



The time to act is now

**2022
ANNUAL
REPORT**

**RESEARCH,
DEVELOPMENT, AND
DEMONSTRATION**

“California is leading the planet
in building a clean energy future...



...and **SoCalGas**[®], the nation's largest natural gas distribution utility, is collaborating with stakeholders to innovate...



...and to deploy new energy technologies so that every Californian can have access to **clean, safe, and reliable energy.**”

—MARYAM BROWN
PRESIDENT
SOCALGAS



Contents

Introduction	5
Vision, Mission, & Values	7
Program Benefits	8

2022 in Review .. 9

Financial Highlights	10
Significant 2022 Milestones	12
2022 Equity Activities	16
Equity Spotlight	17

Program

Program Goals and Structure	20
Research Collaborators	21
Program Areas	
Low Carbon Resources	22
Gas Operations	25
Clean Transportation	28
Clean Generation	31
Customer End-Use Applications	34

Appendix

2022 Attributions	38
Endnotes	39

Introduction

Atmospheric greenhouse gas (GHG) emissions from human activities are driving climate change and are now at their highest levels in recorded history.^{1,2} These GHGs trap heat, melting glaciers, warming the world's oceans, and raising sea levels.³ A hotter Earth is also associated with more extreme weather-related events, including floods, heat waves, droughts, and hurricanes.⁴

As a result, some of the world's most sensitive ecosystems—from the High Arctic tundra to the ice shelves of Antarctica—are undergoing massive and sometimes irreversible change. The cost of climate change is not limited to the natural world. It affects every country on the Earth, and the poorest and most vulnerable people are often impacted the most.

The time to act is now.

To slow the pace of climate change and avoid its most significant consequences, aggressive action to reduce and ultimately eliminate net GHG emissions is required. One of the most impactful ways to do this is through a massive transformation in how the world produces and consumes energy. Fortunately, there has never been a time in human history when we have had more tools to do just that.

Guided by forward-thinking energy and environmental policy, countries around the world are developing scalable, effective, and increasingly affordable clean energy and clean transportation solutions. More and more people, businesses, and governments are adopting these technologies, driving down costs and increasing confidence in the new technologies. These efforts are paying off. In the last 10 years, the price of solar electricity has dropped by 89% and the price of wind electricity by 70%.⁵

Businesses are on board. Nearly half of the largest companies in the U.S. now recognize that they have a responsibility to tackle climate change and help preserve the planet for future generations.⁶

SoCalGas is a leader among those companies.

“We’ve already waited too long to deal with this climate crisis. We can’t wait any longer. We see it with our own eyes, we feel it. We know it in our bones. And it’s time to act.”

—PRESIDENT JOE BIDEN

SoCalGas RD&D Pursues Innovation and Decarbonization

With more than 21 million customers and one of the nation's largest gas distribution systems, consisting of pipeline and storage facilities, SoCalGas is playing a central role in the ongoing decarbonization of the energy industry.

In the short term, the existing gas distribution network can be used to carry clean fuels, such as renewable natural gas (RNG) and, potentially, green hydrogen. Sustainable progress, however, will require a diversified portfolio of clean energy sources, technologies, and tools, as well as energy efficiency, to provide resilience and reduce the risks of over-dependence on any one technology.

SoCalGas Research, Development, and Demonstration (RD&D)—a department within SoCalGas—is tasked with identifying and supporting projects and technologies with the potential to save energy, reduce GHG emissions, improve air quality, and increase the safety, reliability, and affordability of energy.

In 2022 alone, RD&D staff invested \$13,430,264 in hundreds of energy technology and clean fuels projects—from technology that converts carbon dioxide (CO₂) from industrial sources into consumer products to fuel-flexible power generators or innovative hydrogen fuel cell yard trucks for demanding port operations.

Driven by scientific research and collaboration with subject matter experts from universities, national labs, public agencies, private industry, and research consortia, RD&D staff are committed to accelerating the energy transition to clean fuels and to educating policy-makers, industry, and the public about the many opportunities and technology pathways to achieve that goal.

“We are seeing exciting progress in making hydrogen cleaner, more affordable, and more available for use across different sectors of the economy.”

—FATIH BIROL
EXECUTIVE DIRECTOR
INTERNATIONAL ENERGY
AGENCY

Vision, Mission, & Values

The vision, mission, and values of SoCalGas RD&D align with SoCalGas' mission to build the cleanest, safest, and most innovative energy infrastructure company in America.

RD&D VISION

Advancing innovative technologies for safer, cleaner, and more reliable energy.

RD&D MISSION

Identify transformational energy solutions. Build them. Share them with the world.

RD&D VALUES

Science

Our experts in science, engineering, energy systems, and environmental policy seek answers to some of today's most pressing energy questions.

Synergy

We work with the world's finest researchers in universities, national labs, and industry to develop transformational technologies that support decarbonization, energy security, and economic development.

Equity

We champion technologies that support affordable access to clean, safe, and reliable energy for all Californians.

Program Benefits

Each year, SoCalGas RD&D supports hundreds of projects along the commercialization pathway, with the ultimate goals of saving energy, reducing GHG emissions, improving air quality, and increasing energy safety, reliability, and affordability.



2022

IN REVIEW

“Developing a source of safe, affordable green hydrogen is key to achieving our clean energy future by 2035, while ensuring the reliability we all need and depend on.”

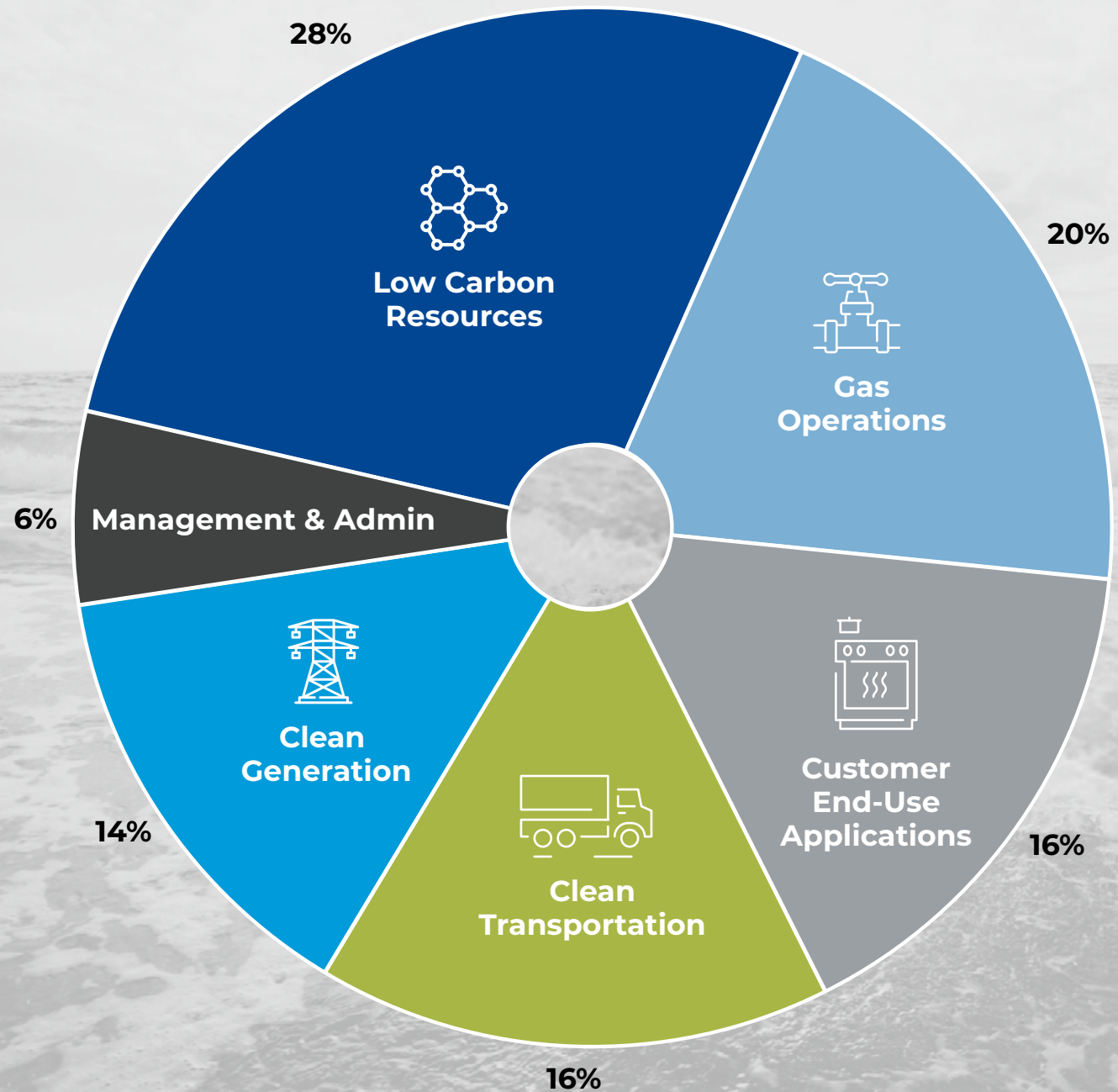
—MARTY ADAMS
CHIEF ENGINEER AND
GENERAL MANAGER,
LOS ANGELES DEPARTMENT
OF WATER AND POWER



Financial Highlights

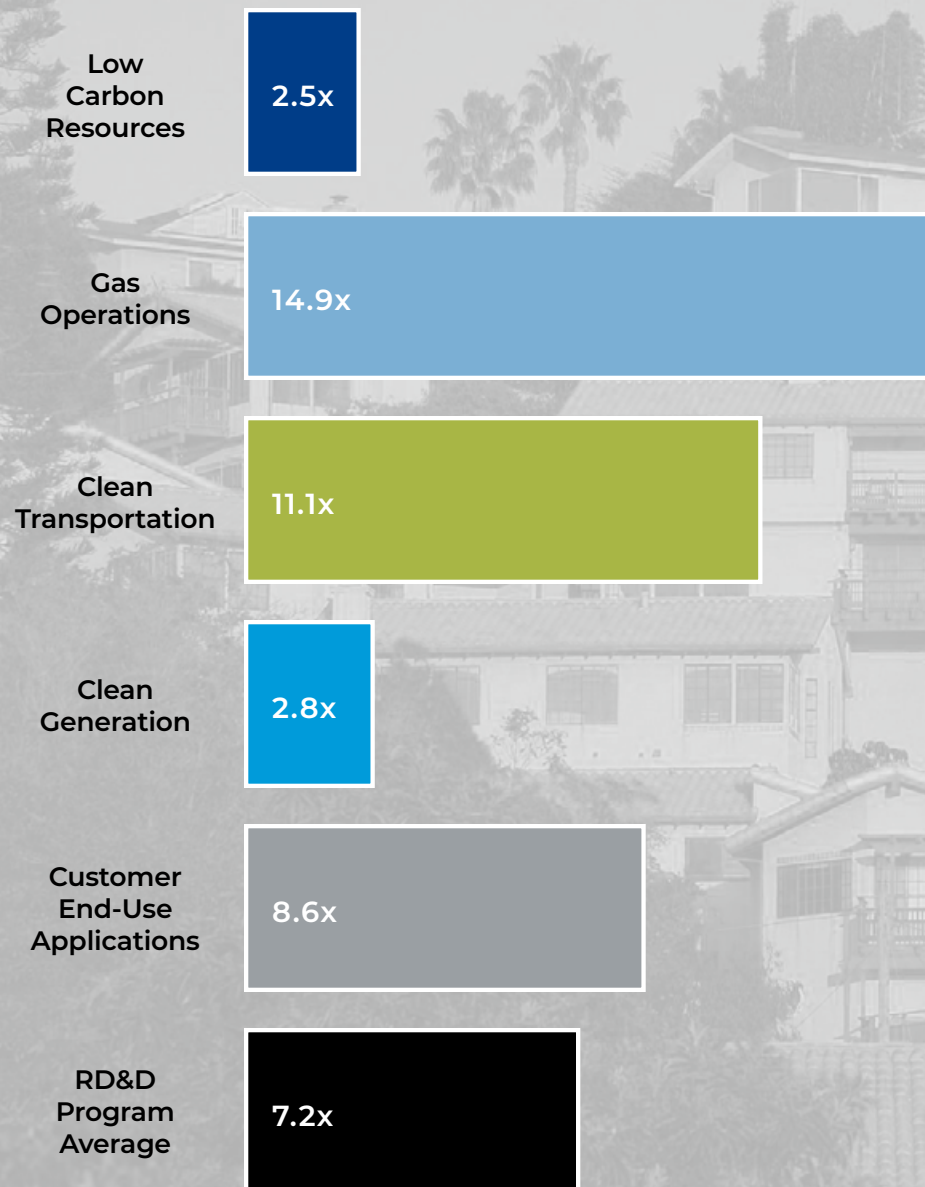
In 2022, SoCalGas RD&D supported 339 RD&D projects and distributed \$13,430,264 to projects across the entire gas value chain in California. In executing these projects, SoCalGas collaborated with many of the most forward-thinking research consortia, universities, national labs, public agencies, and entrepreneurs in the nation and the world. Collectively, these organizations provided significant leveraged funding as well as invaluable guidance, review, technical expertise, and access to resources and infrastructure.

