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PREPARED DIRECT TESTIMONY OF

HILARY STRONG PETRIZZO

ON BEHALF OF SOUTHERN CALIFORNIA GAS COMPANY

AND SAN DIEGO GAS & ELECTRIC COMPANY

(HYDROGEN BLENDING DEMONSTRATION PROGRAM)

BEFORE THE PUBLIC UTILITIES COMMISSION
OF THE STATE OF CALIFORNIA

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CHAPTER 3

PREPARED DIRECT TESTIMONY OF HILARY STRONG PETRIZZO

(Hydrogen Blending Demonstration Program)

I. PURPOSE

The purpose of my prepared direct testimony on behalf of Southern California Gas Company (SoCalGas) and San Diego Gas & Electric Company (SDG&E) is to provide the justification and context for the proposed Hydrogen Blending Demonstration Program (Program). My testimony will focus on a description of the hydrogen blending demonstrations comprising the Program, and how they will help inform the future systemwide hydrogen blending injection standard to be proposed by SoCalGas, SDG&E, Pacific Gas and Electric Company, and Southwest Gas (collectively, the Joint Utilities), while supporting the Joint Utilities' focus on safety, system integrity, and reliability. My testimony will discuss the Program's structure, how the demonstrations and data collected will answer key technical, operational, and safety questions to inform the future hydrogen blending injection standard, and how the Program will serve as a guideline to validate literature and research regarding material compatibility with a hydrogen and natural gas blend.

The Program will focus on small scale field demonstrations, starting with an isolated, primarily polyethylene (PE) plastic distribution system in the SoCalGas territory. This demonstration will inform subsequent demonstrations including an isolated mixed plastic and steel natural gas distribution system, and an isolated steel pipeline demonstration. Initial hydrogen blend levels for the PE plastic project are planned at 1% and up to 5% over time, with a potential to increase to 20%. Subsequent demonstrations, including the mixed material and steel demonstration, will be evaluated to consider using a higher starting blend than 1-5% and increase to a higher blend based on safety and technical feasibility. These three initial demonstrations will inform subsequent broader scale demonstrations addressing additional materials and systems, in line with the Joint Utilities' overall goal to continue research efforts.

II. BACKGROUND

A. API 1173 Pipeline Safety Management System

As noted in Chapter 1, Safety is at the core of this overall application, of paramount importance at SoCalGas and SDG&E, and at the forefront of the Program. The Program utilizes

the American Petroleum Institute (API) 1173 Pipeline Safety Management System (PSMS) Plan-Do-Check-Act model.[1] SoCalGas and SDG&E are currently in the "Plan" Stage. The Program will move into the "Do" Stage, by initiating the controlled blending projects that have been informed by the Plan Stage. Leading up to and during this stage SoCalGas and SDG&E will be establishing operational controls, training to operate with hydrogen blends, documenting and recording data from the demonstrations, and engaging with stakeholders, including the communities and commercial and/or industrial end users. The Program leads into the "Check" Phase where SoCalGas and SDG&E will learn from the data collected, including utilizing the data for an integrity/risk management analysis. The "Act" Phase will be updating the Hydrogen Injection Standard to allow for blended hydrogen in the system more broadly. SoCalGas and SDG&E will translate the knowledge gained from the Program to safety policies and mitigations for the rest of our natural gas system and customer installed equipment. Plan-Do-Check-Act is a continuous loop, and SoCalGas and SDG&E intend to expand risk modeling, revise standards, policies, and procedures to safely blend hydrogen, and as noted above, consider larger scale demonstrations.

