



SOUTHWEST GAS CORPORATION

December 23, 2022

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California Public Utilities Commission

505 Van Ness Avenue
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Subject: Continuing Coordination on Federal Funding Opportunities in the Infrastructure Investment and Jobs Act of 2021

Dear President Reynolds and Commissioners:

Thank you for your follow up letter, dated November 28, 2022, regarding the Infrastructure and Jobs Act of 2021 (IIJA)/Bipartisan Infrastructure Law (BIL) federal funding opportunities available to California electric and gas investor-owned utilities (IOUs) through competitive grants from the Department of Energy (DOE). Per your letter you informed that the DOE has worked to refine and release more specifics on the various clean energy funding opportunities and the Commission plans to develop guidance to assist the IOUs in applying for DOE funding. Per your request of the IOUs, Southwest Gas provides these comments on how the Commission might address the following issues related to awards of federal funding.¹

- **Match-funding or Cost-sharing requirements.**

Southwest Gas is familiar with cost-sharing mechanisms from the DOE programs and is prepared to follow the outlined procedures and guidelines from the Federal Government. Based on Southwest Gas' understanding of these requirements, grant funding applicants may be required to match a percentage of the total project cost and the grant funding will award the remaining amount. For instance, as further discussed below, Southwest Gas' existing proposed hydrogen pilot proposal is estimated to be approximately \$10.21 million. Should the match-funding/cost-sharing requirements only fund 25 percent of the total project costs (or \$2.55 million), Southwest Gas would seek authorization from the Commission to recover the remaining costs (or \$7.66 million) from its customers.

¹ On December 8, 2022, an extension of time to respond to your request was granted to the IOUs until December 23, 2022.



- **Treatment of tax liability for federal funding awarded.**

Based on current tax law, any government grants received would be subject to taxation for both federal and state income tax purposes upon receipt. Currently, there is no mechanism in place to recover these taxes. Southwest Gas suggests that the Commission consider regulatory accounting treatment for recovery of these taxes.

- **Ensuring that each proposed project is competitive in the DOE application process.**

Southwest Gas suggests that the Commission hold workshops with DOE representatives to walk through the requirements of any particular project funding opportunity. This will further assist the IOUs to address any potential deficiencies in their applications.

- **Tracking and oversight of awarded funding to ensure reductions in costs to utility customers.**

An assigned Southwest Gas project manager routinely examines projects with a minimum \$100,000 in total project costs, ensuring projects follow all guidelines and accounting practices to ensure cost efficiencies. The Commission may require the IOUs to report, either through an Advice Letter or other compliance report, on any funding received and demonstrate how project costs will be offset by the funding and reduce cost impact to customers.

- **Any other regulatory issues necessary to support the electric and gas IOUs' abilities to apply for the federal funding.**

Southwest Gas has no other regulatory issues to present at this time.

- **Ensuring the project applications are in alignment with California state goals.**

Southwest Gas is committed to supporting the goals of our customers and communities and aligning with California's state goals to reduce greenhouse gas emissions in energy production and use is aligned with our commitment.

Project Specific Information

- **Identify the specific DOE programs your utility is and is not planning to apply for and why.**

Southwest Gas previously informed in response to your initial inquiry in January 2022, that the Clean Hydrogen Electrolysis Program (Clean Hydrogen) is the most feasible funding opportunity for Southwest Gas with respect to a project in our Northern California service territory. Since that time, Southwest Gas has jointly filed an application in September with Southern California Gas Company and San Diego Gas & Electric Company (Application (A.) 22-09-006), requesting authority to implement pilot projects in our respective service territories to facilitate the development of a hydrogen injection standard. Southwest Gas' proposed hydrogen blending project will produce hydrogen via electrolysis consistent with the merits of the Clean Hydrogen program provided on DOE's website. Per DOE's website, the Clean Hydrogen program has been established to fund projects which, among other things, will improve efficiency, increase durability and lower the cost of producing clean hydrogen through electrolysis. The DOE has \$1 billion allocated for cooperative agreements with industry partnerships to demonstrate technologies producing clean hydrogen through electrolysis to validate data on the cost, efficiency, durability,



and feasibility of commercial deployment of electrolyzers. The estimated application opening date is listed as fourth quarter of 2022; however, as of this writing, the application has not been posted on the DOE web site. Southwest Gas continues to monitor DOE's website for additional information.

- **Provide details about projects proposed for each grant and loan, including the cost range for each project.**

Southwest Gas' proposed project is designed to gain empirical data to establish an optimal percentage blend of hydrogen that will be compatible with natural gas systems in extreme weather conditions such as that in its Northern California service territory. Southwest Gas' hydrogen project will consist of blending hydrogen in an isolated polyethylene plastic distribution system that will serve two existing customers (Southwest Gas' Truckee Operations Center and the California Highway Patrol (CHP)) and a new commercial development of up to sixteen additional commercial customers in Truckee, California. Southwest Gas' project involves an electrolyzer, storage vessels, blending skid, and metering equipment to serve between designated customers in Truckee. Southwest Gas' total estimated costs for its proposed hydrogen blending project are approximately \$10.21 million. A complete description of Southwest Gas' proposed project is included in the attached Prepared Direct Testimony of Kevin L. Lang served in support of A.22-09-006.

- **Identify any applicable CPUC, California Energy Commission (CEC), or other programs that may provide match funding for the project(s) identified.**

Southwest Gas is not aware of any CPUC or CEC programs that may provide match funding for its proposed electrolysis project.

- **Explain how the proposed project(s) maps to existing state priorities, including electric and gas customer rate and bill reductions, safety improvements, reliability enhancements and greenhouse gas emission reductions.**

The proposed project will assist Southwest Gas and other natural gas utility operators to determine safe operating levels of blended natural gas and hydrogen. Southwest Gas will examine how the blended gas affects different pipeline materials and how metering, measurement, leak detection, and appliance validation could also be examined during the proposed project. In addition, and as stated in the attached Prepared Direct Testimony of Hugo Mejia, Victor Cervantes, and Laura Nelson in support of A.22-09-006:

The establishment of a hydrogen blending injection standard could accelerate the adoption of clean fuels and get California closer to achieving broader energy system decarbonization. California's hydrogen economy is poised for accelerated growth, and hydrogen blending could secure California's place beside other global clean energy leaders. The development of a blending standard could signal California's market is open for business and attract the investments needed to reduce production costs and bring it to scale...



- **Explain if the project is related to existing CPUC-authorized funding or cost recovery requests and whether the project has already been CPUC-approved. If funding has not yet been approved, explain how the project contributes to cost reductions for ratepayers.**

As noted above, Southwest Gas, in A.22-09-006, has requested CPUC approval of its proposed hydrogen project. If Southwest Gas is approved for grant funding under the Clean Hydrogen program, the Company anticipates it would use the funding to offset any project costs it proposes to recover from its customers.

- **Identify any proposed projects are in state-designated disadvantaged communities or on Tribal lands.**

Southwest Gas' proposed hydrogen blending project is not in a state-designated disadvantaged communities or on Tribal lands.

- **Explain the coordination and outreach that has already been done with other stakeholders on these projects.**

Initial outreach included a meeting with the Town of Truckee to inform and describe the project. Southwest Gas has also informed the CHP and commercial developer. A detailed outreach plan will be developed upon approval of the Application.

Sincerely,

Amy L. Timperley
Senior Vice President/Chief Regulatory
and Financial Planning Officer

Attachments

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Application: A.22-09-XXX
Witness: Kevin M. Lang
Chapter: 4

PREPARED DIRECT TESTIMONY OF
KEVIN M. LANG
ON BEHALF OF SOUTHWEST GAS CORPORATION
(SOUTHWEST GAS' HYDROGEN BLENDING DEMONSTRATION PROJECT)

BEFORE THE PUBLIC UTILITIES COMMISSION
OF THE STATE OF CALIFORNIA

September 8, 2022

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1 **CHAPTER 4**

2 **PREPARED DIRECT TESTIMONY OF KEVIN M. LANG**
3 **(SOUTHWEST GAS' HYDROGEN BLENDING DEMONSTRATION PROJECT)**

4 **I. PURPOSE**

5 The Southwest Gas Corporation's (Southwest Gas or the Company) hydrogen blending
6 demonstration project (Project) aims to establish critical knowledge complimentary to the other
7 joint utility Applicants' demonstration projects while uniquely targeting hydrogen blending in
8 extremely cold weather conditions in Northern California. Literature research has uncovered
9 hundreds of hydrogen blending projects at various stages around the globe, yet many knowledge
10 gaps about hydrogen blending in natural gas systems still exist regarding safety, system integrity,
11 and reliability. Southwest Gas has a responsibility to ensure that new constituents introduced to
12 the system are compatible with the materials and equipment of each unique system while
13 maintaining the consistent reliability of the distribution network for the communities served by
14 Southwest Gas. Southwest Gas proposes a demonstration project to close knowledge gaps that
15 will focus on establishing an optimal percentage blend and developing policies and procedures
16 for different percentages of hydrogen blends in extremely cold climates. The goal of Southwest
17 Gas' Project is to establish an optimal percentage blend of hydrogen, using empirical data
18 obtained from this demonstration, that will be compatible with the natural gas systems in
19 extreme weather conditions such as that in Northern California.

20 **II. BACKGROUND**

21 Gaseous hydrogen has different properties from natural gas, including higher
22 flammability and lower energy content per volume. As a result, determining the optimal
23 percentage blend in extremely cold areas, which dictates higher heating demand, is further
24 affected by the physical properties of hydrogen in cold temperatures. Understanding how much

1 hydrogen can be blended in these areas will serve as a threshold to discover the optimal
 2 percentage blend in this extreme end of the weather spectrum in California. Discovering the limit
 3 of how much hydrogen can be blended into Southwest Gas’ system and which training activities,
 4 operating policies, and procedures need to be adjusted to accommodate hydrogen blends is
 5 critical to maintaining the system's safety, integrity, and reliability.

6 The Truckee Town Council adopted Resolution 2017-58 on November 28, 2017, which
 7 set a goal of an 80 percent reduction in greenhouse gas (GHG) emissions by 2040. Southwest
 8 Gas has committed to employing new technologies to decarbonize its natural gas pipeline to
 9 assist the Town of Truckee in achieving the town’s GHG reduction goal. The Town of Truckee
 10 is an ideal location to gain understanding of how hydrogen blending affects the existing natural
 11 gas system on the extremities of cold weather conditions in California. The Town of Truckee is a
 12 mountain community located in the northern Sierra Nevada Mountain Range at an elevation of
 13 5,817 feet¹. For eight months of the year, the average low temperature is below freezing. The
 14 average high and low temperatures of Truckee, California can be observed in the table below.

