 as compared to the pretreatment period (the months of November 2015 through March 2016). It only includes customers who were active for the full period.

The default BTA treatment did not deliver a statistically significant result. The impact of the BTA on gas usage for the treatment group was close to zero.

Table 5-2: Estimate of Percent Reduction in Gas Energy Consumption for the 2016–2017 Conservation Campaign SMB Treatment, December 2016 through March 2017

Treatment	Group	Number of Treatment Customers	% Reduction	P-value
SMB BTA	T-44	18,291	-0.39%	0.58

5.3 Comparison to Past Campaigns' Percent Reductions

In the 2015-2016 the third Campaign tested thirteen treatments which all produced measurable savings. The treatments included default BTAs, HERs, and SEUs. The new BTA was tested and found to produce higher savings than the old version of the BTA. The SEU treatments did not continue to receive treatment in the second year. All of the BTA treatments continued to receive the new version of the BTA. The Opower treatments continued except for the Spanish HER.

In 2014–2015 the second Campaign tested seven treatments, which included default BTAs and HERs. The two different varieties of HERs were implemented by Aclara and Opower. The three Opower HERs—Paper-only, Email, and Paper & Email—all produced statistically significant results while the Aclara Paper-only HEU was the only Aclara HEU that produced statistically significant results. The default BTA did not produce measurable savings. The Aclara treatments were stopped while the default BTA and Opower treatments continued.

The four treatments from the first Campaign that produced statistically significant gas usage reductions were the default BTAs and three variations of the Opower HER reports—Paper-only, Email, and Paper & Email. The default BTA customers continued to receive treatment but the Opower treatments have not received reports since the first Campaign.

The treatments that produced measurable savings from the first, second, and third Campaigns were also tested in the fourth Campaign.

However, to interpret the comparisons of the treatments from the four Campaigns it is important to note several key differences between the Campaigns. First, as discussed in Section 2.5, the research sample in each year was pulled from the population that received advanced meters in the year leading up to the summer before each Campaign. These meters were rolled out to different geographic areas each year and the underlying characteristics of the different populations could bias the results from one year to next. Due to the process of sampling customers in the fourth Campaign, there are very few areas with high rates of a Latino population compared to the first and second Campaigns. Second, as explained in Section 3.1, the HERs eligibility screens applied in the second Campaign resulted in a much higher exclusion rate, with 35% of advanced meter customers being screened out in the second year versus only 4% in the first year. This large difference may have created systematic differences between the populations of the first Campaign and the following Campaigns. Third, as described in Section 2.2, the implementation of the default BTAs differed in that the BTAs from the third Campaign were tested with and without promotional materials, while the BTAs from the fourth Campaign were tested with and without tips included in the report.

With these caveats considered, Figure 5-3 shows the comparison of results for the similar Opower HER treatments across the four Campaigns. The results shown in Figure 5-1 are the savings rates from the first year of treatment for each of the different Campaigns. The Opower Paper-only HER provides consistent measurable percent reductions for each of the Campaigns. The Opower Paper & Email HER was sent to CARE customers in third and fourth Campaigns, but produced different results both years.

Figure 5-3: Comparison of Opower Treatments Percent Reduction Estimates for all Campaign Years

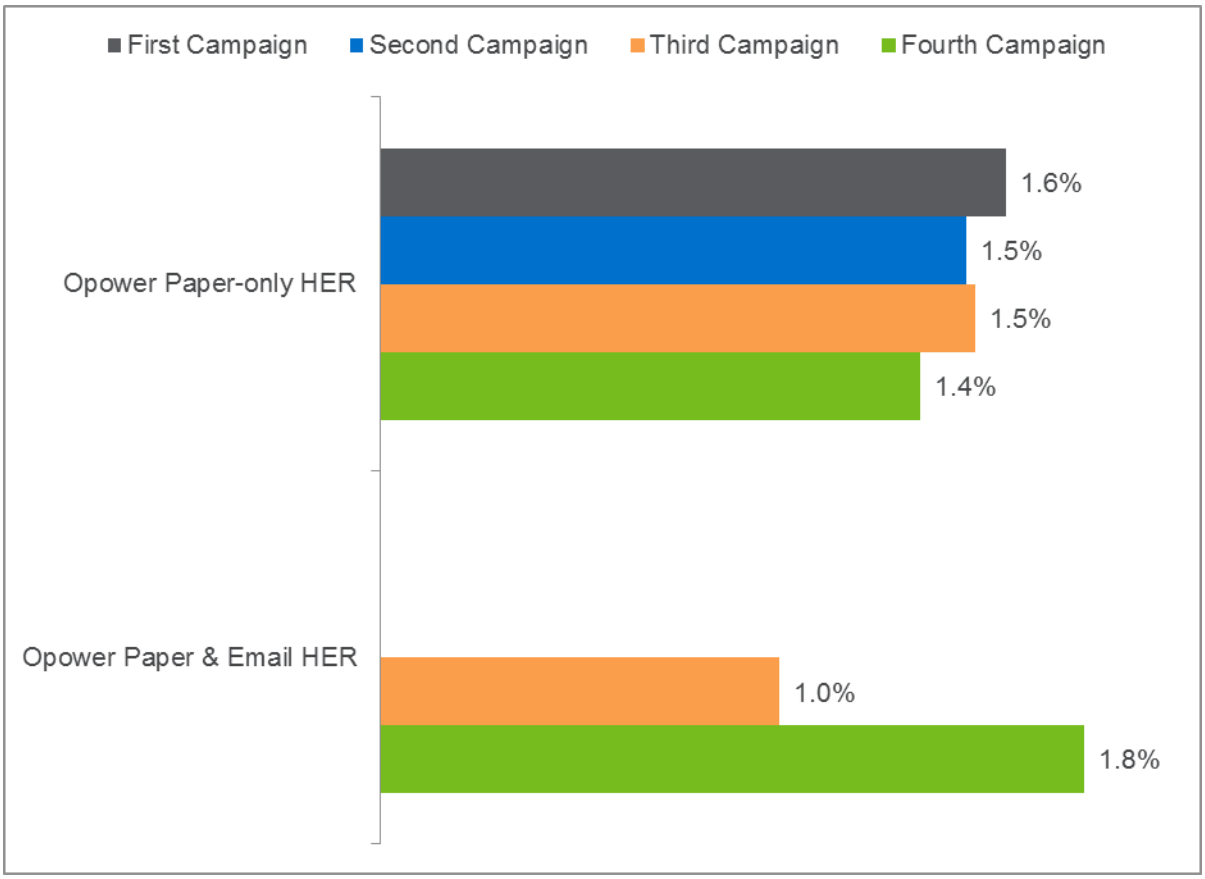


Figure 5-4 shows the comparison of results for new BTA treatments from the third and fourth Campaigns. The results shown in Figure 5-4 are the savings rates from the first year of treatment for each of the Campaigns. The New BTA with supplemental promotional materials produced the highest savings rate of the default BTA treatments. Both of the BTA treatments with additional tips or materials had higher percent reductions than the versions without, but this difference is not statistically significant. The new BTA provided consistent results for the two years it was tested.

Figure 5-4: Comparison of BTA Treatments Percent Reduction Estimates for Third and Fourth Campaigns

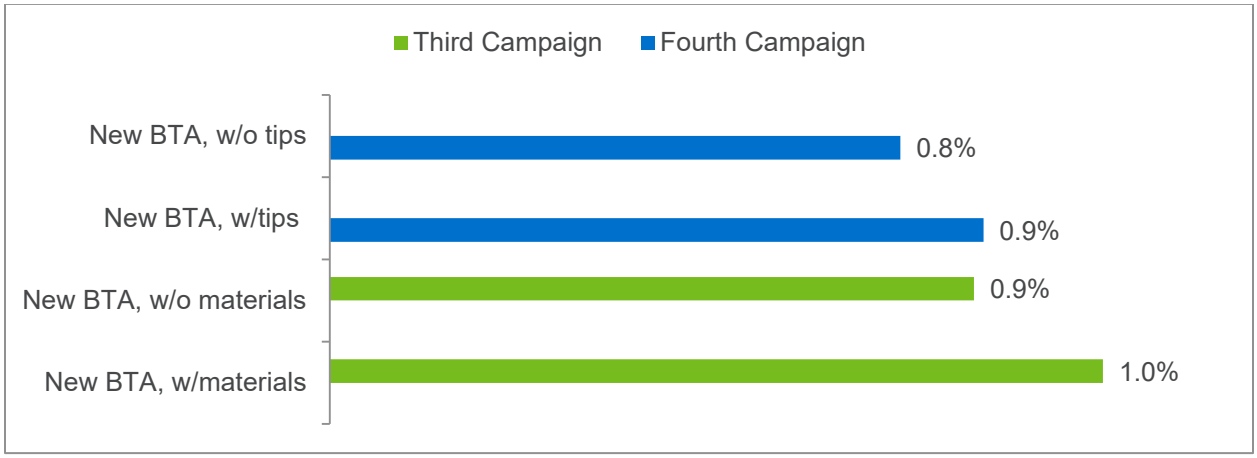
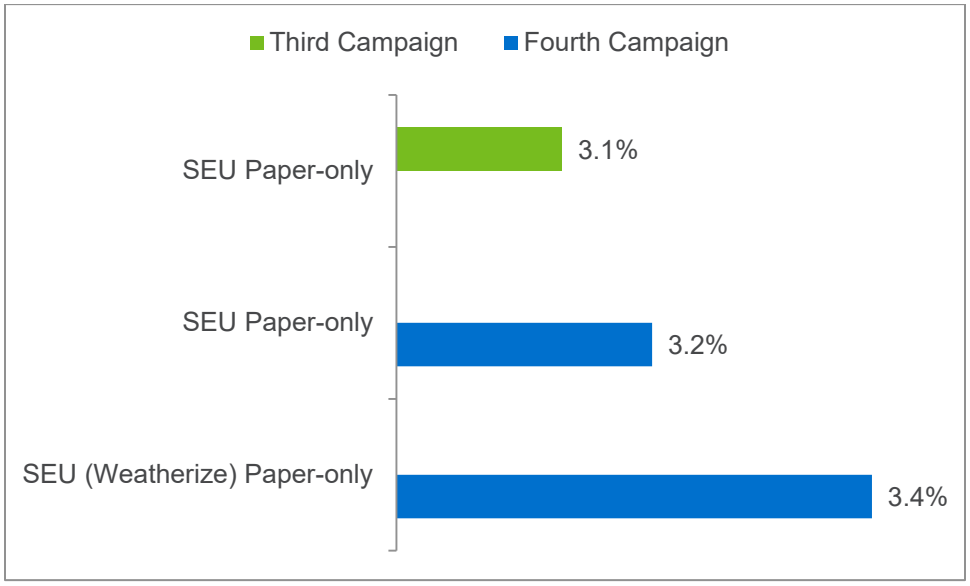


Figure 5-5 shows the comparison of results for SEU treatments from the third and fourth Campaigns. This comparison only includes the SEU treatments that were sent to the Non-My Account customer segment so that the results could be comparable. These results are the savings rates from the first year of treatment for both of the Campaigns. The SEU treatments sent to Non-My Account customers had percent reductions over 3% in both Campaigns.

Figure 5-5: Comparison of SEU Non-My Account Treatments Percent Reduction Estimates for Third and Fourth Campaigns



5.4 Gas Savings by Usage Quartile

Over the course of the four campaigns it has been useful to examine how natural gas savings vary across customer segments. If some segments do not respond well to the information treatments and others do, it will be more cost-effective to focus future campaigns on segments that are more responsive to the information offerings.

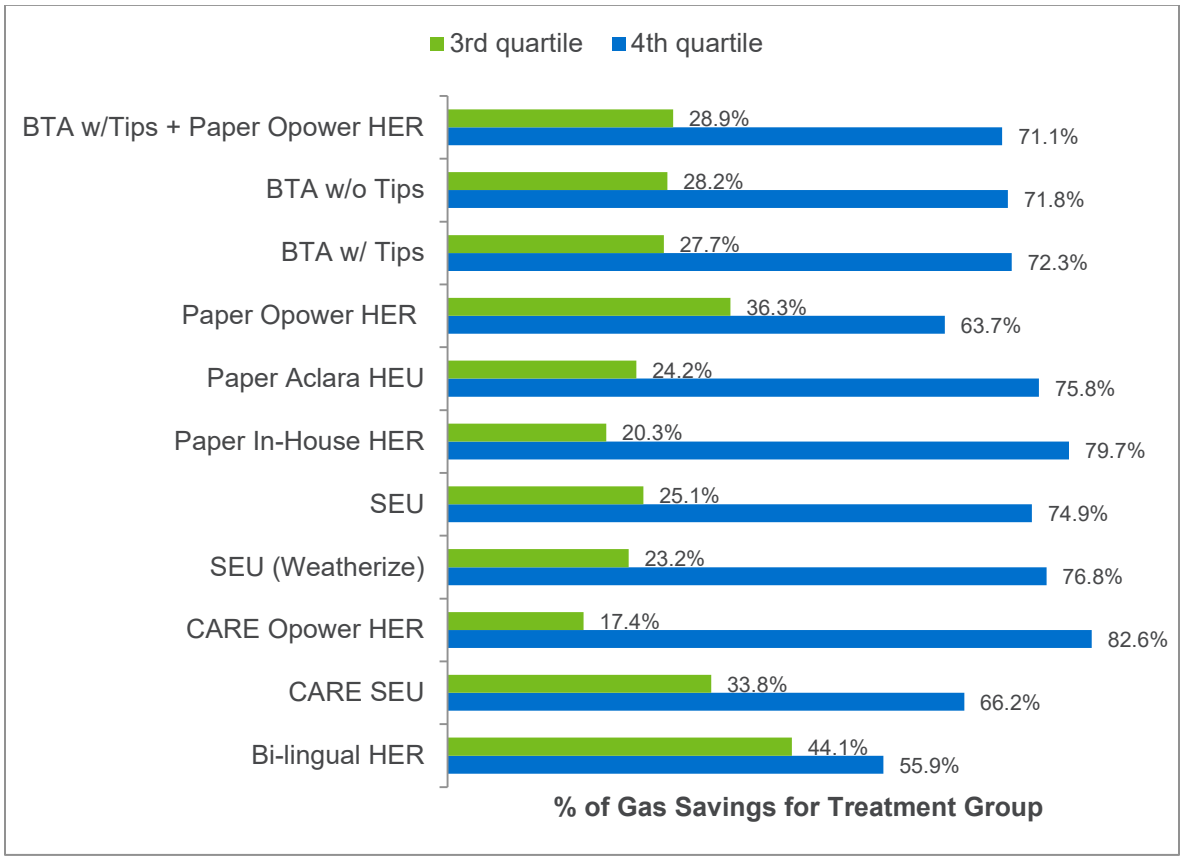
A segmentation with consistent results across years is customers grouped into usage quartiles. To put these usage quartiles in context, it is helpful to note their likely influence on the contents of a participant's HER. A key component of HER messaging is the neighbor comparison component, which informs the participant whether their household gas usage is above, below, or in-line with usage for similar homes. Due to the nature of this comparison, top usage quartile customers are more likely to receive messages indicating that their usage is higher than usage for similar homes, thereby providing a signal to conserve. This segmentation was explored in the report for the first Campaign, leading to the conclusion that "both the magnitude of savings and percent savings consistently increase as usage increases."[34] This conclusion led to the decision to focus the following three campaigns on the top two usage quartiles only.

Figure 5-6 shows the share of aggregate gas savings in therms attributable to the third versus the fourth usage quartile for each treatment. The gas savings for the third quartile customers range from 17% to 44% of the overall savings across treatments. All treatments have less than

[34] For further details, refer to Exhibit E: "Evaluation of Southern California Gas Company's 2013-14 Conservation Campaign," included in the "Southern California Gas Company Advanced Meter Semi-Annual Report" dated August 29, 2014.

50% of their aggregate savings come from the customers in the third quartile. As in the previous Campaigns, both the magnitude of savings and percent savings consistently increase as usage increases. For fourth usage quartile customers, high usage combined with larger impacts leads to a large percentage of the overall therm savings. Considering that customers in the top usage quartile consistently produce the largest share of therm savings, it may make sense for SoCalGas to further hone conservation efforts by focusing on customers in this group going forward.

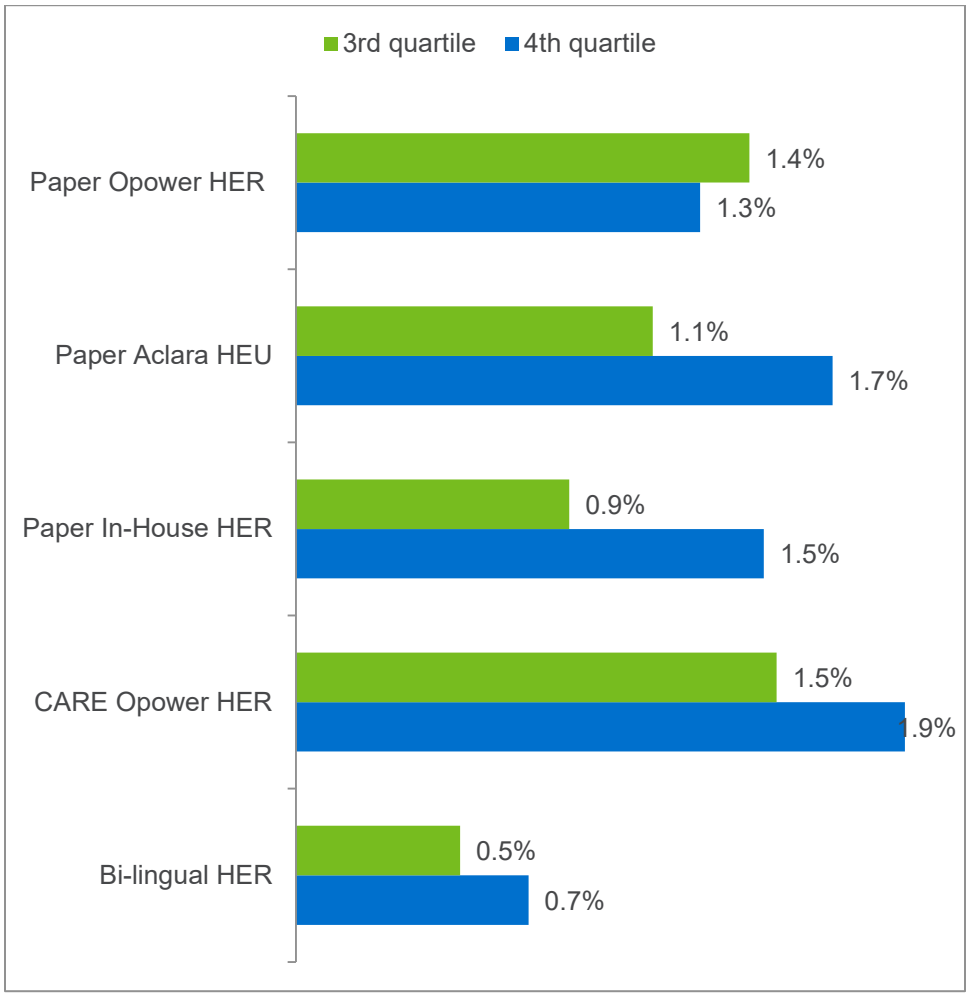
Figure 5-6: Percent of Gas Savings Attributable to Each Usage Quartile (Statistically Insignificant Results are in Gray)



HER Gas Savings by Usage Quartile

Figure 5-7 compares percent reductions for the top two quartiles for each of the HER treatments in the fourth Campaign. As in the prior three campaigns, the HER treatments consistently show similar or higher reductions for the fourth usage quartile as compared to the third quartile. The Paper Opower HER is the only HER treatment where the fourth quartile percent reduction is not higher than the third quartile percent reduction. In the previous Campaigns the third quartile usage was much lower than the fourth quartile usage for the paper-only HER. This suggests that for this population the participants were more responsive to paper-only HERs than in the past.

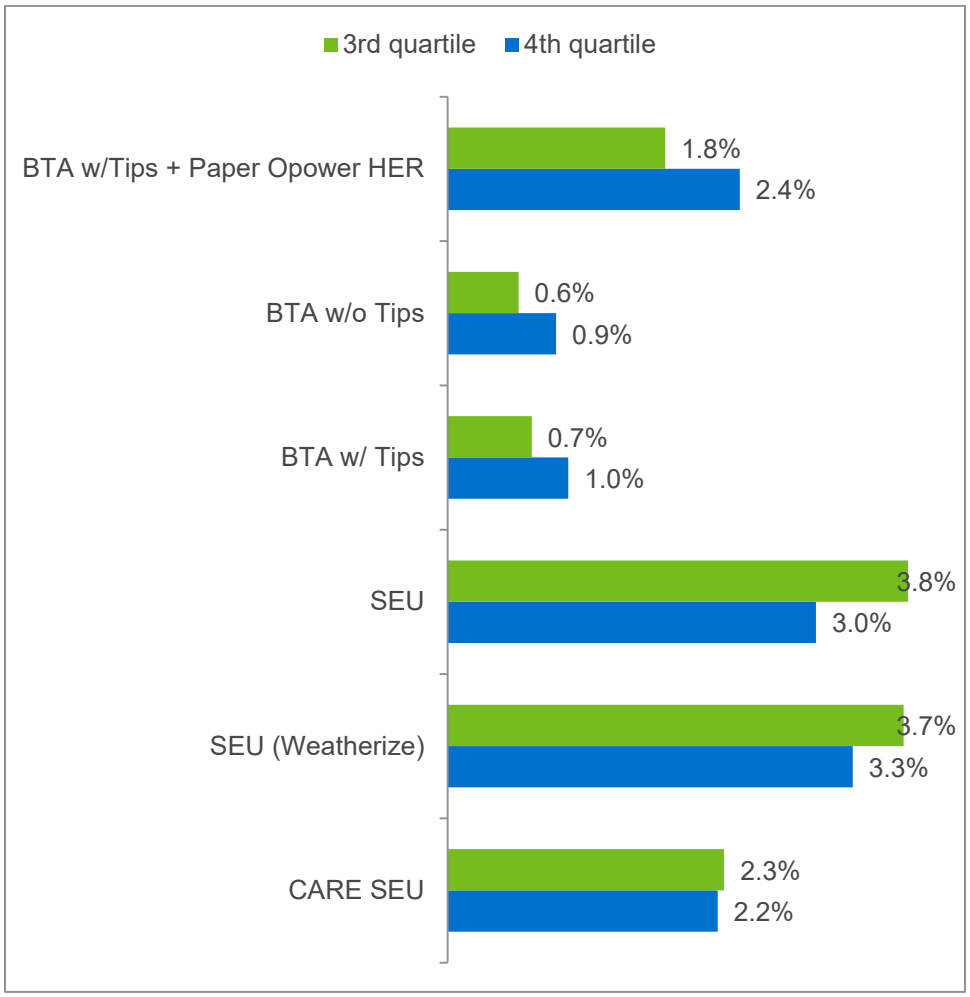
Figure 5-7: Comparison of HER Fourth Campaign Treatments by Quartile (Statistically Insignificant Results are in Gray)



SoCalGas BTA and SoCalGas/Aclara SEU Gas Savings by Usage Quartile

Figure 5-8 compares percent reductions for the top two quartiles for each of the BTA and SEU treatments in the fourth Campaign. All of the BTA treatments have larger percent reductions for the fourth quartile. Unlike the HER and BTA treatments, all three of the SEU treatments have larger percent reductions for the third quartile customers. This suggests that weather sensitive customers in the third and fourth quartiles are responsive to the SEU treatment.

Figure 5-8: Comparison of BTA and SEU Fourth Campaign Treatments by Quartile (Statistically Insignificant Results are in Gray)



Other Segmentations Analyzed

As with each treatment in the first two Conservation Campaigns, Nexant segmented the 2016-2017 gas savings results by several demographic variables using granular block-level data from the 2010 U.S. Census. However, there weren't any consistent trends in 2016-2017 gas savings to report here. Given that the test cell design of the fourth Campaign leveraged many segmentation-based insights from the first three Campaigns, consistent drivers of differences in gas savings across demographic characteristics have been accounted for in the segmentation of the treatment population. For example, gas savings for CARE customers were consistently lower in the first two Campaigns for email-based treatments, so the design for the 2015-2016 and 2016-2017 Campaigns segmented those customers into a sub-population that received paper-based treatments. Similarly, gas savings for customers in census blocks with a high percentage of Latinos were also consistently lower, so those customers were segmented into a population that received a Spanish-language treatment instead. These data-driven improvements from one year to the next highlight the benefits of the adaptive "test and learn" strategy. The rigorous research design, data analysis and segmentations of the results yielded several quick insights that led to SoCalGas identifying the types of treatments that are most cost-effective for each segment of the population.

