

## Angeles Link – Technical Documents Summary

### **Key Findings:**

- 1) *As part of the ongoing body of studies used to inform its proposal to develop Angeles Link, a green hydrogen energy infrastructure system to deliver clean, reliable, renewable energy to the Los Angeles region, SoCalGas posted on its website several technical analyses and reports (the “pre-feasibility study” or “Study”) that are in addition to the many studies cited in the Memorandum Account Application and used to inform its proposal to develop Angeles Link.*
- 2) *Consistent with the robust and transparent stakeholder engagement process envisioned in [SoCalGas’ recent application](#) to the California Public Utilities Commission (CPUC) requesting approval to track incremental costs related to the development of Angeles Link, these documents include technical information that informed the project’s ongoing development.*
- 3) *Together, and along with more recent reports such as the IPCC report published after the filing of the Application, these works present substantial and growing evidence that clean fuels like green hydrogen and associated infrastructure are essential to achieving California’s climate and clean air goals, particularly for reliable electric generation and hard-to-electrify sectors of our economy like heavy duty transportation and high heat manufacturing.*
- 4) *Included in the pre-feasibility study are preliminary conceptual engineering data and supporting information. While this information is a conceptual analysis, it supports the technical feasibility of the Angeles Link project and identifies potential issues that need further study and review. Further research and evaluation will take place as part of Phase 1 of the Angeles Link project, including research into several key areas such as potential infrastructure routes, water supplies, hydrogen storage, engineering and others.*
- 5) *With existing relationships to thousands of industrial end users, an extraordinary workforce to do the job safely, and a regulatory framework that promotes a transparent and robust stakeholder process serving the public interest, SoCalGas is well positioned to help California capitalize on this pioneering opportunity to jump start the green hydrogen economy in Southern California and to help the State compete for more than \$8 billion in federal funds allocated for regional hydrogen hubs.*

### **Background on Angeles Link:**

- *Earlier this year, SoCalGas announced a proposal to develop what would be the nation's largest green hydrogen energy infrastructure system (the "Angeles Link") to deliver clean, reliable renewable energy to the Los Angeles region.*

- *As proposed, the Angeles Link could support the integration of more renewable electricity resources like solar and wind and could significantly reduce greenhouse gas emissions from electric generation, industrial processes, heavy-duty transportation, and other hard-to-electrify sectors of the Southern California economy.*
- *The proposed Angeles Link could also significantly decrease demand for natural gas, diesel, and other fossil fuels in the LA Basin, helping to accelerate meeting California's and the region's climate and clean air goals.*
- *As the nation's largest manufacturing hub, the Los Angeles Basin is home to many potential green hydrogen users. As proposed, Angeles Link's green hydrogen could:*
  - *Displace up to 3 million gallons of diesel fuel per day by replacing diesel powered heavy-duty trucks with green hydrogen fuel cell trucks,*
  - *Eliminate up to nearly 25,000 tons of smog forming NOx per year, and also*
  - *Provide the clean fuel to convert up to four natural gas power plants to green hydrogen.*
- *As contemplated, the Angeles Link could deliver green hydrogen in an amount equivalent to almost 25 percent of the natural gas SoCalGas delivers today. Building the system to provide a clean alternative fuel could, over time and combined with other future clean energy projects, reduce natural gas demand served by the Aliso Canyon natural gas storage facility, facilitating its ultimate retirement while continuing to provide reliable and affordable energy to the region.*

### **Details on Recent Technical Work**

In addition to the technical studies referenced in the Memorandum Account Application and herein, in 2021, SoCalGas commissioned SPEC Services, Inc. ("SPEC") to undertake a conceptual and preliminary assessment to better understand the feasibility of green hydrogen market opportunities, including possible conceptual solutions, challenges, and risks to hydrogen delivery in order to begin to explore the potential for development of green hydrogen infrastructure at scale for customers in Southern California (the "*pre-feasibility study*"). Similar to the other technical reports referenced in the Memorandum Account Application and herein, the Study was prepared by consultants and the statements and conclusions in the *pre-feasibility study* do not necessarily represent the position of the Company.

The *pre-feasibility study* is made up of two parts, both of which may be utilized by SoCalGas as it sets out to design, analyze, and further study a potential green hydrogen transport system. Pre-feasibility Study Part 1, which SPEC completed in early 2022, provided the foundation for additional analysis conducted in Pre-feasibility Study Part 2, which SPEC finalized in July 2022.