B. Global Hydrogen Blending Projects

In developing the Program, SoCalGas and SDG&E have reviewed global hydrogen blending projects (see Table 1 below) and continue to learn from involvement with international consortiums[2] focused on hydrogen blending. As noted in Chapter 1, several European countries, Australia, and Canada are leading hydrogen blending research projects and demonstrations. International feasibility studies and demonstrations have concluded that 5% to 20% of hydrogen can be blended into plastic distribution pipelines and utilized by residential and small commercial customers (see Table 1 below). On the steel transmission side, Snam – an Italian energy infrastructure company – completed a trial in 2019 blending hydrogen into a steel pipeline, feeding a pasta factory and bottled water company.[3] Hawaii Gas also operates a steel

[1] *See* Chapter I at 5.
[2] Including the Pipeline Research Council International, NYSEARCH, and Low Carbon Resource Initiative.
[3] *See* Press Release, Snam, Snam: Europe's first supply of hydrogen and natural gas blend into transmission network to industrial users (April 1, 2019), *available at* https://www.snam.it/export/sites/snam-rp/repository/ENG_file/Media/Press_releases/2019/Press_release_Snam_hydrogen.pdf.

transmission line with synthetic gas containing a 12% blend of hydrogen.[4] Lastly, on November 12, 2020, the Department of Energy released its Hydrogen Program Plan where it emphasizes that "realizing the true potential for hydrogen requires a commitment to continued research and development as well as ramping up demonstrations and deployments with the private sector to achieve scale."[5]

It is important to emphasize that safety and technical assessments were used to verify a system's potential for hydrogen blending in these global projects, and in some cases, new hydrogen-compatible infrastructure was installed. It is also important to note early adopters of hydrogen were primarily focused on material compatibility, rather than operational compatibility, and are now looking at potential long-term integrity impacts. SoCalGas and SDG&E can lead this area of integrity impact assessment of hydrogen blending in California by utilizing our integrated pipeline risk modeling to analyze data from the demonstration program to inform operational practices and integrity considerations.

Table 1

Selected Global Hydrogen Blending Projects

Utility (Country)	Percent Blend	Project Site/Infrastructure	Timeframe
SoCalGas (USA)	1%-5% to start, up to 20%	Existing PE plastic, Single Fed, residential community	Target start 2021, 5-year duration
SDG&E (USA)	1%-5% start, up to 20%	Existing isolated community	Target start 2022, 5-year duration
SoCalGas/ SDG&E (USA)	TBD	Steel Commercial/Industrial Partner	Target start 2022
ATCO (Australia)[6]	5%	Existing R&D Facility Microgrid, and new Demonstration House	Now Operational
ATCO/Canadian Utilities (Canada)[7]	5%	Existing Infrastructure, 5000 residential customers	Construction commencing 2021

[4] Hawaii Gas procures their natural gas from Naptha, which has approximately 12% hydrogen naturally occurring in it. *See* What is Hydrogen, Hawaii Gas, https://www.hawaiigas.com/clean-energy/hydrogen/.
[5] U.S. Department of Energy, Hydrogen Program Plan at p. ii (released November 12, 2020), *available at* https://www.hydrogen.energy.gov/pdfs/hydrogen-program-plan-2020.pdf.
[6] ATCO, ATCO's Hydrogen Journey, *available at* https://www.atco.com/en-au/projects/hydrogen.html.
[7] ATCO, Fort Saskatchewan Hydrogen Blending, *available at* https://www.atco.com/en-ca/for-home/natural-gas/hydrogen.html#blend.

AGN (Australia)[8]	5%	700 residential properties in a suburb of Adelaide	Operational mid-2020, expect to operate 5+ years
AGN (Australia)[9]	10%	10% across entire Gladstone distribution network (mix of 770 residential, small commercial, and industrial customers)	Operational by end of 2021
Enbridge (Canada)	Up to 2%	Approximately 3600 customers in a closed loop system	Construction commencing 2021
Fortis B.C. (Canada)[10]	TBD	Distribution demonstration considering existing residential communities and one commercial end user	TBD
Engie/GRHYD (France)[11]	<20%	200 residential properties (new neighborhood - Le Petit Village) and NG vehicle refueling station	5-year demonstration, Project studies kicked off 2014
Cadent (England)[12]	<20%	Stage 1 – Keele University, feeding 100 campus homes and 30 faculty buildings Stage 2 – Larger demo in NE England supplying >650 homes Stage 3 – further demos in NW England	Stage 1 (Keele University) operational in 2020, 3-year trial
Cadent (England)[13]	15-100%	Inject to Northwest England (Liverpool, Manchester, Cheshire) transmission system at 4 points supplying >2 million homes and businesses (15-20% targeted blend); Dedicated line to 10-15 Industrial customers (60-100% targeted blend)	Final Investment Decision due late 2022
Snam (Italy)[14]	5% and 10%	New steel pipeline feeding two industrial customers	Trial completed in 2019, Now Operational Full Time