5.5 Percent Reductions in Second Year for 2015-2016 Conservation Campaign

Table 5-3 provides the estimated second year percent reductions for treatments from the third Campaign, shown alongside the impacts from the previous year (year 1) for these same treatments. The estimates were derived by using the LDV model to compare customer usage from December 2016 through March 2017 as compared to usage in the pretreatment period (December 2014 through March 2015). It is important to note that the first year results are for the period of November- March while the second year results are for the period containing December-March. Four of the thirteen treatments did not produce statistically significant results in the second year. The Old BTA w/o tips and the Spanish HER had the lowest savings rate in the first year of treatment and did not produce statistically significant savings in the second year. Both of the SEU treatments produced around 1% savings this year, but this was not statistically significant. Of the nine treatments that continued to produce statistically significant savings, seven treatments had percent reductions that were higher in the second year. This could be due in part to the slightly colder weather conditions as well as measuring the effect from December-March instead of November-March. Several treatments initiated in the 2015-2016 campaign did not continue to receive treatment in winter 2016-2017. The paper HER treatments received four paper reports in the initial year, and the treatments that continued received only one paper report in the second, 2016-2017 treatment year. Both of the 2015-2016 SEU treatments did not receive reports in the 2016-2017 treatment winter. The Email HER treatments that were continued were the same as the initial year treatment (one paper report and 12 email reports).

Table 5-3: Estimates of Percent Reductions in Gas Energy Consumption for Residential Treatments Initiated in 2015–2016, December 2016 through March 2017 (Statistically Insignificant Results are in Gray)

Segment	My Account	Treatment	Group	Number of Treatment Customers	Year 2 results (LDV)		Year 1 results (LDV)	
					% Reduction	P-value	% Reduction	P-value
Non-CARE	Yes	Opower Email HER[35]	T-16	13,086	1.12%	0.00	0.86%	0.00
		Opower Email Thermostat	T-19	13,094	1.58%	0.00	1.28%	0.00
		Paper & Email SEU[35]	T-24	17,877	1.20%	0.28	3.04%	0.00
		Old BTA, w/materials	T-26	19,069	1.04%	0.00	0.70%	0.00
		Old BTA, w/o materials	T-27	19,032	0.43%	0.12	0.49%	0.04
		New BTA, w/materials	T-28	19,035	1.46%	0.00	1.04%	0.00
		New BTA, w/o materials	T-29	19,062	1.18%	0.00	0.86%	0.00
	No	Opower Paper-only HER	T-17	13,364	1.02%	0.01	1.50%	0.00
		Opower Paper-only Thermostat	T-20	13,342	1.57%	0.00	1.32%	0.00
		Paper-only SEU[35]	T-25	23,494	1.08%	0.14	3.08%	0.00
CARE	Yes/No	Opower Paper & Email HER[35]	T-15	13,082	1.01%	0.00	1.01%	0.00
		Opower Thermostat	T-18	23,796	1.84%	0.00	1.53%	0.00
Spanish		Opower Spanish Paper-only[35]	T-21	13,319	0.42%	0.22	0.82%	0.00

Table 5-4 provides the estimated percent reductions during spring and summer of 2016 for the treatments from the third Campaign. The estimates were derived by using the LDV model to compare customer usage from April 2016 through November 2016 as compared to usage in the pretreatment period—April 2015 through October 2015. The November pretreatment month used is November 2014 since treatment started during November 2015 for this Campaign.

[35] This treatment cell did not receive treatment during winter 2016-2017.

Email HERs continued to receive treatment during the summer which is apparent in the results as the majority email based treatments continued to produce statistically significant savings. Both of the SEU treatments did not produce measurable savings during this time period.

Table 5-4: Estimates of Percent Reductions in Gas Energy Consumption for Residential Treatments Initiated in 2015–2016, April 2016 through November 2016 (Statistically Insignificant Results are in Gray)

Segment	My Account	Treatment	Group	Number of Treatment Customers	Year 1 results (LDV)	
					% Reduction	P-value
Non-CARE	Yes	Opower Email HER	T-16	11,978	0.80%	0.04
		Opower Email Thermostat	T-19	11,928	0.87%	0.02
		Paper & Email SEU	T-24	16,357	0.76%	0.61
		Old BTA, w/materials	T-26	17,443	0.81%	0.01
		Old BTA, w/o materials	T-27	17,439	0.85%	0.01
		New BTA, w/materials	T-28	17,351	0.62%	0.05
		New BTA, w/o materials	T-29	17,433	0.21%	0.51
	No	Opower Paper-only HER	T-17	12,617	0.02%	0.96
		Opower Paper-only Thermostat	T-20	12,580	0.51%	0.15
		Paper-only SEU	T-25	22,075	1.55%	0.15
CARE	Yes/No	Opower Paper & Email HER	T-15	13,082	1.09%	0.00
		Opower Paper & Email Thermostat	T-18	24,099	1.14%	0.00
Spanish		Opower Spanish Paper-only	T-21	12,659	0.58%	0.10

5.6 Percent Reductions in Third Year for 2014-2015 Conservation Campaign

Table 5-5 provides the estimated third year percent reductions for treatments from the second Campaign, shown alongside the impacts from the previous two years for these same treatments. The estimates were derived by using the LDV model to compare customer usage from December 2016 through March 2017 as compared to usage in the pretreatment period (December 2013 through March 2014). This table only includes results for treatments that produced statistically significant savings in the prior years. The default BTA and Aclara HEU treatments that also started in the second Campaign, did not produce statistically significant savings during the first and second years of observing these customers. The Opower Paper-only HER was the only treatment that continued to produce statistically significant savings this year. The percent reduction for this treatment went down from the previous years. The Opower Email HER and Opower Paper & Email HER did not produce statistically significant savings this winter season. In the second year of treatment in 2015-2016, the Opower Paper & Email HER and the Opower Paper-only HER treatments received four paper reports. The Opower Email HER treatment only received one paper report and 12 Email HERs in this time period. None of the treatments received any reports in 2016-2017.

Table 5-5: Estimates of Percent Reductions in Gas Energy Consumption for Residential Treatments Initiated in 2014–2015, December 2016 through March 2017 (Statistically Insignificant Results are in Gray)

My Account	Treatment	Group	Number of Treatment Customers	Year 3 results (LDV)		Year 2 results (LDV)		Year 1 results (LDV)	
				% Reduction	P-value	% Reduction	P-value	% Reduction	P-value
Yes	Opower Email HER	T-8	10,974	0.80%	0.07	0.96%	0.02	0.74%	0.05
	Opower Paper & Email HER	T-10	10,988	0.73%	0.09	1.38%	0.00	1.45%	0
No	Opower Paper-only HER	T-13	44,590	1.31%	0.00	1.86%	0.00	1.48%	0

Table 5-6 provides the estimated percent reductions during spring and summer of 2016 for the treatments from the second Campaign. The estimates were derived by using the LDV model to compare customer usage from April 2016 through November 2016 as compared to usage in the pretreatment period—April 2014 through October 2014. The November pretreatment month used is November 2013 since treatment started during November 2014 for this Campaign. The Opower Paper & Email HER and Opower Paper-only HER continued to show measurable savings during the summer period. The Opower Email HER did not produce measurable savings during the spring / summer period for a second year in a row. The Aclara treatments were not monitored this year as these customers were recycled in the 2016-2017 Campaign sampling. The Opower Paper & Email HER treatment received email reports during this time period while the Opower Paper-only HER treatment did not receive any reports.

Table 5-6: Estimates of Percent Reductions in Gas Energy Consumption for Residential Treatments Initiated in 2014–2015, April 2016 through November 2016 (Statistically Insignificant Results are in Gray)

My Account	Treatment	Group	Number of Treatment Customers	Year 2 spring / summer results (LDV)		Year 1 spring / summer results (LDV)	
				% Reduction	P-value	% Reduction	P-value
Yes	Opower Paper & Email HER	T-10	11,369	1.43%	0.00	1.35%	0.00
No	Opower Paper-only HER	T-13	45,874	1.15%	0.00	0.77%	0.00

5.7 Percent Reductions in Fourth Year for 2013–2014 Conservation Campaign

Table 5-7 provides the estimated fourth year percent reductions for treatments from the first Campaign, shown alongside the impacts from the previous three years for these same treatments. The estimates were derived by using the LDV model to compare customer usage from December 2016 through March 2017 as compared to usage in the pretreatment period (December 2012 through March 2013). This table only includes the results for the BTA treatment as Opower email HER did not have enough customers to find statistically significant and valid savings in the fourth year. The Opower Paper & Email HER (T-2) and the Opower Paper-only HER (T-1) did stopped producing statistically significant savings in the third year. The default BTA is the only treatment from the first Campaign that is still receiving treatment. The percent reduction for the BTA treatment decreased to .83% and is not statistically significant at the 95% confidence level.

Table 5-7: Estimates of Percent Reductions in Gas Energy Consumption for Residential Treatments Initiated in 2013–2014, December 2016 through March 2017 (Statistically Insignificant Results are in Gray)

My Account	Treatment	Group	Number of Treatment Customers	Result Year	% Reduction	P-value
Yes	Default BTA	T-4	17,031	1	0.70%	0.02
				2	1.20%	0.00
				3	1.28%	0.00
				4	0.83%	0.06

None of the treatments from the first Campaign provided statistically significant results during the spring/summer period in 2016 or 2015.

5.8 Comparison of Aggregate Savings for Different Winter Periods

The fourth campaign was the only campaign to start treatments in December rather than November. This raises the question of whether it is more effective to start treatments in November or December. In order to test this hypothesis, it would be necessary to run a randomized control trial splitting the treatment into two groups; one group starting treatment in November and the other in December. However, it is possible to look at past results to see how the percent reductions and aggregate monthly reductions compare when including November.

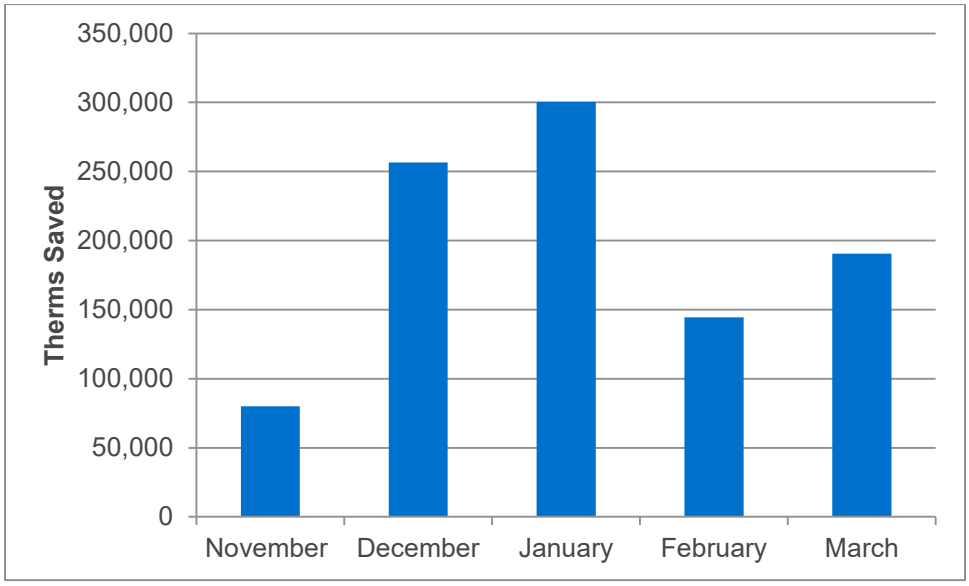
Table 5-8 compares the percent reductions for the third Campaign treatments from November 2015 – March 2016 to the percent reductions from December 2015 – March 2016. The percent reductions estimated for the December 2015 – March 2016 time period are higher for all of the treatments compared to the percent reductions estimated for the November 2015 – March 2016 period. However, this is not a true comparison since this is not able to measure the effect of starting the campaign in December. It is clear that November provides lower savings to due lower gas usage in general compared to December.

Table 5-8: Comparison of the Estimated Gas Savings for the 2015–2016 SoCalGas Conservation Campaign Treatments

Segment	My Account	Treatment	Group	Number of Treatment Customers	Nov 2015 - Mar 2016		Dec 2015 - Mar 2016	
					% Reduction	P-value	% Reduction	P-value
Non-CARE	Yes	Opower Email HER	T-16	13,086	0.86%	0.00	0.95%	0.00
		Opower Email Thermostat	T-19	13,094	1.28%	0.00	1.48%	0.00
		Paper & Email SEU	T-24	17,877	3.04%	0.00	3.09%	0.00
		Old BTA, w/materials	T-26	19,069	0.70%	0.00	0.77%	0.00
		Old BTA, w/o materials	T-27	19,032	0.49%	0.04	0.56%	0.02
		New BTA, w/materials	T-28	19,035	1.04%	0.00	1.13%	0.00
		New BTA, w/o materials	T-29	19,062	0.86%	0.00	0.91%	0.00
	No	Opower Paper-only HER	T-17	13,364	1.50%	0.00	1.65%	0.00
		Opower Paper-only Thermostat	T-20	13,342	1.32%	0.00	1.56%	0.00
		Paper-only SEU	T-25	23,494	3.08%	0.00	3.23%	0.00
CARE	Yes/No	Opower Paper & Email HER	T-15	13,082	1.01%	0.00	1.24%	0.00
		Opower Thermostat	T-18	23,796	1.53%	0.00	1.75%	0.00
Spanish		Opower Spanish Paper-only	T-21	13,319	0.82%	0.00	0.83%	0.00

Figure 5-9 compares the average monthly aggregate therms savings for all of the 2015-2016 campaign first year treatments. Compared to the other winter months, November had the smallest aggregate therms reduction. Approximately 80,000 therms were saved in November compared to 256,000 therms saved in December. Although the savings are lower in November, there are still therms being saved during this month.

Figure 5-9: Monthly Aggregate Gas Savings for the 2015–2016 SoCalGas Conservation Campaign Treatments



The key takeaway from this analysis is that the savings are much smaller in November compared to December. However, it isn't possible to know if starting the campaign in November rather than December has any sort of effect on the savings from December through March. It may be possible that starting the campaign in November sets the stage for the large savings in December. The results from the 2016-2017 winter when the campaigns started in December aren't directly comparable with the prior winter due to the different customer populations and weather. Ultimately, as noted above, the only way to truly ascertain the impact of starting the campaign in November versus December is to run a randomized control trial splitting the treatment into two groups; one group starting treatment in November and the other in December.

5.9 Estimated Gas Savings

Once a statistically significant usage reduction within a given test cell is identified, the analysis can be done at the monthly level, which allows for the re-inclusion of some customers that may not have had usage data for every month, but do have data for some pre- and post-treatment months.

Table 5-9 summarizes the estimated gas savings for the 2016–2017 SoCalGas Conservation Campaign, based on the monthly-level analysis. Gas savings are only calculated for the treatments that produced statistically significant usage reductions using the LDV model, which includes the Opower Paper-only treatment and the Opower Paper & Email HER from the 2014–2015 Conservation Campaign, nine of the treatments from the 2015-2016 Campaign, and all of the residential treatments from the 2016–2017 Campaign. Overall, the new and continued treatments produced gas savings of almost 2.7 million therms between April 2016 and March 2017, or about 1.5%.

In total, approximately 1.6 million therms were conserved as a result of the new treatments for the 2016–2017 Conservation Campaign, representing a savings of almost 1.7%.

The treatments initiated in the 2015–2016 Conservation Campaign conserved a total of almost 517,000 therms during the 2016–2017 winter. An additional almost 200,000 therms were saved over the summer / spring of 2016 as a result of treatments in the 2015–2016 Conservation Campaign with statistically significant reductions. The CARE Opower Thermostat treatment saved the most therms during this time period as well as having the highest percent reduction for the treatments initiated in 2015-2016.

Roughly 173,000 therms were conserved during the winter as a result of the treatments in the 2014–2015 Conservation Campaign. Only the Opower Paper-only HER continued to produce measurable savings in third winter. During the summer / spring of 2016 approximately 160,000 therms were saved due to the Opower Paper-only HER and the Opower Paper & Email HER.

None of the first Campaign treatments produced measurable savings during the 2016-2017 year.

Table 5-9: Estimated Gas Savings for the 2016–2017 SoCalGas Conservation Campaign

Initial Treatment Year	Treatment	Group	Number of Active Customers per Month	Average Customer Total Usage for December-March			Aggregate Usage for December-March		
				Reference Therms	Observed Therms	Therms Saved	Reference Therms	Observed Therms	Therms Saved
2016-2017	BTA w/Tips + Paper & Email Opower HER	T-31	38,700	293.2	286.6	6.6	11,345,338	11,090,016	255,322
	BTA w/o Tips	T-36	30,906	294.0	291.7	2.3	9,086,707	9,016,272	70,435
	BTA w/ Tips	T-37	30,649	293.2	290.5	2.7	8,987,059	8,903,956	83,103
	Paper-only Opower HER	T-32	51,508	302.5	298.4	4.1	15,580,888	15,370,945	209,944
	Paper Aclara Home Energy Update report (HEU)	T-40	31,772	301.4	296.9	4.5	9,577,422	9,434,047	143,375
	Paper In-House HER	T-39	13,414	309.3	305.3	4.0	4,149,178	4,095,583	53,596
	Paper SEU	T-34	19,612	341.4	330.6	10.8	6,695,902	6,483,976	211,926
	Paper SEU (Weatherize)	T-35	19,625	341.3	329.9	11.4	6,697,060	6,473,857	223,203
	Paper & Email Opower HER - CARE	T-30	49,995	262.9	258.2	4.7	13,143,012	12,906,696	236,316
	Paper SEU - CARE	T-33	18,364	304.0	297.3	6.7	5,582,822	5,458,890	123,932
	Paper Bi-lingual HER	T-41	13,453	185.1	184.1	0.9	2,489,546	2,476,930	12,616
Overall for 2016-2017 treatments (winter)			**317,997**	**293.5**	**288.4**	**5.1**	**93,334,934**	**91,711,168**	**1,623,768**

Initial Treatment Year	Treatment	Group	Number of Active Customers per Month	Average Customer Total Usage for December-March			Aggregate Usage for December-March		
				Reference Therms	Observed Therms	Therms Saved	Reference Therms	Observed Therms	Therms Saved
2015-2016	Opower Email HER[7]	T-16	12,008	282.8	279.6	3.2	3,395,683	3,357,236	38,447
	Opower Email Thermostat HER[6]	T-19	11,950	281.8	277.1	4.7	3,367,997	3,311,737	56,261
	Old BTA, w/materials	T-26	17,452	282.0	279.0	3.0	4,921,216	4,869,656	51,561
	New BTA, w/materials	T-28	17,392	282.1	277.9	4.1	4,905,432	4,833,330	72,103
	New BTA, w/o materials	T-29	17,465	282.1	278.7	3.4	4,925,873	4,866,770	59,103
	Opower Paper-only HER[6]	T-17	12,609	295.0	292.2	2.9	3,720,273	3,684,308	35,966
	Opower Paper-only Thermostat HER[6]	T-20	12,580	293.7	289.3	4.5	3,695,294	3,638,860	56,434
	Opower Paper & Email HER[7]	T-15	11,987	255.5	252.9	2.5	3,062,292	3,031,967	30,326
	Opower Thermostat Email HER (ESA & Non-ESA)[6]	T-18	24,146	254.9	250.1	4.9	6,155,619	6,037,872	117,747
Overall for 2015-2016 treatments (winter)			**137,588**	**277.3**	**273.5**	**3.8**	**38,149,679**	**37,631,736**	**517,947**
2015-2016	Opower Email HER	T-16	12,024	223.2	221.3	1.8	2,683,287	2,661,400	21,887
	Opower Email Thermostat	T-19	11,980	220.5	218.5	2.0	2,641,595	2,617,993	23,602
	Old BTA, w/materials	T-26	17,500	222.1	220.4	1.7	3,886,298	3,856,222	30,076
	Old BTA, w/o materials	T-27	17,499	221.7	219.9	1.8	3,879,196	3,847,366	31,829
	Opower Paper & Email HER	T-15	12,028	226.7	224.2	2.5	2,726,227	2,696,360	29,866
	Opower Thermostat HER (ESA & Non-ESA)	T-18	24,209	227.0	224.5	2.6	5,496,242	5,433,610	62,632
Overall for 2015-2016 treatments (summer/spring)			**95,241**	**223.8**	**221.7**	**2.1**	**21,312,845**	**21,112,951**	**199,893**

Initial Treatment Year	Treatment	Group	Number of Active Customers per Month	Average Customer Total Usage for December-March			Aggregate Usage for December-March		
				Reference Therms	Observed Therms	Therms Saved	Reference Therms	Observed Therms	Therms Saved
2014-2015	Opower Paper-only HER[7]	T-13	45,184	296.5	292.7	3.8	13,397,634	13,224,593	173,041
Overall for 2014-2015 treatments (winter)			**45,184**	**296.5**	**292.7**	**3.8**	**13,397,634**	**13,224,593**	**173,041**
2014-2015	Opower Paper & Email HER[7]	T-10	11,658	226.3	222.9	3.4	2,638,390	2,598,369	40,022
	Opower Paper-only HER[7]	T-13	46,764	226.9	224.4	2.6	10,612,781	10,492,993	119,788
Overall for 2014-2015 treatments (summer/spring)			**58,423**	**226.8**	**224.1**	**2.7**	**13,251,171**	**13,091,362**	**159,809**
Overall			**654,431**	**274.2**	**270.1**	**4.1**	**179,446,268**	**176,771,810**	**2,674,458**

6 Recommendations and Conclusions

Throughout the AM rollout until the end of 2017, SoCalGas is implementing a cycle of innovation in which continuous assessment and improvement in the performance of feedback programs is the primary objective. This is referred to as the "test and learn" process, which is consistent with what the CPUC envisioned in D.10-04-027. This decision approved SoCalGas' AM application, as discussed in Section 2. As the implementation proceeded, high performing program design options were retained and offered to an increasingly larger share of customers who received advanced meters. At the same time, new program design alternatives were tested based on the experiences gained from the prior rounds of implementation. Programs and program design features that were less effective were abandoned or modified. In this way, over the course of the AM rollout, the most effective means for encouraging energy savings from information feedback were identified and offered to customers.

As discussed in Section 2.4, the 2015-2016 and 2016-2017 winters were colder than the previous two winters. As a result, the residential gas usage was substantially higher than the prior two years. The higher observed gas usage was also associated with higher percentage savings relative to the prior campaigns. This is reasonable given there are more opportunities to conserve when the usage is higher. Based on the weather and results observed to date, it would be reasonable to expect that in warmer years the conservation savings may be lower compared to years with relatively colder weather.

Furthermore, a fundamental tenant of the "test and learn" process is to continuously improve toward more cost-effective solutions. The last two of the four Campaigns were the only Campaigns to have all residential treatments produce statistically significant results. The SEU treatment continued to have the highest percent reductions in the first year of treatment. However, it is still possible to produce comparable (or higher) energy savings at a lower cost. Staying consistent with the literature on SMB behavioral programs, there were no statistically significant savings from the SMB BTA treatment this year or in the very first year. A follow-on analysis to be conducted by Nexant for SoCalGas will look into the cost-effectiveness and overall takeaways moving forward from the four Conservation Campaigns in further detail. Some of the key conclusions moving forward as these programs are transitioned into the energy efficiency program portfolio are[10]:

- BTAs and HERs consistently produce savings of around .75% to 1.5%;
- The Opower Paper HER + BTA w/Tips achieves higher savings than the BTA treatments alone;
- SEUs and BTA+HER, which were developed in part by SoCalGas and leveraged AM data, were the only treatments to produce savings over 2%, including savings over 3% in all four non-CARE SEU treatments;
- The SMB BTA treatment does not produce measurable savings;
- The SEU treatment materials in combination with targeting weather sensitive customers achieves the highest percent reductions during the winter period;
- The Aclara, Opower, and SoCalGas HERs all produced savings above 1% and the difference between them was not statistically significant;

- The percent reductions of the Bi-lingual English-Spanish report, Spanish report, and English report for the customer segment containing customer in areas with high rates of Latino populations consistently fall below 1%;
- Treatments targeted at CARE customers can be successful, but they cannot be solely based on email communications (BTAs or e-HERs) – paper-based communications through direct mail is required for success;
- Energy savings generally persist if treatment continues, and in some cases, savings persist for more than one year if treatment is reduced/discontinued;
- These types of behavioral interventions consistently produce energy savings for default (auto-enrolled) participants, residential customers, and top two usage quartiles (highest in top quartile); and
- Little to no savings measured for treatments involving opt-in participants, small/medium business customers, bottom two usage quartiles, and customers in highest density Hispanic neighborhoods (78%+ of population).