2022 ACTUAL FUNDING BY PROGRAM AREA AND ADMINISTRATIVE COSTS



Split across five program areas—Low Carbon Resources, Gas Operations, Clean Transportation, Clean Generation, and Customer End-Use Applications—these projects encompassed everything from fundamental research and laboratory testing to real-world demonstrations and pilots. Most importantly, they achieved progress toward commercializing new safe, reliable, and affordable clean energy products and technologies.

RATIO OF OUTSIDE FUNDING TO SOCALGAS FUNDING



2022 Funds Expended

In 2022, SoCalGas RD&D invested \$13,430,264 in hundreds of projects across the gas value chain, with an additional \$1,567,990 going to program management and administration. SoCalGas RD&D allocated funding across the five program areas and multiple subprograms. Collectively, these projects leveraged significant co-funding from businesses, research consortia, the California Energy Commission (CEC), the U.S. Department of Energy (DOE), and other participating organizations. On average, every dollar of RD&D funds expended was matched by approximately \$7.20 of funding from other sources in 2022.

PROGRAM	2022 ACTUALS
Low Carbon Resources	\$4,952,553
Gas Operations	\$3,228,435
Clean Transportation	\$1,778,809
Clean Generation	\$1,697,347
Customer End-Use Applications	\$1,773,120
SUBTOTAL	\$13,430,264
Management & Administration	\$1,567,990
TOTAL	\$14,998,254

Significant 2022 Milestones

402

PEOPLE ATTENDED
THE 2022 ANNUAL
STAKEHOLDER
WORKSHOP

612

PEOPLE ATTENDED
SOCALGAS RD&D
RESEARCH
WEBINARS
IN 2022

2022 ANNUAL STAKEHOLDER WORKSHOP

On April 27, 2022, SoCalGas RD&D hosted an online workshop attended by 402 individuals from a variety of organizations, including the Electric Power Research Institute (EPRI), Pacific Northwest National Laboratory, Southern California Edison, the National Renewable Energy Laboratory, Regional CAL Black Chamber SFV, Hermandad Mexicana Nacional, the California Institute of Technology, and the University of California. RD&D staff incorporated input received at the workshop into the 2023 RD&D SoCalGas Research Plan.

RESEARCH WEBINARS

In 2022, SoCalGas presented quarterly research webinars discussing four projects supported by SoCalGas RD&D.

» Thermal Particle Fluid for Commercial and Industrial Emissions Reductions

February 25, 2022: This webinar was with GTI Energy, discussing an innovative thermal particle fluid (TPF) that can recover, store, and transport heat for large commercial and industrial processes. By recovering and reusing waste heat, TPFs can reduce fuel demand for large process heat systems, resulting in lower combustion emissions and decreased customer costs.

» Gas Mapping LiDAR™ Airborne Methane Leak Detection and Emissions Monitoring

May 20, 2022: During this program, Mike Thorpe, CTO of Bridger Photonics, Inc., spoke about Gas Mapping LiDAR™ (GML), an airborne methane emission monitoring technology that detects, localizes, and quantifies methane emissions from all segments of the natural gas value chain. Thorpe provided an overview of the GML technology, discussed results from performance validation testing, and described how it's being used for emissions monitoring surveys in the SoCalGas service area.

» An Inflection Point for Global Pipeline Safety and Integrity

August 15, 2022: In this webinar, Cliff Johnson, President of Pipeline Research Council International (PRCI), introduced his organization's drive for lower emissions and a lower carbon future. This session explained the multifaceted strategy that PRCI is taking to enable the safe transport and storage of hydrogen and renewable natural gas.

» Metal Supported Solid Oxide Fuel Cells: The Key to Efficient, Fast Start Backup Power Generation

October 27, 2022: In this webinar, SoCalGas RD&D and Lawrence Berkeley National Laboratory (LBNL) discussed an innovative metal-supported solid oxide fuel cell (MS-SOFC) that can be used for clean power generation and electrolytic hydrogen production.

Significant 2022 Milestones

TOTAL
FOLLOW-ON
FUNDING
\$513M+
IN 2022

FOLLOW-ON FUNDING

Numerous companies that received early support from SoCalGas RD&D have received significant follow-on investment, demonstrating the program's ability to not only identify promising, early-stage technologies, but also to advance them toward commercialization. In 2022, 14 companies received follow-on funding:

» AVNOS

In addition to a \$650,000 investment from SoCalGas in 2021, Avnos raised \$3.2 million in funding to advance research and development of a carbon capture technology called Isothermal Water Vapor and CO₂ Capture. This includes partial funding from the DOE.

» BLUE FRONTIER

Blue Frontier raised a \$20 million Series A equity investment in 2022 from its commercialization partner Modern Niagara as well as through Breakthrough Energy Ventures, 2150 Urban Tech Sustainability Fund, and VoLo Earth Ventures.

» BRIDGER PHOTONICS

Bridger Photonics raised a \$55 million investment in 2022 from Beaverhead Partners LLC—a syndicate including Madison Valley Partners, Carica Sustainable Investments, and Next Frontier Capital—to support the company's growth and the continued development of methane detection technology.

» BRIMSTONE

In April 2022, Breakthrough Energy Ventures and DCVC co-led a \$55-million funding round in Brimstone to further the commercialization of carbon-negative cement.

» CAPTURA

Captura raised \$500,000 from the Advanced Research Projects Agency-Energy through the Supporting Entrepreneurial Energy Discoveries program in 2022 for the development of thin film composite hollow-fiber membranes for direct ocean capture of carbon dioxide.

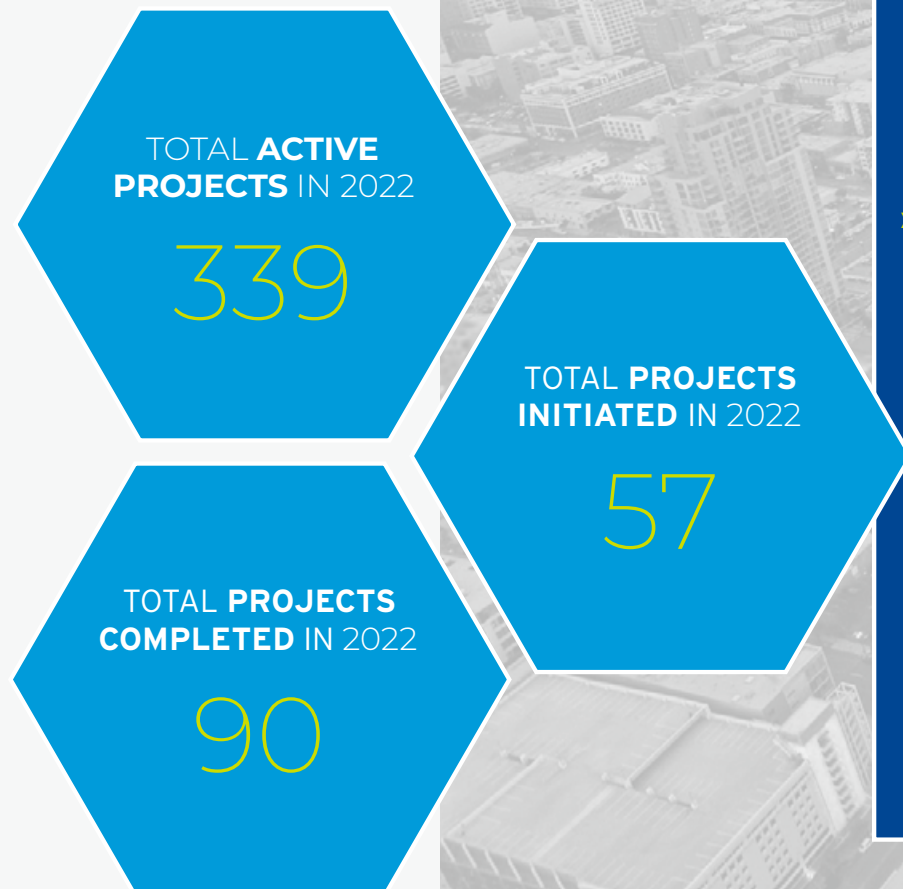
» C-ZERO

C-Zero secured \$34 million through a financing round led by SK Gas, Engie New Ventures, and Trafigura, in addition to participation from existing investors Breakthrough Energy Ventures, Eni Next, Mitsubishi Heavy Industries, and AP Ventures.

» ELECTROCHAEA

Electrochaea completed its fifth round of funding in January 2022, raising \$41 million from investors including Baker Hughes Co. and Engie SA to advance commercialization efforts.

Significant 2022 Milestones



FOLLOW-ON FUNDING

(continued)

» H2U

In addition to raising \$7 million in Series A financing in 2021, H2U raised \$11 million in Series A funding in 2022 from investors including Jericho Energy Ventures, Freeflow Ventures, VoLo Earth Ventures, and Hess Corporation.

» KEVALA

Kevala raised \$12.1 million in Series A funding in 2022, led by Cercano Management and with participation from existing investors Costanoa Ventures, High Alpha, and PSL Ventures.

» MAINSPRING

Led by global growth equity investor Lightrock, Main-spring's first stage of Series E funding in 2022 raised over \$150 million. Additional investors include Khosla Ventures, Bill Gates, Fine Structure Ventures, Princeville Capital, and Lineage Ventures. The funding will contribute to the development of new linear generator models and the acceleration of zero-carbon electricity production.

» STARS

Fuse Fund led a \$500,000 funding round for STARS for the deployment of a commercial hydrogen generator. Fuse invested \$150,000 and collaborated with other investors to raise a total of \$500,000.