III. PROGRAM DESCRIPTION

[8] Renewables SA, Hydrogen Park South Australia, *available at* http://www.renewablessa.sa.gov.au/topic/hydrogen/hydrogen-projects/hydrogen-park-south-australia.
[9] Owen Sharp, Australian Gas Infrastructure Group, Hydrogen Park Gladstone, *available at* https://www.agig.com.au/hydrogen-park-gladstone.
[10] RH_2C, Renewable Hydrogen Canada, *available at* http://www.renewableh2canada.ca/.
[11] The GRHYD demonstration project, Engie, *available at* https://www.engie.com/en/businesses/gas/hydrogen/power-to-gas/the-grhyd-demonstration-project.
[12] Hydrogen is vital to tackling climate change, HyDeploy, *available at* https://hydeploy.co.uk/.
[13] HyNet North West at a Glance, HyNet North West, *available at* https://hynet.co.uk/.
[14] Snam: Hydrogen Blend Doubled to 10% in Contursi Trial, Snam (Jan. 15, 2020, 17:48 CET), *available at* https://www.snam.it/en/Media/news_events/2020/Snam_hydrogen_blend_doubled_in_Contursi_trial.html.

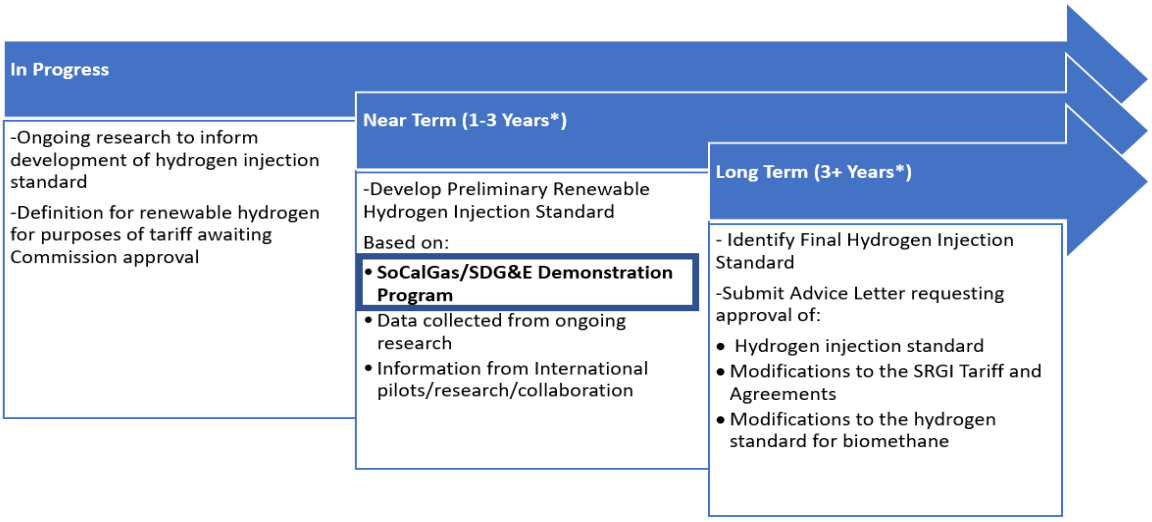
A. Overview

SoCalGas and SDG&E, like the international operators, have engaged in hydrogen blending literature reviews, research, and lab testing (see Chapter 4). The next step for SoCalGas and SDG&E is to safely implement their own Program focused on blending in their service territories. This Program will begin with a PE plastic project which will inform subsequent projects that may include an isolated mixed plastic and steel natural gas system and a steel transmission pipeline demonstration. The PE project will support the overall Joint Utilities' goal to continue research efforts to progressively increase the hydrogen blending injection percentage and to update the standard accordingly. A report reviewing each project will be completed. These projects are forecasted to take place over several years with the vision of establishing a hydrogen blending injection standard to allow for ongoing blending as a regular part of the natural gas system.