Appendix A Opower Home Energy Report Materials

Appendix A presents the standard Opower HER materials utilized in the 2016-2017 new and continuing treatments.

In addition to the paper and email HER examples in Section 2.2, Opower also sent a HER welcome insert and a door hanger, which are included in this appendix.

Figure A - 1 shows the front and back of the Opower HER welcome insert. Figure A - 2 shows the inside page of the HER welcome insert. Figure A - 3 displays the door hanger that was delivered to all of the Opower HER customers.

Figure A - 4 through Figure A - 9 show the front and back of the standard paper HER, the CARE paper HER, and the thermostat paper HER. Figure A - 10 shows the email HER sent December and in subsequent months (January 2017 and after).

A.1 Opower HER Welcome materials

Figure A - 1: December Opower HER Welcome Insert (Front and Back)



Figure A - 2: December Opower HER Welcome Insert (Inside Page)

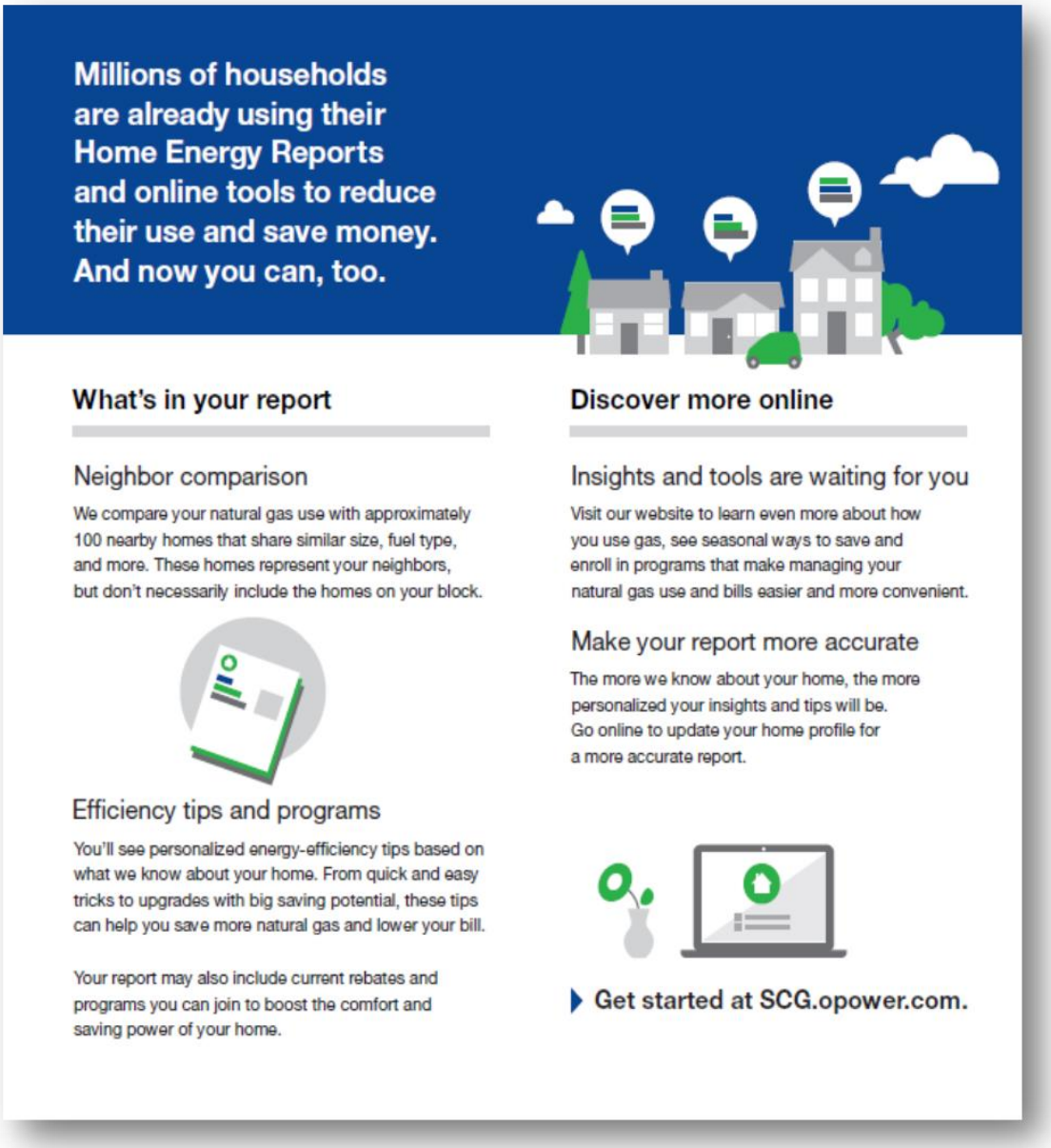


Figure A - 3: Opower HER Door Hanger

Front **Back**



A.2 Opower Paper HERs

Figure A - 4: Opower Paper December HER Example (Front)

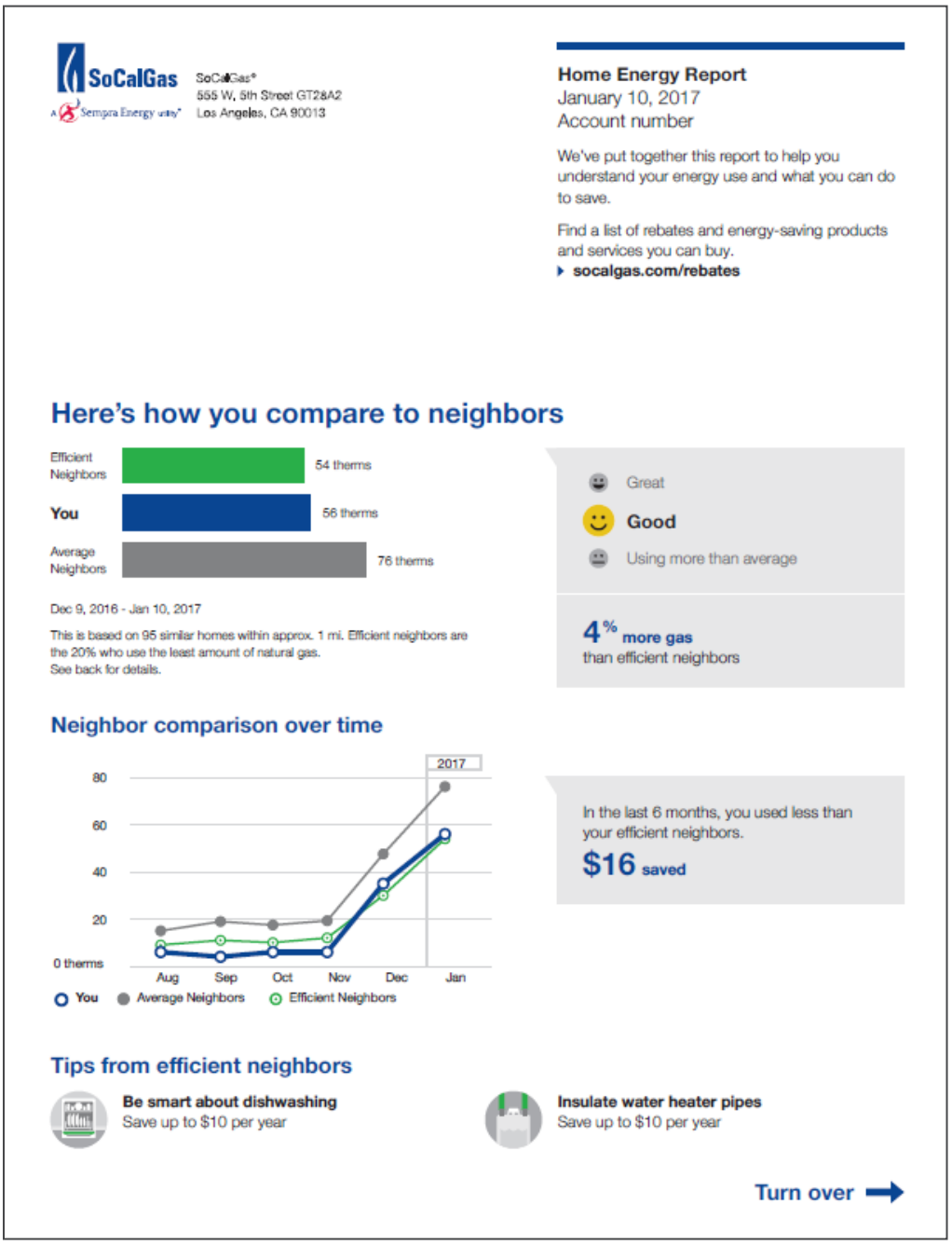


Figure A - 5: Opower Paper December HER Example (Back)

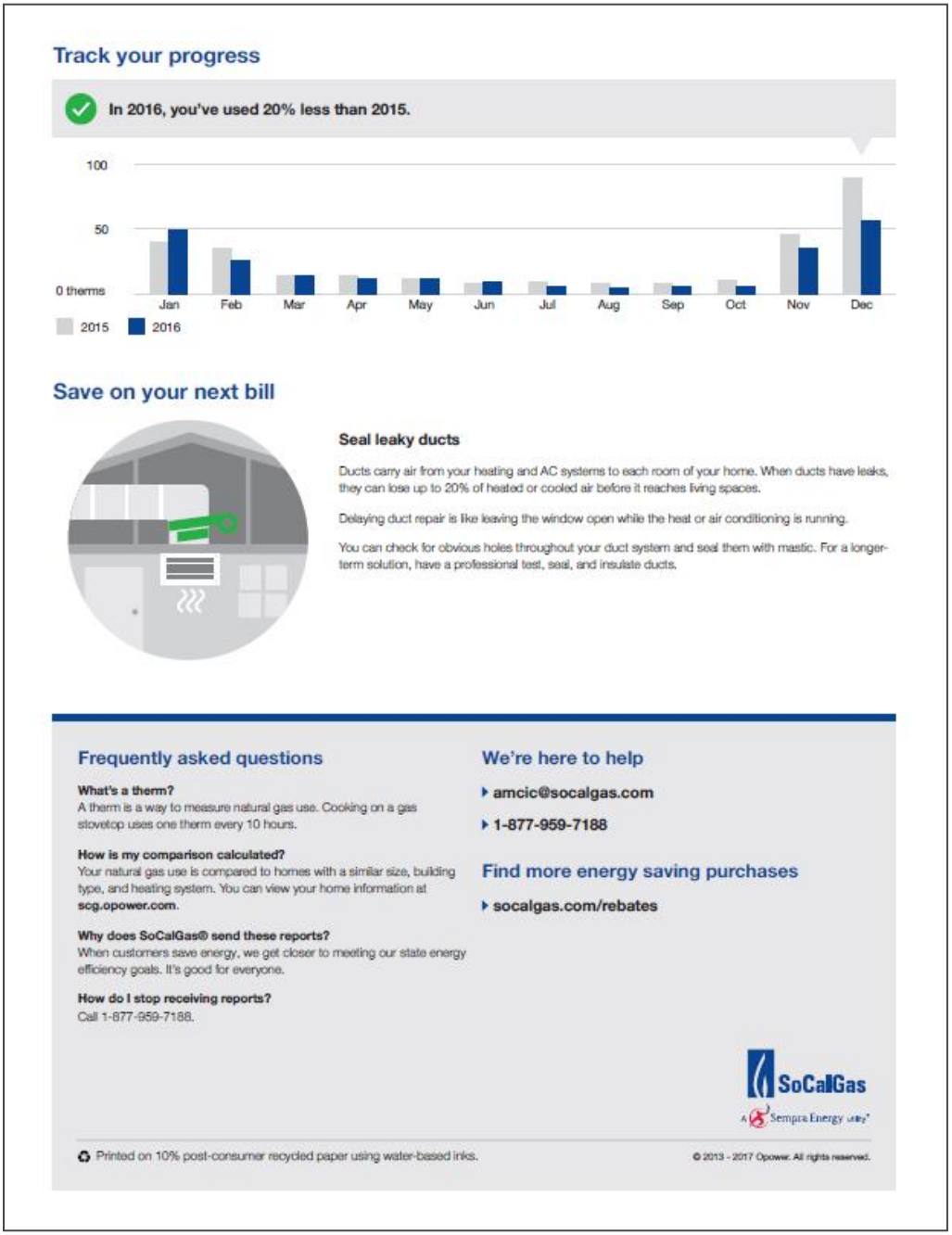


Figure A - 6: Opower CARE Paper December HER Example (Front)



Figure A - 7: Opower CARE December Paper HER Example (Back)

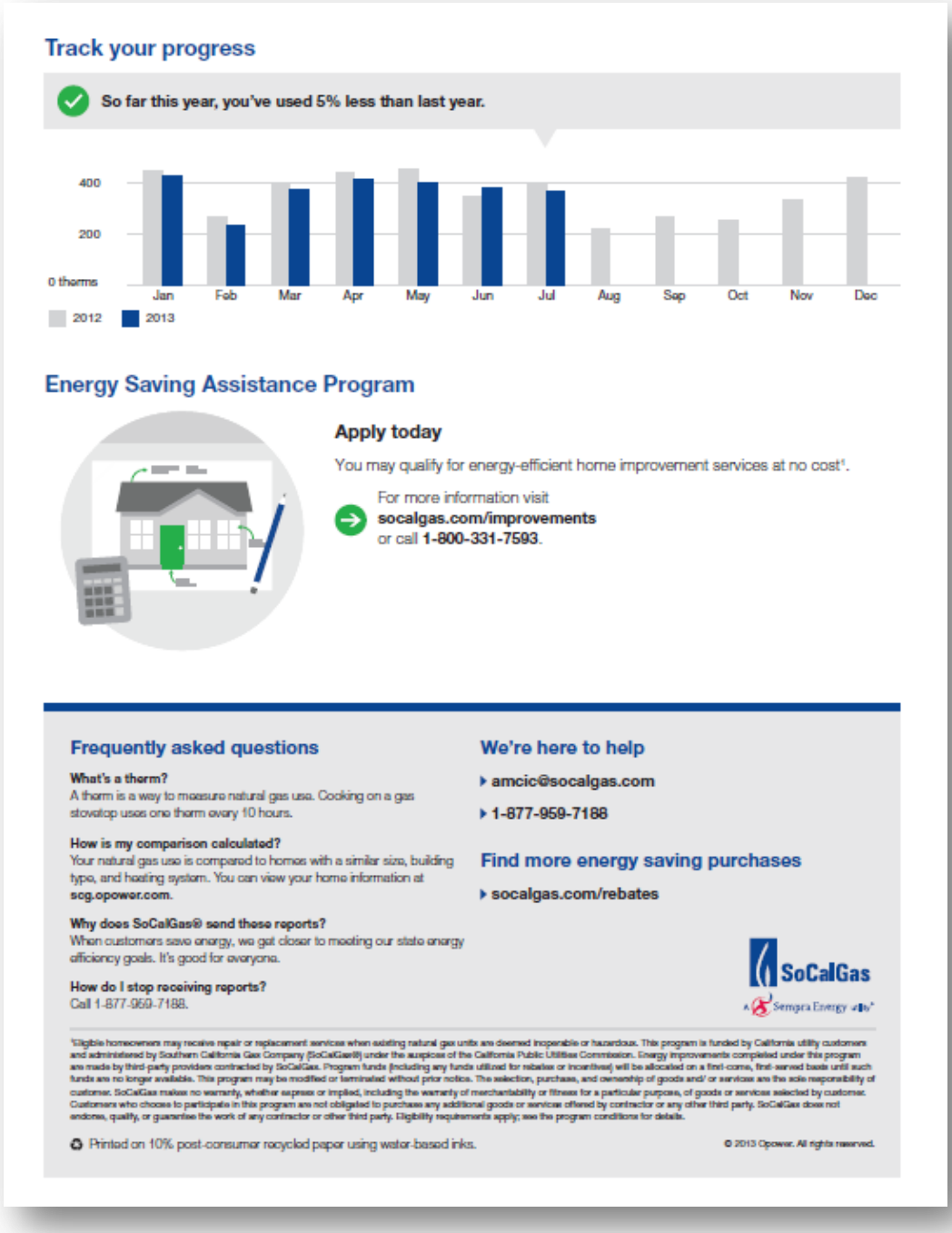


Figure A - 8: Opower Thermostat December Paper HER Example (Front)

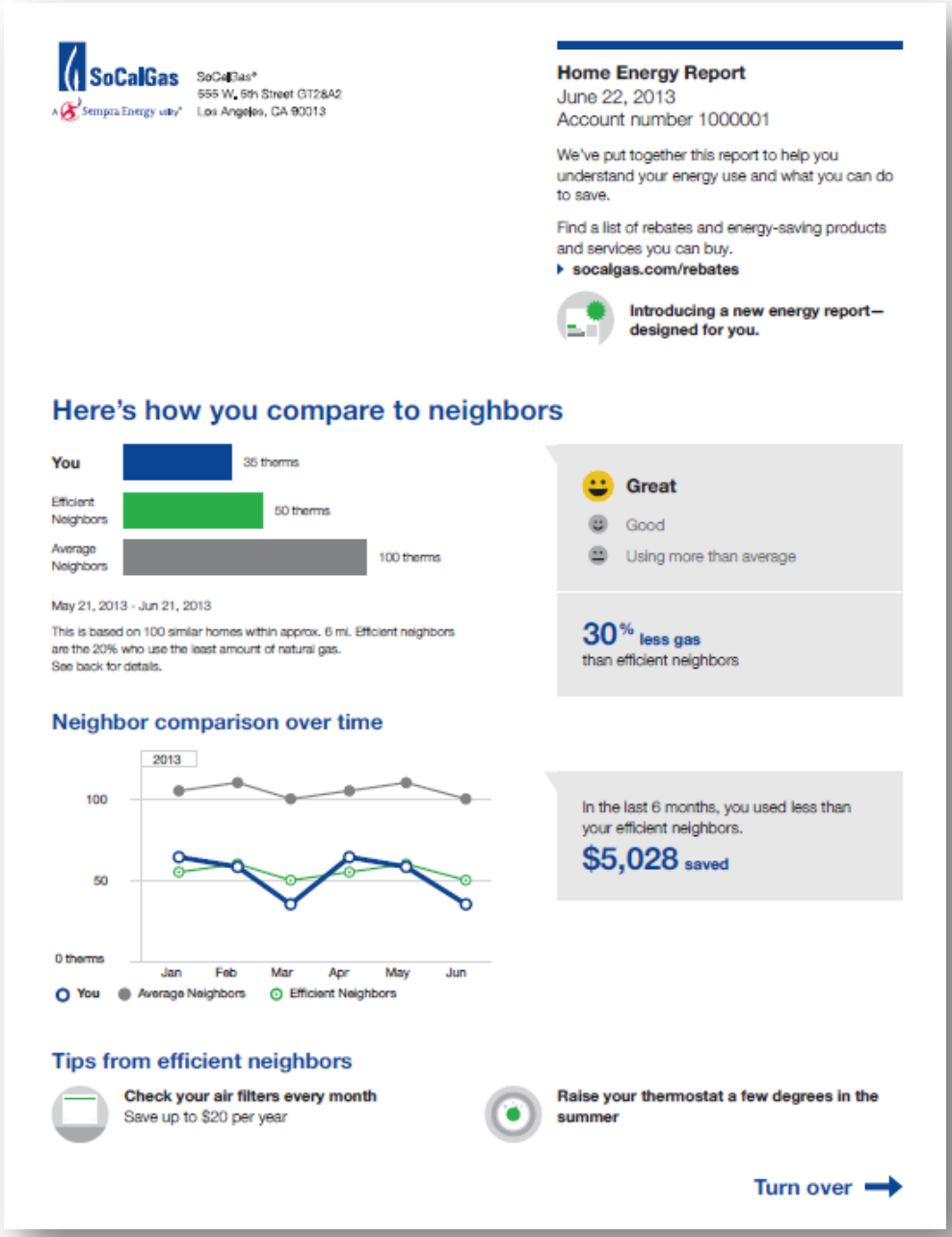
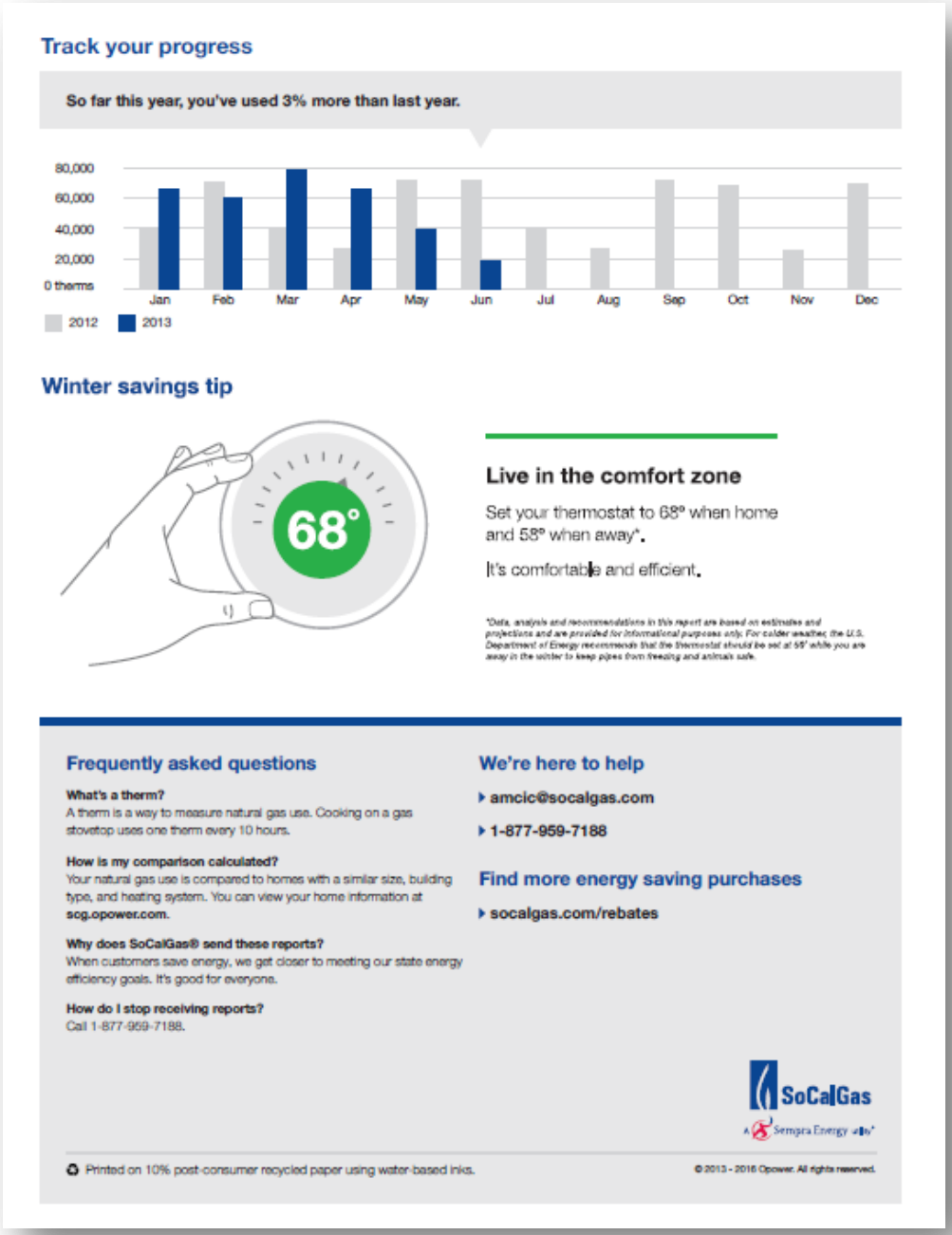


Figure A - 9: Opower Thermostat December Paper HER Example (Back)



Track your progress

So far this year, you've used 3% more than last year.

Winter savings tip

Live in the comfort zone

Set your thermostat to 68° when home and 58° when away*.

It's comfortable and efficient.

*Data, analysis and recommendations in this report are based on estimates and projections and are provided for informational purposes only. For colder weather, the U.S. Department of Energy recommends that the thermostat should be set at 55° while you are away in the winter to keep pipes from freezing and animals safe.

Frequently asked questions

What's a therm?
A therm is a way to measure natural gas use. Cooking on a gas stovetop uses one therm every 10 hours.

How is my comparison calculated?
Your natural gas use is compared to homes with a similar size, building type, and heating system. You can view your home information at **scg.opower.com**.

Why does SoCalGas® send these reports?
When customers save energy, we get closer to meeting our state energy efficiency goals. It's good for everyone.

How do I stop receiving reports?
Call 1-877-959-7188.