» SUSTAERA

Sustaera raised \$500,000 from the Advanced Research Projects Agency-Energy through the Supporting Entrepreneurial Energy Discoveries program in 2022 for development of a novel direct air capture demonstration unit.

» SUSTEON

After early support from SoCalGas, Susteon received \$1 million from the DOE in 2022 to investigate a CO₂ carbon capture solvent.

» TWELVE

Following support from SoCalGas RD&D, this electro-chemical carbon dioxide reduction startup raised \$130 million in Series B funding, with participation from Series A lead investors Capricorn Technology Impact Fund and Carbon Direct Capital Management. Twelve has also secured a Series B and strategic program investment from the Chan Zuckerberg Initiative.

Significant 2022 Milestones

PUBLICATIONS

In 2022, 37 projects co-funded or otherwise supported by SoCalGas RD&D were featured in articles, reports, and technology briefs. Additionally, three technologies supported by RD&D received patents from the U.S. Patent and Trademark Office.

PUBLIC FUNDING

In 2022, RD&D staff supported eight winning proposals applying for public funding. These projects were awarded \$18,305,406 in research funding from the California Energy Commission (CEC) and Department of Energy (DOE).

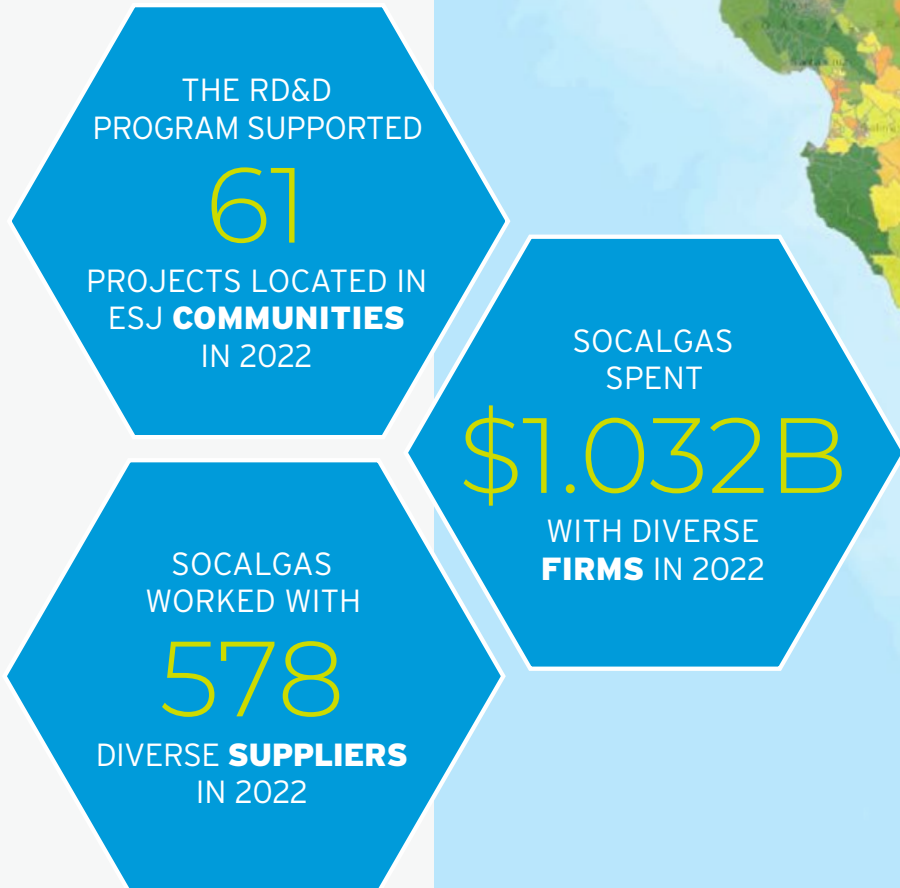
8
PROJECTS WON
A TOTAL OF
\$18,305,406
FROM THE
CEC AND DOE

DEPLOYED TECHNOLOGIES

A major goal of SoCalGas RD&D is to bring technology from the lab to market. In 2022, organizations across California and throughout the nation deployed numerous products and technologies for real-world use as a direct result of the support they received from SoCalGas RD&D. Examples from 2022 include:

- » Blending Modeling (Hydrogen)
- » Center for Hydrogen Safety
- » Common RNG Interconnection Skid Development for Utilities (T-789)
- » Computed Tomography (CT) Fundamentals with Calibration and Reference Standards for Pipeline Anomaly Detection (NDE-2-12)
- » Expansion of NYSEARCH Range Model (M2018-008) Phase II-a
- » Gas Composition and Quality
- » GIS Portal Data Quality Improvement
- » Hydrogen Blend into Natural Gas - Phase 2 - Metallic Materials (6.14.b.2)
- » LDC Focused Gap Analysis & SOTA Study on Decarbonization (M2021-010)
- » Modeling and Assessing PE Assets with 3D Scanning Technology
- » OIML Test Data Summary for New Generation Ultra Sonic Meters (MEAS-6-21)
- » Remaining Life Model and Assessment Tool for Dents and Gouges (MD-4-16)
- » Steel Transmission Pipeline System Analysis
- » Uniform Frequency Code (5.18.m)
- » Update ASTM Standard on Soil Compaction Using the DCP (5.20.o)
- » Update of PRCI Pipeline Repair Manual (MATR-3-1A)

2022 Equity Activities



EQUITY ENGAGEMENT ROADMAP

To better empower under-resourced communities in the decision-making process around clean energy, SoCalGas RD&D continued development of its Equity Engagement Roadmap. This document describes a multi-year vision for improving equity engagement within SoCalGas RD&D. The goal of this engagement is to maximize the likelihood that the benefits of new, clean energy technology positively and equitably impact all communities within California, with special consideration for environmental and social justice (ESJ) communities that have been historically under-resourced.

In 2022, RD&D staff worked closely with 2020vet, a veteran- and woman-owned company with leaders highly experienced in strategy, advocacy, working with local communities facing conflict and crisis, and including both internal and external stakeholders at the table. Working with 2020vet, RD&D staff conducted an extensive literature review, assessed SoCalGas' current community engagement capabilities through interviews with internal stakeholders, and identified six key action items designed to increase engagement.

SPOT
LIGHT

2022
EQUITY
ACTIVITIES

Engineering professor realizes childhood dream and inspires others

Dr. Bihter Padak conducts combustion engineering research while providing guidance, insight, and encouragement to aspiring female and minority students.



Dr. Bihter Padak: "I'm not only trying to show the students what it's like to be an engineer, but also to serve as a role model for female or minority students."

As a child, Dr. Bihter Padak dreamed of becoming a professor. "Growing up in Istanbul, Turkey, my first encounters with professors were in the medical field," said Padak, who realized her childhood dream and now serves as both an Assistant Professor in the Mechanical and Aerospace Engineering Department at The University of California, Irvine (UCI) and the Associate Director of the UCI Combustion Laboratory (UCICL).

Dr. Padak's educational journey was one of exploration and knowledge-seeking. In high school, she first became interested in chemistry. A few years later, while studying chemical engineering at the Istanbul Technical University (İTÜ), she took a course on reaction engineering. "I knew then that I wanted to pursue graduate studies in reaction engineering and kinetics," said Padak.

At this point, she encountered what appeared to be an insurmountable hurdle. At İTÜ, it is usually expected that faculty candidates spend time outside the country to broaden their perspectives. "I don't come from a wealthy

family, so I didn't think I could afford to travel to the United States or enter a PhD program—a pivotal step to becoming a professor," said Padak.

Fortunately, Dr. Padak studied under Professor Birgul Ersolmaz, who would become her mentor. "In my junior year, Professor Ersolmaz, who received her PhD in the United States, told me that if I could receive a graduate assistant position, then I would not have to pay for tuition and would receive a stipend to cover my living expenses," said Padak.

Armed with this revelation, Dr. Padak dedicated herself to her studies and soon entered graduate programs at Worcester Polytechnic Institute in Worcester, Massachusetts and then at Stanford University. After earning her doctorate from Stanford, she accepted a faculty appointment in the Chemical Engineering Department at the University of South Carolina, where she conducted research until her move to UCI in 2018.

At UCICL, Dr. Padak and her team are researching ways to reduce greenhouse gas emissions and combat climate change. To secure funding for these activities, she spends considerable time preparing grant applications. On several occasions, she has also worked closely with SoCalGas, including on a project recently funded by the California Energy Commission (CEC). “One of the best parts about collaborating with SoCalGas on fundamental research is their willingness to publish the results,” said Padak. “With their help, we are actually contributing to science.”

In addition to this technical and scientific work, Dr. Padak believes in the importance of serving as a role model to female or minority students who may not receive much encouragement in Science, Technology, Engineering, and Math (STEM).

“People are often surprised to find that I am an engineering professor conducting combustion-related research,” said Padak. “As both a graduate student and as a professor, I have noticed that it can be challenging for women to advance in academia, especially in the sciences. I am doing my part to change this situation.”

Looking back on her career to date, Dr. Padak believes that the relationships she has formed and maintained have been instrumental in helping her achieve and far exceed her childhood goals. “My work with Professor Ersolmaz showed me the value of having a mentor,” said Padak. That experience inspired Dr. Padak to help her own students with career development decisions and preparation of application materials.

Dr. Padak also participates in outreach activities to underrepresented minorities, especially school-age children. She has helped elementary students perform hands-on

science experiments and regularly gives a lecture called “Why Chemical Engineering” to middle and high school students. “I’m not only trying to show the students what it’s like to be an engineer, but also to serve as a role model for female or minority students,” said Padak.

“I want to help the students expand their ideas about what is possible for them to achieve and to find a career they feel passionate about,” said Padak. “I know it worked for me. I love research and teaching and if I had to do it all over, I would be a professor again.”



Dr. Padak works with graduate students in the lab.



SoCalGas RD&D Program Areas

Program Goals and Structure	20
Research Collaborators	21
PROGRAMS	
Low Carbon Resources	22
Gas Operations	25
Clean Transportation	28
Clean Generation	31
Customer End-Use Applications	34

Program Goals and Structure

The goals of SoCalGas RD&D are to identify, test, and commercialize transformational new energy technologies that will reduce GHG and criteria air pollutant emissions, maintain the energy affordability that natural gas has historically provided, and advance the safety, operational efficiency, and reliability of California's gas delivery networks and systems in an ever-changing operational environment.

Concurrent with the pursuit of these goals, SoCalGas seeks to decarbonize its pipeline by replacing conventionally sourced, fossil-based natural gas with increasingly higher amounts of RNG and, potentially, blends of hydrogen to benefit its customers and support California in the achievement of its ambitious climate change goals.

Consistent with the framework established in Public Utilities Code Section 740.1, program staff considers multiple factors when selecting projects to support. These factors include regulatory and policy drivers, input from knowledgeable industry stakeholders, equity, and corporate policy and goals.

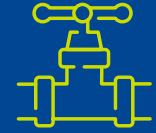
In 2022, SoCalGas RD&D allocated funding across five research program areas: Low Carbon Resources, Gas Operations, Clean Transportation, Clean Generation, and Customer End-Use Applications.