Average Temperatures (Fahrenheit) in Truckee, CA						
	Jan	Feb	Mar	Apr	May	Jun
Average high in °F	41°F	44°F	49°F	55°F	64°F	74°F
Average low in °F	14°F	16°F	21°F	24°F	31°F	36°F
Avg snowfall in inches	41”	44”	34”	16”	4”	1”
	Jul	Aug	Sep	Oct	Nov	Dec
Average high in °F	83°F	82°F	75°F	64°F	49°F	40°F
Average low in °F	41°F	40°F	34°F	27°F	20°F	15°F
Avg snowfall in inches	0”	0”	1”	4”	19”	38”
Source: usclimatedata.com						

¹ United States Geological Survey, National Elevation Dataset.

1 Southwest Gas' Project is designed to test, analyze, and report the hydrogen blending
2 process at a high altitude, cold weather climate. Moreover, the scope is unique as it contemplates
3 testing the technology on commercial customers with different natural gas appliances including a
4 back-up natural gas generator, a range, gas lights, radiant heaters, furnaces, boilers, and water
5 heaters.

6 **A. Objectives**

7 To complement the programs led by the other Applicants, Southwest Gas' Project
8 objectives aim to:

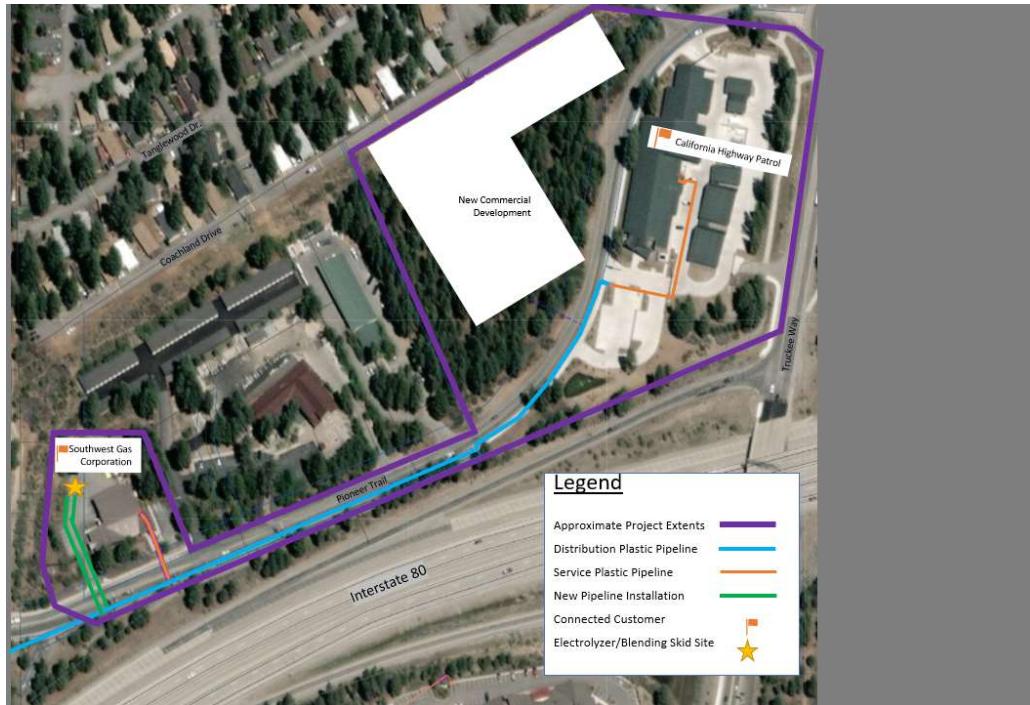
- 9 • Recommend optimal hydrogen blending percentages based on system
10 considerations including, but not limited to, sensitivity of system materials, safety
11 and operational equipment, end-user application, and changes in supply demand
12 caused by substantial changes in seasonally cold weather.
- 13 • Recommend changes to Southwest Gas' operations and emergency response
14 manuals including applicable policies, operational, and training procedures to
15 accommodate hydrogen blending.

16 **III. PROJECT DESCRIPTION**

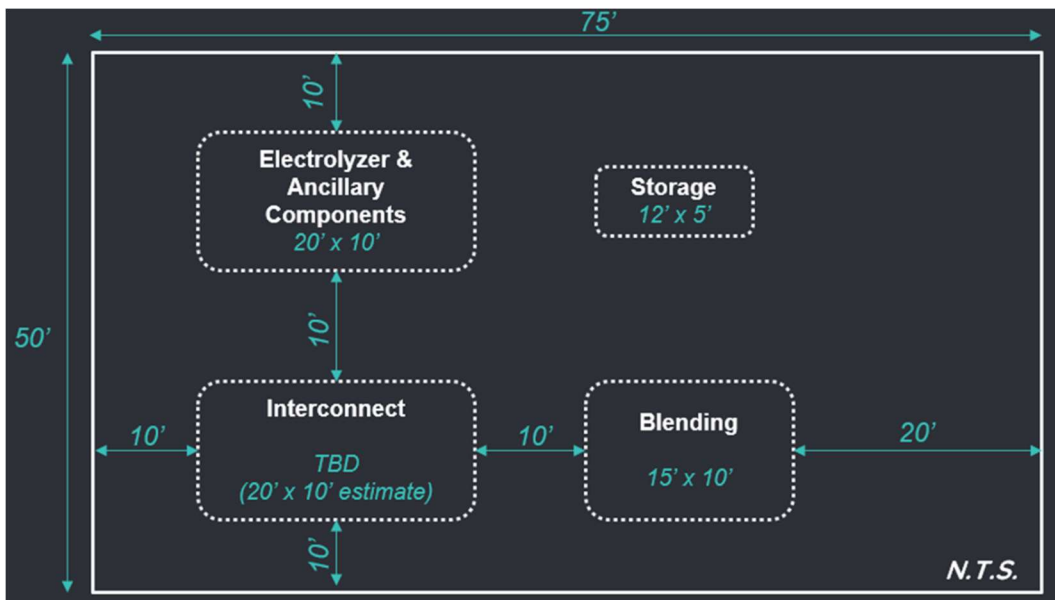
17 **A. Demonstration Project Scope**

- 18 • Generation of hydrogen from an electrolyzer for an 18-month project duration
- 19 • Flow of hydrogen-blended gas through plastic pipelines, steel house lines and
20 end-user equipment for an 18-month project duration
- 21 • Increasing hydrogen blending from 5% up to 20% percentage by volume over an
22 18-month project duration

1 The Project scope includes commercial accounts with a peak hour load of approximately
 2 17 MCFH. This load is based on two existing customers, Southwest Gas' Truckee Operations
 3 Center, and California Highway Patrol office, depicted in the image below, and a new
 4 commercial development of up to 16 customers expected to be constructed in 2022/2023.



Project Site Map



Plot Plan of Electrolyzer and Hydrogen Blending Site

1

B. Demonstration Project Timing

PHASE & ACTIVITY	DESCRIPTION	ESTIMATED DURATION
1. Planning, Design, Construction and Commissioning	Hydrogen equipment is procured; system is designed, constructed, permitted, and commissioned on campus; pipeline system replacement and inspections and any necessary remediation are conducted; stakeholder engagement commences.	21 months
2. Testing and Demonstration	Hydrogen is blended in system on a testing schedule; data is collected; periodic inspection of equipment and pipelines; samples of pipelines and components are collected	21 months (18 months live blending, + 3 months asset inspection & validation)
3. Decommissioning & Equipment Removal, and System Restoration	Hydrogen equipment is removed from location and location restored;	5 months
4. Knowledge Sharing	Data from pilot is interpreted and disseminated; a public report will be released	9 months

2

1. Planning, Design, Construction, and Commissioning

3

1. Upon approval of the application, Southwest Gas will design and construct a

4

pipeline that will feed natural gas into the blending skid at the Truckee

5

Operations facility to feed the building and the connected California Highway

6

Patrol office downstream of the isolated distribution system.

7

2. Southwest Gas will work with an Engineering Procurement Construction (EPC)

8

firm to engineer, procure, construct, and commission the hydrogen production

9

facility, storage and blending skid at the Company’s Truckee operations facility.

10

2. Testing and Demonstration

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1. Increasing percentages of hydrogen will be blended in system on a testing

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schedule; data will be collected quarterly; periodic inspection of equipment and

1 Electrolyzer Procurement: 6 – 12 months

2 Blending Skid & Storage: 12 – 18 months

3 Construction: 12 months

4 This Project schedule assumes normal material procurement times. As a result of impacts
5 from the COVID-19 pandemic, worldwide supply chain timing has been impacted. Southwest
6 Gas cannot reasonably project at this time whether these supply chain impacts will have a
7 negative impact on this project schedule.

8 **IV. PROJECT GUIDANCE**

9 **A. Pipeline Safety Management System (PSMS) API 1173**

10 Southwest Gas supports the American Petroleum Institute’s (API) Recommended
11 Practice 1173: Pipeline Safety Management System. Southwest Gas will integrate the Plan-Do-
12 Check-Act (PDCA) model into this demonstration project. The PDCA model is a continuous
13 loop used to plan, implement, review, and course-correct based on safety checks and efficiency.
14 This loop is used to solve problems and manage change, including unexpected issues along the
15 way. By implementing this 4-step model, Southwest Gas aims to conduct this demonstration
16 program as efficiently and effectively as possible by continuously reviewing the plan and
17 mitigating changes as they naturally arise.

18 **B. Risk Identification and Assessment**

19 One prominent example of risk identification, assessment, and change with the
20 introduction of hydrogen into a natural gas system that requires a modification of our system’s
21 protocols for the safety of the community, personnel, and property, are safety procedures relating
22 to ventilation procedures. Natural gas has a relatively short range at which it is flammable with
23 air. The lower explosivity limit (LEL) of natural gas in air is 4%, and the upper explosivity limit

1 (UEL) is 14%. By contrast, pure hydrogen's LEL is 4% hydrogen in air and has an UEL of up to
 2 75% hydrogen in air. Gaseous hydrogen is over five times more likely to ignite with air than
 3 natural gas is. The addition of hydrogen in our existing natural gas infrastructure will increase
 4 the hazardous limits of flammability. Therefore, safety policies and procedures require
 5 evaluation and solutions to mitigate risks relating to emergency response in the case of a leak in
 6 an enclosed space. This is just one of many examples of topics that a natural gas utility must
 7 consider to ensure the continued delivery of safe and reliable energy when introducing hydrogen
 8 to a natural gas distribution system. Resources are necessary to ensure policies, procedures, and
 9 training and can meet the challenge of mitigating this risk.