We're here to help

- **amcic@socalgas.com**
- **1-877-959-7188**

Find more energy saving purchases

- **socalgas.com/rebates**

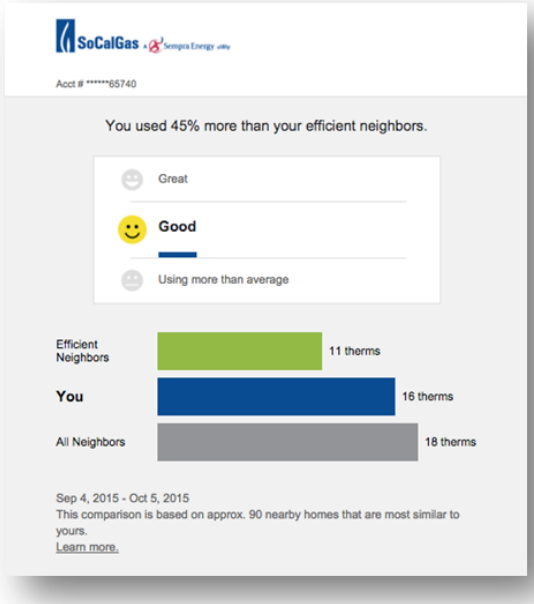
SoCalGas
A Sempra Energy utility

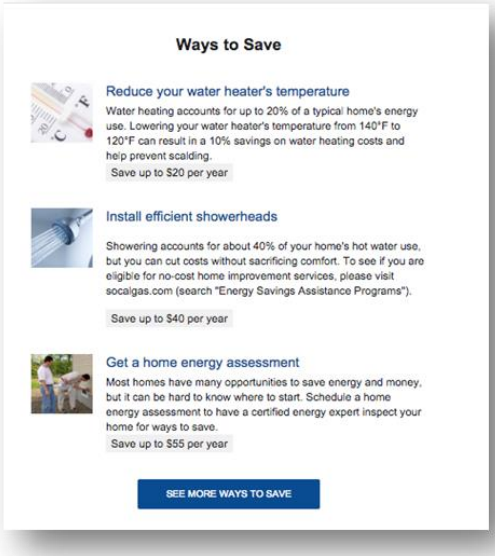
Printed on 10% post-consumer recycled paper using water-based inks.

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A.3 Opower Email HERs

Figure A - 10: Opower Email HER Example, December and subsequent months





Appendix B Aclara Home Energy Update Materials

This appendix contains all the Aclara HEU materials. In addition to the paper HEU examples in Section 2.2, Aclara also sent a HEU welcome insert and repositionable sticker.

Figure B-1 shows the Aclara HEU welcome insert, which was delivered to nearly 33,000 Aclara paper-only HEU customers in early December 2016. Figure B presents the repositionable sticker that was sent in January 2017.

Figure B - 1: December Aclara HEU Welcome Insert

SoCalGas
A Sempra Energy utility®

Welcome to
Your Home Energy Update
from SoCalGas®!

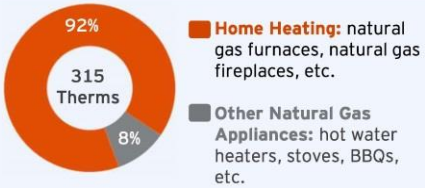
SoCalGas® is pleased to provide you with a series of four Home Energy Update reports throughout this winter. These personalized updates can help you better understand how your household uses natural gas when temperatures get cold, and how to use energy more wisely to lower your bills.

Each report contains these three features:

1 Comparison to Similar Homes
Learn how your natural gas use compares to homes of similar type and size in your area when it gets cold.



2 Breakdown of Your Natural Gas Use
Uncover insights into how much of your natural gas use goes towards home heating. The calculation is based on the change in your home's natural gas consumption during colder weather.



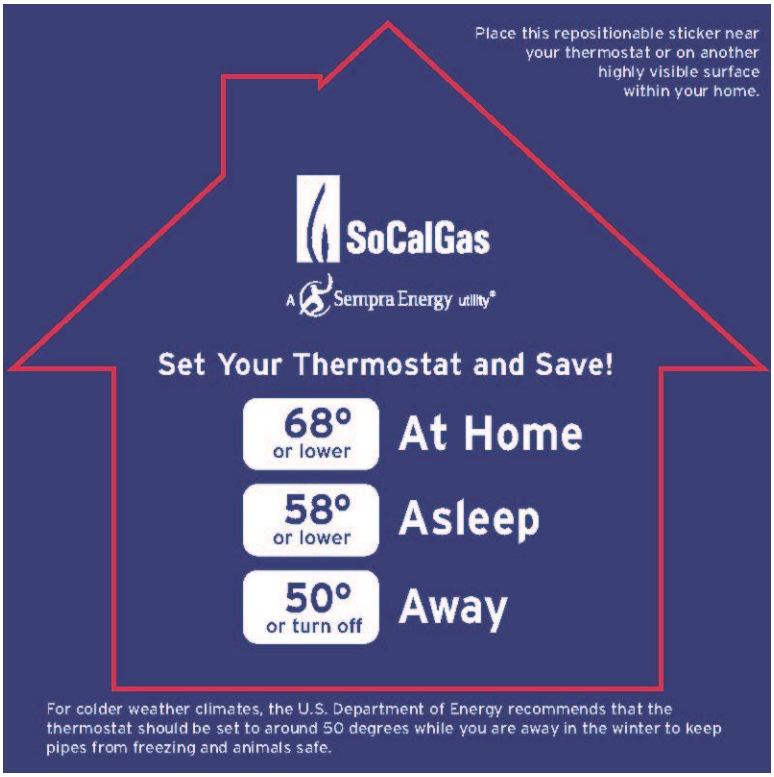
3 Savings Tips
Act now to save, based on personalized savings tips just for you.



We hope these reports will help you better understand and manage your natural gas usage during the colder months.

Data, analysis, and recommendations in the reports are based on estimates and projections, and are provided for informational purposes only.
For questions regarding the reports, please call 888-873-4894, Monday through Friday, from 8 a.m. to 6 p.m. PT, or visit pages.socalgas.aclara.com/FAQ. Images and charts shown above are for illustrative purposes only.
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Figure B - 2: Aclara HEU Repositionable Sticker



Appendix C SoCalGas In-House HER Materials

In addition to the paper “SoCalGas Usage Report” HER examples in Section 2.2, SoCalGas also sent a welcome insert and a door hanger, which are included in this appendix.

Figure C – 1 shows the front of the welcome insert, which was delivered to nearly 13,750 SoCalGas In-House paper-only HER customers in December 2016. Figure C – 2 shows the back of the HER welcome insert. Figure C – 3 displays the door hanger that was delivered to all of the In-house HER participants.

Figure C - 1: December SoCalGas In-House HER Welcome Insert (Front)

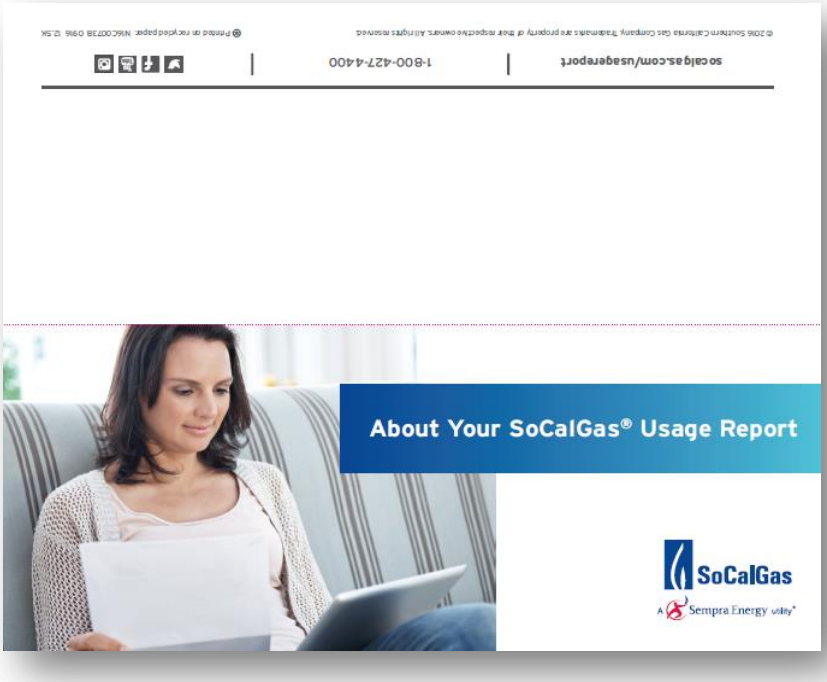


Figure C - 2: December SoCalGas In-House HER Welcome Insert (Back)



WHAT IS THIS REPORT AND WHY ARE YOU RECEIVING IT?

This year, we selected you randomly from our SoCalGas customer database to participate in a pilot program that's geared toward motivating customers to take action and conserve energy. We believe that the information contained on this report will provide you insights and also help guide you to use gas more efficiently.

WHAT TO EXPECT?

In the next few months, you will be receiving personalized letters that will include your previous months' usage compared to nearby homes. These nearby homes have been identified based on size, age, type of home (e.g. home owner or renter). Aside from these, we also considered your weather zone in the calculation. Information from a third-party data provider was also used. More specific details on the algorithm can be found on **socalgas.com/usage report**. Please note that some figures used are estimates only and may not represent actual information.

YOUR INFORMATION AND PRIVACY

SoCalGas is committed to protecting your Energy Usage information and ensuring appropriate protection exists when collecting, storing, using and reporting that information. For more information visit **socalgas.com/privacy-notice**.

TO OPT OUT

If you do not wish to participate in this pilot program, you can opt out at any time by calling **1-800-427-4400**.

SoCalGas

Your SoCalGas® Usage Report

Account Number: 12347890
Report Period: 00/01/16 - 00/01/16

9/1/2016

James Johnson
1234 Main Street
Anytown, USA, 90000-000

This report summarizes your natural gas usage and offers customized suggestions to help you save energy this winter.

LAST MONTH HOUSEHOLD COMPARISON

XXX XXX XXX

Highly Efficient Homes | YOUR HOME | Similar Homes

Great news James! **Your home is highly efficient.** Keep this up by following these simple tips.

HOW TO SAVE ENERGY AND MONEY

Here are some easy to follow tips:

- Set your therm ostat to **68 degrees** when home and turn it off when away. This can save you up to 5 percent on heating cost.*
- Close your **curtains and shades** at night to protect against cold drafts; open them during the day to let in warming sunlight.*

Take action and follow these simple tips. You can be comfortable and efficient this winter. For more energy saving tips visit **socalgas.com/usagereport**

Thank you,
SoCalGas®

Better understanding your natural gas usage is the first step in saving energy and money.

Figure C - 3: SoCalGas In-House HER Door Hanger

Front



Back

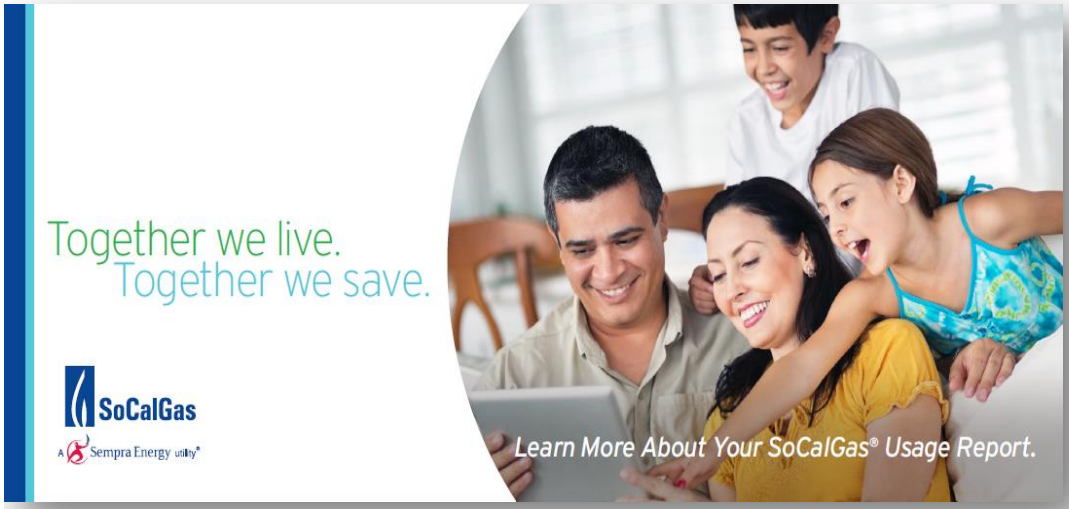


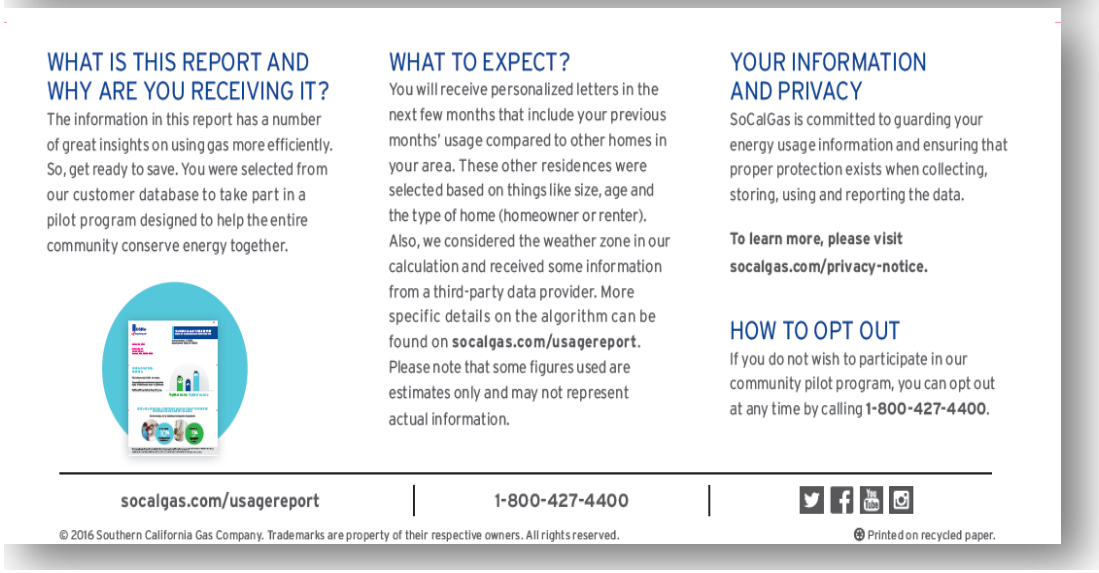
Appendix D SoCalGas Bi-lingual HER Materials

In addition to the paper HER examples in Section 2.2, SoCalGas also sent a welcome insert and a door hanger, which are included in this appendix.

Figure D – 1 shows the front of the welcome insert, which was delivered to nearly 13,750 SoCalGas Bi-lingual paper-only HER customers in December 2016. Figure D – 2 shows the back of the HER welcome insert. Figure D – 3 displays the door hanger that was delivered to all of the In-house HER participants.

Figure D - 1: SoCalGas Bi-lingual HER Welcome Insert (Front)





WHAT IS THIS REPORT AND WHY ARE YOU RECEIVING IT?

The information in this report has a number of great insights on using gas more efficiently. So, get ready to save. You were selected from our customer database to take part in a pilot program designed to help the entire community conserve energy together.

WHAT TO EXPECT?

You will receive personalized letters in the next few months that include your previous months' usage compared to other homes in your area. These other residences were selected based on things like size, age and the type of home (homeowner or renter). Also, we considered the weather zone in our calculation and received some information from a third-party data provider. More specific details on the algorithm can be found on **socalgas.com/usagereport**. Please note that some figures used are estimates only and may not represent actual information.

YOUR INFORMATION AND PRIVACY

SoCalGas is committed to guarding your energy usage information and ensuring that proper protection exists when collecting, storing, using and reporting the data.

To learn more, please visit socalgas.com/privacy-notice.

HOW TO OPT OUT

If you do not wish to participate in our community pilot program, you can opt out at any time by calling **1-800-427-4400**.

socalgas.com/usagereport | 1-800-427-4400

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Printed on recycled paper.

Figure D - 2: SoCalGas Bi-lingual HER Welcome Insert (Back)



Figure D - 3: SoCalGas Bi-lingual HER Door Hanger

Front



Back



Appendix E Aclara/SoCalGas Seasonal Energy Update Materials

In addition to the paper SEU example in Section 2.2, Aclara/SoCalGas also sent a welcome letter, frequently asked questions insert, and a repositionable sticker, which are included in this appendix. There was also a slightly different version of the paper SEU reports sent in January and February which are included in the appendix.

Figure E – 1 shows the front of the Aclara facilitated SEU welcome letter, which was delivered to nearly 59,950 SEU customers in December 2016. Figure E – 2 shows the back of the SEU welcome letter. Figure E – 3 displays the SEU frequently asked question insert. Figure E – 4 displays the repositionable sticker that was sent to all of the SEU customers. Figure E – 5 and Figure E – 6 show the front and back of the November paper SEU report. Figure E – 7 and Figure E – 8 show the front and back of the November paper SEU (weatherize) report.

Figure E - 1: Aclara-Facilitated November SEU Welcome Letter (Front)

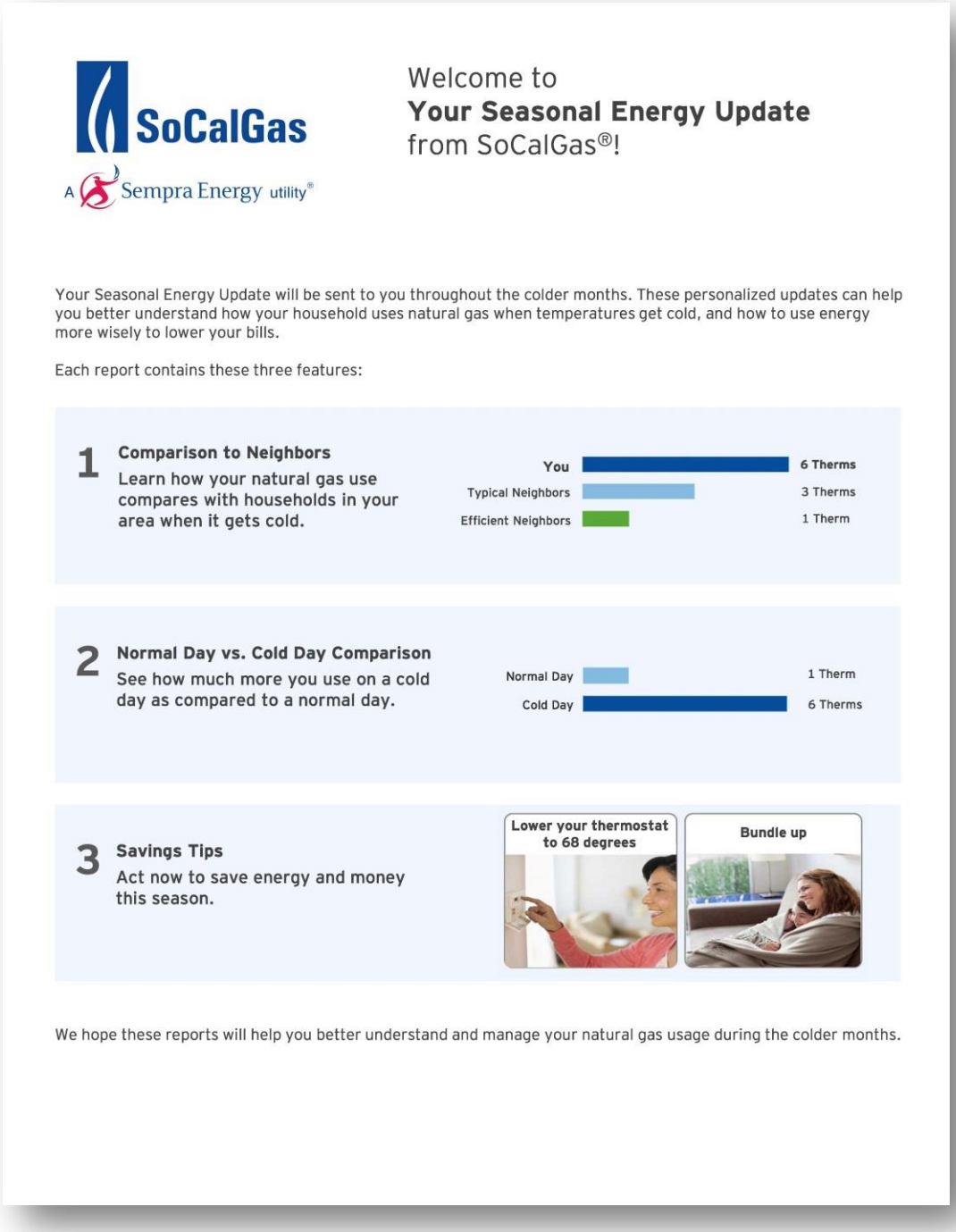


Figure E - 2: Aclara-Facilitated November SEU Welcome Letter (Back)

SoCalGas
A Sempra Energy utility®

Seasonal Energy Update

Frequently Asked Questions & Reference Guide

Q. Why am I receiving this Seasonal Energy Update report?
A. The report you received is part of a pilot program from SoCalGas® to help customers like yourself understand your seasonal energy usage patterns through the fall and winter months, and to discover opportunities where you might be able to save energy and reduce your gas bills. These reports are being distributed for a limited time to a select group of SoCalGas customers in the pilot program. The reports will then be evaluated before potentially offering them in subsequent years or expanding the number of customers who will receive them.

Q. How was I selected to be part of this program?
A. You were selected for this program because you may have potential to save energy and money this winter. Based on historical data, your household gas usage has been shown to be sensitive to cold weather and amongst those with highest average gas usage on cold days.

Q. How many reports will I receive and how often will they be sent? What if I'd rather not receive them?
A. Program participants will receive four monthly paper reports provided from November 2016 through February 2017. You may call 888-873-4894, Monday through Friday, from 8 a.m. to 6 p.m. PT, if you would prefer to stop receiving these reports.

Q.Which neighbors/households is my gas usage being compared to in the "Cold Day Usage Comparison" chart on the front side of the Seasonal Energy Update report?
A. Your household's average daily gas usage for the five coldest days last winter is compared to that of other households in your area that have similar usage levels and experience similar weather. For the first two monthly reports, the comparison period is last winter (December 2015 through February 2016). For the January 2017 and February 2017 monthly reports, the comparison period is the most recent two prior months.

- **"Households in your area that experience similar weather":** "Your area" refers to one of six SoCalGas-defined climate zones. These geographically defined climate zone areas are comprised of High Mountain, High Desert, Low Desert, Coastal, Valley and Inland Valley. They were developed by SoCalGas for purposes of factoring in regional weather conditions to forecast gas supply needs for SoCalGas' service territory.
- **Households with similar usage levels** are those households in your area that used average or greater than average gas usage during the comparison period.
- **Typical Neighbors:** The bar shown is approximately the average daily gas usage on the five coldest days during the comparison period for households in your area experiencing similar weather.
- **Efficient Neighbors:** The bar shown is the average daily gas usage for the 20 percent of households in your area that have the lowest average daily gas usage for the five coldest days during the comparison period.