FIVE RESEARCH PROGRAM AREAS



Low Carbon Resources

Carbon Capture, Utilization, and Sequestration
Renewable Gas Production



Gas Operations

Environmental & Safety
Operations Technology
System Design & Materials
System Inspection & Monitoring



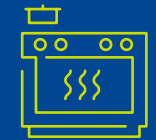
Clean Generation

Distributed Generation
Integration & Controls



Clean Transportation

Off-Road
Onboard Storage
On-Road
Refueling Stations



Customer End-Use Applications

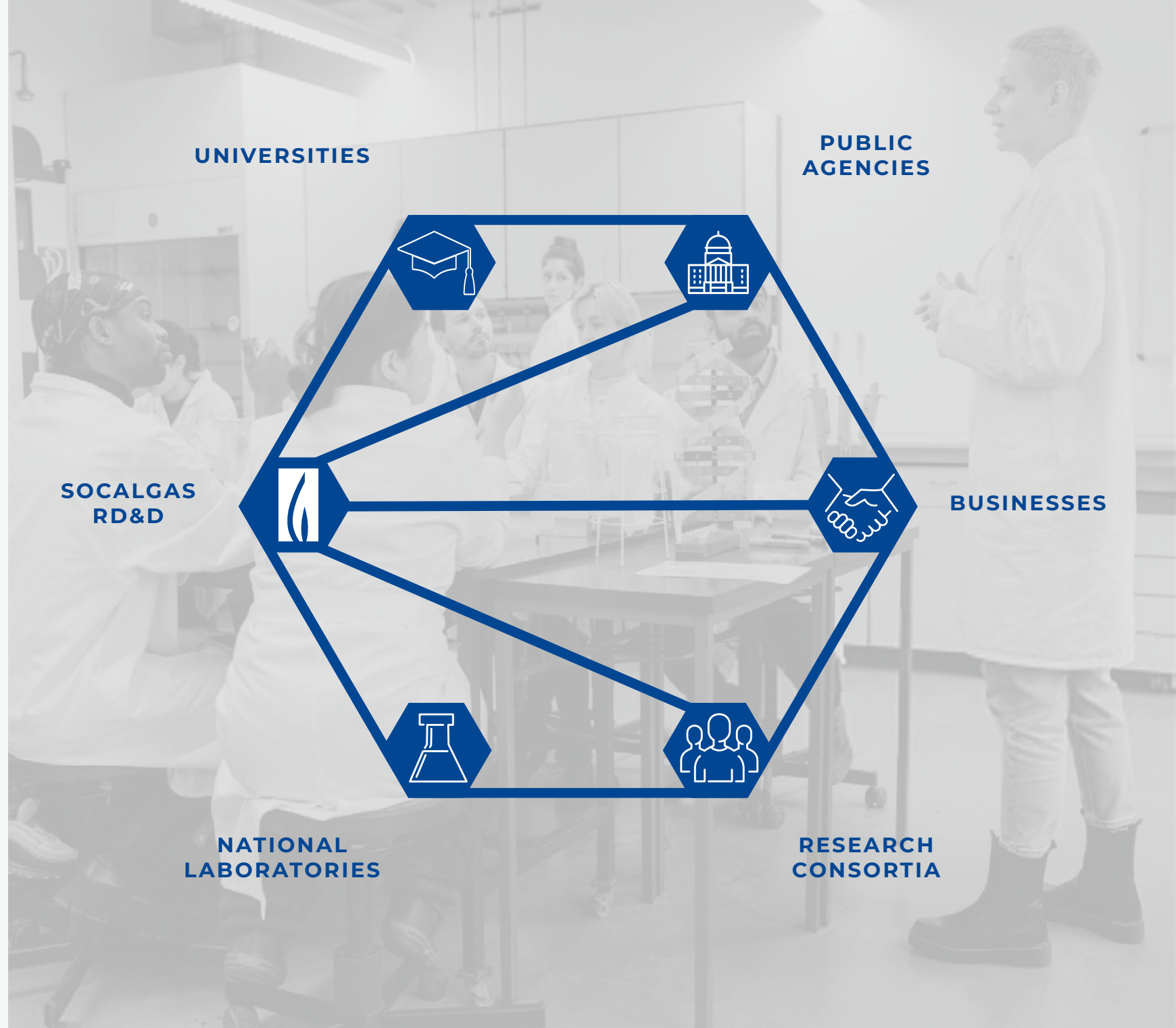
Advanced Innovation
Commercial Applications
Commercial Food Service
Industrial Process Heat
Residential Appliances

Research Collaborators

SoCalGas RD&D is a vital element of a much larger technology funding ecosystem that includes gas industry research consortia and numerous federal, state, and regional public agencies. Program staff work with professionals and subject matter experts from these organizations, as well as from universities, national labs, and businesses, to maximize the impact of their investments in promising technologies and products with clear commercialization pathways.

These relationships enable SoCalGas to engage science and technology experts, other utilities, and industry stakeholders in open dialogues. These dialogues help SoCalGas effectively identify and close knowledge and research gaps, avoid duplication of previous and ongoing research, and mitigate technical, economic, and commercialization risks. This helps program staff develop products and technologies that reduce customer costs, save energy, increase safety and reliability, improve air quality, and reduce GHG emissions.

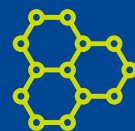
Together, RD&D staff and research collaborators exchange information and research concepts, collaborate on project development, establish collaborative partnerships, and seek public and private funding opportunities, with the goals of securing additional co-funding and assembling the most capable and impactful team of subject matter experts to work on a project.





PROGRAM:

LOW CARBON RESOURCES



The primary goal of the Low Carbon Resources program area is to decarbonize the gas supply while maintaining its affordability and reliability. To accomplish this goal, program staff members promote and advance new technologies aimed at increasing the production of renewable gas to displace conventionally sourced pipeline gas, while also limiting or recycling GHG emissions. In addition, the Low Carbon Resources program area aims to promote and advance new technologies for carbon capture and the reuse of captured carbon in the manufacturing of useful products or its permanent sequestration in depleted oil wells and saline aquifers.

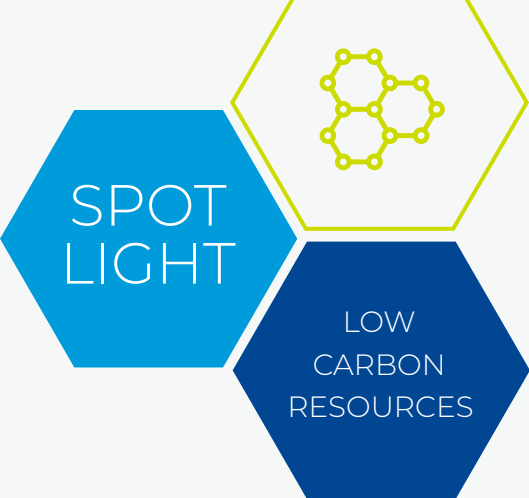
This program area includes two subprograms.

Carbon Capture, Utilization, and Sequestration

This subprogram focuses on carbon capture, utilization, and sequestration (CCUS)—all vital in the fight against climate change. Roughly half of the excess CO₂ released into the atmosphere by human activity is absorbed by plants and the world’s oceans. CCUS technologies seek to capture and utilize or sequester the balance of these CO₂ emissions through a variety of approaches, including direct air capture coupled with either conversion into plastics, cement, and biofuels (carbon capture utilization, or CCU) or sequestration into depleted oil fields and saline aquifers (carbon capture sequestration, or CCS). This subprogram’s portfolio also includes methane pyrolysis projects in which solid carbon is produced from a methane feedstock and captured simultaneously with hydrogen generation.

Renewable Gas Production

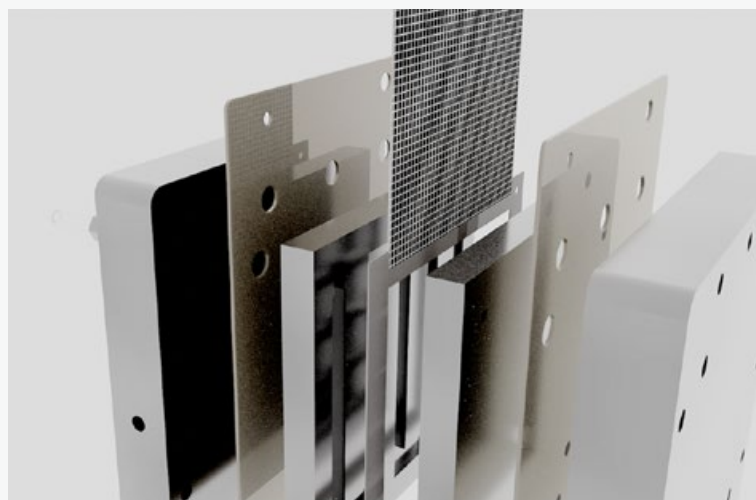
This subprogram focuses on the safe, reliable, and cost-effective production of renewable gaseous fuels—specifically RNG and hydrogen—from various feedstocks and multiple technological pathways.



A carbon dioxide-converting device enables useful carbon-neutral consumer products

Electrochemical decomposition of carbon dioxide paves the way for shifting petroleum-derived materials to becoming carbon-neutral.

\$	TOTAL PROJECT COST: \$3,125,000
	SOCALGAS: \$500,000
	COFUNDING: \$125,000
	DOE: \$2,500,000



Twelve's electrochemical system is built in repeating stacked units, each consisting of alternating charged plates, gaskets, electrodes, and membranes.

The United States emitted approximately six billion metric tons of carbon dioxide equivalent emissions in 2020.⁷

Combatting these emissions will require significant investment in zero-carbon energy sources as well as in the capture, utilization, and/or underground sequestration of greenhouse gases. Carbon capture and utilization (CCU) is a growing field that leverages chemical processes to produce carbon-neutral consumer products that are traditionally made from petroleum.

In 2015, Dr. Etosha Cave and Dr. Kendra Kuhl teamed up with Nicholas Flanders to commercialize an electrochemical conversion system they developed at Stanford University. The system transforms carbon dioxide from common emission sources into carbon monoxide and other compounds. Their company, Twelve, couples this process with a variety of chemical reactions to produce useful materials such as polymers for sunglasses or low-carbon jet fuel, among other applications.

“Most of the carbon intensity from something like jet fuel comes from the fact that it is derived from petroleum,” said Dr. Cave. “Our products are essentially carbon-neutral because they incorporate carbon dioxide from biogenic or other emission sources. The result is a 90% reduction in carbon emissions because you’re not burning something that was formerly in the ground.”

Electrochemical systems like the one Twelve is developing are built in repeating stacked units, much like sandwiches. “Each unit consists of alternating charged plates, gaskets, electrodes, and membranes,” said Dr. Cave. “Water permeates one side of the stack and a gaseous stream of carbon dioxide the other. As the gas and water make their way through the unit, they eventually meet at the catalyst.”

This intersection drives the desired chemical reaction when an operator applies electricity to the system. In this case, carbon dioxide is transformed into carbon monoxide and water, with a small amount of hydrogen as a byproduct. These outputs become inputs to a secondary process in which

operators can produce useful chemicals and compounds from recycled carbon that form the basis of polymers for car parts, sunglasses, other daily household objects, and fuels.

“At Twelve, we’re a carbon transformation company,” said Dr. Cave. “We see carbon dioxide as a molecule that, once transformed, can become an array of products that we currently make from petroleum.”