Figure 1 and 2

Program Overview and Integration with Research and Hydrogen Injection Standard

	Project 1 (2021)	Project 2 (2022)	Project 3 (2022)
Project	Blend hydrogen in **polyethylene plastic**, isolated pressure district in SoCalGas Territory	Blend hydrogen into **mixed material** isolated distribution network	Blend hydrogen in dedicated **steel** line to commercial/industrial end user
Blend Target	Start at 1% and go up to 20% blend of Hydrogen	1-5% to start, consider 20%, or conversion to 100% long term	Determine with End User
Technology	Hydrogen injection skid, residential appliances, leak detection equipment (Solar panels, electrolyzer)	Same as PE Plastic Demonstration, Plus Assessment of Mixed Material Network	Same as PE Demonstration, Plus Assessment of Steel and of Transmission System
Goal	Establish Hydrogen Blending Demonstration workflow including data acquisition to set Integrity Management approach; Set standard for PE Plastic Sections of Distribution Network	Set Standard For Mixed Material Distribution Network	Data acquisition on steel will feed into Integrity Management Analysis to set Standard for Transmission Network



*As of Application Filing Date

1. Project 1 – PE Plastic Project in Isolated Natural Gas System

Project 1 will target an isolated section of the gas distribution network in the SoCalGas territory that is composed of primarily PE plastic pipe. A single-fed pressure district will be selected to keep the blended hydrogen isolated to the demonstration infrastructure. The injection point will be at a strategic location (likely just downstream of the regulator station) in order to accurately monitor the flow and composition of the gas supply and verify that it is reaching intended customers. This project utilizes Plan-Do-Check-Act for PE plastic and residential end user equipment which research and other global pilots show to be compatible with hydrogen (see Chapter 4 for details). The project will commence with a low percentage (1%) of hydrogen by volume. During the course of the project, the hydrogen percentage will progressively increase over time to a potential maximum of 20% by volume. SoCalGas is targeting to begin the demonstration project in 2021. The project is forecasted to take place over several years with the intent of informing the development of a hydrogen blending injection standard to allow for ongoing blending as a regular part of the natural gas distribution system. The time period selected for each project will allow for data collection at seasonal and other load variations over time.

Subsequent PE plastic projects may include a higher blend percentage, and/or a higher number of end users. Furthermore, future projects are anticipated to start as soon it is deemed feasible given the learnings from the first project.

2. Project 2 – Mixed PE Plastic and Steel in Isolated Natural Gas System

Project 2 will target an isolated natural gas system that consists of a mix of steel and PE plastic piping. This project will analyze how a blend of hydrogen and natural gas affects a mixed material distribution system in addition to the end-user appliances. This project targets Plan-Do-Check-Act for mixed materials, and represents (on a small scale) the interconnected nature of gas systems in California. The project will likely commence with a low percentage (1%) of hydrogen by volume, and is anticipated to increase as SoCalGas and SDG&E enhance their knowledge of operating with hydrogen blends. It is anticipated that during the course of the project, the hydrogen percentage will progressively increase over time to no more than 20% by volume. This project will likely take place in the SDG&E service territory and commence in 2022.

As with the PE plastic only project, this project is forecasted to take place over several years with the intent of informing the development of a hydrogen blending injection standard to allow for ongoing blending as a regular part of the natural gas distribution system. The time period selected for this project will allow for data collection at seasonal and other load variations over time. Subsequent Mixed Materials projects may include a higher blend percentage, and/or a higher number of end users. Furthermore, future mixed materials projects are anticipated to start as soon it is deemed feasible.

3. Project 3 – Steel Project

Project 3 is a steel demonstration project. The steel project will target one industrial or commercial end user to partner with rather than a community like Projects 1 and 2. SoCalGas or SDG&E will isolate a segment of steel transmission line to the customer. Depending on the partner, the project may include installing a new steel pipeline or utilizing an existing steel pipeline to determine impact on pipelines already installed and used. Once safely isolated, the utility will flow a blend agreed upon with the commercial or industrial end user. As with Projects 1 and 2, this project is forecasted to take place over several years with the intent of informing the development of a hydrogen blending injection standard to allow for ongoing blending as a regular part of the natural gas system. The time period selected for this project will allow for data collection at seasonal and other load variations over time.