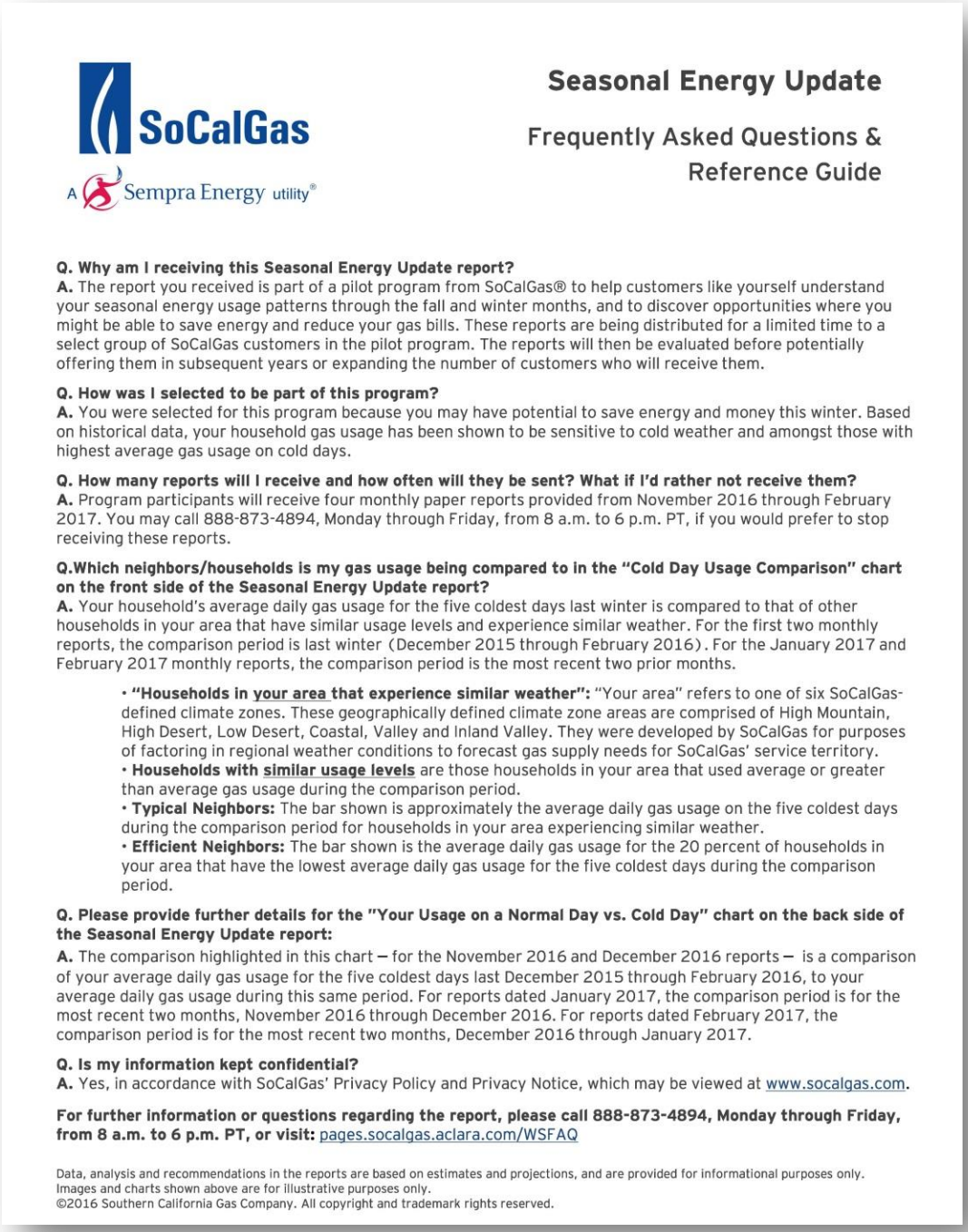
Q. Please provide further details for the "Your Usage on a Normal Day vs. Cold Day" chart on the back side of the Seasonal Energy Update report:
A. The comparison highlighted in this chart — for the November 2016 and December 2016 reports — is a comparison of your average daily gas usage for the five coldest days last December 2015 through February 2016, to your average daily gas usage during this same period. For reports dated January 2017, the comparison period is for the most recent two months, November 2016 through December 2016. For reports dated February 2017, the comparison period is for the most recent two months, December 2016 through January 2017.

Q. Is my information kept confidential?
A. Yes, in accordance with SoCalGas' Privacy Policy and Privacy Notice, which may be viewed at www.socalgas.com.

For further information or questions regarding the report, please call 888-873-4894, Monday through Friday, from 8 a.m. to 6 p.m. PT, or visit: pages.socalgas.aclara.com/WSFAQ

Data, analysis and recommendations in the reports are based on estimates and projections, and are provided for informational purposes only.
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Figure E - 3: Aclara-Facilitated SEU Frequently Asked Questions Insert



SoCalGas
A Sempra Energy utility®

Seasonal Energy Update

Frequently Asked Questions & Reference Guide

Q. Why am I receiving this Seasonal Energy Update report?
A. The report you received is part of a pilot program from SoCalGas® to help customers like yourself understand your seasonal energy usage patterns through the fall and winter months, and to discover opportunities where you might be able to save energy and reduce your gas bills. These reports are being distributed for a limited time to a select group of SoCalGas customers in the pilot program. The reports will then be evaluated before potentially offering them in subsequent years or expanding the number of customers who will receive them.

Q. How was I selected to be part of this program?
A. You were selected for this program because you may have potential to save energy and money this winter. Based on historical data, your household gas usage has been shown to be sensitive to cold weather and amongst those with highest average gas usage on cold days.

Q. How many reports will I receive and how often will they be sent? What if I'd rather not receive them?
A. Program participants will receive four monthly paper reports provided from November 2016 through February 2017. You may call 888-873-4894, Monday through Friday, from 8 a.m. to 6 p.m. PT, if you would prefer to stop receiving these reports.

Q.Which neighbors/households is my gas usage being compared to in the "Cold Day Usage Comparison" chart on the front side of the Seasonal Energy Update report?
A. Your household's average daily gas usage for the five coldest days last winter is compared to that of other households in your area that have similar usage levels and experience similar weather. For the first two monthly reports, the comparison period is last winter (December 2015 through February 2016). For the January 2017 and February 2017 monthly reports, the comparison period is the most recent two prior months.

- **"Households in your area that experience similar weather":** "Your area" refers to one of six SoCalGas-defined climate zones. These geographically defined climate zone areas are comprised of High Mountain, High Desert, Low Desert, Coastal, Valley and Inland Valley. They were developed by SoCalGas for purposes of factoring in regional weather conditions to forecast gas supply needs for SoCalGas' service territory.
- **Households with similar usage levels** are those households in your area that used average or greater than average gas usage during the comparison period.
- **Typical Neighbors:** The bar shown is approximately the average daily gas usage on the five coldest days during the comparison period for households in your area experiencing similar weather.
- **Efficient Neighbors:** The bar shown is the average daily gas usage for the 20 percent of households in your area that have the lowest average daily gas usage for the five coldest days during the comparison period.

Q. Please provide further details for the "Your Usage on a Normal Day vs. Cold Day" chart on the back side of the Seasonal Energy Update report:
A. The comparison highlighted in this chart – for the November 2016 and December 2016 reports – is a comparison of your average daily gas usage for the five coldest days last December 2015 through February 2016, to your average daily gas usage during this same period. For reports dated January 2017, the comparison period is for the most recent two months, November 2016 through December 2016. For reports dated February 2017, the comparison period is for the most recent two months, December 2016 through January 2017.

Q. Is my information kept confidential?
A. Yes, in accordance with SoCalGas' Privacy Policy and Privacy Notice, which may be viewed at www.socalgas.com.

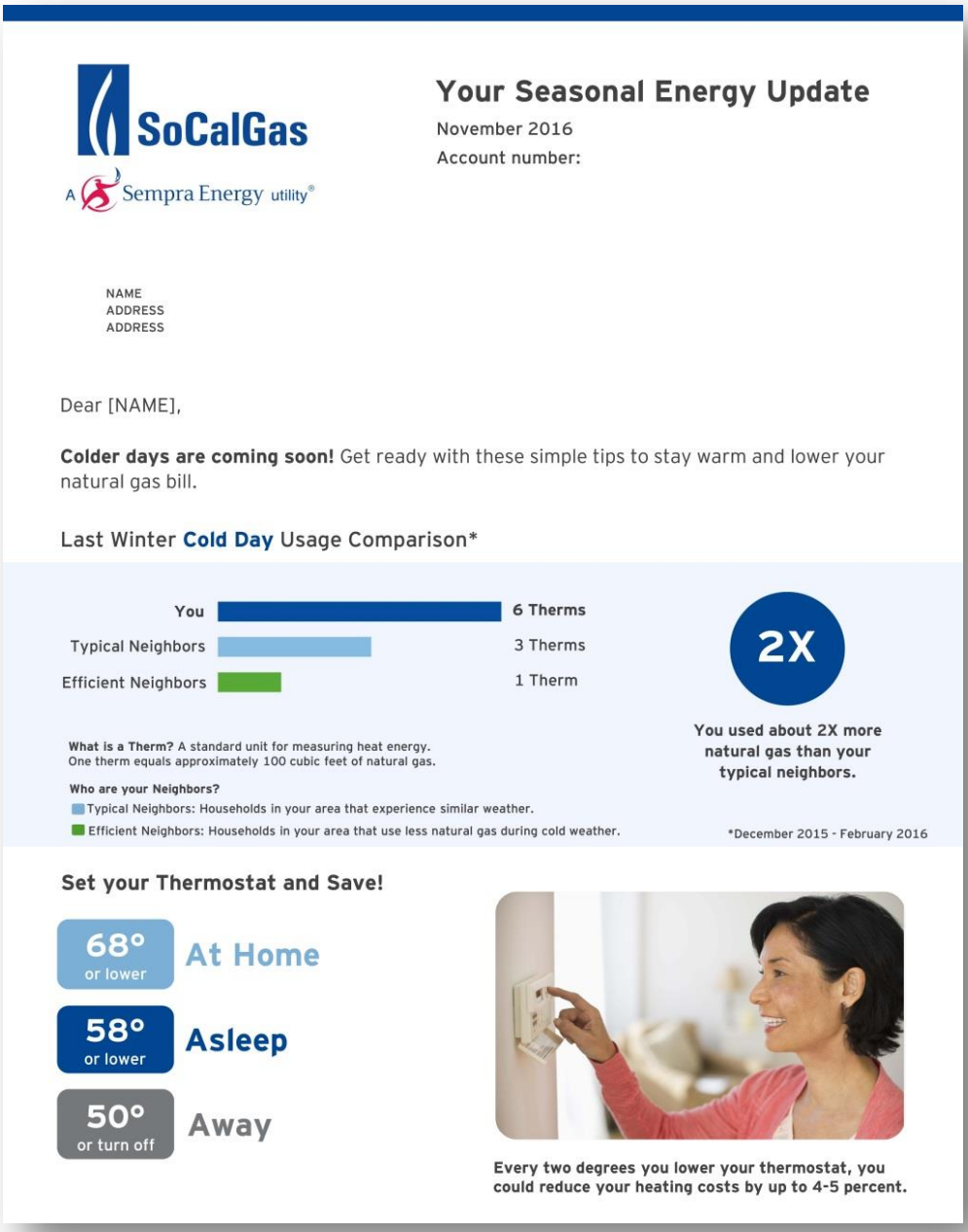
For further information or questions regarding the report, please call 888-873-4894, Monday through Friday, from 8 a.m. to 6 p.m. PT, or visit: pages.socalgas.aclara.com/WSFAQ

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Figure E - 4: Aclara-Facilitated SEU Repositionable Sticker



Figure E - 5: Aclara-Facilitated November SEU Paper Report (Front)



SoCalGas
A Sempra Energy utility®

Your Seasonal Energy Update

November 2016
Account number:

NAME
ADDRESS
ADDRESS

Dear [NAME],

Colder days are coming soon! Get ready with these simple tips to stay warm and lower your natural gas bill.

Last Winter **Cold Day** Usage Comparison*

Set your Thermostat and Save!

Every two degrees you lower your thermostat, you could reduce your heating costs by up to 4-5 percent.

Figure E - 6: Aclara-Facilitated November SEU Paper Report (Back)

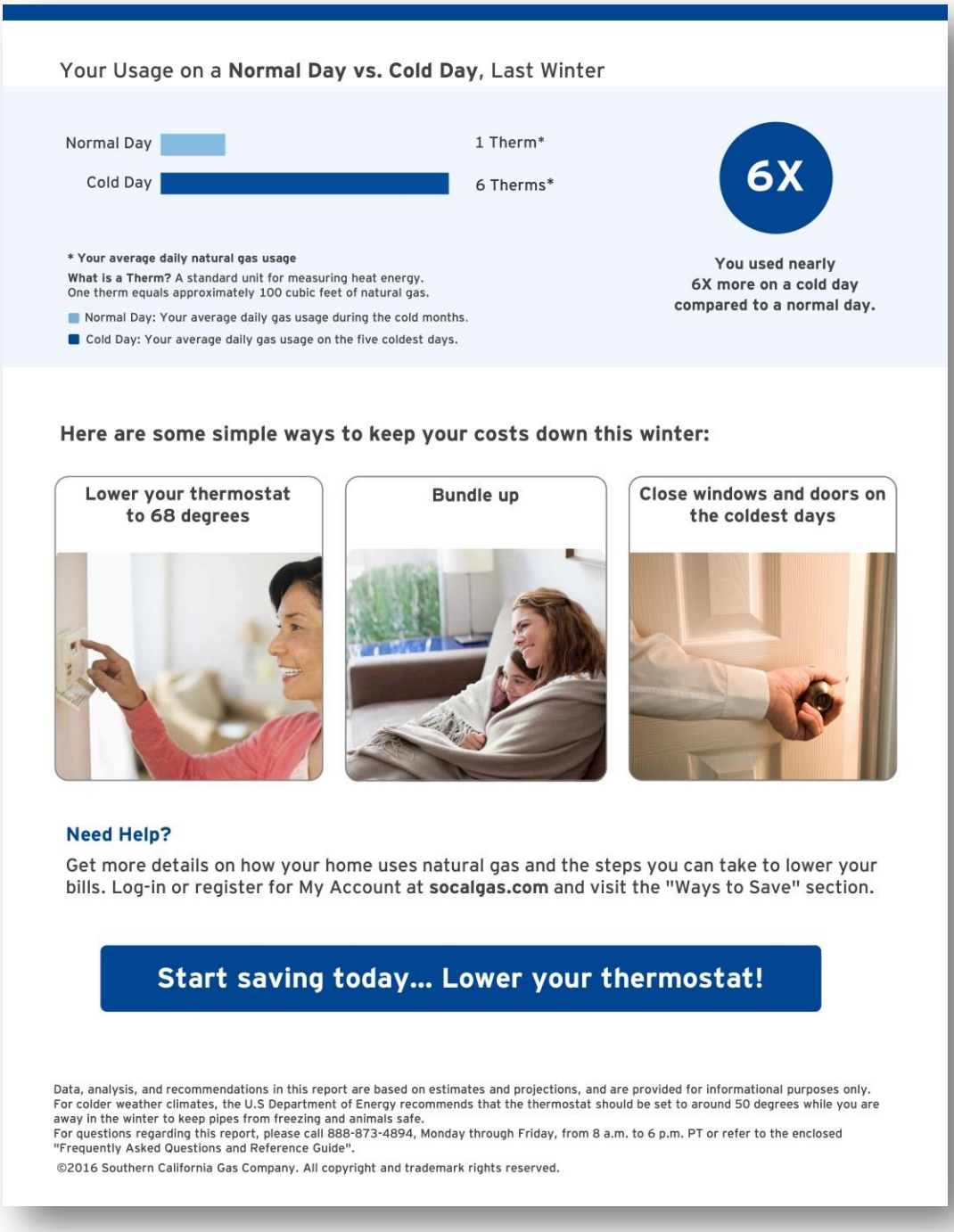


Figure E - 7: Aclara-Facilitated November SEU (Weatherize) Paper Report (Front)

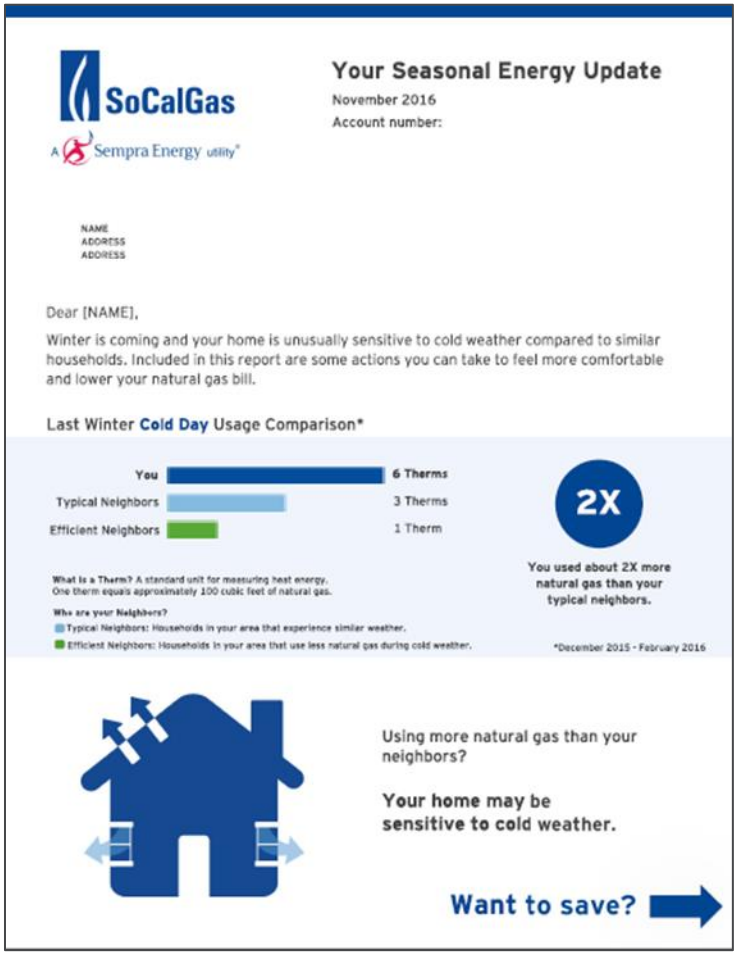
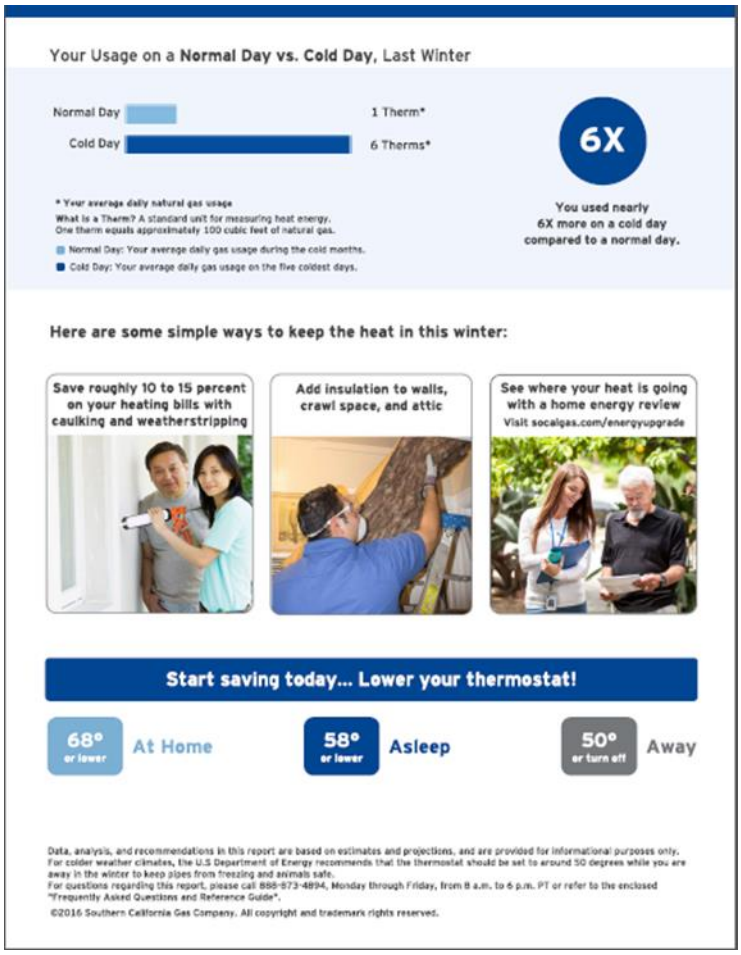


Figure E - 8: Aclara-Facilitated November SEU (Weatherize) Paper Report (Back)



Attachment O

Apex Analytics' Evaluation of SoCalGas's 2024 Residential Behavioral Outreach Program

Evaluation of Southern California Gas Company's 2024 Residential Behavioral

Submitted to:

Southern California Gas Company

Prepared by:

Eric Bell, Ph.D., Principal
Aimee Savage, Senior Associate
Duncan Ward, Senior Analyst

February 21, 2025

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1. Executive Summary

SoCalGas's (Southern California Gas Company) Behavioral Outreach Program is designed to engage and educate residential customers in ways that encourage energy-saving behaviors and reduce overall gas consumption. Customers assigned to treatment conditions receive periodic Home Energy Reports (HERs) from either Opower (now Oracle) or Bidgely which offer no- and low-cost tips for reducing natural gas consumption. To help homeowners understand whether their energy use is typical, the reports also include comparisons of the customer's usage with similar households. This report documents therm savings for the program for Program Year 2024 (PY2024), which covers the period from November 2023 through October 2024.

Table 1-1 summarizes aggregate PY2024 savings by season and vendor (Oracle or Bidgely). Approximately 1.6 million customers received treatment in PY2024, and the total natural gas savings was equal to 9.9 million therms.

Table 1-1: Aggregate PY2024 Therm Savings by Vendor and Season

Season	Vendor	Treatment Customers	Aggregate Therms Saved	Impact (%)	Savings (Per Customer)
Winter	Opower	1,084,652	5,621,333	1.8%	5.2
	Bidgely	556,431	1,491,341	1.3%	2.7
	Total	**1,641,084**	**7,112,674**	**1.7%**	**4.3**
Non-Winter	Opower	1,064,645	2,055,255	1.1%	1.9
	Bidgely	542,168	762,737	1.0%	1.4
	Total	**1,606,812**	**2,817,992**	**1.0%**	**1.8**
Annual	Opower	1,072,954	7,676,588	1.5%	7.2
	Bidgely	548,091	2,254,077	1.2%	4.1
	Total	**1,621,045**	**9,930,665**	**1.4%**	**6.1**

The Behavioral Outreach Program is comprised of sixteen cohorts known as "waves". With the exception of Wave 12 and Wave 14, all treatment groups include customers in the top two quartiles of natural gas consumption. Impacts were estimated for each wave, outlined in Table 1-2.

Table 1-2: Waves Receiving Treatment in PY2024

Wave	Initial Treatment Year	Original Treatment	PY2018-PY2021 Treatment	PY2022-PY2024 Treatment	Wave Description	PY2024 Treatment Customers	Avg. Therms per Month
Wave 1	PY2016	Opower + BTA	Opower + BTA	Opower HER	My Account	100,771	38.5
Wave 2	PY2016	Opower HER	Opower HER	Opower HER	Non-My Account	76,373	38.8
Wave 3	PY2016	Opower HER	Javelin	Bidgely Alerts	CARE	12,136	36.2
Wave 4	PY2017	Opower + BTA Javelin + BTA	Opower + BTA	Opower HER	My Account	102,936	39.8
Wave 5	PY2017	Opower HER Javelin	Opower + BTA	Opower HER	Non-My Account	178,027	40.3
Wave 6a	PY2017	Opower HER	Javelin HER	Bidgely Alerts	CARE	16,946	37.3
Wave 6b		Javelin				4,910	39.5
Wave 7	PY2019	N/A	Aclara HER	Opower HER	Non-CARE	348,279	42.3
Wave 8	PY2019	N/A	Javelin HER	Bidgely Alerts	CARE, Weather Sensitive	36,544	28.8
Wave 9	PY2019	N/A	Javelin HER	Bidgely Alerts	CARE, Non-Weather Sensitive	77,640	37.3
Wave 10	PY2020	N/A	Opower HER	Opower HER	Top 2 Quartiles of Natural Gas Consumption	77,857	31.3
Wave 11	PY2020	N/A	Aclara HER	Bidgely Alerts	Top 2 Quartiles of Natural Gas Consumption	61,798	42.6
Wave 12	PY2020	N/A	Bidgely Alerts	Bidgely Alerts	Average Natural Gas Consumption, Email-Only Treatment	272,425	20.8
Wave 13	PY021	N/A	Opower HER	Opower HER	Top 2 Quartiles of Natural Gas Consumption	111,431	38.3
Wave 14	PY021	N/A	Javelin HER	Bidgely Alerts	Top 3 Quartiles of Natural Gas Consumption, MyAccount, and CARE eligible (but not yet enrolled in CARE)	47,990	37.0
Wave 15	PY021	N/A	Aclara HER	Bidgely Alerts	Top 2 Quartiles of Natural Gas Consumption	17,702	42.3
Wave 16	PY023	N/A	N/A	Opower HER	Top 2 Quartiles of Natural Gas Consumption	77,281	35.6

Each treatment cohort, or wave, in SoCalGas's Behavioral Outreach Program is designed as an independent randomized controlled trial (RCT) in which eligible customers are randomly assigned to either treatment or control conditions; customers assigned to treatment conditions receive HERs and those assigned to control conditions do not.

Customers in Wave 1 through Wave 3 were initially sampled for treatment as part of the 2015-2016 AMI Conservation Campaign. Wave 1 is comprised of customers enrolled in My Account while Wave 2 targeted non-My Account customers. Wave 3 is a low-income wave that only includes customers enrolled in the California Alternate Rates for Energy (CARE) program. Similarly, Wave 4, Wave 5, and Wave 6 were originally launched as part of the 2016-2017 AMI Conservation Campaign. Wave 4 and Wave 5 are My Account and non-My Account cohorts, respectively, and Wave 6 is a low-income wave. A portion of treatment customers in Wave 1, Wave 4, and Wave 5 received Bill Tracker Alerts (BTAs) in addition to Opower HERs.