10 Other policies and procedures relating to the safety and operation of distribution gas that
 11 will be affected by the introduction of gaseous hydrogen include, but are not limited to:

12 Policies & Procedures relating to

13	• Purging & Ventilation	26	• Pressure/Temperature Recorders
14	• Leak Detection	27	• Odorization
15	• Compressor Stations	28	• Pipe & Component Testing & Design
16	• Damage Prevention	29	• Pipe Joining
17	• Corrosion Control	30	• Pigging Design
18	• Integrity Management	31	• Pressure Control Design
19	• Electronic Instruments	32	• Process Transmitters Inspections and
20	• Emergency Response	33	Calibration Procedure
21	• Facilities Protection	34	• Repairs
22	• Gas Control	35	• SCADA
23	• Gas Quality	36	• Selection of Materials
24	• Metering	37	• Welding
25	• Main & Service Pipeline Design	38	• Tools & Equipment

1 Additionally, end-users may observe differences in the distributed gas that may impact
2 end-user equipment.

3 **C. Reporting**

4 Southwest Gas will use a third party to help evaluate hazards, analyze risks, and validate
5 compatibility of materials, equipment and procedures relating to blending hydrogen throughout
6 the duration of the Project. A third party will perform and report a baseline and periodic analysis
7 of the existing materials, components, and equipment of the isolated system that hydrogen will
8 be introduced, such as but not limited to materials, corrosion, electronic instruments, supervisory
9 control and data acquisition (SCADA), metering equipment, leak detection equipment, house
10 lines, and end-user equipment.

11 Baseline, periodic examination, and analysis of the following will be completed and
12 reported:

- 13 • Existing materials and components for the purpose of reporting all affected or
- 14 unaffected topics related to system integrity
- 15 • Existing policies and procedures for the purpose of reporting recommended changes
- 16 to safety protocols

17 Annual progress reports on the status of the project and relevant finds will be submitted
18 to the CPUC. A final report with an optimal percentage blend based on the conditions of the
19 project will be made publicly available at the end of the demonstration program.

20 **V. DEMONSTRATION PROJECT COST ESTIMATE**

Activity	Cost
Design & installation of new infrastructure required to support hydrogen blended pipeline (Design, Equipment, Installation)	\$295,000*

Design & build hydrogen generator, storage and blending skid, labor, and equipment	\$8.61 million**
Baseline readings and data collection	\$1.25 million
Periodic analysis and to report concerns and unexpected changes in the system and end-user equipment	
Final Reports	
Decommissioning of Equipment	\$62,500
Total Costs:	\$10.21 million

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*Cost estimates associated with installation of utility infrastructure for this project are as follows:

Natural gas (Southwest Gas, Material and Labor):	\$235,000
Electric and water (Tahoe Donner PUD, Material and Labor):	\$60,000
Total Estimated Price:	\$295,000

**Cost estimates associated with installation of an appropriately sized electrolyzer for this project are as follows:

Electrolyzer (Materials Only):	\$669,000
Blending Skid (Material and Labor):	\$969,000
Storage	\$92,000
Southwest Gas Metering Equipment (Material and Labor):	\$625,000
Hydrogen Compound Construction (Labor):	\$6,250,000
Total Estimated Price:	\$8,605,000

Caveats associated with the costs:

- 1 • Cost estimates were not officially bid to subcontractors. Costs are based on rough
2 estimation from subcontractors that Southwest Gas has executed Non-Disclosure
3 Agreements with.
- 4 • Southwest Gas has talked with several companies (both EPC and equipment suppliers)
5 that have expressed interest in bidding on this type of project. Southwest Gas plans to bid
6 this work out to several subcontractors should we get approved to move forward.
- 7 • These costs represent a preliminary analysis of the Project from our subcontractors. As
8 the project progresses, Southwest Gas will be able to more accurately determine the costs
9 associated with the Project.
- 10 • All costs shown include a 25% contingency above the estimated value.

11 **VI. CONCLUSION**

12 Truckee, CA, where the proposed Southwest Gas Hydrogen Demonstration Project will
13 be located, is one of the coldest regions in California. Undoubtedly the colder climate, which
14 leads to higher demand for energy use, will affect a blended hydrogen and natural gas system
15 differently than in warmer climate conditions. This Project will fill in knowledge gaps that are
16 complimentary with the other joint utilities Applicants' demonstration projects. In this way, the
17 Applicants will have more complete information to determine an optimal percentage blend
18 throughout the different regions in California. This concludes my testimony.

1 **VII. QUALIFICATIONS**

2 My name is Kevin M. Lang and I am the director/Engineering Services for Southwest
3 Gas. I direct and coordinate engineering and technical support to the Company's five operating
4 divisions across three states for pipeline safety code compliance; right-of-way and land rights
5 acquisition and maintenance, material specifications and approval; environmental policies and
6 procedures; proper energy measurement; pipeline cathodic protection; technical support of the
7 SCADA system; project design review; hydraulic modeling support; and the training and
8 qualification of technical services personnel. I previously oversaw the Company's Distribution
9 Integrity Management Program (DIMP) and laboratory services under the same capacity.

10 I joined Southwest Gas in 2003 as an engineer in Victorville, CA. I was subsequently
11 promoted to distribution engineer in 2005, supervisor/Engineering in 2006 and
12 manager/Engineering in 2007. During this period, I oversaw the design of transmission and
13 distribution facilities for new business, franchise and system reinforcements; PVC pipeline
14 replacements; pipeline safety code compliance; MAOP studies and requalification programs; and
15 preparation of short and long-term capital budgets.

16 I was promoted to director/Gas Operation Support Staff in 2011 where I directed the
17 Company's technical skills training, Operator Qualification (OQ) training and testing, tool and
18 equipment evaluations, operations-related procedures manuals, Incident Command System
19 training and operation of the Emergency Response Training Facilities in Tempe and Las Vegas. I
20 was subsequently promoted to director/Engineering Services in November of 2012.

21 I hold a Bachelor of Science degree in Mining Engineering from Virginia Tech and am a
22 registered Professional Engineering in the state of Nevada with a proficiency in Civil
23 Engineering. I currently serve on the American Gas Association's Operations Safety Regulatory
24 Action Committee.

Application: A.22-09-XXX
Witness: H. Mejia, V. Cervantes, and L. Nelson
Chapter: 1

**PREPARED DIRECT TESTIMONY OF
HUGO MEJIA, VICTOR CERVANTES, AND LAURA NELSON ON BEHALF OF
SOUTHERN CALIFORNIA GAS COMPANY, SAN DIEGO GAS & ELECTRIC
COMPANY, AND SOUTHWEST GAS CORPORATION
(POLICY)**

BEFORE THE PUBLIC UTILITIES COMMISSION
OF THE STATE OF CALIFORNIA

September 8, 2022

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1 **CHAPTER 1**

2 **PREPARED DIRECT TESTIMONY OF HUGO MEJIA, VICTOR CERVANTES, AND**
3 **LAURA NELSON**
4 **(Policy)**

5 **I. PURPOSE**

6 Southern California Gas Company (SoCalGas), San Diego Gas & Electric Company
7 (SDG&E), and Southwest Gas Corporation (Southwest Gas) (collectively, the Applicants) seek
8 approval of an application proposing live hydrogen blending demonstration projects (Projects) to
9 collect necessary safety and integrity data in support of the development of a hydrogen injection
10 standard (Application). Resultant project data can provide key technical, operational, and safety
11 information to support the development of a future hydrogen injection standard of up to 20%
12 hydrogen gas by volume.

13 The purpose of this chapter’s testimony is to provide the policy justification and context
14 for how hydrogen blending could be an essential component of California’s carbon neutral
15 energy economy, as well as describe the immediate need to begin testing and understanding live
16 hydrogen injection and blending on the gas system, consistent with recommendations from the
17 “Hydrogen Blending Impacts Study” completed by the University of California (UC), Riverside,
18 for the California Public Utilities Commission (CPUC or Commission). This testimony will
19 elaborate on how blending supports state energy policy objectives, provides an overview of
20 hydrogen market development leadership in the United States (U.S.) and California, and details
21 how Applicants’ Projects are unique and distinguishable from other hydrogen blending research
22 efforts in California.

23 **II. LEVERAGING THE APPLICANTS' EXISTING GAS SYSTEMS TO INJECT**
24 **AND BLEND HYDROGEN COULD HELP ACCELERATE THE**
25 **DEVELOPMENT OF A CLEAN FUELS NETWORK**
26

27 **A. Introduction**

28 Applicants support California’s climate and energy goals, including Senate Bill (SB) 32,¹

¹ California Senate Bill 32 (Pavley, 2016), *available at:*
https://leginfo.legislature.ca.gov/faces/billTextClient.xhtml?bill_id=201520160SB32.

1 achieving carbon neutrality by 2045 (E.O. B-55-18),² and fulfilling the 100% Clean Energy Act
2 of 2018 by 2045 (SB 100).³ Applicants acknowledge various challenges that will need to be
3 addressed to meet these targets, and recognize that both clean molecules and clean electrons, as
4 well as a diverse energy technology toolkit, will likely be required to reach carbon neutrality
5 while providing safe, reliable and resilient energy.

6 Hydrogen is poised to become an essential component of the low carbon energy economy
7 of the future. In California and other parts of the world, hydrogen can be integral to achieving
8 energy decarbonization at scale. The flexibility of hydrogen as an energy carrier across multiple
9 sectors makes it a unique carbon neutral energy solution enabling transportation, distribution,
10 and storage of clean energy. By decarbonizing multiple sectors of the economy, hydrogen is
11 uniquely positioned to transform California’s future energy system. At its July 2021 workshop,
12 the California Energy Commission (“CEC”) recognized the importance of hydrogen, stating
13 “[A]s we look at different options and alternatives for the state to transition to a decarbonized
14 electricity system by 2045, hydrogen has emerged as an important element that we need to assess
15 and understand,” especially for grid reliability.