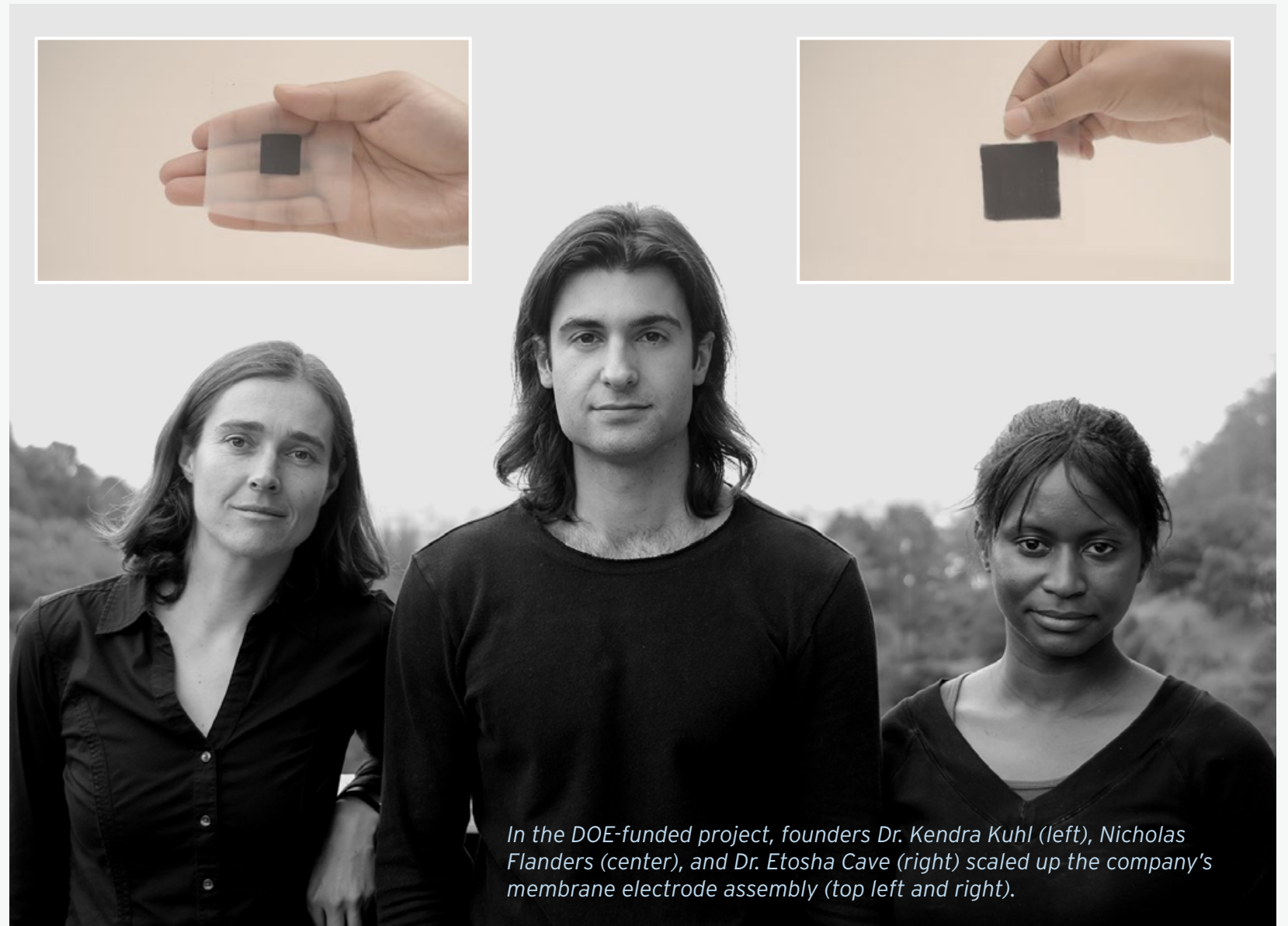
“Carbon transformation technology exists and, with support from strategic partners and government sources, we are building up the industry,” said Dr. Cave. Twelve is developing a way to consume carbon dioxide instead of putting it into the atmosphere. This approach enables society to make carbon-based products that they already enjoy out of carbon dioxide instead of petroleum.

For help developing its carbon transformation technology, Twelve applied for and won a \$2.6-million grant from the U.S. Department of Energy (DOE) in 2019. “SoCalGas RD&D provided \$500,000 in cost share to the project, which really strengthened our application,” said Dr. Cave. “Equally important, SoCalGas brought credibility to the new technology. Having a well-known name like that in the reviewer pool at the DOE was consequential and really showed our commitment to commercialization.”

The goal of the DOE-funded project, which kicked off at the end of 2020, was to advance the demonstration-scale system from several kilowatts (kW) to a megawatt-sized unit by scaling up the membrane electrode assembly (MEA). The first step involved sizing up the individual pieces and then optimizing their performance by tweaking the electrochemistry. “Once the MEAs had been scaled up and met quality control requirements, the team assembled them into modular 100- to 200-kW stacks for testing,” said Dr. Cave.

“By increasing unit size to hundreds of kilowatts, overcoming the quality control issues, and demonstrating the larger system’s performance, a megawatt-scale process is now within reach,” said Dr. Cave. At that size, the system

outputs can become inputs for large jet fuel production facilities. Success on this project has brought the U.S. one step closer to having a scalable source of sustainable aviation fuel.

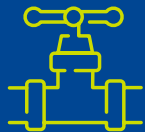


In the DOE-funded project, founders Dr. Kendra Kuhl (left), Nicholas Flanders (center), and Dr. Etosha Cave (right) scaled up the company’s membrane electrode assembly (top left and right).



PROGRAM:

**GAS
OPERATIONS**



The Gas Operations RD&D program area supports pipeline gas delivery networks and storage operations through innovations that enhance pipeline and employee safety, maintain system reliability, increase operational efficiency, and minimize GHG impacts to the environment.

The program also supports technology development driven by emerging regulatory requirements. Its primary goals are to develop, test, and introduce new gas operations technologies that are beneficial to ratepayers through improvements in public and pipeline safety, system reliability, operational efficiency, and environmental benefits.

The program invests in technology development projects that are divided into the following subprograms.

Environmental & Safety

This subprogram seeks to advance the environmental integrity of the pipeline network and the safety of those who live and work in proximity to it. Environmental projects focus on developing technologies that also support state goals. Safety projects are concerned with protecting the pipeline from intentional and unintentional damage and with improving the safety of the public, company employees, and contractors working on or around the pipeline. Projects include exploring how blending hydrogen into the pipeline impacts the operation and maintenance of the pipeline system regarding safety, reliability, integrity, and environmental impacts.

Further gas emissions monitoring and reduction research is being supported by the SoCalGas Gas Emissions R&D Emission Strategy Program under the SB 1371 compliance plan, pursuant to the Gas Leak Abatement OIR (R.15-01-008).

Operations Technology

This subprogram supports technologies that improve employee training, efficiency of construction, and the

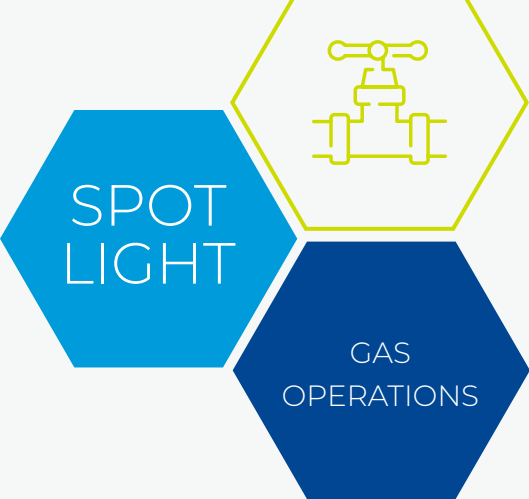
operation/maintenance/rehabilitation of gas pipelines as well as systems that facilitate continued safe and reliable service. This subprogram also explores how best to prevent gas leaks that result from blending hydrogen into the pipeline.

System Design & Materials

The objectives of this subprogram are to advance materials and materials science, materials tracking and traceability, and technical tools for designing pipeline systems and infrastructure for safety, reliability, efficiency, and maintainability throughout the life cycle of pipeline assets. Projects include research to advance engineering design standards and models, developing risk analytical tools to comply with pipeline integrity regulations, modeling operational efficiencies of gas storage and compressor station assets, and assessing the effects of incorporating gas from nontraditional sources (biogas and hydrogen-blend) on overall natural gas quality and system integrity.

System Inspection & Monitoring

This subprogram's objectives include developing technologies and methods for inspection, monitoring, and testing of pipelines and pipeline components to assess the condition and performance of pipeline facilities. The goal is to improve system performance, reliability, safety, and operational efficiencies through data management to identify precursors to failures or incidents. Projects in this subprogram area leverage artificial intelligence, machine learning, and preventive and predictive maintenance technologies—including data analytic models and data lakes—and include innovative data sources such as Crowd Source and the Internet of Things. This subprogram also seeks to explore tools for managing the potential impacts of blending hydrogen into the gas pipeline.



Research consortium creates a better way to implement low-carbon innovation

NYSEARCH supports development of database that enables utilities and RNG producers to streamline the interconnection process and reduce capital costs.

\$	TOTAL PROJECT COST: \$222,380
	SOCALGAS: \$24,710
	COFUNDING: \$197,670

Renewable natural gas (RNG) is natural gas derived from a variety of organic waste materials, including food waste, garden clippings, and degradable carbon sources such as cardboard or wood. A study conducted by the University of California, Davis estimates that more than 20 percent of California’s current residential natural gas demand could be met by RNG derived from the state’s existing organic waste.⁸

To realize the benefits of producing RNG at scale, production facilities must interconnect with existing natural gas infrastructure. To date, RNG producers have had to produce custom engineering designs for each interconnection (IC) skid, resulting in high capital costs and lengthy development cycles.⁹

To address these challenges, the NYSEARCH research consortium—on behalf of 11 of its Local Distribution Company (LDC) members—collaborated with SoCalGas to develop a digital database that would provide a common framework

for RNG interconnection. This framework would enable LDCs and RNG producers to select IC skid designs that best fit their needs, streamline the IC process, and reduce capital costs that may otherwise have been prohibitive.

NYSEARCH engaged Campos EPC—a diverse business enterprise specializing in engineering, procurement, and construction—to develop a standardized design and database.

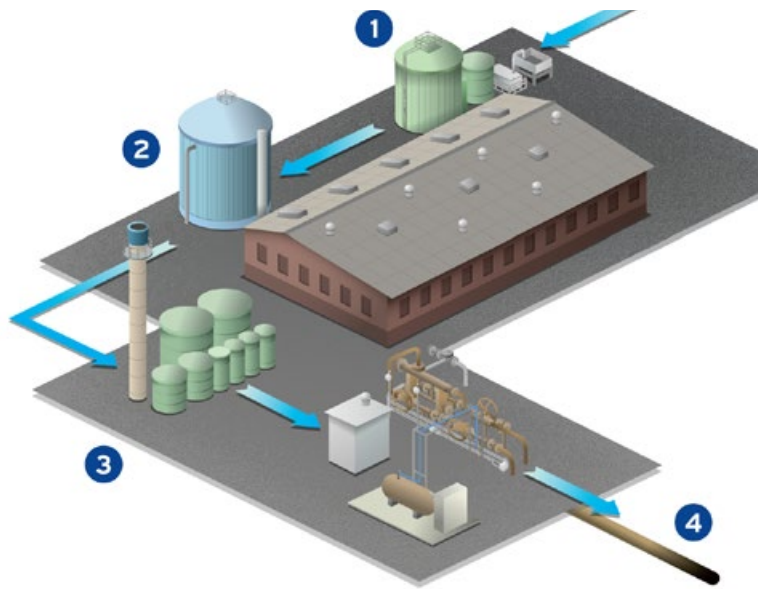
Campos EPC conducted interviews with utility members of NYSEARCH in early 2022. The company also distributed a comprehensive questionnaire. The goal of this information gathering was to establish the basic engineering conditions and design parameters necessary for developing two foundational IC skid designs, one open-air and one enclosed.