Wave 7, Wave 8, and Wave 9 launched in November 2018 targeting non-My Account and CARE customers. Wave 10 and Wave 11 began treatment in November 2019. These waves include CARE and non-CARE customers, and both customers with and without My Account. Wave 12 launched in December 2019 and includes the largest customers in the second quartile of natural gas consumption. Per-customer savings were expected to be smaller than in other waves, as smaller customers typically produce smaller savings. However, aggregate savings are on par with other waves due to the large number of customers in the treatment group.

In November 2020, Wave 13 and Wave 15 began treatment. These two waves include customers in the top two quartiles of natural gas consumption. Wave 14 launched in December 2020 and includes the top three quartiles of natural gas consumption who are eligible for CARE (but not yet enrolled in CARE).

As of PY2022, SoCalGas no longer contracts with Javelin or Aclara as vendors. Customers in waves that were treated with Javelin or Aclara in PY2018 through PY2021 are now receiving treatment from Opower or Bidgely. Table 2 includes the original treatment, PY2018 through PY2021 treatment, and PY2022 through PY2024 treatment for each wave.

More specifically, customers in Wave 7 were recently treated with Javelin reports but transitioned to Oracle reports in November 2021. Customers in Waves 3, 6a, 6b, 8, 9, 11, 14, and 15 were previously treated with Aclara or Javelin reports in PY2018 through PY2021 and transitioned to treatment with Bidgely in PY2022. However, treatment with Bidgely alerts did not launch until the end of February 2022. As a result, any therm savings incurred in November 2021 through February 2022 are attributable to persistence in savings from prior treatments.

The newest wave in the program, Wave 16, launched in December 2022 (one month later than initially planned). Customers in Wave 16 are treated with Opower HERs. The sampling strategy for Waves 7 through 16 accounted for the fact that many of the customers were historically enrolled in BTAs. Energy savings associated with BTAs are no longer being estimated for these groups. Therefore,

these customers were included in the random assignment to treatment and control. If there is an effect of BTAs for customers in the newer waves, it is essentially cancelled out because the percentage of treatment and control customers receiving the alerts is not statistically different as a result of the random assignment.

This report is organized as follows. Section 2 documents the methodology for estimating therm savings, and Section 3 summarizes the aggregate and seasonal therm savings estimates.

2. Methodology

Natural gas savings achieved by the program were estimated using a lagged dependent variable (LDV) model. An LDV model includes pretreatment therms consumption as an explanatory variable for post-treatment usage. This is a standard approach for estimating energy savings attributable to behavioral programs designed as a randomized controlled trial (RCT). The analysis dataset includes individual monthly therms consumption for each customer in the treatment and control groups. The regression specification is presented in Equation 2-1, followed by definitions for each term in Table 2-1.

Equation 2-1: Lagged Dependent Variable Model Specification

$$\boldsymbol{therms_i} = \boldsymbol{\beta_0} + \boldsymbol{\beta_1} \cdot \boldsymbol{treatment_i} + \boldsymbol{\beta_2} \cdot \boldsymbol{pretherms_i} + \sum_{\boldsymbol{m}} \boldsymbol{\gamma_m} \cdot \boldsymbol{pretherms_{i,m}} \cdot \boldsymbol{month_m} + \sum_{\boldsymbol{m}} \boldsymbol{\delta_m} \cdot \boldsymbol{month_m} + \boldsymbol{u_i}$$

Table 2-1: Lagged Dependent Variable Model Definitions

Variable	Definition
$\boldsymbol{therms_i}$	Customer *i*'s average daily therms consumption
$\boldsymbol{\beta_0}$	The estimated constant for energy consumption (average for all customers in all periods).
$\boldsymbol{treatment_i}$	The treatment indicator variable for customer *i*. Equal to 1 for treatment customers and 0 otherwise.
$\boldsymbol{\beta_1}$	The estimated coefficient for ***treatment***
$\boldsymbol{pretherms_i}$	Pretreatment usage for customer *i* for month *t*. Pretreatment consumption for a particular month in the post treatment period refers to the same calendar month in the pretreatment period.
$\boldsymbol{\beta_2}$	The estimated coefficient for ***pretherms***
$\boldsymbol{month_m}$	Binary indicator for each month ***m*** in the analysis dataset
γ_m	The estimated coefficient for the interaction between ***pretherms*** and the month indicator variable
δ_m	Coefficient for each month indicator variable
u_i	Error term, clustered by customer

Therms savings for the Residential Behavioral Outreach Program were estimated separately for each wave. To maintain comparability between treatment and control groups, opt-outs (that is, customers assigned to treatment groups that requested to be removed from receiving the reports) are retained in the treatment groups throughout the course of the entire analysis period. Two reasons underlie this decision.

- First, because the experiment uses an opt-out delivery design (in which households in the treatment receive the reports without requesting them), households that subsequently opt out of receiving the reports received at least one report before they dropped out. So, strictly speaking, they were treated.
- Second, it is impossible to remove parties in the control group who would have opted out, because their identity is unknown. Removing opt-outs only from the treatment group without doing so for the control group would compromise the internal validity of the savings estimates.

HERs are assumed not to affect the rate at which customers close their accounts due to moving or other reasons; this appears to be true since the attrition rate between treatment and control groups are virtually identical. Treatment and control customers who move out during the analysis period are retained in each sample until their accounts close. This means that the population of interest grows smaller for both the control and treatment groups as time progresses.

3. Savings Summary

3.1 Annual and Seasonal Therm Savings

This section summarizes the savings for each treatment wave in the Residential Behavioral Outreach Program. Table 3-1 presents aggregate therm savings for the full program year from November 2023 through October 2024. The table also includes a 90% confidence interval, percent savings, and therm savings per customer.

In total, the program achieved 9.9 million therms saved across 1.6 million treated residential customers. This is equivalent to 1.4% or 6.1 therms per customer and is statistically significant. Wave-specific percent savings ranged from 0.4% (Wave 3, Bidgely) to 3.3% (Wave 1, Opower). At the annual level, savings were statistically significant for all waves with one exception. Wave 3, which specifically targeted CARE customers, did not achieve statistically significant savings in PY2024. In addition to relatively low savings, Wave 3 only included roughly 12,000 customers in PY2024. Small sample sizes likely contributed to the lack of statistical significance. Wave 1, on the other hand, includes treatment with BTAs and is one of the oldest waves in the program. This wave achieved per customer savings of 15.4 therms.

A majority of customers in the program are treated with Opower HERs. Waves under these treatment conditions achieved total annual savings equal to 7.7 million therms, or 1.5%. Customers treated by Bidgely reached aggregate savings of 2.3 million therms or 1.2%.

Table 3-1: Aggregate PY2024 Annual Therm Savings by Wave

Season	Wave	Vendor	Treatment Customers	Aggregate Therms Saved	90% Confidence Interval		Impact (%)	Therm Savings (Per Customer)
Annual	Wave 1	Opower	100,771	1,551,192	1,396,914	1,705,470	3.3%	15.4
	Wave 2	Opower	76,373	514,224	385,365	643,083	1.4%	6.7
	Wave 3	Bidgely	12,136	19,899	-17,024	56,823	0.4%	1.6
	Wave 4	Opower	102,936	1,070,822	880,694	1,260,951	2.2%	10.4
	Wave 5	Opower	178,027	1,675,446	1,381,222	1,969,670	1.9%	9.4
	Wave 6a	Bidgely	16,946	77,987	38,184	117,791	1.0%	4.6
	Wave 6b	Bidgely	4,910	27,226	533	53,918	1.2%	5.5
	Wave 7	Opower	348,279	1,873,455	1,097,782	2,649,128	1.1%	5.4
	Wave 8	Bidgely	36,544	147,256	88,679	205,833	1.2%	4.0
	Wave 9	Bidgely	77,640	315,360	210,939	419,781	0.9%	4.1
	Wave 10	Opower	77,857	325,555	231,074	420,036	1.1%	4.2
	Wave 11	Bidgely	61,798	430,520	253,248	607,791	1.4%	7.0
	Wave 12	Bidgely	272,425	967,909	772,505	1,163,313	1.4%	3.6
	Wave 13	Opower	111,431	423,986	243,642	604,331	0.8%	3.8
	Wave 14	Bidgely	47,990	159,545	40,689	278,402	0.7%	3.3
	Wave 15	Bidgely	17,702	108,375	43,203	173,546	1.2%	6.1
	Wave 16	Opower	77,281	241,908	134,638	349,179	0.7%	3.1
	Total		**1,621,045**	**9,930,665**	**8,969,558**	**10,891,772**	**1.4%**	**6.1**

Table 3-2 documents winter aggregate therm savings and includes savings realized from November 2023 through March 2024. Per-customer savings were equal to 4.3 therms or 1.7%, which amounts to 7.1 million therms across 1.6 million customers. Percent savings in the winter months ranged from 0.8% (Wave 3 and Wave 14, Bidgely) to 3.7% (Wave 1, Opower). Winter therm savings were statistically significant for the program as a whole and for most waves individually. The two exceptions were Wave 3 and Wave 6b (currently the two smallest waves in the program in terms of active treatment customers).

Table 3-2: Aggregate PY2024 Winter Therm Savings by Wave

Season	Wave	Vendor	Treatment Customers	Aggregate Therms Saved	90% Confidence Interval		Impact (%)	Therm Savings (Per Customer)
Winter	Wave 1	Opower	101,776	1,082,029	957,766	1,206,291	3.7%	10.6
	Wave 2	Opower	77,182	370,177	263,661	476,693	1.6%	4.8
	Wave 3	Bidgely	12,278	26,717	-4,395	57,829	0.8%	2.2
	Wave 4	Opower	103,900	704,066	560,277	847,855	2.3%	6.8
	Wave 5	Opower	180,010	1,147,687	908,278	1,387,096	2.1%	6.4
	Wave 6a	Bidgely	17,164	53,514	20,683	86,346	1.2%	3.1
	Wave 6b	Bidgely	4,978	21,625	-1,046	44,296	1.5%	4.3
	Wave 7	Opower	352,304	1,544,514	910,912	2,178,115	1.4%	4.4
	Wave 8	Bidgely	37,059	107,519	58,672	156,366	1.4%	2.9
	Wave 9	Bidgely	78,717	219,786	134,267	305,304	1.1%	2.8
	Wave 10	Opower	78,715	235,839	159,943	311,735	1.3%	3.0
	Wave 11	Bidgely	62,667	276,648	155,493	397,804	1.6%	4.4
	Wave 12	Bidgely	276,799	635,985	472,646	799,323	1.6%	2.3
	Wave 13	Opower	112,661	350,164	213,726	486,602	1.2%	3.1
	Wave 14	Bidgely	48,697	99,271	14,971	183,570	0.8%	2.0
	Wave 15	Bidgely	18,074	50,276	341	100,211	0.9%	2.8
	Wave 16	Opower	78,105	186,857	97,569	276,146	0.9%	2.4
	Total		**1,641,084**	**7,112,674**	**6,336,920**	**7,888,428**	**1.7%**	**4.3**

Finally, Table 3-3 summarizes non-winter therm savings. As a reminder, the non-winter period includes the months from April through October 2024. Multiple waves did not realize statistically significant savings during the warmer months, however savings were statistically significant for the program as a whole. On average, customers saved about 1.8 therms or 1.0%. This is equivalent to 2.8 million therms.

Table 3-3: Aggregate PY2024 Non-Winter Therm Savings by Wave

Season	Wave	Vendor	Treatment Customers	Aggregate Therms Saved	90% Confidence Interval		Impact (%)	Therm Savings (Per Customer)
Non-Winter	Wave 1	Opower	100,057	469,163	377,727	560,598	2.7%	4.7
	Wave 2	Opower	75,798	144,047	71,527	216,567	1.1%	1.9
	Wave 3	Bidgely	12,034	-6,818	-26,702	13,067	-0.3%	-0.6
	Wave 4	Opower	102,251	366,756	242,364	491,149	1.9%	3.6
	Wave 5	Opower	176,618	527,759	356,729	698,789	1.7%	3.0
	Wave 6a	Bidgely	16,791	24,473	1,970	46,976	0.8%	1.5
	Wave 6b	Bidgely	4,862	5,601	-8,489	19,690	0.7%	1.2
	Wave 7	Opower	345,420	328,941	-118,516	776,398	0.5%	1.0
	Wave 8	Bidgely	36,178	39,737	7,407	72,067	0.8%	1.1
	Wave 9	Bidgely	76,875	95,575	35,655	155,494	0.7%	1.2
	Wave 10	Opower	77,248	89,716	33,444	145,987	0.8%	1.2
	Wave 11	Bidgely	61,181	153,871	24,463	283,280	1.1%	2.5
	Wave 12	Bidgely	269,319	331,925	224,671	439,178	1.2%	1.2
	Wave 13	Opower	110,556	73,822	-44,114	191,758	0.3%	0.7
	Wave 14	Bidgely	47,488	60,275	-23,514	144,063	0.6%	1.3
	Wave 15	Bidgely	17,438	58,099	16,220	99,977	1.7%	3.3
	Wave 16	Opower	76,696	55,051	-4,401	114,503	0.4%	0.7
	Total		**1,606,812**	**2,817,992**	**2,250,601**	**3,385,383**	**1.0%**	**1.8**

Table 3-4 summarizes annual therm savings for program years PY2018 through PY2024. In the past seven years, per-customer and percent savings were highest just prior to the COVID-19 pandemic (PY2019). That year, savings were equal to 8.9 therms per customer, which represents a 1.6% reduction in natural gas consumption. Per-customer savings were lowest in PY2022; an in-depth analysis found that a notable decrease in natural gas consumption across both treatment and control customers was a driving factor behind declining savings. Possible reasons behind this change include lingering effects of the COVID-19 pandemic, high energy prices, and inflation.

Table 3-4: Annual Therm Savings by Program Year

Program Year	Treatment Customers	Aggregate Therms Saved	% Impact	Per-Customer Therm Savings
PY2018	718,744	4,753,856	1.4%	6.6
PY2019	1,354,695	12,114,579	1.6%	8.9
PY2020	1,848,878	13,618,991	1.5%	7.4
PY2021	1,939,045	13,077,736	1.4%	6.7
PY2022	1,716,984	9,977,803	1.4%	5.8
PY2023	1,701,053	11,392,652	1.3%	6.7
PY2024	1,621,045	9,930,665	1.4%	6.1

Figure 3-1 illustrates the relationship between winter natural gas consumption and average daily temperature among control customers for PY2018 through PY2024. Each marker represents the average daily temperature and baseline therms per customer for one winter month. As indicated by the purple (PY2022) and green (PY2023) trendlines, natural gas consumption was lower than prior years at similar temperatures. In PY2024, average daily therms consumption was similar to PY2022 and PY2023 when temperatures were below 60 degrees. At warmer temperatures, consumption was more similar to PY2018 and PY2019.

Figure 3-1: Average Winter Daily Therms per Control Customer vs. Average Daily Temperature

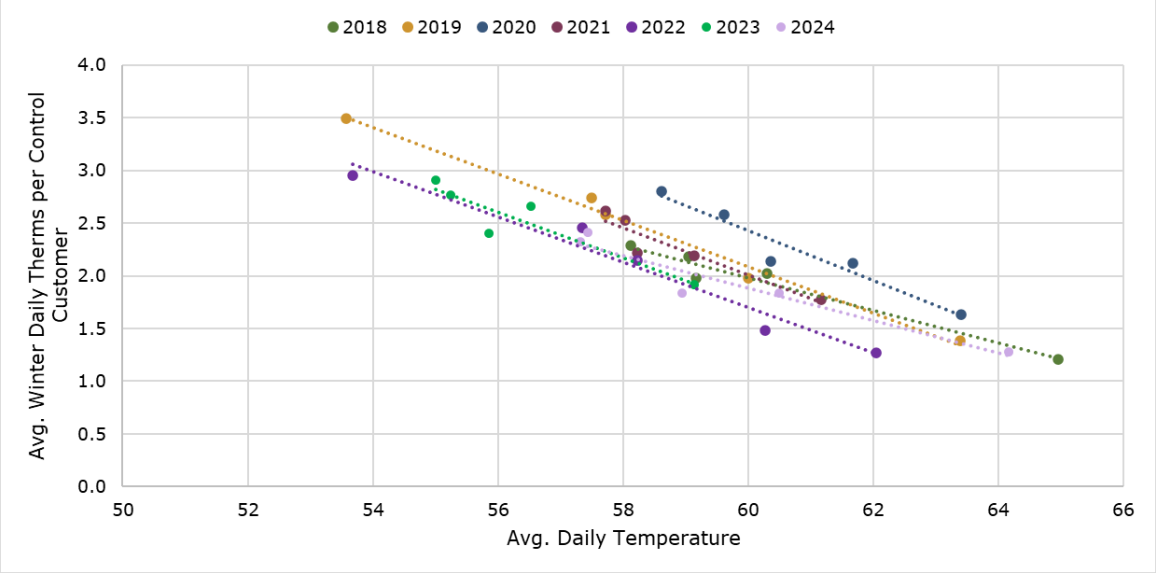


Table 3-5 summarizes PY2024 therm savings compared to those in PY2023. While per-customer therm savings decreased from 6.7 therms to 6.1 therms, percent impact remained steady (1.3% in PY2023 and 1.4% in PY2024). The winter months in PY2024 were warmer than the prior year, reducing some of the potential for

customer savings due to lower heating needs (and therefore lower baseline consumption).

Table 3-5: Year-over-Year Comparison (PY2023 vs. PY2024)

Season	Vendor	Treatment Customers		Aggregate Therm Savings		Percent Savings		Per-Customer Therm Savings	
		PY2023	PY2024	PY2023	PY2024	PY2023	PY2024	PY2023	PY2024
Winter	Opower	1,131,159	1,084,652	6,319,874	5,621,333	1.5%	1.8%	5.6	5.2
	Bidgely	593,236	556,431	1,869,843	1,491,341	1.3%	1.3%	3.2	2.7
	Total	**1,724,395**	**1,641,084**	**8,189,717**	**7,112,674**	**1.4%**	**1.7%**	**4.7**	**4.3**
Non-Winter	Opower	1,108,779	1,064,645	2,487,860	2,055,255	1.2%	1.1%	2.2	1.9
	Bidgely	576,158	542,168	715,074	762,737	0.8%	1.0%	1.2	1.4
	Total	**1,684,937**	**1,606,812**	**3,202,935**	**2,817,992**	**1.1%**	**1.0%**	**1.9**	**1.8**
Annual	Opower	1,117,885	1,072,954	8,807,734	7,676,588	1.4%	1.5%	7.9	7.2
	Bidgely	583,168	548,091	2,584,917	2,254,077	1.1%	1.2%	4.4	4.1
	Total	**1,701,053**	**1,621,045**	**11,392,652**	**9,930,665**	**1.3%**	**1.4%**	**6.7**	**6.1**

3.2 Savings versus Projection

Prior to this analysis, the Apex Analytics team developed a therm savings projection for PY2024. The therm savings forecast inputs were based on historical monthly therm savings and weather data from PY2021 through PY2024 (a total of 36 months). A comparison of projected and actual therm savings is presented in Table 3-6. The forecasted annual savings for the HER program was 9.8 million therms. The program achieved 101% of that forecast, with a total savings of 9.9 million therms.

Table 3-6: PY2024 Therm Savings vs. Projection

Season	Wave	Vendor	Projected			Actual			% of Projection Achieved
			Customers	Therm Savings Per Customer	Aggregate Therm Savings	Customers	Therm Savings Per Customer	Aggregate Therm Savings	
PY2024 (Nov - Oct)	Wave 1	Opower	100,778	11.9	1,208,439	100,771	15.4	1,551,192	128%
	Wave 2	Opower	76,449	6.7	516,629	76,373	6.7	514,224	100%
	Wave 3	Bidgely	12,149	4.1	50,068	12,136	1.6	19,899	40%
	Wave 4	Opower	103,057	10.5	1,084,937	102,936	10.4	1,070,822	99%
	Wave 5	Opower	178,243	7.6	1,366,609	178,027	9.4	1,675,446	123%
	Wave 6a	Bidgely	16,959	5.7	97,640	16,946	4.6	77,987	80%
	Wave 6b	Bidgely	4,906	5.8	28,739	4,910	5.5	27,226	95%
	Wave 7	Opower	348,483	6.5	2,257,778	348,279	5.4	1,873,455	83%
	Wave 8	Bidgely	36,602	3.6	134,323	36,544	4.0	147,256	110%
	Wave 9	Bidgely	78,079	4.5	354,545	77,640	4.1	315,360	89%
	Wave 10	Opower	78,379	4.3	335,977	77,857	4.2	325,555	97%
	Wave 11	Bidgely	61,832	7.7	475,729	61,798	7.0	430,520	90%
	Wave 12	Bidgely	272,953	3.3	910,008	272,425	3.6	967,909	106%
	Wave 13	Opower	111,851	3.9	434,667	111,431	3.8	423,986	98%
	Wave 14	Bidgely	49,418	3.4	170,181	47,990	3.3	159,545	94%
	Wave 15	Bidgely	17,619	7.6	135,053	17,702	6.1	108,375	80%
	Wave 16	Opower	77,392	3.6	282,995	77,281	3.1	241,908	85%
	Annual Therm Savings		**1,625,149**	**6.1**	**9,844,316**	**1,621,045**	**6.1**	**9,930,665**	**101%**

4. Conclusions & Recommendations

Total estimated savings for SoCalGas's Behavioral Outreach Program reached nearly 10 million therms for the months from November 2023 through October 2024. This is equivalent to a 1.4% reduction in natural gas consumption among over 1,600,000 treated customers, an increase in percentage savings from 1.3% per customer in PY2023. Overall energy savings decreased from 6.7 therms per customer in PY2023 to 6.1 therms per customer in PY2024. In the winter months (November through March) the program provided roughly 7.1 million therms of savings – equivalent to a 1.7% reduction (an increase compared to the prior winter). For context, it should be noted that the PY2024 winter was considerably warmer than the PY2023 winter, reducing some of the potential for customer savings due to lower heating needs.

The Residential Behavioral Outreach Program continues to make a valuable contribution to the SoCalGas energy efficiency portfolio by generating significant natural gas savings. However, it may be beneficial for SoCalGas to explore strategies to increase savings in future program years and consider opportunities outside of the Behavioral Outreach Program. For instance, targeting natural gas water heater owners with high consumption, providing additional reminders and notifications, and leveraging customers' interest in sustainability could prove effective. As new waves are introduced to the program, SoCalGas should continue to focus on higher energy users, as these customers tend to deliver greater therm savings.

Attachment P

Apex Analytics' Evaluation of SoCalGas's 2025 Residential Behavioral Outreach Program

Evaluation of Southern California Gas Company's 2025 Residential Behavioral Outreach Program

Submitted to:

Southern California Gas Company

Prepared by:

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November 17, 2025

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1. Executive Summary

SoCalGas's (Southern California Gas Company) Behavioral Outreach Program is designed to engage and educate residential customers in ways that encourage energy-saving behaviors and reduce overall gas consumption. Customers assigned to treatment conditions receive periodic Home Energy Reports (HERs) from either Opower (now Oracle) or Bidgely which offer no- and low-cost tips for reducing natural gas consumption. To help homeowners understand whether their energy use is typical, the reports also include comparisons of the customer's usage with similar households. This report documents therm savings for the program for Program Year 2025 (PY2025), which covers the period from November 2024 through October 2025. It should be noted that reports from both vendors were paused following the January 2025 wildfires in the SoCalGas territory. Oracle reports resumed on February 19 (email) and February 20 (paper), 2025 and reports resumed for Bidgely on April 28, 2025.

Table 1-1 summarizes aggregate PY2025 savings by season and vendor (Oracle or Bidgely). Approximately 1.9 million customers received treatment in PY2025, and the total natural gas savings was equal to 10.5 million therms (not including a market effect adjustment of 5% per D.12.11.015[1]).

Table 1-1: Aggregate PY2025 Therm Savings by Vendor and Season

Season	Vendor	Treatment Customers	Aggregate Therms Saved	Impact (%)	Savings (Per Customer)
Winter	Oracle	1,209,527	5,860,239	1.6%	4.8
	Bidgely	693,068	1,543,353	1.0%	2.2
	Total	**1,902,595**	**7,403,592**	**1.5%**	**3.9**
Non-Winter	Oracle	1,178,361	2,521,781	1.2%	2.1
	Bidgely	672,791	611,989	0.6%	0.9
	Total	**1,851,152**	**3,133,771**	**1.0%**	**1.7**
Annual	Oracle	1,191,254	8,382,021	1.5%	7.0
	Bidgely	680,809	2,155,342	0.9%	3.2
	Total	**1,872,063**	**10,537,363**	**1.3%**	**5.6**

The Behavioral Outreach Program is comprised of eighteen cohorts known as "waves". With the exception of Wave 12 and Wave 14, all treatment groups include customers in the top two quartiles of natural gas consumption. Impacts were estimated for each wave, outlined in Table 1-2.