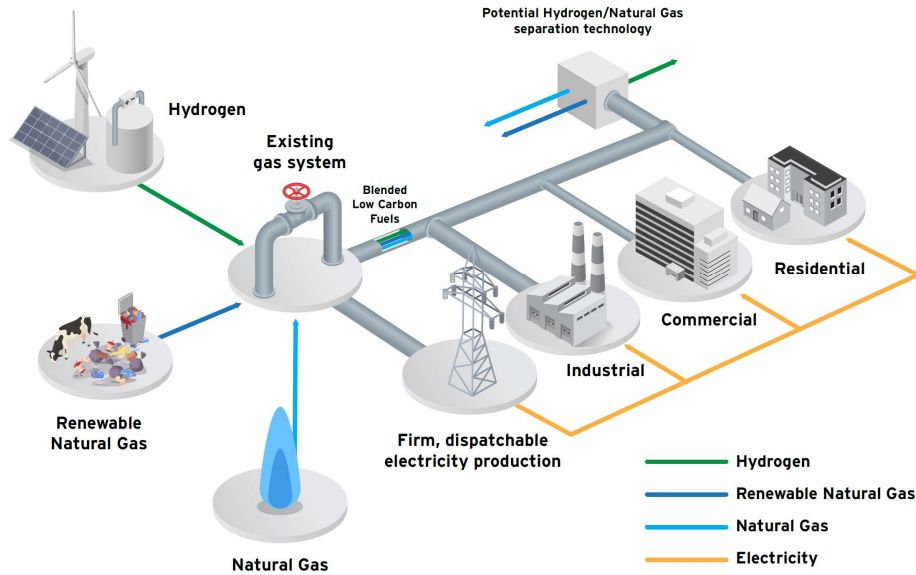
16 Blending hydrogen has the potential to lower greenhouse gas (GHG) emissions on both
17 the electric and gas grids, serve as a low-cost hydrogen storage and transportation medium, and
18 provide system resiliency through energy diversity and redundancy. For example, as indicated in
19 Figure 1 below, the existing gas system could be leveraged to deliver clean molecules to many
20 sectors of the economy, including heavy duty transportation, high heat for industrial applications,
21 power and heat for buildings, and clean, firm dispatchable power for electric generation. In the
22 future, hydrogen separation technology may be added to the system for specific end point
23 applications requiring pure hydrogen fuel.

² Executive Dept., State of California, “Executive Order B-55-18 To Achieve Carbon Neutrality”
available at: <https://www.ca.gov/archive/gov39/wp-content/uploads/2018/09/9.10.18-Executive-Order.pdf>.

³ California Senate Bill 100 (De León, 2018), available at:
https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201720180SB100.

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Figure 1: Hydrogen Blending on the Existing Gas System



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Since hydrogen is carbon-free at the point of consumption, it could make a significant contribution to lower emissions in various sectors of the economy. For example, at a 20% hydrogen blend by volume, the typical carbon dioxide (CO₂) reduction potential of hydrogen is 6.3%.⁴ Given the scale of the gas system today, a 6.3% CO₂ reduction is significant: if California’s gas system was 20% hydrogen by volume in 2020,⁵ the CO₂ reduction would be equivalent to removing 1.52 million gasoline-powered passenger vehicles from the road, or

⁴ International Energy Agency, *Reduction of CO₂ Emissions by Adding Hydrogen to Natural Gas*. Report No. PH4/24 (October 2003), available at: https://ieaghg.org/docs/General_Docs/Reports/Ph4-24%20Hydrogen%20in%20nat%20gas.pdf.

⁵ As of May 10, 2022, the 2022 California Air Resources Board’s (CARB) Draft Scoping Plan Update’s selected Proposed Scenario (Alternative 3) includes renewable hydrogen blended in natural gas pipelines at 7% energy (~20% by volume), ramping up between 2030 and 2045. ⁵ California Air Resources Board, *Draft 2022 Scoping Plan Update* (May 10, 2022), available at: <https://ww2.arb.ca.gov/sites/default/files/2022-05/2022-draft-sp.pdf>.

1 replacing about 6% of California’s registered automobiles with zero emission vehicles.^{6,7,8,9}

2 The establishment of a hydrogen blending injection standard could accelerate the
3 adoption of clean fuels and get California closer to achieving broader energy system
4 decarbonization. California’s hydrogen economy is poised for accelerated growth, and hydrogen
5 blending could secure California’s place beside other global clean energy leaders. The
6 development of a blending standard could signal California’s market is open for business and
7 attract the investments needed to reduce production costs and bring it to scale. In addition,
8 blending hydrogen into our existing system could provide an opportunity for our existing
9 workforce to adopt safe operating practices and participate in the clean hydrogen economy
10 future.

11 **B. Delivering Clean Fuels as a Potential Strategy to Timely and Cost-**
12 **Effectively Meet State’s Climate Goals**

13 Leveraging existing pipelines is one of the most cost-effective and timely ways to serve
14 clean fuels to our electric power, industrial, commercial, and residential customers. This position
15 is supported by the findings and recommendations outlined in the June 2020 UC Final Project
16 Report prepared by the University of California (UC) Irvine’s Advanced Power and Energy
17 Program for the CEC.¹⁰ One of the top UC Irvine recommendations is to “[p]romote access to
18 the natural gas system for renewable hydrogen transport and storage—establish blending limits

⁶ U.S. Energy Information Administration, *Natural Gas Delivered to Consumers in California*, available at: <https://www.eia.gov/dnav/ng/hist/n3060ca2m.htm>.

⁷ U.S. Environmental Protection Agency, *Greenhouse Gas Emissions from a Typical Passenger Vehicle*, available at: <https://www.epa.gov/greenvehicles/greenhouse-gas-emissions-typical-passenger-vehicle>.

⁸ California Department of Motor Vehicles, *Estimated Vehicles Registered by County for the Period of January 1 through December 31, 2020*, available at: https://www.dmv.ca.gov/portal/uploads/2021/02/estimated_fee_paid_by_county_report.pdf.

⁹ Calculation: (2,019 BCF of natural gas consumed in CA 2020)*(0.0552 kg CO₂/CF) produces 112.16 MMT CO₂/year from natural gas system. If 20% of the natural gas by volume had been replaced by hydrogen: 6.3%*111MMT CO₂ = 7.0 MMT of CO₂ emissions could have been avoided. In passenger vehicle equivalency, (7.0 MMT of CO₂*10⁶)/4.5 MT CO₂/car/year (per EPA average)= 1,524,280 cars removed from the road. As there were 25,507,660 registered cars in California in 2020, this is equivalent to removing 6% of all cars from the road in California.

¹⁰ University of California, Irvine, Advanced Power and Energy Program, *Roadmap for the Deployment and Buildout of Renewable Hydrogen Production Plants in California* (June 2020), available at: https://www.apep.uci.edu/PDF_White_Papers/Roadmap_Renewable_Hydrogen_Production-UCI_APEP-CEC.pdf.

1 and interconnection requirements.”¹¹ The report urges timely action so that renewable hydrogen
2 fuel producers receive the same open access to the common-carrier pipeline system as other fuel
3 types and recognizes the Commission’s critical role in enabling this.¹²

4 In October 2021, SoCalGas published a report titled “The Role of Clean Fuels and Gas
5 Infrastructure in Achieving California’s Net Zero Climate Goal.”¹³ The study compared four
6 future energy scenarios for California, ranging from “high clean fuels” to “full electrification,”
7 which considered fully decommissioning the fuels network. The results demonstrated that in the
8 three scenarios featuring a clean fuels network, California’s energy system would be more
9 affordable, resilient, and carry less technology risk than the “no fuels network” (aka “full
10 electrification”) scenario. Notably, the study projected that clean fuel systems, comprised of
11 increasing levels of clean molecules, including higher blend rates of hydrogen into the existing
12 pipeline along with dedicated hydrogen pipelines, would save California energy customers
13 between \$45 billion and \$75 billion over the course of the next 30 years in avoided costs that
14 would otherwise be needed without a clean fuels network. To unlock these savings and help
15 Californians receive highest return on investment for a reliable and resilient path to net zero
16 emissions, Applicants recognize significant innovation and infrastructure investment is required.
17 In this respect, the demonstration Projects detailed in Chapters 2-4, comprising live evaluation of
18 hydrogen blending in sections of the present gas distribution system inform the critical path to
19 efficiently achieving statewide climate goals.

20 In April 2022, SDG&E published a study, “The Path to Net Zero: A Decarbonization
21 Roadmap for California,” which shared its vision on how to decarbonize the California economy
22 while also prioritizing grid reliability, affordability, and equity. The SDG&E study evaluated
23 several combinations of decarbonization strategies, which included clean fuel pipeline blending,
24 designed to achieve the state’s goals over the study horizon. Based on that effort, SDG&E’s
25 position is that the composition of fuel in the pipeline in 2045 is likely to be comprised of a
26 blend of natural gas, renewable natural gas (RNG), and clean hydrogen, while acknowledging a

¹¹ *Id.* at 6.

¹² *Id.* at C-24.

¹³ SoCalGas, *The Role of Clean Fuels and Gas Infrastructure in Achieving California’s Net Zero Climate Goal* (October 2021), available at: https://www.socalgas.com/sites/default/files/2021-10/Roles_Clean_Fuels_Full_Report.pdf.

1 significant decline of gas system throughput due to broad electrification of the building sector.¹⁴

2 Importantly, while the 2045 costs of hydrogen are uncertain and challenging to predict
3 over such a long-time horizon, clean hydrogen is likely to be a competitively priced fuel by
4 2045. Analysis by the Hydrogen Council, in collaboration with McKinsey, prior to the U.S.
5 Department of Energy’s (DOE) “Hydrogen Shot” announcement, found that the production costs
6 of green hydrogen could decline by 60% from 2020 to 2030 in the U.S.¹⁵ This is because clean
7 hydrogen production, including that which qualifies as renewable or “green,” is well positioned
8 to benefit from massive economies of scale.