During this process, Campos EPC interviewed the SoCalGas engineering team responsible for RNG interconnection. “SoCalGas contributed a wealth of information



Traditionally, RNG producers have had to produce custom engineering designs for each interconnection skid, resulting in high capital costs and lengthy development cycles.

How organic waste is converted into RNG



- ① Waste products, such as sludge, food waste or manure are processed in a biodigester.
- ② The biodigester breaks down the organic material to create biogas – a mixture of methane and other elements.
- ③ The biogas can then be processed and conditioned leaving behind RNG, which can be used interchangeably with traditional natural gas.
- ④ This RNG can be used where it is produced for things like generating electricity or fueling vehicles, or it can be injected into a utility pipeline for transportation to other customers.

that helped Campos EPC develop foundational designs that could easily be modified to meet the needs of the SoCalGas service territory, while remaining compliant with California and federal requirements,” said Ahra Kwon, Senior Project Manager for NYSEARCH. Importantly, the same foundational designs could be modified to meet the needs of utilities anywhere in the country.

Based on these utility interviews and the responses to the questionnaire, Campos EPC developed piping and instrumentation, electrical, and structural drawings for the open-air and enclosed IC skids, as well as 3D models. The development of standardized designs was important to the funding utilities, which sought ways to minimize cost and time spent on design.

Once the designs were complete, Campos EPC set out to develop the Microsoft® Excel®-based equipment database, which incorporated American Society of Mechanical Engineers (ASME) requirements, standards, and calculations.

“Using the tool’s drop-down menus and color-coded cells, RNG producers and gas utilities could input a variety of utility-specific parameters such as operating pressure and flow rate and then select the specific types of equipment that would complete a site-specific IC skid design,” said Kwon. The database then provides a detailed cost estimate that includes both the skid itself and associated materials. It also provides the information that can serve as the basis for additional engineering and construction drawings.

One of the greatest challenges facing RNG producers is understanding how to share IC costs with an LDC. A project’s database and foundational designs would aid producers in delineating which parts of a system are

owned by the gas utility and which are producer-owned, thereby providing a basis for cost share.

The IC database also gives LDCs and RNG producers a head start, enabling them to avoid time-consuming and costly custom engineering by starting with one of the two foundational designs. “This solution provides a baseline that can then be modified and customized to fit the specific needs of any given utility,” said Daphne D’Zurko, Executive Director at NYSEARCH.

Campos EPC has completed development of the software tool and, through NYSEARCH, distributed it to the 11 member utilities. “There is tremendous value in the collaborations between NYSEARCH and our consortium members,” said D’Zurko. “Through their membership dues, they can leverage their research dollars and also their knowledge. In many cases, the amount of innovation they get as a result is ten- or twentyfold what they would have gotten on their own.”

“SoCalGas is a champion of many of the innovations that NYSEARCH pursues,” said D’Zurko. “I can’t say enough about the value of gas companies that take the lead in finding innovations and then backing them up with both people and resources. They are leading the industry.”

For this project, the true innovation was standardization. NYSEARCH member utilities—which collectively serve 32 million customers across the United States—were encouraged to focus on standardization to accomplish project objectives. By employing the same design standards and requirements when accepting gas from RNG producers, the process would reduce the cost of implementation and facilitate more use of RNG nationwide. “Innovation breeds innovation,” said Kwon. “Once LDCs begin to use this solution, there is no telling what they will develop.”



PROGRAM:

CLEAN TRANSPORTATION



The Clean Transportation program supports activities that reduce environmental impacts related to the transportation sector. Focusing on utilization of hydrogen, this program facilitates the development of zero-emissions technology for on-road and off-road applications, fueling infrastructure, and on-board storage technologies.

This program area includes four subprograms.

Off-Road

This subprogram focuses on developing zero-emission off-road transportation solutions using hydrogen. Its goal is to achieve emissions reductions from off-road vehicles such as trains, ocean-going vessels, commercial harbor craft, construction equipment, and cargo handling equipment. This subprogram has also begun to explore aviation applications, including hydrogen fuel cell aircraft and drones.

Onboard Storage

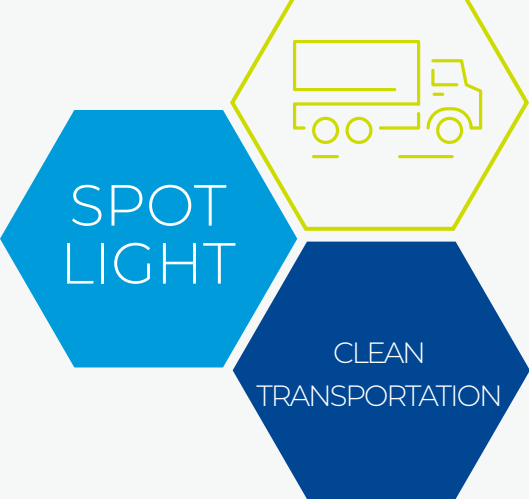
This subprogram targets the development, demonstration, and deployment of cost-effective technologies and systems that improve onboard storage for gaseous transportation fuels. Areas of focus include advanced materials, low-pressure systems, and conformable tanks for hydrogen storage. Onboard storage, which requires compressed storage and/or the use of advanced adsorption technologies, is a critical element needed for increased utilization of hydrogen as a transportation fuel.

On-Road

This subprogram targets the development, demonstration, and deployment of zero-emission medium- and heavy-duty on-road vehicles. The focus is zero-emission, on-road transportation technologies using hydrogen.

Refueling Stations

This subprogram targets the development, demonstration, and deployment of technologies and systems that support refueling for alternative fuels, including gaseous and liquid hydrogen. This subprogram also seeks to identify and manage concerns and issues related to refueling, from storage and safety to standardization.



California Port deploys hydrogen fuel cell trucks for zero-emission cargo handling

GTI Energy leads demonstration of hydrogen fuel cell yard tractors for emissions reductions at the Port of Los Angeles.

\$	TOTAL PROJECT COST: \$12,105,413
	SOCALGAS: \$372,500
	COFUNDING: \$11,732,913

For over two decades, the Port of Los Angeles has had more shipping container throughput than any other port in the Western Hemisphere. Every day, thousands of containers arrive at the port via ship, train, or truck and are then transported to the next steps on their journeys using heavy-duty cargo handling equipment powered by diesel, which provides the power, performance, and ease of refueling needed to operate in the demanding port environment.

Unfortunately, diesel-powered equipment is also a major source of carbon emissions and toxic air pollutants, including nitrogen oxides (NOx) and particulate matter (PM). The single largest source of port-related cargo handling emissions is the diesel yard truck, also known as the terminal tractor. These workhorses of the port put in as many as 20 hours per day, lifting and moving heavy cargo trailers, stopping only once daily for refueling.

In 2019, GTI Energy, SoCalGas, ZEN Clean Energy Solutions, Frontier Energy, Capacity Trucks, and HTEC–Canada’s

leading clean hydrogen production, distribution, and dispensing solutions company—began collaborating on the Zero-Emissions for California Ports (ZECAP) project.¹⁰ Funded in part by the California Air Resources Board, the project’s goal was to develop and demonstrate two zero-emission hybrid hydrogen fuel cell yard trucks at port terminals operated by TraPac at the Port of Los Angeles.

For each unit, the team configured a Capacity Trucks Trailer Jockey Series TJ9000 glider with a BAE Systems electric drive powertrain and an FCveloCity®-HD85 fuel cell from Ballard Power Systems, as well as onboard hydrogen storage tanks. “We chose yard trucks because they were well suited to replacement of their diesel engines with the hydrogen fuel cell drive,” said Bart Sowa, a senior project manager with GTI Energy. “Their duty cycle is also quite demanding, making them an ideal test case.”

SoCalGas provided \$372,500 in cost share to the project as well as access to its network of customers, technology



The project team developed and demonstrated two zero-emission hybrid hydrogen fuel cell yard trucks at port terminals operated by TraPac at the Port of Los Angeles.

partners, and research organizations. SoCalGas RD&D staff also offered valuable perspectives about infrastructure utilization and product commercialization.

In 2020, the project team completed engineering design on the hydrogen fuel cell yard trucks and the custom fueling infrastructure, beginning assembly of the yard trucks late in the year. Despite COVID-related delays, the team took the project through permitting, manufacturing, and implementation at the end of 2022 and is expected to complete all elements of the project in 2023. The project had multiple components.

The first was identifying a demonstration site. TraPac, a port terminal operator, offered the use of its facilities, allowing the project team to locate the on-site hydrogen refueler in an area of its terminal optimized for yard truck refueling but out of the way of normal operations. “TraPac was very enthusiastic about integrating the hybrid hydrogen fuel cell yard trucks into their operations,” said Sowa.

The second critical component was developing the two hybrid hydrogen fuel cell yard trucks. “No commercial version of this type of vehicle existed anywhere in the world,” said Sowa. “It took Capacity Trucks seven different iterations juggling multiple design constraints before they delivered the final vehicles.”

The resulting trucks combine a hydrogen fuel cell drivetrain with 9 kilograms of onboard hydrogen storage and an 85-kilowatt-hour battery. This architecture enables the yard trucks to operate for approximately 11 hours on hydrogen and an additional 6 hours on batteries. Refueling takes roughly 10-20 minutes—slightly slower than diesel but an order of magnitude faster than recharging the trucks’ electric batteries.

Designed to be skid-mounted and temporarily bolted down, the on-site fueler developed by HTEC could hold up to 190 kilograms of hydrogen. “With the demonstration duty cycle of eight hours per day, that was enough fuel for two to three weeks of operation,” said Mary Fry, Director of Production Assets at HTEC. “During the project, we sought to mimic the diesel fueling process as much as possible.” Zen Clean Energy Solutions helped permit the fueling station.

To quantify the project’s results and better understand vehicle performance and energy consumption, Frontier Energy is collecting and analyzing vehicle data throughout the operations period. Frontier will disseminate its findings through conferences and other venues and will use the data to develop a commercialization study that includes a market study and a model of potential adoption rates. To share information with the public, the project team developed a website and conducted a webinar.^{11,12}

“The project has been a great success,” said Sowa. “We have demonstrated that hydrogen can be a safe and clean alternative to diesel fuel in the port environment.” The yard truck operators particularly appreciated the new vehicles, which were designed to look and operate like their diesel counterparts. “The new yard trucks are also quiet, do not smell or vibrate, and provide significantly more torque than

the vehicles they replaced. Some of the TraPac drivers specifically asked to be assigned to the new yard trucks.”

Based on this project’s success, TraPac has begun exploring how to transition all of its cargo handling equipment to zero emission. “They are not alone,” said Sowa. “Other potential end users have been asking about testing the hybrid hydrogen fuel cell yard trucks at their own facilities. As a result, Capacity has already begun developing a second-generation model for demonstration and commercialization.”