*The reports, while conceptual, support the technical feasibility of the Angeles Link project. They also highlight several potential aspects that need further study and review. Such further research and evaluation are contemplated as part of Phase 1 of the Angeles Link project, including several key areas such as potential infrastructure routes, water use, hydrogen storage, engineering and others.*

Upon further research and evaluation contemplated as part of Phase 1 of Angeles Link, SoCalGas will be able to determine the technical feasibility and economic viability of a large-scale green hydrogen transport system serving Southern California. That said, the *pre-feasibility study* is an important first step, albeit at a very conceptual level, toward assessing the major technical aspects of producing, storing, and transporting large quantities of green hydrogen and the Study helps to prioritize areas requiring further study. Specifically, the *pre-feasibility study* identifies key technical areas that will guide future engineering and technical studies that aim to refine and improve these initial concepts and operational designs.

The *pre-feasibility study* preliminarily explores, at a conceptual level, multiple demand, production, transport, and storage variables to better understand the key parameters of green hydrogen infrastructure development and to identify the most promising opportunities for further analysis and development. Given the initial conceptual nature of the *pre-feasibility study*, as anticipated in Angeles Link's phased planning approach, additional analysis is required prior to drawing specific conclusions on areas including but not limited to, demand, production, routing, or cost, at this time. The *pre-feasibility study* is one source of information among many that SoCalGas intends to use to inform its Angeles Link plans moving forward.

At this conceptual level of study, the primary focus of the *pre-feasibility study* was to provide an initial overview of the major technical aspects of a green hydrogen transport system, which include:

- **Demand:** The conceptual green hydrogen demand assessment initially identified six key sectors: power generation; transportation; petroleum refining; residential; commercial; and industrial. Based on historical demand data from these sectors, *pre-feasibility study* Part 1 developed "Low," "Medium," and "High," conceptual demand scenarios that formed the basis of further analysis. Based on the results of *pre-feasibility study* Part 1, the *pre-feasibility study* Part 2 refined these conceptual demand scenarios and eliminated residential blending. The analysis focused on potential sectors that could adopt green hydrogen. Further analysis would be required to identify specific potential end-users, which would be the subject of future analysis in a forthcoming phase of the Angeles Link process.
- **Production:** The *pre-feasibility study* assessed, at a conceptual level, the power generation potential and optimized design for multiple conceptual green hydrogen production sites (four in California and one in Utah). The *pre-feasibility study* generally found that since the power generated by current commercially available wind technologies varied substantially by site, wind power-produced hydrogen may require more land than was likely to be available and suitable based on demand, and did not lead to substantial cost reduction. Thus, although actual development may be able to economically implement a combination of solar and wind power, particularly as wind technology advances, the *pre-feasibility study* assumed the green hydrogen would be produced using only solar power (PV panels) and short-term battery storage. The *pre-feasibility study* analysis does not attempt to or otherwise identify specific potential producers, which could be the subject of future analysis in a forthcoming phase of the Angeles Link process. While Angeles Link

focuses on developing a green hydrogen transport system, further analysis of production potential can help inform routing analysis.

- **Transport:** *Pre-feasibility study* Part 1 analyzed the length, diameter, pressure, configuration, and storage requirements for conceptual pipeline systems that could potentially begin at the proposed production site and end at demand centers in the Los Angeles Basin and surrounding area. In *pre-feasibility study* Part 2, additional conceptual pipeline configurations were studied. The *pre-feasibility study* suggests that a green hydrogen pipeline system's design could be linked with the storage needed to accommodate the daily and seasonal changes in solar power and green hydrogen production rates as well as demand needs. Green hydrogen storage could include a combination of (a) excess pipeline capacity allowing storage by packing/unpacking, (b) underground storage delivered by pipeline, and/or (c) onsite pressurized gas storage. Additional evaluation of transportation options would be conducted in a forthcoming phase of the Angeles Link process.
- **Storage:** *Pre-feasibility Study Part 1* found that salt caverns, which have been used for gaseous storage for decades, are currently considered to be the best method to store large quantities of hydrogen gas underground. In addition, the Study found that porous media, such as oil and gas reservoirs, can offer greater volume, are more abundant, and are often furnished with infrastructure that could potentially be repurposed. The *pre-feasibility study* found that based on an initial assessment of oil and gas fields in Southern California, the viability of converting oil/gas production reservoirs to hydrogen storage sites requires more in-depth analysis. An additional evaluation of storage issues would be conducted in a forthcoming stage of the Angeles Link process.
- **Water:** The initial water resources assessment of the Study was based on the preliminary conceptual demand cases and estimated production rates and corresponding water requirements. Several types of water sources were explored in the Study, including groundwater, imported water, recycled water, and desalination. An additional evaluation of water issues would be conducted in a forthcoming stage of the Angeles Link process.