Depending on approval of the industrial or commercial customer, SoCalGas and SDG&E will also be able to gain insight on the interaction between the hydrogen blend and the

customer's end-use operations and/or processes. Additional steel demonstrations may include other industrial or commercial end users and may demonstrate transportation of up to 100% hydrogen through a dedicated hydrogen pipeline.

B. Blending Exception Report

A blending exception report will accompany the demonstration projects. The report will follow the "Utility Evaluations" steps in the Renewable Gas Interconnection Tariff[15] and document the evaluation of the feasibility of blending and the safety assessment supporting blending percentages. The report will incorporate the following considerations:

- Flow rates and directional consistency of receiving pipeline(s), including daily and seasonal variations.
- Historical gas composition and gas quality specification at the chosen demonstration system and area of influence for purposes of determining impact on a BTU District.
- Current and expected future composition of natural gas in the pipeline system for the purpose of determining interchangeability on customers' end use equipment and the pipeline system's future capability to accommodate supplies.
- Current and future customers in receiving pipeline flow rate, distance to these customers, time to first receiving customer, and anticipated downstream gas demand growth.
- Maximum time and distance required for complete mixing to occur under all pipeline flow conditions.
- The design, operation, and overall condition of the receiving pipeline(s), including any sensitivities to gas constituents.
- Additional monitoring, control, and/or mixing equipment that may be required to verify and ensure that adequate blending has occurred in the receiving pipeline system.

C. Overall Project Guidance

SoCalGas has identified the following program processes for each project – Safety, Site Selection, Asset Inspection, Stakeholder Engagement, Hydrogen Source, Equipment Procurement, Construction, Operation and Operational Tests, Data Acquisition, Demonstration

[15] Standard Renewable Gas Interconnection Tariff Section L. Pipeline Blending Study (Blending Study) approved August 4, 2020.

Inspection, and Data Analysis. These steps will guide the project and the project intent – to help inform a hydrogen blending injection standard and set up a guideline of how to physically implement hydrogen blending in a natural gas system. The following table outlines the processes and additional details. Project 1 is the furthest along in planning and the tables are most appropriate for this project. Project 2 will follow a similar process, and Project 3 will be tailored to a single end use customer.

Table 2

Project Overview

Overarching Safety Case				
Site Selection	**Asset Inspection**	**Stakeholder Engagement**	**Renewable Hydrogen Source**	**Equipment Procurement**
Identify several potential locations Preliminary desktop database surveys (pipe properties and histories) Identify typical high and low load usage Determine criteria for site selection	End user appliances (e.g. are appliances operating properly?) Leak detection Detailed survey of pipeline and system	Define engagement approach Communication strategy in place Engagement activities with demonstration location Gather feedback on mobile demo unit	Identification of existing or potential local source Producer agreements, including option to have SCG or SDG&E produce Procure CNG - fuelled truck for initial trucking in of hydrogen Longer term onsite generation plan	Procurement of hydrogen injection equipment designed to fit demonstration blending volume needs Procurement of other standard equipment that is tuned to hydrogen

Construction	**Operation**	**Data Acquisition**	**Demonstration Inspection**	**Data Analysis**
Replace any pipeline or components in advance of demonstration (if needed) Install/upgrade equipment, including any monitoring/data acquisition equipment	Operation and monitoring Data collection Customer feedback	Additional meters/sensors required Non-invasive testing Potential Post Trial Coupon testing Customer Feedback	Appliance inspection Leak detection Inspection of pipeline End of demonstration inspection	Matching of existing research to the results of the demonstration Identification of any additional knowledge gaps that may exist Identification of any modification to

				and/or creation of operational practices Feed into Risk/Integrity Management Analysis

1. Overarching Safety Case

SoCalGas's and SDG&E's safety efforts to be taken before, during, and after the Program include, but are not limited to:

- Hydrogen Safety Training for personnel
- Safety Assessment for hydrogen storage
- Distribution site selection will prioritize (i) single-fed, hydrogen-compatible PE plastic infrastructure, and (ii) single-fed, mixed hydrogen-compatible PE plastic and steel infrastructure.
- Survey end use customer equipment to confirm what behind-the-meter appliances are present (SoCalGas successfully tested residential end-use equipment for hydrogen compatibility up to 20%).
- Steel commercial or industrial site selection will prioritize collaboration with the end user and may involve replacement of existing pipeline or pipeline components with hydrogen-compatible materials.
- Conduct pre, during, and post-implementation leak surveys
- Create hydrogen blending specific customer protocols and emergency response
- Conduct gas system operational tests, including low-pressure and high-pressure situations, and equipment tests (e.g. customer appliance leak, customer appliance flame-out, or pilot light failure), meter replacements, and other operational activities that occur in a natural gas distribution system.
- Test existing and new leak survey equipment.

2. Site Selection

In considering a site for each project, SoCalGas and SDG&E will perform an assessment of safety, technical feasibility, adjustment to operational processes, and stakeholder support. The primary criteria of this assessment for Project 1 are identified in the chart below. Project 2 will

follow similar criteria, with an additional consideration for the steel pipeline population. Project 3 will also follow similar criteria; however, it will target steel pipeline and focus on commercial/industrial customer load requirements and customer support.

Table 3

PE Plastic Project Site Selection Criteria

Safety Assessment	Technical Assessment	Operational Assessment	Stakeholder Assessment
Isolated from main network % PE Plastic in Pipeline Pipe Vintage and Operational History	Constructability Hydrogen Supply Access Summer Load and Yearly Load (sufficient flow to blend)	Time to survey pipeline system and load (pre, during, and post demonstration)	Local Political Support Local Customer Support Easement acquisition cost and feasibility Pilot Community Members CPUC – Safety and Enforcement Division and Energy Division

3. Asset Inspection

Once project sites are selected, SoCalGas and SDG&E will conduct an asset inspection. This will include a table-top review of all materials in the selected systems, followed by a detailed validation in the field. For the PE plastic and mixed materials demonstrations, this will include a survey of customer appliances in the demonstration area to confirm there are no required modifications to end use. In the unlikely event that modifications are required to customer appliances, these will be completed prior to injecting hydrogen. The PE plastic and mixed material asset inspections will include a detailed survey of the pipelines and appurtenances. The steel transmission pipeline demonstration will focus on a single end user and single steel pipeline. For all demonstration projects, any material repair or replacement needed will be completed prior to injecting hydrogen. Asset inspection also includes leak surveys prior to the demonstration, as well as planning for increased surveys during and after the demonstration.

4. Stakeholder Engagement

Education and outreach are important components of the Program as the projects will affect a range of stakeholder groups from various internal SoCalGas and SDG&E organizations,

to external organizations, including industrial or commercial customers, residential communities, cities, counties, state regulatory agencies, and legislators and their staff. Hydrogen has the potential to play an important role in California's efforts to achieve carbon neutrality, and stakeholders, from utility personnel to customers to policy makers, need to understand how blended hydrogen can be utilized safely and reliably.

As such, SoCalGas and SDG&E intend to conduct outreach to educate stakeholders about hydrogen and specifically how the gas system can safely utilize blended hydrogen. Outreach concepts include a mobile demonstration facility that showcases the interchangeability of hydrogen-natural gas blends on common natural gas appliances,[16] webinars, and targeted information sessions for key stakeholder groups, beginning with utility personnel and customers potentially involved in demonstration projects.

SoCalGas and SDG&E will work with hydrogen industry associations active in California such as the California Hydrogen Business Council, the Green Hydrogen Coalition, and the California Hydrogen Infrastructure Coalition, on outreach efforts and educational materials in order to reach targeted industry audiences to show that SoCalGas' hydrogen blending program is structured to support safe technical and operational development of hydrogen blending in California.