[1] https://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M034/K299/34299795.PDF

Table 1-2: Waves Receiving Treatment in PY2025

Wave	Initial Treatment Year	Original Treatment	PY2018-PY2021 Treatment	PY2022-PY2025 Treatment	Wave Description	PY2025 Treatment Customers	Avg. Therms per Month
Wave 1	PY2016	Oracle + BTA	Oracle + BTA	Oracle HER	My Account	96,987	38.1
Wave 2	PY2016	Oracle HER	Oracle HER	Oracle HER	Non-My Account	73,072	38.5
Wave 3	PY2016	Oracle HER	Javelin	Bidgely Alerts	CARE	11,646	36.0
Wave 4	PY2017	Oracle + BTA Javelin + BTA	Oracle + BTA	Oracle HER	My Account	98,919	40.1
Wave 5	PY2017	Oracle HER Javelin	Oracle + BTA	Oracle HER	Non-My Account	170,376	40.5
Wave 6a	PY2017	Oracle HER	Javelin HER	Bidgely Alerts	CARE	16,197	37.1
Wave 6b		Javelin				4,667	39.8
Wave 7	PY2019	N/A	Aclara HER	Oracle HER	Non-CARE	332,433	42.6
Wave 8	PY2019	N/A	Javelin HER	Bidgely Alerts	CARE, Weather Sensitive	34,803	28.8
Wave 9	PY2019	N/A	Javelin HER	Bidgely Alerts	CARE, Non-Weather Sensitive	73,798	37.0
Wave 10	PY2020	N/A	Oracle HER	Oracle HER	Top 2 Quartiles of Natural Gas Consumption	74,555	31.2
Wave 11	PY2020	N/A	Aclara HER	Bidgely Alerts	Top 2 Quartiles of Natural Gas Consumption	58,391	42.6
Wave 12	PY2020	N/A	Bidgely Alerts	Bidgely Alerts	Average Natural Gas Consumption, Email-Only Treatment	256,981	21.0
Wave 13	PY2021	N/A	Oracle HER	Oracle HER	Top 2 Quartiles of Natural Gas Consumption	106,733	38.1
Wave 14	PY2021	N/A	Javelin HER	Bidgely Alerts	Top 3 Quartiles of Natural Gas Consumption, MyAccount, and CARE eligible (but not yet enrolled in CARE)	44,275	37.4
Wave 15	PY2021	N/A	Aclara HER	Bidgely Alerts	Top 2 Quartiles of Natural Gas Consumption	16,410	41.8

Wave	Initial Treatment Year	Original Treatment	PY2018-PY2021 Treatment	PY2022-PY2025 Treatment	Wave Description	PY2025 Treatment Customers	Avg. Therms per Month
Wave 16	PY2023	N/A	N/A	Oracle HER	Top 2 Quartiles of Natural Gas Consumption	74,254	35.3
Wave 17	PY2025	N/A	N/A	Bidgely Alerts	Top 2 Quartiles of Natural Gas Consumption (Equivalent eligible pool with Wave 18)	163,641	36.1
Wave 18	PY2025	N/A	N/A	Oracle HER	Top 2 Quartiles of Natural Gas Consumption (Equivalent eligible pool with Wave 17)	163,926	37.8

Each treatment cohort, or wave, in SoCalGas's Behavioral Outreach Program is designed as an independent randomized controlled trial (RCT) in which eligible customers are randomly assigned to either treatment or control conditions; customers assigned to treatment conditions receive HERs and those assigned to control conditions do not.

Customers in Wave 1 through Wave 3 were initially sampled for treatment as part of the 2015-2016 AMI Conservation Campaign. Wave 1 is comprised of customers enrolled in My Account while Wave 2 targeted non-My Account customers. Wave 3 is a low-income wave that only includes customers enrolled in the California Alternate Rates for Energy (CARE) program. Similarly, Wave 4, Wave 5, and Wave 6 were originally launched as part of the 2016-2017 AMI Conservation Campaign. Wave 4 and Wave 5 are My Account and non-My Account cohorts, respectively, and Wave 6 is a low-income wave. A portion of treatment customers in Wave 1, Wave 4, and Wave 5 received Bill Tracker Alerts (BTAs) in addition to Opower HERs.

Wave 7, Wave 8, and Wave 9 launched in November 2018 targeting non-My Account and CARE customers. Wave 10 and Wave 11 began treatment in November 2019. These waves include CARE and non-CARE customers, and both customers with and without My Account. Wave 12 launched in December 2019 and includes the largest customers in the second quartile of natural gas consumption. Per-customer savings were expected to be smaller than in other waves, as smaller customers typically produce smaller savings. However, aggregate savings are on par with other waves due to the large number of customers in the treatment group.

In November 2020, Wave 13 and Wave 15 began treatment. These two waves include customers in the top two quartiles of natural gas consumption. Wave 14 launched in December 2020 and includes the top three quartiles of natural gas consumption who are eligible for CARE (but not yet enrolled in CARE). Wave 16 launched in December 2022 (one month later than initially planned). Customers in Wave 16 are treated with Oracle HERs.

As of PY2022, SoCalGas no longer contracts with Javelin or Aclara as vendors. Customers in waves that were treated with Javelin or Aclara in PY2018 through PY2021 are now receiving treatment from Oracle or Bidgely. The table above includes the original treatment, PY2018 through PY2021 treatment, and PY2022 through PY2025 treatment for each wave.

More specifically, customers in Wave 7 were recently treated with Javelin reports but transitioned to Oracle reports in November 2021. Customers in Waves 3, 6a, 6b, 8, 9, 11, 14, and 15 were previously treated with Aclara or Javelin reports in PY2018 through PY2021 and transitioned to treatment with Bidgely in PY2022. However, treatment with Bidgely alerts did not launch until the end of February 2022. As a result, any therm savings incurred in November 2021 through February 2022 are attributable to persistence in savings from prior treatments.

The newest waves in the program are Wave 17 and Wave 18. These two waves were designed to compare energy savings across vendors. A group of 700,000 eligible customers was divided evenly, with half provided to Bidgely and half

provided to Oracle. Each vendor was instructed to select 210,000 customers (from 350,000) to be assigned to either treatment or control conditions.[2] Wave 18, the Oracle wave, launched in November 2025. Wave 17, the Bidgely wave, launched one month later than planned, in December 2025.

This report is organized as follows. Section 2 documents the methodology for estimating therm savings, and Section 3 summarizes the aggregate and seasonal therm savings estimates.

[2] Oracle and Bidgely were provided with statistically identical groups of eligible customers from which to select customers for treatment. Interestingly, customers selected by Oracle were higher energy users compared to those selected by Bidgely. Of the 210,000 households selected by each vendor, 175,000 were assigned to treatment and 35,000 to control.

2. Methodology

Natural gas savings achieved by the program were estimated using a lagged dependent variable (LDV) model. An LDV model includes pretreatment therms consumption as an explanatory variable for post-treatment usage. This is a standard approach for estimating energy savings attributable to behavioral programs designed as a randomized controlled trial (RCT). The analysis dataset includes individual monthly therms consumption for each customer in the treatment and control groups. The regression specification is presented in Equation 2-1, followed by definitions for each term in Table 2-1.

Equation 2-1: Lagged Dependent Variable Model Specification

$$therms_i = \beta_0 + \beta_1 \cdot treatment_i + \beta_2 \cdot pretherms_i + \sum_m \gamma_m \cdot pretherms_{i,m} \cdot month_m + \sum_m \delta_m \cdot month_m + u_i$$

Table 2-1: Lagged Dependent Variable Model Definitions

Variable	Definition
$therms_i$	Customer *i*'s average daily therms consumption
β_0	The estimated constant for energy consumption (average for all customers in all periods).
$treatment_i$	The treatment indicator variable for customer *i*. Equal to 1 for treatment customers and 0 otherwise.
β_1	The estimated coefficient for ***treatment***
$pretherms_i$	Pretreatment usage for customer *i* for month *t*. Pretreatment consumption for a particular month in the post treatment period refers to the same calendar month in the pretreatment period.
β_2	The estimated coefficient for ***pretherms***
$month_m$	Binary indicator for each month ***m*** in the analysis dataset
γ_m	The estimated coefficient for the interaction between ***pretherms*** and the month indicator variable
δ_m	Coefficient for each month indicator variable
u_i	Error term, clustered by customer

Therms savings for the Residential Behavioral Outreach Program were estimated separately for each wave. To maintain comparability between treatment and control groups, opt-outs (that is, customers assigned to treatment groups that requested to be removed from receiving the reports) are retained in the treatment groups throughout the course of the entire analysis period. Two reasons underlie this decision.

- First, because the experiment uses an opt-out delivery design (in which households in the treatment receive the reports without requesting them), households that subsequently opt out of receiving the reports received at least one report before they dropped out. So, strictly speaking, they were treated.
- Second, it is impossible to remove parties in the control group who would have opted out, because their identity is unknown. Removing opt-outs only from the treatment group without doing so for the control group would compromise the internal validity of the savings estimates.

HERs are assumed not to affect the rate at which customers close their accounts due to moving or other reasons; this appears to be true since the attrition rate between treatment and control groups are virtually identical. Treatment and control customers who move out during the analysis period are retained in each sample until their accounts close. This means that the population of interest grows smaller for both the control and treatment groups as time progresses.

3. Savings Summary

3.1 Annual and Seasonal Therm Savings

This section summarizes the savings for each treatment wave in the Residential Behavioral Outreach Program. Table 3-1 presents aggregate therm savings for the full program year from November 2024 through October 2025. The table also includes a 90% confidence interval, percent savings, and therm savings per customer. Savings estimates that are not statistically significant are shaded in gray. Reports from both vendors were paused following the January 2025 wildfires in the SoCalGas territory. Oracle reports resumed on February 19 (email) and February 20 (paper), 2025 and reports resumed for Bidgely on April 28, 2025. Additionally, Wave 17 launched one month later than intended (December 2025).

In total, the program achieved 10.5 million therms saved across 1.9 million treated residential customers. This is equivalent to 1.3% savings, or 5.6 therms per customer, and is statistically significant. Wave-specific percent savings ranged from 0.2% (Wave 3 and Wave 17, Bidgely) to 3.2% (Wave 1, Oracle). At the annual level, savings were statistically significant for all waves except for a few smaller or newly launched waves, including Wave 3 (Bidgely), Wave 14 (Bidgely), Wave 15 (Bidgely), and Wave 17 (Bidgely).

Wave 1, which includes treatment with BTAs and is one of the oldest waves in the program, achieved per-customer savings of 14.7 therms. In contrast, Wave 3, which is also one of the mature waves (but specifically targeted CARE customers), did not achieve statistically significant savings in PY2025.

Wave 17 and Wave 18, launched in late 2024, are the newest waves in the program. As expected, therm savings are modest in their initial year of treatment (0.2% and 0.6%, respectively) but are expected to grow as these cohorts mature.

A majority of customers in the program are treated with Oracle HERs. Waves under these treatment conditions achieved total annual savings equal to 8.4 million therms, or roughly 1.5%. Customers treated by Bidgely achieved 2.2 million therms saved, corresponding to 0.9% savings.

Table 3-1: Aggregate PY2025 Annual Therm Savings by Wave

Season	Wave	Vendor	Treatment Customers	Aggregate Therms Saved	90% Confidence Interval		Impact (%)	Therm Savings (Per Customer)
Annual	Wave 1	Oracle	96,987	1,429,356	1,274,403	1,584,309	3.2%	14.7
	Wave 2	Oracle	73,072	567,846	438,049	697,642	1.7%	7.8
	Wave 3	Bidgely	11,646	10,108	-27,162	47,379	0.2%	0.9
	Wave 4	Oracle	98,919	1,162,267	965,595	1,358,939	2.4%	11.7
	Wave 5	Oracle	170,376	1,745,751	1,445,270	2,046,233	2.1%	10.2
	Wave 6a	Bidgely	16,197	78,071	37,906	118,236	1.1%	4.8
	Wave 6b	Bidgely	4,667	44,232	16,982	71,482	2.0%	9.5
	Wave 7	Oracle	332,433	2,113,991	1,321,300	2,906,682	1.2%	6.4
	Wave 8	Bidgely	34,803	158,505	98,117	218,893	1.3%	4.6
	Wave 9	Bidgely	73,798	235,915	130,580	341,250	0.7%	3.2
	Wave 10	Oracle	74,555	335,523	237,805	433,242	1.2%	4.5
	Wave 11	Bidgely	58,391	407,145	225,767	588,524	1.4%	7.0
	Wave 12	Bidgely	256,981	969,383	765,856	1,172,910	1.5%	3.8
	Wave 13	Oracle	106,733	349,713	163,031	536,394	0.7%	3.3
	Wave 14	Bidgely	44,275	78,086	-42,565	198,737	0.4%	1.8
	Wave 15	Bidgely	16,410	46,907	-20,456	114,269	0.6%	2.9
	Wave 16	Oracle	74,254	196,546	81,974	311,118	0.6%	2.6
	Wave 17	Bidgely	163,641	126,990	-32,206	286,185	0.2%	0.8
	Wave 18	Oracle	163,926	481,028	313,666	648,389	0.6%	2.9
	Total		**1,872,063**	**10,537,363**	**9,526,934**	**11,547,792**	**1.3%**	**5.6**

The total therm savings for the winter period, summarized in Table 3-2, was roughly 7.4 million therms, which is a percent savings of 1.5%. Therm savings were statistically significant in most waves (the confidence intervals do not include zero), with winter percent impacts ranging from 0.1% to 3.5%. The greatest percentage savings, 3.5%, was observed in Wave 1, which is a population that received BTAs in addition to Oracle HERs. Customers in Wave 3, Wave 14, Wave 15, and Wave 17 did not have statistically significant therm savings in the winter months. Wave 17 and Wave 18 launched in December and November 2025, respectively, and are the newest waves in the program. Therm savings are expected to grow in the first several years of treatment.

Table 3-2: Aggregate PY2025 Winter Therm Savings by Wave

Season	Wave	Vendor	Treatment Customers	Aggregate Therms Saved	90% Confidence Interval		Impact (%)	Therm Savings (Per Customer)
Winter	Wave 1	Oracle	98,067	982,268	857,608	1,106,928	3.5%	10.0
	Wave 2	Oracle	74,059	413,450	306,033	520,866	1.9%	5.6
	Wave 3	Bidgely	11,790	21,030	-10,425	52,486	0.7%	1.8
	Wave 4	Oracle	100,081	722,959	572,500	873,418	2.4%	7.2
	Wave 5	Oracle	172,613	1,192,245	943,300	1,441,189	2.2%	6.9
	Wave 6a	Bidgely	16,403	58,157	24,924	91,389	1.3%	3.5
	Wave 6b	Bidgely	4,736	33,248	9,666	56,830	2.3%	7.0
	Wave 7	Oracle	336,965	1,601,658	945,894	2,257,422	1.4%	4.8
	Wave 8	Bidgely	35,245	122,407	71,857	172,957	1.7%	3.5
	Wave 9	Bidgely	74,770	180,449	93,688	267,210	0.9%	2.4
	Wave 10	Oracle	75,357	229,320	149,795	308,845	1.3%	3.0
	Wave 11	Bidgely	59,330	297,771	170,774	424,768	1.8%	5.0
	Wave 12	Bidgely	261,005	690,847	517,256	864,439	1.8%	2.6
	Wave 13	Oracle	107,926	314,232	172,300	456,164	1.1%	2.9
	Wave 14	Bidgely	44,860	73,513	-13,519	160,544	0.7%	1.6
	Wave 15	Bidgely	16,777	4,729	-47,200	56,659	0.1%	0.3
	Wave 16	Oracle	75,062	116,286	20,716	211,856	0.6%	1.5
	Wave 17	Bidgely	168,153	61,201	-58,163	180,566	0.1%	0.4
	Wave 18	Oracle	169,398	287,822	155,095	420,550	0.6%	1.7
	Total		**1,902,595**	**7,403,592**	**6,579,912**	**8,227,272**	**1.5%**	**3.9**

Finally, Table 3-3 summarizes non-winter therm savings. As a reminder, the non-winter period includes the months from April through October 2025. Multiple waves did not realize statistically significant savings during the warmer months, however savings were statistically significant for the program as a whole. On average, customers saved about 1.7 therms or 1.0%. This is equivalent to 3.1 million therms.

Table 3-3: Aggregate PY2025 Non-Winter Therm Savings by Wave

Season	Wave	Vendor	Treatment Customers	Aggregate Therms Saved	90% Confidence Interval		Impact (%)	Therm Savings (Per Customer)
Non-Winter	Wave 1	Oracle	96,224	447,088	355,055	539,122	2.7%	4.6
	Wave 2	Oracle	72,375	154,396	81,534	227,258	1.3%	2.1
	Wave 3	Bidgely	11,545	-10,922	-30,912	9,068	-0.5%	-0.9
	Wave 4	Oracle	98,099	439,308	312,651	565,964	2.5%	4.5
	Wave 5	Oracle	168,798	553,507	385,234	721,779	1.9%	3.3
	Wave 6a	Bidgely	16,052	19,914	-2,643	42,472	0.7%	1.2
	Wave 6b	Bidgely	4,618	10,984	-2,671	24,640	1.4%	2.4
	Wave 7	Oracle	329,234	512,333	66,988	957,678	0.9%	1.6
	Wave 8	Bidgely	34,492	36,098	3,062	69,134	0.7%	1.0
	Wave 9	Bidgely	73,112	55,466	-4,267	115,199	0.4%	0.8
	Wave 10	Oracle	73,990	106,204	49,417	162,990	1.0%	1.4
	Wave 11	Bidgely	57,728	109,374	-20,125	238,873	0.8%	1.9
	Wave 12	Bidgely	254,142	278,536	172,285	384,787	1.1%	1.1
	Wave 13	Oracle	105,892	35,480	-85,785	156,746	0.2%	0.3
	Wave 14	Bidgely	43,862	4,573	-78,986	88,133	0.1%	0.1
	Wave 15	Bidgely	16,151	42,177	-731	85,085	1.3%	2.6
	Wave 16	Oracle	73,684	80,260	17,069	143,451	0.7%	1.1
	Wave 17	Bidgely	161,089	65,788	-39,546	171,123	0.2%	0.4
	Wave 18	Oracle	160,065	193,205	91,258	295,152	0.7%	1.2
	Total		**1,851,152**	**3,133,771**	**2,548,520**	**3,719,021**	**1.0%**	**1.7**

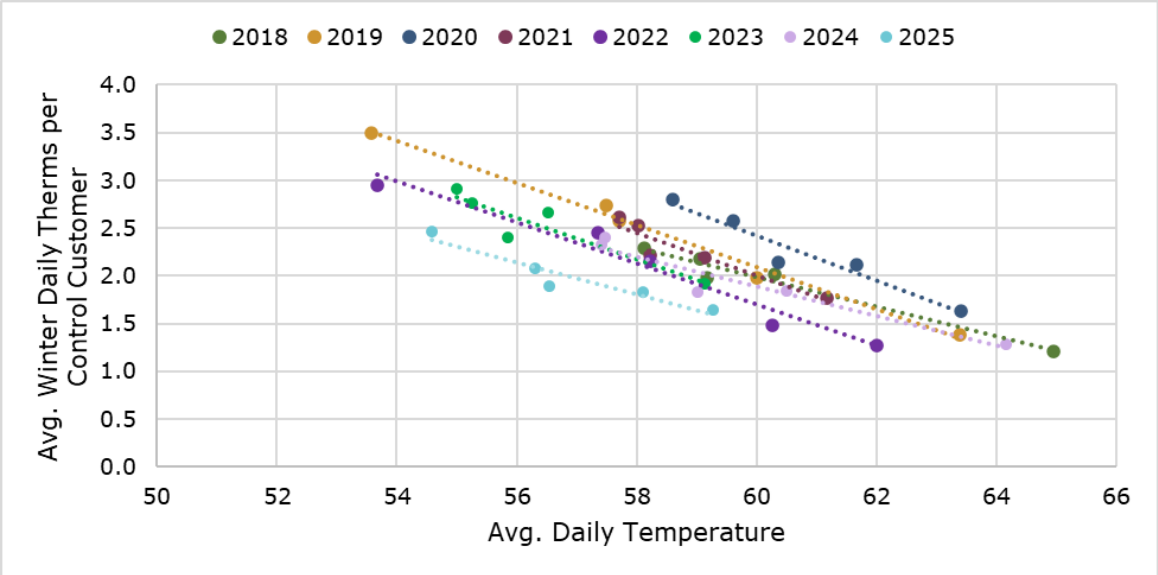
Table 3-4 summarizes annual therm savings for program years PY2018 through PY2025. In the past seven years, per-customer and percent savings were highest just prior to the COVID-19 pandemic (PY2019). That year, savings were equal to 8.9 therms per customer, which represents a 1.6% reduction in natural gas consumption. Per-customer savings were lower in PY2022; an in-depth analysis found that a notable decrease in natural gas consumption across both treatment and control customers was a driving factor behind declining savings. Once again, in PY2025, baseline consumption was notably lower than it was in the past. This, combined with the launch of two new waves in PY2025 (which have yet to ramp up to their full savings potential) may have contributed to smaller per-customer savings.

Table 3-4: Annual Therm Savings by Program Year

Program Year	Treatment Customers	Aggregate Therms Saved	% Impact	Per-Customer Therm Savings
PY2018	718,744	4,753,856	1.4%	6.6
PY2019	1,354,695	12,114,579	1.6%	8.9
PY2020	1,848,878	13,618,991	1.5%	7.4
PY2021	1,939,045	13,077,736	1.4%	6.7
PY2022	1,716,984	9,977,803	1.4%	5.8
PY2023	1,701,053	11,392,652	1.3%	6.7
PY2024	1,621,045	9,930,665	1.4%	6.1
PY2025	1,872,063	10,537,363	1.3%	5.6

Figure 3-1 illustrates the relationship between winter natural gas consumption and average daily temperature among control customers for PY2018 through PY2025. Each marker represents the average daily temperature and baseline therms per customer for one winter month.[3] As indicated by the purple (PY2022) and green (PY2023) trendlines, natural gas consumption was lower than earlier years (2018 through 2021) at similar temperatures. In winter PY2024 (shown in light purple), the relationship between consumption and weather was beginning to return to pre-2022 trends, especially at warmer temperatures. As discussed above, in PY2025, baseline consumption was lower than prior years, possibly due to a drier winter in the service territory.

Figure 3-1: Average Winter Daily Therms per Control Customer vs. Average Daily Temperature



[3] This figure only includes historical data for Wave 1 through Wave 6 to focus on waves that were in the field in PY2018 through PY2025.

Table 3-5 summarizes PY2025 therm savings compared to those in PY2024. While per-customer therm savings decreased from 6.1 therms to 5.6 therms, percent impact had a smaller decline (1.4% in PY2024 and 1.3% in PY2025). Again, the decline in per-customer savings may be attributed to a variety of factors, including the launch of two new treatment waves and the pause in treatment following wildfires within SoCalGas's service territory.

Table 3-5: Year-over-Year Comparison (PY2024 vs. PY2025)

Season	Vendor	Treatment Customers		Aggregate Therm Savings		Percent Savings		Per-Customer Therm Savings	
		PY2024	PY2025	PY2024	PY2025	PY2024	PY2025	PY2024	PY2025
Winter	Oracle	1,084,652	1,209,527	5,621,333	5,860,239	1.8%	1.6%	5.2	4.8
	Bidgely	556,431	693,068	1,491,341	1,543,353	1.3%	1.0%	2.7	2.2
	Total	**1,641,084**	**1,902,595**	**7,112,674**	**7,403,592**	**1.7%**	**1.5%**	**4.3**	**3.9**
Non-Winter	Oracle	1,064,645	1,178,361	2,055,255	2,521,781	1.1%	1.2%	1.9	2.1
	Bidgely	542,168	672,791	762,737	611,989	1.0%	0.6%	1.4	0.9
	Total	**1,606,812**	**1,851,152**	**2,817,992**	**3,133,771**	**1.0%**	**1.0%**	**1.8**	**1.7**
Annual	Oracle	1,072,954	1,191,254	7,676,588	8,382,021	1.5%	1.5%	7.2	7.0
	Bidgely	548,091	680,809	2,254,077	2,155,342	1.2%	0.9%	4.1	3.2
	Total	**1,621,045**	**1,872,063**	**9,930,665**	**10,537,363**	**1.4%**	**1.3%**	**6.1**	**5.6**

3.2 Savings versus Projection

Prior to this analysis, the Apex Analytics team developed a therm savings projection for PY2025. The therm savings forecast inputs are based on historical monthly therm savings and historical weather data from PY2021 through PY2024 (a total of 48 months). A comparison of projected and actual therm savings is presented in Table 3-6. The forecasted annual savings for the HER program was 9.7 million therms. The program achieved 109% of that forecast, with total savings of 10.5 million therms.