The project made significant progress in reducing some of the stigma associated with hydrogen. “The new hydrogen fuel cell yard trucks broke down barriers by educating the operators, many of whom had expressed hesitation about trying out the new technology,” said Sowa. “Now, they understand that hydrogen, like other conventional fuels, can be safely used as a fuel.”

The project also represented an important step forward in developing a thriving hydrogen market in Southern California. “The hydrogen industry has struggled for decades to balance supply and demand to justify large investments in either production or end-use applications,” said Sowa. “This project demonstrated to the industry that hydrogen is feasible as a heavy-duty transportation fuel and could begin to realize economies of scale.”



CALIFORNIA CLIMATE INVESTMENTS
Cap and Trade Dollars at Work

ZECAP is part of California Climate Investments, a statewide initiative that puts billions of Cap-and-Trade dollars to work reducing greenhouse gas emissions, strengthening the economy, and improving public health and the environment—particularly in disadvantaged communities.

www.calclimateinvestments.ca.gov



PROGRAM:

**CLEAN
GENERATION**



This program targets the development and demonstration of high-efficiency products and technologies associated with the generation of power for the residential, commercial, and industrial market segments. Its goals are to reduce emissions, lower customer costs, integrate renewable fuels, and improve energy reliability and resiliency.

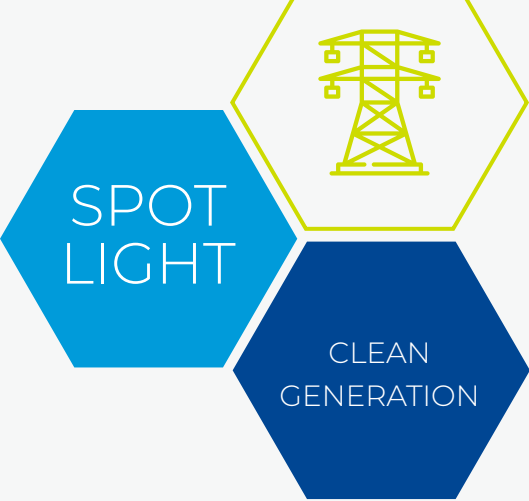
Clean Generation is composed of two subprograms.

Distributed Generation

This subprogram develops and enhances distributed generation technologies. Microgrids and the increasing availability of RNG and hydrogen offer new opportunities for the deployment of low-emission and renewably fueled distributed generation technologies.

Integration & Controls

This subprogram develops, enhances, and demonstrates technologies and control systems that integrate diverse distributed generation resources and thermal loads. The focus is on enabling low-emissions, distributed generation, and storage technologies to provide energy resilience and affordability to customers.



Highly scalable generators have potential to accelerate transition to carbon-free grid

Mainspring Energy has introduced a novel, proven power generation technology that is modular, dispatchable, and fuel flexible.

\$	TOTAL PROJECT COST: \$2,381,725
	SOCALGAS: \$100,000
	COFUNDING: \$2,281,725



Mainspring Energy deployed its modular linear generator at Food 4 Less, a Kroger brand grocery store in Colton, California.

The move to decarbonize the grid is picking up speed, driven by cost reductions in clean electricity, legislation, and growing interest among investors and consumers. As increasing amounts of wind and solar electricity come online, however, their variability challenges grid stability and jeopardizes the smooth transition to a carbon-free grid.

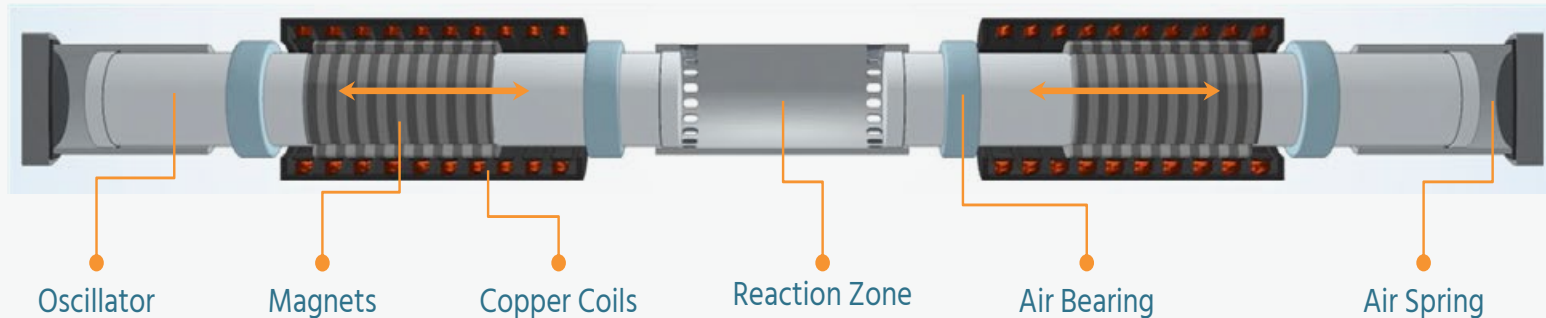
To help overcome these obstacles, Mainspring Energy developed a modular linear generator capable of providing dispatchable power using a variety of gaseous fuels, including natural gas, renewable natural gas (RNG), green ammonia, and green hydrogen. The company sought and won a grant from the California Energy Commission's Public Interest Energy Research Program to demonstrate this innovative technology in 2017.

"Our goal was to deploy this novel approach at a customer's site to illustrate high system uptime, low emissions, and high electrical efficiency over nine months," said Adam Simpson, Chief Product Officer and Founder of

Mainspring Energy. Mainspring deployed the unit at Food 4 Less, a Kroger brand grocery store, in Colton, California.

SoCalGas provided valuable support to the project, bringing \$100,000 in match funding and facilitating a quick interconnection to its natural gas network. "It was great working with them," said Simpson. "This project enabled SoCalGas to evaluate an early installation of our linear generator with an eye toward potentially purchasing it for applications at some of its own sites. More broadly, it helped us understand the technology so that we could better promote its adoption by a wide range of customers looking for low-emission energy reliability and resilience."

The linear generator consists of a center reaction cylinder, two opposed oscillators, and two outer air springs. Each oscillator incorporates magnets for electricity production using copper coils that encircle portions of the generator. For this project, Mainspring installed a grid-connected, modular 230-kilowatt (kW) linear generator operating on natural gas.



The Linear Generator Core: A linear generator is an electromechanical device that directly converts linear motion into electricity using chemical or thermal energy.

The power generation cycle: **1.** A mixture of air and fuel are compressed in the center reaction zone until a low temperature reaction occurs. **2.** The reaction drives the two oscillators, carrying magnets, through copper coils, directly producing electricity through linear motion. **3.** The outer air springs are compressed to return the oscillators for the next cycle.

The operating cycle of the generator begins with the compression of a fuel-air mixture in the reaction cylinder. This reaction is driven by energy stored in the air springs from the previous cycle. Compression continues until a low-temperature, non-combustion reaction occurs uniformly, without burning or a flame. The reaction causes the oscillators to move outward.¹³ “A portion of the kinetic energy is directly converted into electricity through the copper coils and the rest is stored in the air springs for the next compression cycle,” said Simpson.

The system’s low-temperature reaction achieves high thermodynamic efficiency and near-zero emissions. “By eliminating the need for flame, it also keeps the peak temperature well below the threshold for NOx formation,” said Simpson. “That, in turn, removes the need for any NOx after-treatment equipment.”

The demonstration proved highly successful. The linear generator provided dispatchable power 24 hours per day for the entire nine-month demonstration. The system

produced 230 kW of net AC power when building load was sufficient and followed building load when it dropped below 230 kW.¹⁴

“Mainspring’s linear generator technology has allowed our business to manage electricity expenses better and lower its carbon footprint,” said Jeff Guth, Regional Director, Construction, at The Kroger Co. “We have already begun adopting this technology at other locations in our enterprise to expand this program.”

Moving forward, the linear generator has great potential. “Because it is fuel-flexible, end users can switch to cleaner fuels such as RNG or green hydrogen as they become available,” said Simpson. “This flexibility enables them to select the fuel with the greatest abundance, lowest cost, and lowest carbon intensity at any given time.” The generators are also portable, allowing end users to place them exactly where power is needed and to combine multiple 230-kW units into larger, megawatt-scale systems.

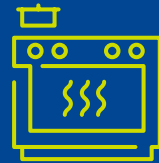
The technology can provide valuable benefits to the electricity grid. “With our dispatchable generators, end users can ramp power down as on-site solar generation ramps up, turn off power while the PV system exports power, and then ramp power back up as on-site solar stops producing,” said Simpson. “Customers like this flexibility because it not only provides cost savings while maximizing the value of their solar, but it also helps displace or offset grid power from the dirtiest power plants.”

Mainspring Energy learned valuable lessons from this project and was able to develop design improvements that it expects will increase power, efficiency, and reliability while lowering cost. “Since completing the project, we have seen significant market interest from national and multi-national corporations and have been able to raise capital for a sustained market launch,” said Simpson. “From both our perspective and the customer’s perspective, the project was a big success.”



PROGRAM:

CUSTOMER
END-USE
APPLICATIONS



This program focuses on developing, demonstrating, and commercializing technologies that cost-effectively improve the efficiency and reduce the environmental impacts of gas equipment used in residential, commercial, and industrial settings.

This program includes five subprograms.

Advanced Innovation

This subprogram seeks to develop new, nontraditional technologies to improve energy efficiency and decrease emissions. Relevant applications include smart thermostats, sensors, advanced construction technologies, and machine learning.

Commercial Applications

This subprogram develops and enhances technologies and advancements related to gas consumption and end uses in the commercial sector. Relevant applications include commercial heating, ventilation, and air conditioning (HVAC), hot water service, and commercial laundry.

Commercial Food Service

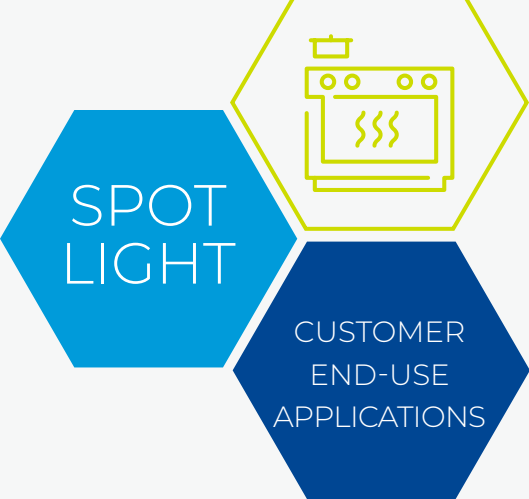
This subprogram develops and enhances technologies and advancements related to commercial food service. This includes restaurants, catering services, and institutional kitchens that rely primarily on fuel supplied by SoCalGas for cooking and water heating.

Industrial Process Equipment

This subprogram develops advanced heating technologies and systems for use in the industrial sector. In particular, the industrial process heat end-use sector represents some of the largest users of gaseous fuels and the most difficult applications to decarbonize. Examples include food processing, manufacturing, cement production, chemical processing, textile drying, and agriculture.

Residential Appliances

This subprogram develops, demonstrates, and enhances technologies and advancements related to gas-consuming appliances in residences. Relevant appliances include furnaces, water heaters, stoves, ovens, and dryers.