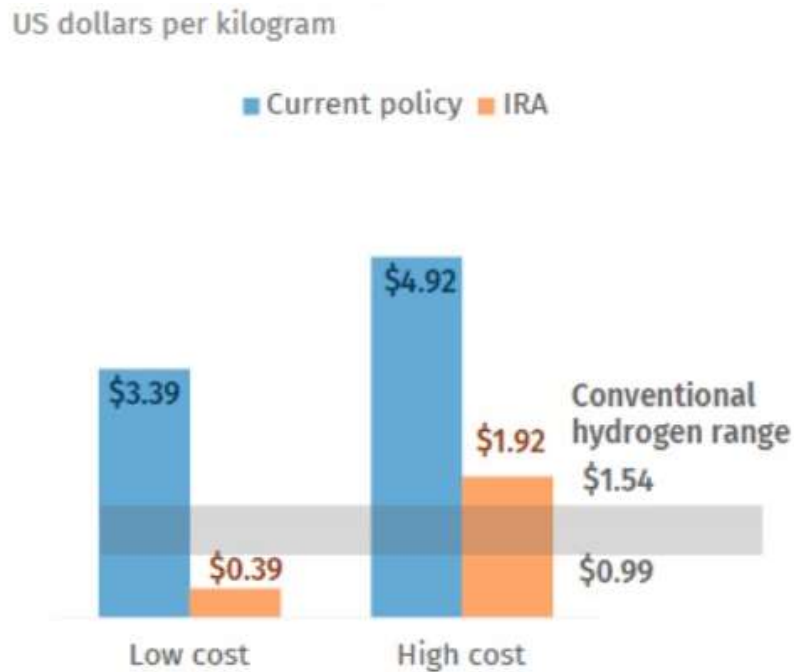
9 The downward cost trajectory of clean hydrogen is further accelerated and solidified by
10 the new clean hydrogen production tax credit within the Inflation Reduction Act (IRA) passed by
11 the U.S. Congress on August 12th, 2022. Low carbon-intensity hydrogen reaches a maximum
12 credit value of \$3.00/kg, enabling cost to reach parity or fall below the cost of conventional grey
13 hydrogen by 2030 (Figure 3).¹⁶ With this powerful economic incentive in place, clean hydrogen
14 is ideally positioned for widespread deployment across California. Hydrogen blending could play
15 a major role in this process by providing producers with a viable alternative to transport clean
16 hydrogen by leveraging the existing gas system, and at the same time, by enabling California to
17 benefit from clean, federally subsidized hydrogen to progress towards its climate goals.

¹⁴ San Diego Gas & Electric, *The Path to Net Zero: A Decarbonization Roadmap for California* (April 2022), available at: <https://www.sdge.com/netzero>

¹⁵ Hydrogen Council and McKinsey & Company, *Hydrogen Insights: A perspective on hydrogen investment, market development and cost competitiveness* (February 2021), available at: <https://hydrogencouncil.com/wp-content/uploads/2021/02/Hydrogen-Insights-2021-Report.pdf>.

¹⁶ Rhodium Group, *A Turning Point for US Climate Progress: Assessing the Climate and Clean Energy Provisions in the Inflation Reduction Act* (August 2022), available at: <https://rhg.com/research/climate-clean-energy-inflation-reduction-act/>.

Figure 3: Forecasted Clean Hydrogen Prices in 2030, with and without IRA Clean Hydrogen Production Tax Credit



C. Hydrogen Blending Could Reduce Emissions in Multiple Sectors

As a carbon-free fuel, hydrogen could help reduce GHG emissions from multiple sectors of the economy currently fueled by natural gas from the power sector to the industrial sector, to buildings (commercial and residential).

Power Sector

Currently, natural gas fired generators are needed to support the state with firm, dispatchable electric power. In 2020, 30% of the state’s total natural gas consumption went to electricity production.¹⁷ Hydrogen blended with natural gas could support the transition to carbon-neutral electricity by 2045 by lowering CO₂ emissions from existing natural gas-powered generators over the next 20 years. Power producers and utilities in the state are studying or

¹⁷ U.S. Energy Information Administration, *Natural Gas Consumption by End Use, California, Annual*, available at: https://www.eia.gov/dnav/ng/ng_cons_sum_dc_u_sca_a.htm.

1 executing this option to support a phased transition. Turbine manufacturers including Mitsubishi,
2 General Electric (GE), and others either currently offer or are working on designs to allow for
3 power production with a high content of blended hydrogen.¹⁸ For example, Solar Turbines
4 Incorporated, with DOE funding and support from Pipeline Research Council International
5 (which SoCalGas is a member of), is developing a retrofittable dry low emissions gas turbine
6 combustion system that can operate with hydrogen blends and 100% hydrogen.¹⁹ Another
7 example is the Los Angeles Department of Water and Power’s conversion of a power plant in
8 Delta, Utah to operate on a blend of 30% hydrogen and 70% natural gas by 2025, using turbines
9 supplied by Mitsubishi Power.²⁰ SDG&E is preparing to blend hydrogen at its Palomar Energy
10 Center 565 megawatt combined cycle plant in the next year, using existing turbine technology.²¹

11 In addition to reducing power sector CO₂ emissions, hydrogen blending on the gas system
12 could support renewable resource integration while increasing the efficiency and reliability of the
13 electric grid.

14 Electrolytic hydrogen production could take advantage of low-cost, excess renewable
15 energy when it is available to create clean hydrogen gas. In addition to utilizing excess
16 renewable energy that is otherwise curtailed, that clean hydrogen gas could be stored in pipelines
17 and dispatched back to the grid in the form of electricity when required via turbines or fuel cells.
18 California is seeing a large increase in curtailed clean energy. For example, between 2018 and
19 2019 alone, the amount of curtailed energy from solar and wind in California more than doubled,
20 according to the California Independent System Operator (CAISO).²² If curtailed resources were
21 paired with electrolyzers, the otherwise wasted energy could be used to create hydrogen.

22 Hydrogen could meaningfully contribute to power sector reliability and resiliency owing

¹⁸ Mitsubishi Hydrogen Power Generation Handbook (2021); GE Power to Gas: Hydrogen for Power Generation (2019).

¹⁹ National Energy Technology Laboratory, *U.S. Department of Energy Selects 12 Projects to Improve Fossil-Based Hydrogen Production, Transport, Storage and Utilization*, available at: <https://netl.doe.gov/node/10875>.

²⁰ Los Angeles Times, *This Tiny Utah Town Could Shape West’s Energy Future* (Sammy Roth, May 19, 2022) available at: <https://www.latimes.com/environment/newsletter/2022-05-19/this-tiny-utah-town-could-shape-the-wests-energy-future-boiling-point>.

²¹ San Diego Gas and Electric, *Powering the future: Palomar Energy Center Green Hydrogen Project* available at: <https://www.sdgenews.com/article/powering-future-palomar-energy-center-green-hydrogen-project>.

²² California Independent System Operator, *Managing oversupply*, available at: <http://www.caiso.com/informed/Pages/ManagingOversupply.aspx>.

1 to its superior capability as a long duration energy storage medium. Many existing
2 electrochemical battery technologies have operating profiles in minutes to hours, and are unable
3 to meet the challenge of weekly or seasonal balancing of the grid that will be needed as the state
4 moves toward higher penetrations of renewables. In contrast, hydrogen is a very long-duration
5 (weeks to months) and scalable (from megawatts to gigawatts) energy storage medium that could
6 become a critical solution to avoid curtailment and provide reliability to the future net-zero
7 electric grid.

8 **Industrial Sector**

9 Hydrogen is an attractive carbon free energy solution for industries that cannot rely on
10 electrification alone because they depend on fuels to create process heat and steam. Examples of
11 these industries include makers and processors of iron, steel, aluminum, glass, paper, cement,
12 and food. California's industrial sector makes up over 10% of the state's economy, with a total
13 manufacturing output of \$324 billion in 2019.²³ Much of this sector relies on the natural gas
14 system for fuel; a full 34% of California's gas consumption supported industrial processes in
15 2020. Blending hydrogen into the natural gas system could support industrial decarbonization in
16 the short to medium term by lowering overall emissions, while also protecting the state's
17 manufacturing economy. Ultimately, it is anticipated that industries will likely seek to form or
18 organize clusters around dedicated hydrogen pipelines, but hydrogen blending is a
19 complementary strategy that could be implemented more rapidly.

20 **Building Sector (Commercial and Residential)**

21 To date, minimal efforts to promote clean fuels development have been directed at end-
22 use customers, specifically in commercial and residential buildings, which accounted for a total
23 of 35% of natural gas consumption in 2020 (12% and 23% respectively).²⁴ These customers
24 include individuals and major corporations who are increasingly interested in reducing their
25 environmental impact but may not be able to afford new appliances or are waiting for their
26 current appliances to achieve end of life. As these customers increasingly demand access to

²³ National Association of Manufacturers, *2021 California Manufacturing Facts*, available at: <https://www.nam.org/state-manufacturing-data/2021-california-manufacturing-facts/>.

²⁴ U.S. Energy Information Administration, *Natural Gas Consumption by End Use, California, Annual*, available at: https://www.eia.gov/dnav/ng/ng_cons_sum_dc_u_sca_a.htm.

1 renewable energy, the gas pipeline system, through the integration of hydrogen blending, could
2 be viewed as a resource in California’s clean energy strategy by delivering clean molecules for
3 end-use energy consumption. Leveraging the gas pipeline system enables built-in resiliency
4 while supporting customers in the clean energy transition.

5 **D. Real World Demonstration Scale Testing Is Necessary to Support the**
6 **Development of a Hydrogen Blending Injection Standard**

7 The Commission has acknowledged that “existing efforts and research status on hydrogen
8 affirm that the issue is ripe for consideration.”²⁵ The Commission has also indicated that any
9 impacts to the safety of the gas systems or to customer end-uses must be clearly understood and
10 mitigated (in addition to the impacts and benefits on the environment and to customers) before a
11 hydrogen injection standard can be implemented. The Applicants agree with this position and are
12 undertaking steps to achieve this end, leveraging recently set forth recommendations from the
13 “Hydrogen Blending Impacts Study” completed by UC Riverside Study for the Commission.²⁶
14 As an outcome of their findings, UCR recognized that a single, systemwide injection standard
15 would have to consider the most susceptible conditions observed through all infrastructure
16 components as well as end-uses, appliances, and industrial processes. The study further
17 highlights “as there are knowledge gaps in several areas, including those that cannot be
18 addressed through modeling or laboratory scale experimental work, it is critical to conduct real
19 world demonstration of hydrogen blending under safe and controlled conditions.” UCR
20 recommended that the utilities:

21 “Conduct demonstration of hydrogen blending in a section of the infrastructure that is
22 isolated or is custom-built to include the commonly present materials, vintages, facilities, and
23 equipment of the generic California natural gas infrastructure with appropriate maintenance,
24 monitoring and safety protocols over extended periods. The recommended hydrogen percentages
25 for this demonstration are 5 to 20%. Such demonstration projects can allow critical knowledge
26 gaps to be filled, including the effect of parameters such as weather induced temperature

²⁵ Assigned Commissioner’s Scoping Memo and Ruling Opening Phase 4 of Rulemaking 13-02-008
(November 21, 2019) at 7, available at:
<http://docs.cpuc.ca.gov/PublishedDocs/Efile/G000/M320/K307/320307147.PDF>.