5. Renewable Hydrogen Source

The Program is focused on demonstrating hydrogen blending technical and operational aspects from injection and blending to end use. SoCalGas and SDG&E will consider initially trucking renewable hydrogen purchased from a third party to expedite the timing of the PE plastic demonstration and plan to install solar panels and an electrolyzer to produce renewable hydrogen nearby or onsite as the demonstration progresses. SoCalGas and SDG&E will work towards the installation of solar panels and electrolyzers for the later demonstrations – Project 2 (mixed materials) and Project 3 (steel pipeline) as feasible. Part of site selection will include focus on sites with adequate renewable energy potential, such as existing solar or wind generation in the vicinity, or the ability (space and permission) to install solar or wind power generation. For commercial or industrial partnered demonstrations, the end user will have an opportunity to further green their facility by adding renewable energy generation if not already

[16] Television viewing will be set up and the appliances will be on carts to help with socially-distanced observation (if needed).

present. SoCalGas and SDG&E will explore the potential to add renewable energy generation to company operating bases near demonstrations to reduce the carbon footprint of the facilities and serve as hydrogen producers.

6. Equipment Procurement and Construction

SoCalGas and SDG&E will procure equipment required for gas infrastructure projects that is compatible with hydrogen, such as leak detection equipment able to detect a blend of hydrogen and natural gas. SoCalGas and SDG&E will also acquire new hydrogen blending equipment, including hydrogen blending injection skids. Furthermore, SoCalGas is in dialogue with vendors who have built hydrogen blending injection skids. Commissioning blending skids for the demonstration projects will be key to learn about sizing and operation of these units that will likely be utilized for injection throughout the California system when a final Joint Utility hydrogen injection standard is in place.

7. Operations and Data Acquisition

The Program's goal is to follow PSMS Plan-Do-Check-Act: (1) translate laboratory research and literature review into actual system operations and cover as many aspects of the technical considerations as possible, (2) confirm understanding of material response, end use/appliance response, load balancing and blend consistency, and (3) establish protocol for leak detection of the new gas composition (should it occur). The selected sites will allow for these objectives to be achieved physically and operationally.

Operational needs include training, additional leak surveying, gas handling, customer service, routine service operations and customer interactions, and emergency response plans. Monitoring during demonstrations will include both system monitoring as well as collecting feedback from customers.

8. Demonstration Inspection

Similar to the pre-demonstration asset inspection, inspections of the PE plastic and mixed material pipeline systems – including leak detection – will be completed during the demonstration, along with a survey of residences and their respective appliances. Likewise, inspection of the steel pipeline will be completed and a survey of the commercial or industrial end use equipment response will be collected if the end use customer permits.

9. Data Analysis

The PSMS "Check: Analysis of data" step will analyze quantitative and qualitative data,

and will include an analysis of knowledge gained from any operational changes. Such analysis will inform the Joint Utilities hydrogen injection standard in alignment with the path laid out in Figure 2 above and addressed in Chapters 1 and 4. Many of the items below have been assessed through literature review, laboratory testing, and/or vendor surveying. The Program will allow for operational review and confirmation of the following within the limitations of the proposed demonstration sites:

- Odorant compatibility
- Leak detection equipment compatibility
- Material compatibility (or determine need for material replacement)
- Component (e.g. fittings, valves) compatibility (or determine need for component replacement)
- Long-term integrity modeling
- Blend consistency (hydrogen blending injection skid)
- End use customer feedback
- End use customer appliance compatibility (e.g. residential appliances and commercial and/or industrial equipment)
- Development of new Gas Standards for the construction, maintenance and operations of hydrogen blended natural gas system
- Effects on metering, and the effect on customer's energy use and billing (note: SoCalGas and SDG&E currently do not intend to bill customers for blended hydrogen in the demonstrations)

IV. ESTIMATED COSTS

Table 5 below shows estimated costs for three hydrogen blending demonstrations. These costs are preliminary estimates and based on cost information of other international hydrogen blending projects. The actual costs for the Program, are expected to vary from the early estimated costs and will be recorded in the SoCalGas and SDG&E Hydrogen Blending Demonstration Program Memorandum Account (HBDPMA) described in Chapter 2.

