Hydrogen Policy Work at the CPUC

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California Public
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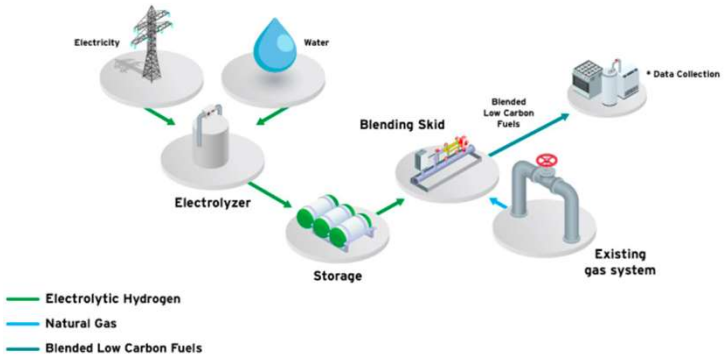
Current Focus Areas

Angeles Link Application

SoCalGas's proposal to develop a "green" hydrogen energy pipeline transportation system from unspecified production sources to serve hard-to-electrify industries and heavy-duty transportation in the Los Angeles Basin.

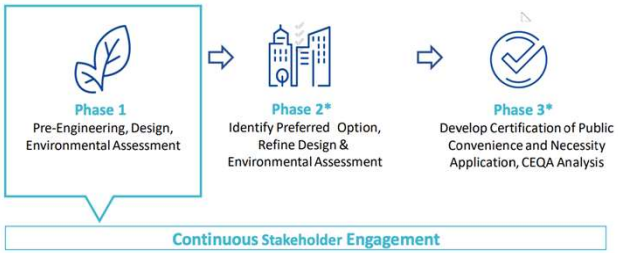


Hydrogen Blending Application

A proposal from SoCalGas, SDG&E, and Southwest Gas to pursue pilot projects to inject clean renewable hydrogen into the existing methane pipeline system in small amounts to better understand real-world safety (e.g., embrittlement, leakage, etc.) and operational impacts in order to inform what a system-wide safe hydrogen injection standard might look like.

Angeles Link Application Activity

- Filed as A.22-02-007 on February 17, 2022 by SoCalGas.
- SoCalGas sought approval to record costs necessary to perform three phases of work:
  - Phase 1 ($26 million): 12-18 months to perform initial assessments.
  - Phase 2 ($92 million): 18-24 months to conduct refined design, engineering, and environmental studies.
  - Phase 3 ("hundreds of millions of dollars"): 18-30 months for final refinements, permitting, and regulatory applications.



- D.22-12-055 granted SoCalGas the authority to establish the Angeles Link Memorandum Account to record the costs of performing Phase 1 feasibility studies for the Angeles Link Project, up to a cap of $26 million with an option for an increase of up to 15%.
- D.22-12-055 also directs SoCalGas to do the following:
  - Join California in its ARCHES application for federal funding and
  - Study the feasibility of a localized (in addition to system-wide) clean renewable hydrogen hub solution in the Los Angeles Basin.
- Recorded costs may or may not be approved for future cost recovery from ratepayers following the conclusion of Phase 1, and there is no guarantee that Angeles Link will ever be built.

Angeles Link: Phase 1 Proposal (In Progress)

Cost: $26 million, **Duration:** 12-18 months

Goal: Produce refined supply, demand, pipeline configuration, and storage analyses to support a pre-Front End Engineering and Design (FEED) analysis:

- Refined assessment of expected green hydrogen demand and identification of initial and subsequent end users in the Los Angeles Basin.
- Refined assessment of potential sources of green hydrogen production to meet the identified demand with preliminary environmental impact analyses.
- Preliminary study of hydrogen storage options to facilitate system operability, processing, and reliability.
- Development of a plan to address safety requirements applicable to the Project.
- A high-level risk assessment and ability to permit analysis.
- A high-level economic analysis of potential Project costs.
- Stakeholder meetings and engagement.
- Preliminary routing analyses.
- Pipeline sizing and design criteria (5% design).