²⁶ Raju, A.S.K, *Hydrogen Blending Impacts Study*, prepared for the California Public Utilities
Commission, July 2022.

1 changes, pressure cycling, length of exposure, effect of natural gas components and
2 contaminants, and potential mitigation techniques.”

3 Per these recommendations, the Applicants’ proposed Projects can demonstrate hydrogen
4 blends in the 5-20% range considering this is the range at which little to no modifications are
5 required to end-use equipment and hydrogen blending is unlikely to impact safety and operation
6 of end-use appliances considering comparable field testing performed in the United Kingdom.²⁷
7 The Projects proposed by the Applicants can inform stakeholders of the critical safety, technical
8 and operational data that will support these parallel efforts. The Applicants also intend to
9 collaborate with stakeholders on these recommended parallel efforts given the opportunity.

10 In addition to the Commission’s interest, California’s other leading energy,
11 environmental, and economic development agencies, including the California Energy
12 Commission (CEC), CARB, and the Governor’s Office of Business and Economic Development,
13 have all recognized hydrogen’s ability to help the state meet its decarbonization goals. Across
14 agencies, hydrogen development has been funded, studied, and proposed in a variety of
15 programs, policies, and proceedings.

16 While these efforts are important, understanding the safety and operational impact of live
17 hydrogen blending on the existing gas system is necessary to develop a safe hydrogen injection
18 standard at appropriate hydrogen blending percentages which utilize existing and planned
19 infrastructure, and work with customer end-use appliances. The establishment of a hydrogen
20 injection standard could enable the state to effectively and safely utilize hydrogen to meet its
21 phased energy transition goals in a timely manner. The Application and the Projects it seeks to
22 authorize serve as the critical lynchpin supporting all other hydrogen efforts in the state.

23 As the foundational stage in a long-term hydrogen blending blueprint, “real-world”
24 blending Projects in this Application can demonstrate practical, distribution-scale
25 implementation in support of an injection standard of up to 20% in some parts of the distribution
26 system. Project results can guide the Applicants to define the parameters of potential
27 transmission-scale blending demonstrations in follow-on phases of the process, towards the

²⁷ HyDeploy, *First UK trial of hydrogen blended gas hailed a success* (September 8, 2021), available at: <https://hydeploy.co.uk/about/news/first-uk-trial-of-hydrogen-blended-gas-hailed-a-success/>.

1 objective of an injection standard for hydrogen blending in the entire gas system.

2 Therefore, it is urgent that we begin studying the behavior and impact of live hydrogen
3 blending in the existing natural gas system today, as it will take time to collect and analyze those
4 results. The Applicants cannot solely rely on bench testing, literature reviews, or results from
5 demonstrations conducted out of state, given that no two gas systems are identical. The
6 Applicants must develop the required level of operational hydrogen blending expertise and
7 experience as soon as possible to establish an injection standard, so that the gas system could
8 incorporate clean hydrogen for blends up to 20% in support of a phased approach toward gas
9 decarbonization through 2045 and beyond.

10 Depending on the data gathered while the Projects are in progress, the Applicants may
11 have enough information collected to develop an interim preliminary hydrogen blending
12 standard for the California gas distribution system. The interim standard could expedite the
13 adoption of lower carbon fuels in California. The Applicants will share information on a
14 potential interim standard with the Commission as it becomes available.

15 **III. RECENT HYDROGEN MARKET DEVELOPMENT LEADERSHIP IN U.S. AND** 16 **CALIFORNIA**

17 In the last two years, the U.S. and California have seen a considerable increase in interest,
18 investment, and activity around clean hydrogen for use in decarbonizing the electric and gas
19 sectors. By being one of the first states to develop a comprehensive hydrogen injection standard
20 for up to 20% hydrogen in the existing natural gas network, California will be well positioned to
21 benefit from federal funding programs and private investment in the hydrogen sector.

22 Developing such a standard also sends a clear signal that California's hydrogen economy is open
23 for business. Not only would this accelerate the low carbon hydrogen economy, but it would also
24 create a major new economic engine for clean energy development in the state, including an
25 entirely new industry for skilled workers and massive potential clean energy export
26 opportunities. According to a recent study by the Fuel Cell & Hydrogen Energy Association, the
27 U.S. hydrogen economy could generate an estimated \$140 billion per year in clean energy

1 revenue and support 700,000 total jobs across the hydrogen value chain by 2030.²⁸ By 2050, it
2 could drive growth by generating about \$750 billion per year in revenue and a cumulative 3.4
3 million jobs.²⁹

4 **U.S. Government Leadership**

5 The Federal Government has provided major signals over the last two years indicating its
6 endorsement for the development of a clean hydrogen economy.

7 For example, on June 7, 2021, the DOE announced its first “Earthshot” initiative, focused
8 on clean hydrogen. The initiative seeks to reduce the cost of clean hydrogen by 80% to \$1 per 1
9 kilogram in 1 decade (“1 1 1”). If the Hydrogen Shot goals are achieved, scenarios show the
10 opportunity for at least a five-fold increase in clean hydrogen use. A U.S. industry estimate
11 shows that the increased use of clean hydrogen has the potential for 16% carbon dioxide
12 emission reduction economy-wide by 2050, in addition to major economic benefits.³⁰

13 On November 15, 2021, the U.S. Congress passed the Infrastructure Investment and Jobs
14 Act (IIJA), which lays the foundation for a national clean hydrogen strategy and roadmap. The
15 IIJA allocates \$9.5 billion in funds toward development of the hydrogen energy economy and,
16 importantly, establishes a federal definition for clean hydrogen.³¹ The new federal law defined
17 “clean hydrogen” as “[h]ydrogen produced with a carbon intensity equal to or less than 2
18 kilograms of carbon dioxide-equivalent produced at the site of production per kilogram of
19 hydrogen produced.”³² The IIJA further mandated the development of a national strategy to
20 facilitate a clean hydrogen economy, the National Clean Hydrogen Strategy and Roadmap, and
21 directed the development of a clean hydrogen production carbon intensity standard.

22 On August 12, 2022, the U.S. Congress passed the Inflation Reduction Act, which
23 strengthens even further the foundation for the development of the U.S. hydrogen economy. The
24 IRA creates a new clean hydrogen production tax credit of up to \$3 per kilogram of hydrogen

²⁸ Fuel Cell & Hydrogen Energy Association (FCHEA), *Roadmap to a US Hydrogen Economy: Reducing emissions and driving growth across the nation* (November 2019), available at:

<https://www.fcchea.org/us-hydrogen-study>.

²⁹ *Id.*

³⁰ Office of Energy Efficiency & Renewable Energy – Hydrogen and Fuel Cell Technologies Office, *Hydrogen Shot*, available at: <https://www.energy.gov/eere/fuelcells/hydrogen-shot>.

³¹ Infrastructure Investment and Jobs Act, Pub. L. No. 117-58, 135 Stat. 429 (2021), available at: <https://www.congress.gov/bill/117th-congress/house-bill/3684/text>.

³² *Id.* at § 40312 (amending § 803 of the Energy Policy Act of 2005, codified at 42 U.S.C. § 16152).

1 produced that will likely dramatically improve the competitiveness of clean hydrogen and
2 accelerate its deployment across the U.S.

3 **California Leadership**

4 As described below, California’s Legislature and Governor’s Office, as well as leading
5 energy, environmental, and economic development agencies, have all recognized hydrogen for
6 its ability to help the state to timely and affordably meet its decarbonization goals. Hydrogen
7 efforts have been funded, studied, and proposed in a variety of programs, policies, and
8 proceedings. However, it is Applicants’ position that a fundamental and timely understanding of
9 live hydrogen blending on the existing gas network of up to 20% hydrogen is necessary to safely
10 achieve the ambitious hydrogen market development and decarbonization goals that these
11 agencies and regulatory and lawmaking bodies are working towards.

12 Some recent hydrogen-related efforts at the state level and at key state agencies are
13 summarized here.

14 **California’s Legislature**

15 California lawmakers have passed a variety of legislation to encourage market
16 development of hydrogen. Recently passed bills include:

- 17 • SB 1505 (2006) – Authorized CARB as the authority to regulate the emissions and
18 renewable content of hydrogen produced for fuel cell electric vehicles (FCEV) and
19 mandated that 33.3% of the hydrogen supplied through the state’s fueling infrastructure
20 be made from “eligible renewable energy resources” as determined by the Public Utilities
21 Code.
- 22 • Assembly Bill (AB) 118 (2007) – Created the CEC’s Alternative and Renewable Fuel
23 and Vehicle Technology Program (ARFVTP).
- 24 • AB 8 (2013) – Mandated \$20 million in annual funding (from the ARFVTP) to support
25 the construction of 100 hydrogen-fueling stations.
- 26 • AB 1369 (2018) – Authorized green electrolytic hydrogen an eligible form of energy
27 storage.

28 Additionally, the Legislature recently passed several budget trailer bills on August 31, 2022 to
29 further advance hydrogen system market development opportunities including allocation of \$100
30 million to create a state Hydrogen Program to provide financial incentives to eligible in-state

1 hydrogen projects for the demonstration or scale-up of the production, processing, delivery,
2 storage, or end use of hydrogen, and \$5 million to the Alliance for Renewable Clean Hydrogen
3 Energy Systems initiative for activities related to establishing a federally-funded hydrogen hub in
4 California.