Table 3-6: PY2025 Therm Savings vs. Projection

Season	Wave	Vendor	Projected			Actual			% of Projection Achieved
			Customers	Therm Savings Per Customer	Aggregate Therm Savings	Customers	Therm Savings Per Customer	Aggregate Therm Savings	
PY2025 (Nov - Oct)	Wave 1	Oracle	97,453	13.4	1,317,429	96,987	14.7	1,429,356	108%
	Wave 2	Oracle	73,709	6.8	507,517	73,072	7.8	567,846	112%
	Wave 3	Bidgely	11,680	2.8	33,552	11,646	0.9	10,108	30%
	Wave 4	Oracle	99,696	11.2	1,121,851	98,919	11.7	1,162,267	104%
	Wave 5	Oracle	171,479	8.3	1,436,891	170,376	10.2	1,745,751	121%
	Wave 6a	Bidgely	16,234	5.4	87,850	16,197	4.8	78,071	89%
	Wave 6b	Bidgely	4,689	5.4	25,489	4,667	9.5	44,232	174%
	Wave 7	Oracle	334,785	5.9	1,971,392	332,433	6.4	2,113,991	107%
	Wave 8	Bidgely	34,853	3.1	107,664	34,803	4.6	158,505	147%
	Wave 9	Bidgely	74,169	3.8	285,170	73,798	3.2	235,915	83%
	Wave 10	Oracle	75,005	3.7	282,513	74,555	4.5	335,523	119%
	Wave 11	Bidgely	58,874	7.1	420,810	58,391	7.0	407,145	97%
	Wave 12	Bidgely	258,076	2.8	717,741	256,981	3.8	969,383	135%
	Wave 13	Oracle	107,320	3.0	326,019	106,733	3.3	349,713	107%
	Wave 14	Bidgely	45,652	2.3	107,150	44,275	1.8	78,086	73%
	Wave 15	Bidgely	16,467	7.3	121,303	16,410	2.9	46,907	39%
	Wave 16	Oracle	74,567	2.7	200,449	74,254	2.6	196,546	98%
	Wave 17	Bidgely	172,263	1.9	324,464	163,641	0.8	126,990	39%
	Wave 18	Oracle	172,263	1.8	306,968	163,926	2.9	481,028	157%
	Annual Therm Savings		**1,899,234**	**5.1**	**9,702,222**	**1,872,063**	**5.6**	**10,537,363**	**109%**

4. Conclusions & Recommendations

Total estimated savings for SoCalGas's Behavioral Outreach Program reached over 10 million therms for the months from November 2024 through October 2025. This is equivalent to a 1.3% reduction in natural gas consumption among over 1,900,000 treated customers, a slight decrease in percentage savings from 1.4% per customer in PY2024. Overall energy savings decreased from 6.1 therms per customer in PY2024 to 5.6 therms per customer in PY2025. In the winter months (November through March) the program provided roughly 7.4 million therms of savings – equivalent to a 1.5% reduction.

The Residential Behavioral Outreach Program continues to make a valuable contribution to the SoCalGas energy efficiency portfolio by generating significant natural gas savings. However, it may be beneficial for SoCalGas to explore strategies to increase savings in future program years and consider opportunities outside of the Behavioral Outreach Program. For instance, targeting natural gas water heater owners with high consumption, providing additional reminders and notifications, and leveraging customers' interest in sustainability could prove effective. As new waves are introduced to the program, SoCalGas should continue to focus on higher energy users, as these customers tend to deliver greater therm savings.

Attachment Q

Alternatives Analysis Detailed Cost Comparison

Proposed Scenario (Scenario 1)
Years: 2025-2050
Direct Costs (in 2025$)

Forecasted Years: 2025-2027

Cost Type	2025	2026	2027
O&M	$ -	$ 3,862,220	$ 4,141,638
Capital	5,385,340	13,746,287	51,323,619
Total	**$ 5,385,340**	**$ 17,608,507**	**$ 55,465,257**

Forecasted Years: 2028-2033

Cost Type	2028	2029	2030	2031	2032	2033
O&M	$ 6,102,889	$ 22,913,637	$ 45,274,296	$ 50,987,923	$ 50,481,467	$ 41,570,019
Capital	62,701,594	204,450,653	303,707,289	255,290,218	196,531,712	135,103,709
Total	**$ 68,804,484**	**$ 227,364,289**	**$ 348,981,586**	**$ 306,278,141**	**$ 247,013,179**	**$ 176,673,728**

Forecasted Years: 2034-2039

Cost Type	2034	2035	2036	2037	2038	2039
O&M	$ 26,349,787	$ 6,787,759	$ 9,306,922	$ 9,306,922	$ 9,306,922	$ 9,306,922
Capital	17,192,104	-	53,882,700	-	-	53,882,700
Total	**$ 43,541,891**	**$ 6,787,759**	**$ 63,189,622**	**$ 9,306,922**	**$ 9,306,922**	**$ 63,189,622**

Forecasted Years: 2040-2045

Cost Type	2040	2041	2042	2043	2044	2045
O&M	$ 9,306,922	$ 9,306,922	$ 9,306,922	$ 9,306,922	$ 9,306,922	$ 9,306,922
Capital	-	-	53,882,700	-	-	53,882,700
Total	**$ 9,306,922**	**$ 9,306,922**	**$ 63,189,622**	**$ 9,306,922**	**$ 9,306,922**	**$ 63,189,622**

Forecasted Years: 2046-2050

Cost Type	2046	2047	2048	2049	2050	**Total**
O&M	$ 9,306,922	$ 9,306,922	$ 9,306,922	$ 9,306,922	$ 9,306,922	**$ 398,075,464**
Capital	-	-	53,882,700	-	-	**1,514,846,025**
Total	**$ 9,306,922**	**$ 9,306,922**	**$ 63,189,622**	**$ 9,306,922**	**$ 9,306,922**	**$ 1,912,921,489**

NOTE: The AMIR Application differs from Scenario 1, as the AMIR Application forecasted costs between 2025 to 2034,

Proposed Scenario (Scenario 1)
Years: 2025-2050
Total Loaded and Escalated Costs wo AFUDC

Forecasted Years: 2025-2027

Cost Type	2025	2026	2027
O&M	$ -	$ 4,822,358	$ 5,062,665
Capital	6,814,709	17,548,429	64,839,848
Total	**$ 6,814,709**	**$ 22,370,787**	**$ 69,902,513**

Forecasted Years: 2028-2033

Cost Type	2028	2029	2030	2031	2032	2033
O&M	$ 7,652,798	$ 30,557,390	$ 72,853,145	$ 88,509,488	$ 88,474,864	$ 74,830,652
Capital	81,670,964	261,605,462	406,070,167	366,579,041	299,008,596	210,647,698
Total	**$ 89,323,762**	**$ 292,162,852**	**$ 478,923,312**	**$ 455,088,529**	**$ 387,483,460**	**$ 285,478,350**

Forecasted Years: 2034-2039

Cost Type	2034	2035	2036	2037	2038	2039
O&M	$ 44,717,963	$ 11,381,980	$ 17,676,115	$ 18,144,214	$ 18,624,892	$ 19,118,491
Capital	33,145,838	-	82,872,065	-	-	92,926,025
Total	**$ 77,863,800**	**$ 11,381,980**	**$ 100,548,180**	**$ 18,144,214**	**$ 18,624,892**	**$ 112,044,516**

Forecasted Years: 2040-2045

Cost Type	2040	2041	2042	2043	2044	2045
O&M	$ 19,625,362	$ 20,145,867	$ 20,680,377	$ 21,229,273	$ 21,792,948	$ 22,371,805
Capital	-	-	104,220,587	-	-	116,909,359
Total	**$ 19,625,362**	**$ 20,145,867**	**$ 124,900,964**	**$ 21,229,273**	**$ 21,792,948**	**$ 139,281,164**

Forecasted Years: 2046-2050

Cost Type	2046	2047	2048	2049	2050	**Total**
O&M	$ 22,966,257	$ 23,576,729	$ 24,203,659	$ 24,847,496	$ 25,508,701	**$ 749,375,491**
Capital	-	-	131,165,542	-	-	**2,276,024,330**
Total	**$ 22,966,257**	**$ 23,576,729**	**$ 155,369,202**	**$ 24,847,496**	**$ 25,508,701**	**$ 3,025,399,821**

Failure-Based Replacement (Scenario 2)
Years: 2025-2050
Direct Costs (in 2025$)

Forecasted Years: 2025-2027

Cost Type	2025	2026	2027
O&M	$ -	$ 4,391,314	$ 5,043,927
Capital	5,385,340	12,543,222	49,190,812
Total	**$ 5,385,340**	**$ 16,934,536**	**$ 54,234,738**

Forecasted Years: 2028-2033

Cost Type	2028	2029	2030	2031	2032	2033
O&M	$ 4,551,271	$ 11,822,831	$ 39,761,548	$ 44,366,285	$ 64,290,746	$ 89,085,231
Capital	55,339,184	75,854,935	127,432,033	88,999,295	109,079,845	192,083,172
Total	**$ 59,890,455**	**$ 87,677,766**	**$ 167,193,581**	**$ 133,365,579**	**$ 173,370,591**	**$ 281,168,403**

Forecasted Years: 2034-2039

Cost Type	2034	2035	2036	2037	2038	2039
O&M	$ 112,765,630	$ 113,959,599	$ 94,501,499	$ 53,783,821	$ 46,724,283	$ 42,535,099
Capital	200,066,109	196,499,656	203,898,423	75,272,739	76,589,680	103,064,802
Total	**$ 312,831,739**	**$ 310,459,255**	**$ 298,399,922**	**$ 129,056,560**	**$ 123,313,963**	**$ 145,599,900**

Forecasted Years: 2040-2045

Cost Type	2040	2041	2042	2043	2044	2045
O&M	$ 37,434,194	$ 9,306,922	$ 9,306,922	$ 9,306,922	$ 9,306,922	$ 9,306,922
Capital	41,694,895	-	53,882,700	-	-	53,882,700
Total	**$ 79,129,088**	**$ 9,306,922**	**$ 63,189,622**	**$ 9,306,922**	**$ 9,306,922**	**$ 63,189,622**

Forecasted Years: 2046-2050

Cost Type	2046	2047	2048	2049	2050	**Total**
O&M	$ 9,306,922	$ 9,306,922	$ 9,306,922	$ 9,306,922	$ 9,306,922	**$ 858,086,495**
Capital	-	-	53,882,700	-	-	**1,774,642,243**
Total	**$ 9,306,922**	**$ 9,306,922**	**$ 63,189,622**	**$ 9,306,922**	**$ 9,306,922**	**$ 2,632,728,738**

Failure-Based Replacement (Scenario 2)
Years: 2025-2050
Total Loaded and Escalated Costs wo AFUDC

Forecasted Years: 2025-2027

Cost Type	2025	2026	2027
O&M	$ -	$ 5,906,994	$ 6,985,430
Capital	6,814,709	16,161,499	62,379,097
Total	**$ 6,814,709**	**$ 22,068,493**	**$ 69,364,527**

Forecasted Years: 2028-2033

Cost Type	2028	2029	2030	2031	2032	2033
O&M	$ 6,172,558	$ 18,303,794	$ 71,183,242	$ 80,000,116	$ 118,538,083	$ 174,740,424
Capital	72,860,881	102,431,317	173,956,438	129,744,228	166,370,292	295,288,837
Total	**$ 79,033,438**	**$ 120,735,111**	**$ 245,139,680**	**$ 209,744,345**	**$ 284,908,375**	**$ 470,029,261**

Forecasted Years: 2034-2039

Cost Type	2034	2035	2036	2037	2038	2039
O&M	$ 227,792,586	$ 237,566,401	$ 200,799,201	$ 112,141,511	$ 97,255,495	$ 89,867,956
Capital	326,579,413	332,951,555	346,705,708	137,405,253	148,194,235	189,793,746
Total	**$ 554,371,999**	**$ 570,517,956**	**$ 547,504,909**	**$ 249,546,764**	**$ 245,449,730**	**$ 279,661,702**

Forecasted Years: 2040-2045

Cost Type	2040	2041	2042	2043	2044	2045
O&M	$ 84,453,800	$ 20,145,867	$ 20,680,377	$ 21,229,273	$ 21,792,948	$ 22,371,805
Capital	78,852,298	-	104,220,588	-	-	116,909,360
Total	**$ 163,306,098**	**$ 20,145,867**	**$ 124,900,965**	**$ 21,229,273**	**$ 21,792,948**	**$ 139,281,165**

Forecasted Years: 2046-2050

Cost Type	2046	2047	2048	2049	2050	**Total**
O&M	$ 22,966,257	$ 23,576,729	$ 24,203,659	$ 24,847,496	$ 25,508,701	**$ 1,759,030,705**
Capital	-	-	131,165,543	-	-	**2,938,784,998**
Total	**$ 22,966,257**	**$ 23,576,729**	**$ 155,369,203**	**$ 24,847,496**	**$ 25,508,701**	**$ 4,697,815,702**

Manual Meter Reading (Scenario 3)
Years: 2025-2050
Direct Costs (in 2025$)

Forecasted Years: 2025-2027

Cost Type	2025	2026	2027
O&M	$ 315,256	$ 2,251,490	$ 2,039,190
Capital	2,915,116	5,295,915	7,841,239
Total	**$ 3,230,372**	**$ 7,547,405**	**$ 9,880,429**

Forecasted Years: 2028-2033

Cost Type	2028	2029	2030	2031	2032	2033
O&M	$ 101,723,450	$ 115,698,297	$ 169,497,899	$ 224,103,145	$ 220,258,544	$ 206,059,102
Capital	411,861,071	10,371,874	32,735,230	31,457,802	25,506,225	25,832,643
Total	**$ 513,584,521**	**$ 126,070,171**	**$ 202,233,130**	**$ 255,560,947**	**$ 245,764,769**	**$ 231,891,745**

Forecasted Years: 2034-2039

Cost Type	2034	2035	2036	2037	2038	2039
O&M	$ 214,433,262	$ 133,765,912	$ 133,765,912	$ 133,765,912	$ 133,765,912	$ 133,765,912
Capital	4,429,188	150,267	8,280,462	150,267	150,267	8,280,462
Total	**$ 218,862,450**	**$ 133,916,179**	**$ 142,046,374**	**$ 133,916,179**	**$ 133,916,179**	**$ 142,046,374**

Forecasted Years: 2040-2045

Cost Type	2040	2041	2042	2043	2044	2045
O&M	$ 133,765,912	$ 133,765,912	$ 133,765,912	$ 133,765,912	$ 133,765,912	$ 133,765,912
Capital	150,267	150,267	8,280,462	150,267	150,267	8,280,462
Total	**$ 133,916,179**	**$ 133,916,179**	**$ 142,046,374**	**$ 133,916,179**	**$ 133,916,179**	**$ 142,046,374**

Forecasted Years: 2046-2050

Cost Type	2046	2047	2048	2049	2050	**Total**
O&M	$ 133,765,912	$ 133,765,912	$ 133,765,912	$ 133,765,912	$ 133,765,912	**$ 3,396,634,224**
Capital	150,267	150,267	5,570,397	150,267	150,267	**598,591,491**
Total	**$ 133,916,179**	**$ 133,916,179**	**$ 139,336,309**	**$ 133,916,179**	**$ 133,916,179**	**$ 3,995,225,715**

Manual Meter Reading (Scenario 3)
Years: 2025-2050
Total Loaded and Escalated Costs wo AFUDC

Forecasted Years: 2025-2027

Cost Type	2025	2026	2027
O&M	$ 582,208	$ 2,952,353	$ 3,236,134
Capital	3,844,586	6,850,951	10,431,510
Total	**$ 4,426,794**	**$ 9,803,304**	**$ 13,667,643**

Forecasted Years: 2028-2033

Cost Type	2028	2029	2030	2031	2032	2033
O&M	$ 138,545,631	$ 196,526,418	$ 296,754,563	$ 411,184,013	$ 415,326,507	$ 399,517,749
Capital	442,987,701	13,556,499	42,323,649	44,304,034	36,961,469	35,889,640
Total	**$ 581,533,332**	**$ 210,082,917**	**$ 339,078,212**	**$ 455,488,048**	**$ 452,287,976**	**$ 435,407,389**

Forecasted Years: 2034-2039

Cost Type	2034	2035	2036	2037	2038	2039
O&M	$ 389,246,311	$ 280,676,316	$ 288,580,286	$ 296,679,422	$ 305,006,923	$ 313,569,252
Capital	7,259,603	175,871	9,868,363	182,138	185,249	10,382,598
Total	**$ 396,505,914**	**$ 280,852,186**	**$ 298,448,648**	**$ 296,861,561**	**$ 305,192,172**	**$ 323,951,850**

Forecasted Years: 2040-2045

Cost Type	2040	2041	2042	2043	2044	2045
O&M	$ 322,373,053	$ 331,425,161	$ 340,732,606	$ 350,302,614	$ 360,142,619	$ 370,260,265
Capital	192,000	196,089	10,926,943	204,528	208,883	11,500,422
Total	**$ 322,565,053**	**$ 331,621,250**	**$ 351,659,548**	**$ 350,507,142**	**$ 360,351,502**	**$ 381,760,687**

Forecasted Years: 2046-2050

Cost Type	2046	2047	2048	2049	2050	**Total**
O&M	$ 380,663,413	$ 391,360,148	$ 402,358,783	$ 413,667,869	$ 425,296,197	**$ 7,826,966,815**
Capital	217,873	222,512	8,145,105	232,089	237,030	**697,487,333**
Total	**$ 380,881,286**	**$ 391,582,660**	**$ 410,503,888**	**$ 413,899,957**	**$ 425,533,228**	**$ 8,524,454,148**

Present Value

Forecasted Years: 2025-2050

	Discount Rate	Present Value
Proposed Scenario (Scenario 1)	7.52%	$ 1,569,177,046
Failure-Based Replacement (Scenario 2)	7.52%	$ 2,124,884,743
Manual Meter Reading (Scenario 3)	7.52%	$ 3,262,174,835

Proposed Scenario (Scenario 1)
Revenue Requirement
Years: 2025-2071

Years: 2025-2030

	2025	2026	2027	2028	2029	2030
Revenue Requirement	$ -	$ 4,969,263	$ 5,240,396	$ 11,808,230	$ 62,021,781	$ 201,211,729

Years: 2031-2037

	2031	2032	2033	2034	2035	2036	2037
Revenue Requirement	$ 274,120,493	$ 319,646,395	$ 342,710,927	$ 319,813,645	$ 252,865,070	$ 254,086,260	$ 247,939,531

Years: 2038-2044

	2038	2039	2040	2041	2042	2043	2044
Revenue Requirement	$ 236,730,177	$ 226,906,570	$ 220,697,448	$ 210,509,597	$ 207,931,631	$ 203,683,326	$ 191,132,283

Years: 2045-2051

	2045	2046	2047	2048	2049	2050	2051
Revenue Requirement	$ 186,047,638	$ 180,360,563	$ 169,232,917	$ 166,183,907	$ 158,230,477	$ 134,414,236	$ 57,663,498

Years: 2052-2058

	2052	2053	2054	2055	2056	2057	2058
Revenue Requirement	$ 16,411,435	$ 3,681,266	$ (966,652)	$ (1,956,874)	$ (2,214,660)	$ (2,455,981)	$ (2,624,586)

Years: 2059-2065

	2059	2060	2061	2062	2063	2064	2065
Revenue Requirement	$ (2,659,205)	$ (2,677,605)	$ (2,695,492)	$ (2,708,412)	$ (2,658,066)	$ (2,381,335)	$ (1,803,015)

Years: 2066-2071

	2066	2067	2068	2069	2070	2071	**Total**
Revenue Requirement	$ (1,085,827)	$ (445,324)	$ (73,987)	$ 15,555	$ 8,145	$ (216)	**$ 4,836,867,153**

Failure-Based Replacement (Scenario 2)
Revenue Requirement
Years: 2025-2078

Years: 2025-2030							
	2025	2026	2027	2028	2029	2030	
Revenue Requirement	$ -	$ 6,086,938	$ 7,196,279	$ 8,811,363	$ 34,050,792	$ 151,712,647	
Years: 2031-2037							
	2031	2032	2033	2034	2035	2036	2037
Revenue Requirement	$ 180,426,118	$ 240,041,534	$ 334,094,874	$ 429,701,770	$ 459,528,669	$ 470,053,465	$ 407,987,492
Years: 2038-2044							
	2038	2039	2040	2041	2042	2043	2044
Revenue Requirement	$ 402,755,566	$ 403,145,118	$ 403,034,541	$ 328,572,165	$ 322,281,971	$ 313,917,943	$ 297,546,961
Years: 2045-2051							
	2045	2046	2047	2048	2049	2050	2051
Revenue Requirement	$ 288,673,738	$ 279,213,734	$ 264,359,088	$ 258,230,231	$ 251,223,060	$ 232,819,911	$ 162,833,121
Years: 2052-2058							
	2052	2053	2054	2055	2056	2057	2058
Revenue Requirement	$ 124,586,206	$ 104,063,378	$ 80,499,904	$ 56,559,073	$ 36,064,242	$ 22,501,493	$ 12,780,929
Years: 2059-2065							
	2059	2060	2061	2062	2063	2064	2065
Revenue Requirement	$ 5,011,266	$ (464,778)	$ (2,801,498)	$ (3,087,241)	$ (3,365,011)	$ (3,585,633)	$ (3,674,177)
Years: 2066-2072							
	2066	2067	2068	2069	2070	2071	2072
Revenue Requirement	$ (3,526,445)	$ (3,256,172)	$ (2,864,702)	$ (2,281,372)	$ (1,640,611)	$ (1,017,364)	$ (668,629)
Years: 2073-2078							
	2073	2074	2075	2076	2077	2078	**Total**
Revenue Requirement	$ (416,615)	$ (183,396)	$ (28,759)	$ 22,403	$ (593)	$ 16	**$ 7,347,524,999**

Manual Meter Reading (Scenario 3)
Revenue Requirement
Years: 2025-2071

Years: 2025-2030

	2025	2026	2027	2028	2029	2030
Revenue Requirement	$ 599,951	$ 3,040,941	$ 4,050,882	$ 175,878,222	$ 269,392,953	$ 381,248,556

Years: 2031-2037

	2031	2032	2033	2034	2035	2036	2037
Revenue Requirement	$ 503,390,456	$ 511,362,536	$ 497,842,356	$ 482,828,523	$ 366,696,476	$ 372,435,767	$ 378,261,580

Years: 2038-2044

	2038	2039	2040	2041	2042	2043	2044
Revenue Requirement	$ 383,878,465	$ 390,390,164	$ 397,014,802	$ 403,358,265	$ 410,646,148	$ 418,057,227	$ 425,179,947

Years: 2045-2051

	2045	2046	2047	2048	2049	2050	2051
Revenue Requirement	$ 433,306,129	$ 441,572,283	$ 449,471,120	$ 457,628,650	$ 466,386,740	$ 475,193,940	$ 31,594,342

Years: 2052-2058

	2052	2053	2054	2055	2056	2057	2058
Revenue Requirement	$ 27,514,036	$ 20,937,088	$ 2,112,319	$ 2,252,110	$ 1,654,629	$ 1,098,984	$ (517,880)

Years: 2059-2065

	2059	2060	2061	2062	2063	2064	2065
Revenue Requirement	$ (202,059)	$ (580,359)	$ (805,782)	$ (1,025,172)	$ (616,683)	$ (255,602)	$ (243,092)

Years: 2066-2071

	2066	2067	2068	2069	2070	2071	**Total**
Revenue Requirement	$ (162,913)	$ (81,064)	$ (22,509)	$ 2,507	$ 1,879	$ (50)	**$ 9,581,767,813**

Revenue Requirement

Present Value of Revenue Requirement

	Years	Discount Rate	Present Value
Proposed Scenario (Scenario 1)	2025-2071	7.52%	$ 1,823,414,783
Failure-Based Replacement (Scenari	2025-2078	7.52%	$ 2,431,500,553
Manual Meter Reading (Scenario 3)	2025-2071	7.52%	$ 3,460,986,730