New insights are created by breaking down industrial data silos with digitization

METRON, a key player in the “industry of the future,” is reducing energy consumption, helping to lower utility bills, and shrinking carbon footprints.

\$	TOTAL PROJECT COST: \$481,460
	SOCALGAS: \$481,460
	COFUNDING: \$0



METRON seeks to tear down data silos in industrial facilities, enabling users to understand and analyze data in real time and gain actionable insights at the machine or asset level.

The world is in the midst of a technology disruption, a fourth industrial revolution driven by increasing interconnectivity and smart automation. This transition has the potential to unlock tremendous increases in the energy efficiency of many industrial processes, reducing energy bills and shrinking carbon footprints.

The primary challenge associated with this transition is data collection. The sheer number of legacy factories, facilities, and power plants that lack connected devices or sensors, however, makes adequate data collection quite difficult.

To address this challenge, energy technology company METRON has created an innovative software-as-a-service (SaaS) product and set of strategies. “We established METRON to tear down the data silos that existed within industrial facilities and bring data to multiple users,” said Pierre Groleau, General Manager North America at METRON. “Our goal was to provide a toolset that helps

users understand and analyze data in real time and gain actionable insights at the machine or asset level.”

METRON’s technology provides great value when it is installed at an industrial facility. In 2020, the company collaborated with SoCalGas to identify a suitable demonstration site among the gas utility’s large customers. After review, METRON selected The Gill Corporation, a leading manufacturer of high-performance composite materials and products for the aerospace, transportation, and other industries.

At project inception, The Gill Corporation did not possess a centralized energy management system for monitoring or visualizing the company’s energy consumption. “With this project, our goal was to better understand and optimize system performance and energy flows, with a particular focus on gas and electricity,” said Groleau. “Our endgame was to reduce energy costs.”

Work on the project began with a detailed analysis of the site’s existing data sources and hardware followed by data aggregation for immediate observation. “We then looked carefully for the gaps in the data stream that prevented full digitalization of the facility’s performance,” said Groleau. Upon completion of this analysis, METRON developed a digitization roadmap that identified the sensors and associated hardware necessary to close the data gaps.

Upon installation of the sensors, METRON deployed its software ecosystem and professional services to drive significant energy use cost savings and emission reductions.

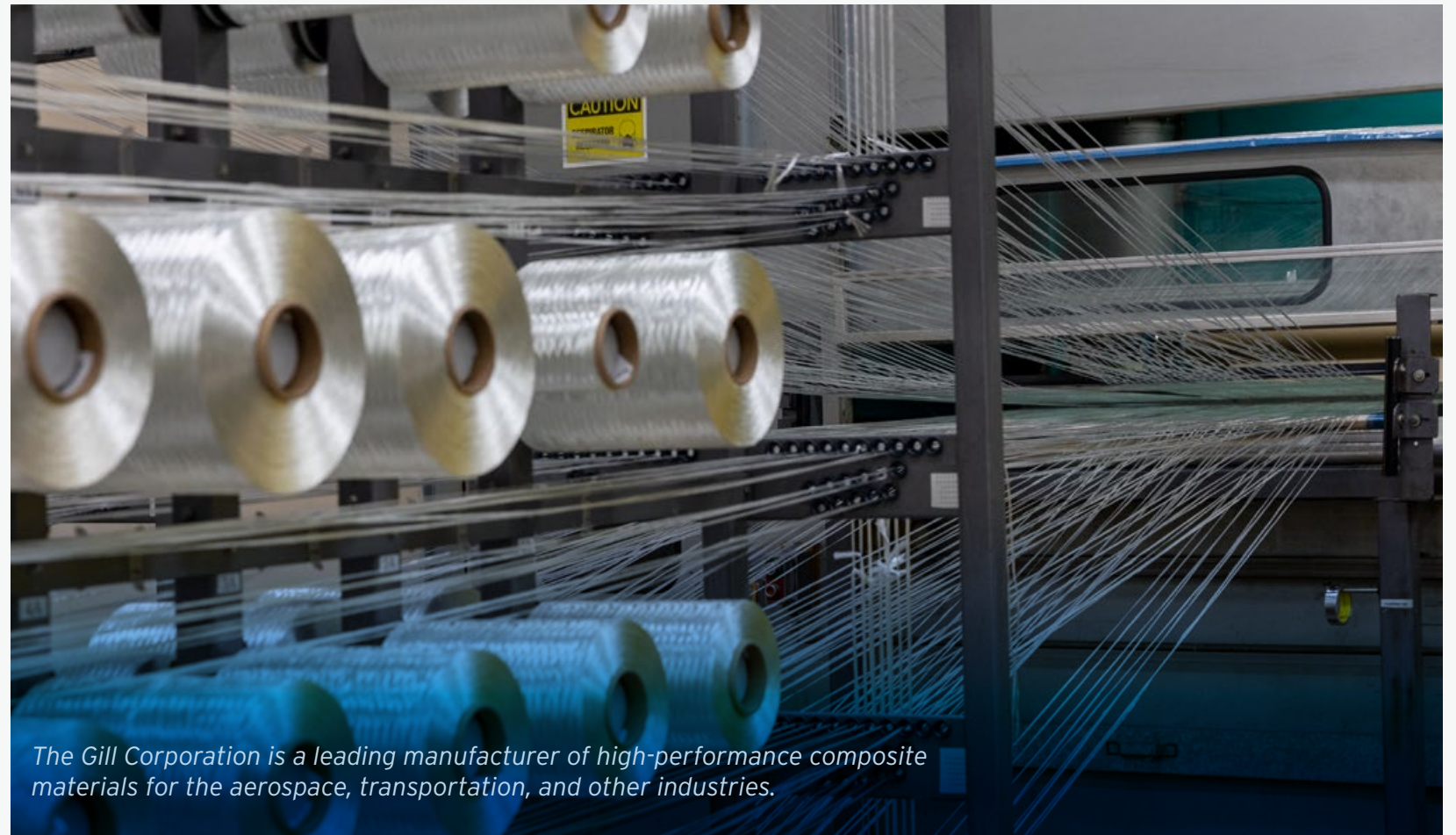
The success of the project was a direct result of the positive collaboration among METRON, The Gill Corporation, and SoCalGas. Through its participation on this project, The Gill Corporation was able to identify an estimated

annual savings of \$150,000—achievable through a capital investment of \$100,000—cutting the facility’s yearly utility bill of \$2,685,000 by 6% and reducing CO₂ emissions by nearly 1,000 metric tons per year. To validate those numbers, SoCalGas had them checked by a third-party measurement and verification organization.

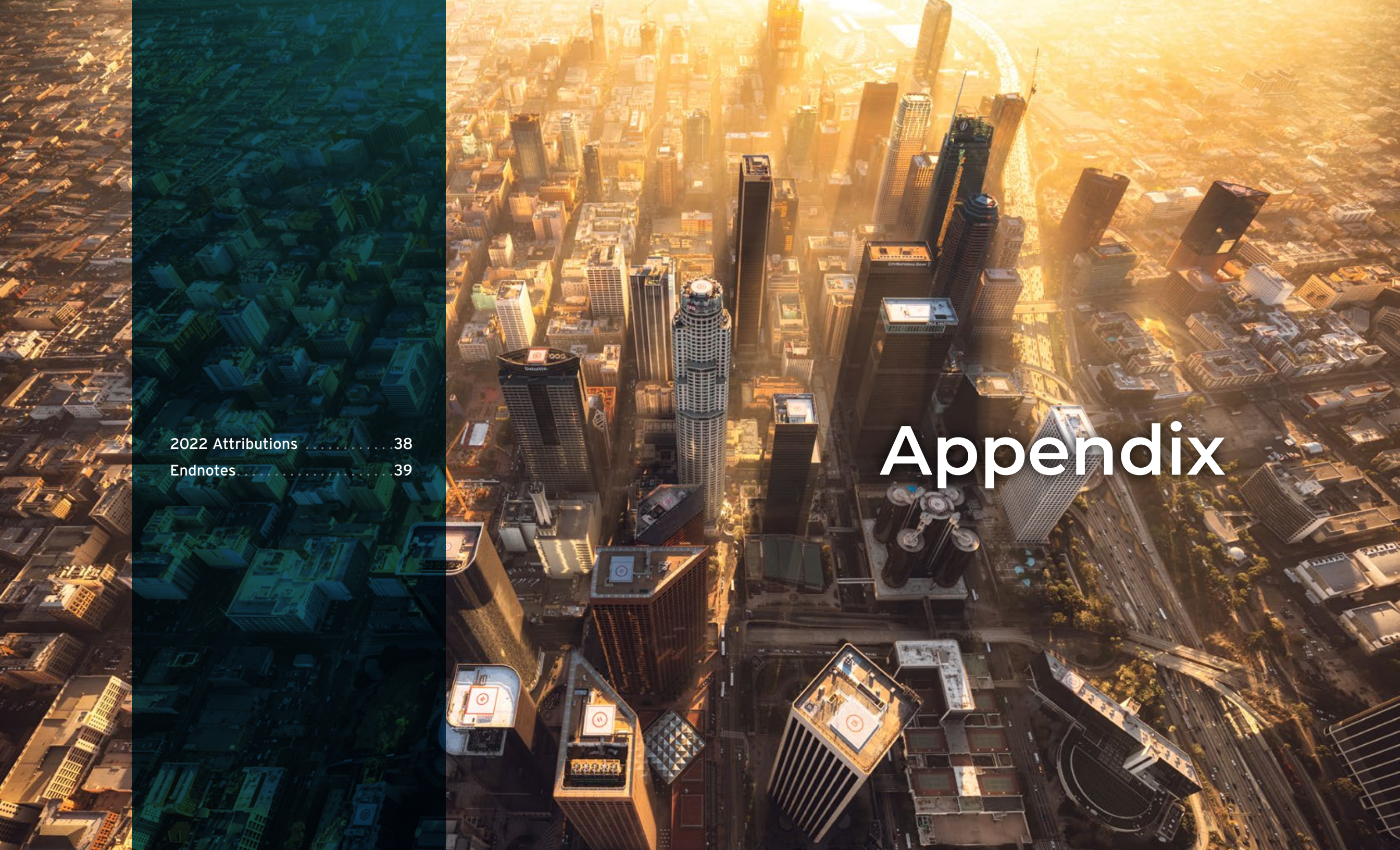
By demonstrating its technology under real-world conditions, METRON gained valuable insight into which parameters consume the most energy and learned where to start deploying resources to create energy models and optimizations for longer term benefits. Siting the project

in the SoCalGas service territory opened up a new market for METRON—one with a large number of potential industrial end users.

“We had already begun commercialization efforts in the U.S. market,” said Groleau. “Through the relationship we built with SoCalGas and our success on this project, we have gained additional traction.” METRON can now approach other clients within the SoCalGas portfolio with proposals to digitize their facilities and implement energy management solutions that can scale at low capital cost. “That benefits us, SoCalGas, and their industrial customers.”



The Gill Corporation is a leading manufacturer of high-performance composite materials for the aerospace, transportation, and other industries.



2022 Attributions	38
Endnotes	39

Appendix

2022 Attributions

Page 5: <https://www.whitehouse.gov/briefing-room/speeches-remarks/2021/01/27/remarks-by-president-biden-before-signing-executive-actions-on-tackling-climate-change-creating-jobs-and-restoring-scientific-integrity/>

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