Table 6 below shows budgets for some of the international projects listed in Table 1. Although international budgets may not be directly translatable, they provide a reasonable sense of scale. We anticipate that larger scale demonstration projects will require additional funds, especially as systems with more customers and varying vintages and types of materials are

tested.

Table 5

Five Year Cost Estimate[17] for 3 Hydrogen Blending Demonstrations

	Capital Expenditure	O&M Expenditure	Total Cost Estimate
1st Demonstration	$12.5M	$2.45M	$14.95M
2nd Demonstration	$6M	$2.45M	$8.45M
3rd Demonstration	$6M	$2.45M	$8.45M

Table 6

Budget of Select International Blending Demonstration Projects

Utility (Country)	**Percent Blend**	**Project Site/Infrastructure**	**Timeframe**	**Budget (not normalized to 2020 dollars)**
ATCO/Canadian Utilities (Canada)[18]	5%	Existing Infrastructure, 5000 residential customers	Construction Commencing 2021	$5.7M
AGN (Australia)[19]	5%	700 residential properties in a suburb of Adelaide	Operational mid-2020, expect to operate 5+ years	$11.4M
AGN (Australia)[20]	10%	10% across entire Gladstone distribution network (mix of 770 residential, small commercial, and industrial customers)	Operational by end of 2021	$4.2M
Enbridge (Canada)[21]	Up to 2%	Approximately 3600 customers in a closed loop system	Construction commencing2021	$4.4M

[17] Cost estimates are shown in direct 2020 dollars only and have not been loaded with overheads or escalated to nominal dollars. Applicable overheads will be applied to the direct costs as incurred.
[18] Tony Seskus, Hydrogen-injected natural gas to heat homes in Alberta city next year, CBC (July 21, 2020, 8:32 PM MT), *available at* https://www.cbc.ca/news/canada/calgary/alberta-hydrogen-home-heating-1.5657736.
[19] RenewablesSA, *supra*.
[20] Sharp, *supra*.
[21] Ontario Energy Board, Low Carbon Energy Project (Oct. 29, 2020), *available at* https://www.oeb.ca/participate/applications/current-major-applications/eb-2019-0294.

Cadent (England)[22]	<20%	Stage 1 – Keele University, feeding 100 campus homes and 30 faculty buildings Stage 2 – Larger demo in NE England supplying >650 homes Stage 3 – further demos in NW England	Stage 1 (Keele University) operational in 2020, 3-year trial	$9.7M
Snam (Italy)[23]	5% and 10%	New steel pipeline feeding two industrial customers	Trial completed in 2019	Unknown

V. CONCLUSION

For the reasons discussed above, the Program in SoCalGas's and SDG&E's territories is in line with the overall Joint Utilities' goal to take the next step in the path from initial research efforts to progressively increase the hydrogen blending injection standard allowed percentage.

This concludes my prepared direct testimony.

[22] Keele University, UK's First Grid-Injected Hydrogen Pilot Gets Underway at Keele (Jan. 2, 2020), *available at* https://www.keele.ac.uk/discover/news/2020/january/hydeploy-goes-live/at-keele-university.php.

[23] Snam, *supra*.

VI. QUALIFICATIONS

My name is Hilary Strong Petrizzo. I am employed at SoCalGas as the Renewable Natural Gas and Hydrogen Engineering Strategy Project Manager in the Gas Engineering organization. Prior to this, I held the position of Reservoir Engineering Team Lead in the Underground Storage organization, and was responsible for managing the Geology, Reservoir, and Land Rights of SoCalGas's underground gas storage facilities. I joined SoCalGas in July 2015 as a Senior Storage Field Engineer, responsible for the geology of all of SoCalGas' underground storage facilities.

Prior to joining SoCalGas, I was a Petroleum Geologist for Occidental Petroleum Corporation in Bakersfield, California and Long Beach, California and for ExxonMobil Corporation in Houston, Texas.

I hold a Master of Science in Geological Sciences from the University of Texas at Austin and a Bachelor of Science in Geology from the University of California Los Angeles.

I have not previously testified before the Commission.