5 **Governor’s Office**

- 6 • Executive Order S-01-07 created the Low Carbon Fuel Standard (LCFS) program,
7 directing CARB to meet a target of at least 10% reduction in the carbon intensity (CI) of
8 California’s transportation fuels by 2020.
- 9 • Executive Order B-48-18 doubled the State’s construction goal for hydrogen stations,
10 establishing new targets of 200 stations and 5 million total zero-emission vehicles on
11 California roads by 2030.
- 12 • On May 18, 2022, Governor Newsom’s administration announced California’s intention
13 to leverage federal investment from the IJA to establish an environmentally and
14 economically sustainable and expanding renewable hydrogen hub.³³

15 **The Governor’s Office of Business and Economic Development (“GO-Biz”)**

- 16 • GO-Biz serves as California’s leader for job growth, economic development, and
17 business assistance efforts.
- 18 • H2Hubs effort: Go-Biz is leading the H2Hubs effort in strong collaboration with
19 stakeholders across sectors, building a collaborative ecosystem of technology, policy, and
20 finance partners to develop a winning proposal for a green hydrogen hub, and more
21 broadly, to advance and accelerate the hydrogen market within the state and beyond.³⁴
22 GO-Biz formally announced California’s intention to leverage federal investment for the
23 IJA to establish an environmentally and economically sustainable and expanding
24 renewable hydrogen hub and they are eyeing Los Angeles as a target geographic

³³ Bloomberg, *California to Join \$8 Billion Hydrogen Hub Race Among US States*, (May 18 2022),
available at: <https://www.bloomberg.com/news/articles/2022-05-18/california-to-join-8-billion-hydrogen-hub-race-among-us-states>.

³⁴ State of California, *California H2Hub Collaborator Form*, available at: <https://business.ca.gov/h2hubs-form/>.

1 location.³⁵

- 2 • Hydrogen Fueling Station Readiness: As part of the Go-Biz Zero Emission Vehicles
3 (ZEVs) program, there is a team specifically dedicated to cultivating opportunities to
4 accelerate zero-emission vehicle market growth, including hydrogen ZEVs.³⁶

5 **California Energy Commission**

6 The CEC is the state's primary energy policy and planning agency. It is committed to
7 reducing energy costs and environmental impacts of energy use while ensuring a safe, resilient,
8 and reliable supply of energy. It has included hydrogen in a variety of efforts over the past years.

9 Examples include:

- 10 • 2021 Integrated Energy Policy Report, Volume III - Decarbonizing the State's Gas
11 System.³⁷
- 12 • Hydrogen Vehicles & Refueling Infrastructure Programs and Grant Funding
13 Opportunities,³⁸ with an increased focus to include onsite hydrogen generation.
- 14 • Block Grant for Medium-Duty and Heavy-Duty Zero-Emission Vehicle Refueling
15 Infrastructure Incentive Projects.³⁹
- 16 • CEC GFO 21-507: Targeted Hydrogen Blending in Existing Gas Systems.⁴⁰
- 17 • CEC GFO 21-503: Examining the Effects of Hydrogen in End Use Appliances for Large

³⁵ State of California, *California Formally Announces Intention to Create a Renewable Hydrogen Hub* (May 18, 2022), available at: <https://business.ca.gov/california-formally-announces-intention-to-create-a-renewable-hydrogen-hub/>.

³⁶ State of California, *Zero-Emission Vehicles (ZEV)*, available at: <https://business.ca.gov/industries/zero-emission-vehicles/>.

³⁷ California Energy Commission, *2021 Integrated Energy Policy Report*, available at: <https://www.energy.ca.gov/data-reports/reports/integrated-energy-policy-report/2021-integrated-energy-policy-report>.

³⁸ California Energy Commission, *Hydrogen Vehicles & Refueling Infrastructure*, available at: <https://www.energy.ca.gov/programs-and-topics/programs/clean-transportation-program/clean-transportation-funding-areas-1>.

³⁹ California Energy Commission, *Energy Infrastructure Incentives for Zero-Emission Commercial Vehicles (EnergIIZE Commercial Vehicles)*, available at: <https://www.energy.ca.gov/proceedings/energy-commission-proceedings/energy-infrastructure-incentives-zero-emission-commercial>.

⁴⁰ California Energy Commission, *GFO-21-507 - Targeted Hydrogen Blending in Existing Gas Network for Decarbonization*, available at: <https://www.energy.ca.gov/solicitations/2022-01/gfo-21-507-targeted-hydrogen-blending-existing-gas-network-decarbonization>.

1 Commercial Buildings and Industrial Applications.⁴¹

- 2 • Natural Gas Research and Development Program: Annually established scope of projects
3 that has increasingly focused on hydrogen technologies. The latest Budget Plan (Fiscal
4 Year 2022-2023) includes a total of \$13 million in funding for hydrogen related
5 activities, including: (1) large-volume hydrogen storage projects for targeted use cases;
6 (2) industrial clusters for clean hydrogen utilization; (3) funding to mitigate criteria air
7 pollutants in hydrogen combustion; and (4) advanced hydrogen refueling for heavy
8 transport refueling infrastructure solutions.⁴²

9 **California Air Resources Board**

10 CARB is the lead agency for climate change programs and oversees all air pollution control
11 efforts in California to attain and maintain health-based air quality standards. CARB has
12 included hydrogen in a variety of efforts over the past few years. Examples include:

- 13 • CARB Scoping Plan (AB 32): In 2006, the Legislature passed the California Global
14 Warming Solutions Act of 2006 (AB 32), which created a comprehensive, multi-year
15 program to reduce GHG emissions in California. AB 32 required CARB to develop a
16 Scoping Plan that describes the approach California will take to reduce GHGs to achieve
17 the goal of reducing emissions to 1990 levels by 2020. The Scoping Plan was first
18 approved by CARB in 2008 and must be updated at least every five years. Since 2008,
19 there have been two updates to the Scoping Plan. Each of the Scoping Plans have
20 included a suite of policies to help the state achieve its GHG targets, in large part
21 leveraging existing programs whose primary goal is to reduce harmful air pollution. As
22 mentioned earlier in this testimony, the 2022 CARB Draft Scoping Plan Update's
23 selected Proposed Scenario (Alternative 3), as of May 10, 2022, includes renewable
24 hydrogen blended in natural gas pipeline at 7% energy (~20% by volume), ramping up

⁴¹ California Energy Commission, *GFO-21-503 - Examining the Effects of Hydrogen in End-Use Appliances for Large Commercial Buildings and Industrial Applications*, available at: <https://www.energy.ca.gov/solicitations/2021-09/gfo-21-503-examining-effects-hydrogen-end-use-appliances-large-commercial>.

⁴² California Energy Commission, *Gas Research and Development Program Proposed Budget Plan for Fiscal Year 2022–23* (March 2022), available at: <https://www.energy.ca.gov/sites/default/files/2022-03/CEC-500-2022-001.pdf>.

1 between 2030 and 2045.⁴³

- 2 • GHG Emission Inventory Program (AB 32).
- 3 • Hydrogen Fueling Infrastructure Report (AB 8).
- 4 • LCFS (AB 32).
- 5 • ZEV Program (Advanced Clean Cars, State Agency ZEV Action plans, California’s ZEV
- 6 Market Development Strategy EO N-79-20).

7 **Other State and Provincial Leadership**

8 Although California is widely recognized for its international leadership in clean energy
9 policy, when it comes to hydrogen blending, Europe, Australia, other U.S. states and Canadian
10 provinces have taken more tangible action, with an understanding that incremental blending of
11 hydrogen into natural gas energy systems will provide a seamless and more resilient transition
12 towards carbon neutrality. Table 1 summarizes the extensive list of hydrogen blending
13 demonstration projects occurring outside the U.S.⁴⁴ Live hydrogen blending studies and pilots
14 have either been announced or are already underway in the U.S. and Canada. These projects are
15 occurring in Minnesota (CenterPoint Energy blending up to 5% H₂ into local gas distribution
16 system)⁴⁵; New York (National Grid’s “HyGrid” blending pilot in Hempstead, NY); New Jersey
17 (NJ Natural Gas’s blending pilot in Howell, NJ)⁴⁶, New Mexico (New Mexico Gas Company)⁴⁷;
18 Ontario (Enbridge Gas in Markham, Ontario, Canada)⁴⁸, Utah (Dominion ThermH₂TM

⁴³ California Air Resources Board, *Draft 2022 Scoping Plan Update* (May 10, 2022), available at:
<https://ww2.arb.ca.gov/sites/default/files/2022-05/2022-draft-sp.pdf>.

⁴⁴ Mahajan, D.; Tan, K., et al. Hydrogen Blending in Gas Pipeline Networks – A Review, *Energies*, 2022,
15, 3582.

⁴⁵ CenterPoint Energy, *Renewable Hydrogen: Accelerating a Cleaner Energy Future*, available at:
<https://www.centerpointenergy.com/en-us/business/services/clean-energy-innovation/renewable-hydrogen>.

⁴⁶ New Jersey Natural Gas, *A Clean Energy New Jersey Starts Here: NJNG’s Green Hydrogen Project*,
available at:
https://www.njrsustainability.com/environmental/NJR_HydrogenProject_Factsheet_01d1.pdf.

⁴⁷ New Mexico Gas Company, *New Mexico Gas Company to Test Hydrogen Blending* (December 3,
2021), available at: <https://www.nmgco.com/userfiles/files/12%203%2021%20Hydrogen%20Project.pdf>.

⁴⁸ Enbridge, *Hydrogen blending project now operational, reducing carbon footprint of natural gas delivered by Enbridge Gas* (January 2022), available at:
<https://www.enbridge.com/stories/2022/january/hydrogen-blending-project-enbridge-gas-cummins-operational-markham-ontario>.

distribution gas blending project at a training facility)⁴⁹, and North Carolina (Dominion Energy in Gastonia, North Carolina). Hawai'i Gas already serves its customers up to 15% hydrogen in its mixed gas system which also consists of synthetic natural gas, RNG, and liquified natural gas (LNG).⁵⁰

Table 1. Rest of World Hydrogen Blending Demonstration Projects.

Project	Country	Year	Blending Vol%	Trial/Project Size
HyDeploy	UK	2019	20	1500 residential
East Neuk Power	UK	2020	20	15 GWh energy annually
Aberdeen Vision	UK	2020	2–20	300 residential
HyNet Northwest	UK	2021	100	30 TWh energy annually
HyNTS Hydrogen Flow Loop	UK	2021	30	-
H21	UK	2018	100	6.4 TWh energy annually
Hy4Heat	UK	2018	100	-
HySpirit	UK	2019	100	-
Zero 2050 South Wales	UK	2020	100	-
Decarbonisation Pathway	UK	2020	100	-
GRHYD	France	2014	20	200 residential
THyGA	EU	2019	10–100	100 residential and commercials
WindGas Falkenhagen	Germany	2013	2	-
WindGas Hamburg	Germany	2015	2	-
HyP SA	Australia	2021	5	700 residential
HyP Gladstone	Australia		10	800 residential and industrials
HyP Murry Valley	Australia	2021	10	40,000 residential
Jemena West Sydney	Australia	2018	2	259 residential
Fort Saskatchewan	Canada	2020	5	2000 residential
Cummins-Enbridge	Canada	2018	2	3600 residential

Although California is slightly behind projects announced and underway in other states, a timely approval of the proposed Projects would squarely position California as a leader in hydrogen development due to the scope, diversity, differentiation, impacts, and knowledge sharing of the hydrogen blending initiatives described herein. Further, Commission approval of a statewide hydrogen injection and blending standard could greatly accelerate potential economic growth from hydrogen market development. Such a standard could put California in a strong leading position to benefit from federal dollars and private investment for hydrogen market development. It could also accelerate creation of hydrogen-related new highly skilled jobs and

⁴⁹ Dominion Energy, *Hydrogen: The Next Frontier of Clean Energy*, available at: <https://www.dominionenergy.com/projects-and-facilities/hydrogen#utah>.

⁵⁰ Hawai'i Gas, *Decarbonization and Energy Innovation*, available at: <https://www.hawaiigas.com/clean-energy/decarbonization>.

1 businesses for California.

2 **IV. DISTINGUISHED TECHNICAL APPROACH: LIVE BLENDING**

3 The Projects’ overarching goal described in Chapters 2 through 4 of the Application is to
4 support the development of a statewide hydrogen injection standard for California at a hydrogen
5 blending percentage that is compatible with existing and planned gas infrastructure as well as
6 end-use appliances. The Projects have been carefully curated amongst the Applicants so that the
7 investigations are distinguishable from and complementary to each other, the Commission-
8 funded UC Riverside Hydrogen Blending Impacts Study, and the recently launched CEC Grant
9 Funding Opportunity 21-507 (Targeted Hydrogen Blending in Existing Gas Network for
10 Decarbonization). While the UC Riverside and CEC activities are important and support our
11 efforts, they are focused on literature review, tabletop experiments, modeling, risk analysis, and
12 developing performance metrics. They do not include live blending on the gas system, as the
13 subject Projects do. Rather, the Projects build upon the UC Riverside Study by implementing the
14 recommended next step for “real-world” demonstration and development of an injection
15 standard. Specifically, UCR recommends conducting demonstration of hydrogen blending in the
16 5-20% range utilizing infrastructure that includes commonly present materials, vintages,
17 facilities, and equipment of the generic California natural gas infrastructure with appropriate
18 maintenance, monitoring, and safety protocols over extended periods.

19 As the companies charged with and dedicated to the safe delivery of energy to our
20 customers and the safety of our workforce, the Applicants agree that the best way to understand
21 and learn how to measure, manage, design, operate, observe, assess, analyze, and mitigate risks
22 associated with the behavior of hydrogen in a blended gas distribution and transmission system,
23 across several materials, is through live blending demonstration projects. Chapters 2 through 4 of
24 the testimony further delve into the details of the proposed live blending projects, which are
25 focused on the distribution system. Applicants agree that multiple distribution-scale projects in
26 different locations represent the lowest-risk and most cost effective first step to evaluate the
27 higher hydrogen blends recommend by the UCR study. Multiple distribution scale projects
28 diversify the learning opportunity across different vintages of pipe, meters, and end-use
29 equipment, the results of which enable more informed potential follow-on transmission scale
30 demonstrations.

1 The body of literature reports that blending in relatively low hydrogen concentration (1-
2 5% by volume) seems to be viable without significantly increasing risk factors in the storage,
3 transmission, and utilization of hydrogen blends.⁵¹ Successful evaluation of hydrogen blending
4 percentages upwards of 5% proposed in the Projects fill some of the knowledge gaps
5 surrounding materials impacts at higher blending percentages and contribute to a conservative
6 floor for a single injection standard. Per the UC Riverside Study, “[A] single injection standard
7 that applies systemwide would have to consider the most susceptible conditions observed
8 throughout all infrastructure components. This type of scenario would also be required to
9 consider all end-uses, appliances, and associated industrial processes. This systemwide blending
10 injection scenario becomes concerning as hydrogen blending approaches 5% by volume. As the
11 percentage of hydrogen increases, end-use appliances may require modifications, vintage
12 materials may experience increased susceptibility, and legacy components and procedures may
13 be at increased risk of hydrogen effects.”

14 Table 2 below compares and contrasts the activities of UC Riverside and the CEC with
15 the Applicants’ proposed activities. While each activity plays a critical role in establishing the
16 knowledge base of hydrogen blending impacts, the Applicants’ proposed Projects will establish
17 key findings from the UC Riverside Study under real-world conditions. For example, the
18 Applicants’ proposed activities include blending into both steel and polyethylene plastic piping,
19 two of the most prevalent pipeline materials in the California natural gas transportation
20 infrastructure.

⁵¹ K. Domptail *et al.*, “Emerging fuels – Hydrogen SOTA , Gap Analysis , Future Project Roadmap,” 2020.

Table 2: Hydrogen Blending Research Projects Comparison.

Project Title	Description	H2 Blends Considered	Pipeline Detail	End Use Equipment Detail	Location & Climate Detail
UCR Hydrogen Impacts Study	A combination of literature review, modeling, and experimental work was performed on materials and leakage rates. Recommendation: live blending demonstration in 5-20% hydrogen range, create single injection standard blueprint including possibility of <5% blend if deemed necessary to safely operate all infrastructure.	Up to 100% hydrogen	Laboratory material testing- Hydrogen impacts on polymeric materials as well as metals and alloys	Not applicable	Laboratory Test
CEC GFO 21-507	No live blending. Develop strategic experimentation and test program and perform quantitative risk analysis; quantify performance metrics.	Up to 100% hydrogen	Unspecified	Power Generation and Industrial Sectors	N/A
SoCalGas – UCI H2 Blending Pilot	Live blending on isolated portion of system.	Up to 20% by volume	Medium Pressure Distribution Pipeline (Steel and Plastic)	Commercial and Residential	Irvine, CA; Moderate coastal conditions
SDG&E – UCSD H2 Blending Pilot	Live blending on isolated portion of system.	Up to 20% by volume	Medium Pressure Distribution Pipeline (Polyethylene Pipe)	Residential	La Jolla, CA; Moderate coastal conditions

Project Title	Description	H2 Blends Considered	Pipeline Detail	End Use Equipment Detail	Location & Climate Detail
Southwest Gas H2 Blending Pilot	Live blending on isolated portion of system.	Up to 20% by volume	Medium Pressure Distribution Pipeline (Polyethylene Pipe)	Commercial	Truckee, CA; Extremely cold weather conditions

1 **V. CONCLUSION**

2 Hydrogen is an important, but developing, tool in California’s clean energy toolkit. If
3 properly employed, it could help accelerate the use of clean fuels in many sectors, allowing for a
4 phased and cost-effective energy transition for all Californians. However, without understanding
5 the safety and operational impact of live hydrogen blending on the existing gas system to
6 develop a safe hydrogen injection standard, it is unlikely that California will be able to
7 effectively and affordably utilize hydrogen to meet its climate goals in a timely manner.

8 If approved, the projects described in this Application could enable and catalyze a myriad
9 of other hydrogen efforts in the state, including a variety of programs, policies, and proceedings
10 supported by the State Legislature, the Governor’s Office, and leading state agencies. The
11 projects included herein are unique, distinguishable from, and complementary to each other and
12 other research underway funded by the state. The Applicants are committed to collaborative
13 knowledge sharing and coordination throughout the projects.

14 In approving the Application, the Commission can secure California’s leadership on
15 hydrogen blending in North America, support the activities and efforts of the state’s leading
16 energy, environmental, and economic development agencies and the Legislature, and position the
17 state to benefit from federal dollars and private investment for hydrogen market development.

18 This concludes our prepared direct testimony.

1 **VI. QUALIFICATIONS**

2 **Hugo Mejia**

3 My name is Hugo Mejia. I have been employed by Southern California Gas Company
4 since 1990. I have held various positions at SoCalGas in the Engineering, Environmental,
5 Transmission, Storage, and PSEP organizations. These roles included working as the
6 Engineering Analysis Center Manager, Environmental Services Manager, Gas Transmission
7 Technical Services Manager, Senior Engineer in Storage Operations and PSEP Project and
8 Execution Manager. I am currently employed as the Engineering Hydrogen Manager in Gas
9 Engineering and System Integrity where my primary responsibility is assessment of Hydrogen
10 Blending into the existing natural gas system. I received a Bachelor's Degree in Engineering
11 from California State University, Northridge and I am a Registered Mechanical Engineer in the
12 State of California. I have previously testified before the commission.

13
14 **Victor Cervantes**

15 My name is Victor Cervantes. My business address is 8690 Balboa Avenue, San Diego,
16 California 92123. In my current role as Director of Hydrogen Business Development, I oversee
17 new business opportunities in the hydrogen sector for San Diego Gas & Electric. Prior to my
18 current position, I was the Business Development Director for the power sector at Sempra
19 Mexico. I have been employed with Sempra Mexico or SDG&E since 2016. Before joining
20 Sempra Mexico, I held various management-level positions in companies in the clean energy
21 sector with work experience in several European and Latin American countries. I hold an MS in
22 Industrial Engineering from the Free University of Brussels (Belgium). I have not previously
23 testified before the California Public Utilities Commission.

24
25 **Laura Nelson, Ph.D**

26 My name is Laura Nelson. My business address is 1600 East Northern Avenue, Phoenix,
27 Arizona 85020. In my current role as Vice President/Sustainability and Public Policy at
28 Southwest Gas, I am responsible for advancing Environmental, Social and Governance practices,
29 focusing on developing and executing initiatives to help customers achieve their energy and
30 environmental goals, including economy-wide decarbonization. Prior to joining Southwest Gas
31 in May 2022, I was the Vice President of Consulting Services at Strategen and a Special Advisor

1 to the Green Hydrogen Coalition. I have served as the Energy Advisor to two Utah Governors
2 (Governor John Huntsman and Governor Gary Herbert) and worked at various government
3 agencies with a focus on advancing markets for clean energy solutions. I hold both a Ph.D. and
4 Bachelor of Science in Economics from the University of Utah.
5