Relevant Aspects to Consider in Angeles Link

- The anticipated costs do not include any future construction or capital costs. The project would not use the existing gas infrastructure and would build a new pipeline.
- The main goal of the Angeles Link Project is to develop a clean renewable hydrogen energy transportation system, likely from multiple local and longer term regional clean hydrogen production sources, to displace the use of natural gas in the Los Angeles Basin.
- The Project seeks to bring clean renewable hydrogen to support current and future hydrogen end users, including hard-to-electrify industries, electric generation, and heavy-duty transportation sector.
- The Project wants to provide a resilient energy source as more intermittent generation is added to the grid.

Hydrogen demand, end uses, and end-users by 2045 (including current natural gas customers and future customers) of the Project.

This study is evaluating potential clean renewable hydrogen demand and assess adoption with a priority on the Mobility, Power Generation, and Industrial sectors.

Current Status of Angeles Link

SoCalGas is working actively with Planning Advisory Group (PAG) members and Community-Based Organizations (CBOs) to explore possible pipeline routing, end-use customers, production sources, project costs, and other relevant issues.

Key Considerations Moving Forward

How should hydrogen transportation be regulated moving forward? Policymakers have not yet determined whether hydrogen transportation should be regulated in a manner similar to natural gas. The existing hydrogen pipeline system is not currently regulated as a public utility service. How hydrogen is regulated will ultimately determine who will pay for its transportation in addition to how it is permitted and how system safety is ensured.

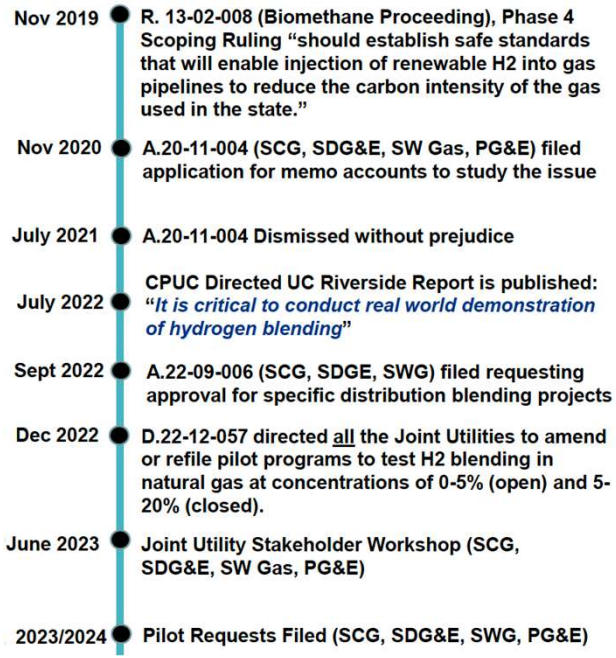
What will the hydrogen market look like in the future? The report ordered by SB 1075 (Skinner, 2022) will inform what role hydrogen will play in California's clean energy future. Other legislation and agency work will be needed to further refine future plans for the use of hydrogen.

How should hydrogen be delivered and stored? It is not yet certain to what extent hydrogen should be transported via pipeline (like natural gas) vs. trucked (like gasoline). Future end uses will determine how best to meet the needs of end-use customers who are hard to electrify while remaining cost-competitive in the long-term.

Hydrogen Blending: Impact Study

- The CPUC released a UC Riverside-led Hydrogen Blending Impacts Study on July 18, 2022 and solicited party comments on its findings. The project analyzed the viability of blending hydrogen with natural gas in California's existing natural gas infrastructure. The study assessed safety concerns associated with injecting hydrogen at various percentages.
- Based on the study's findings, D.22-12-057 directed SDG&E, SoCalGas, PG&E, and Southwest Gas to further study hydrogen blending to better understand real-world safety (e.g., leakage) and operational impacts before adopting a system-wide hydrogen injection standard.
- In response to D.22-12-057, California's large gas IOUs will revise their proposals in A.22-09-006 to reflect the new requirements specified by the CPUC. PG&E will be brought into the Application despite not being part of it previously.

Background and History

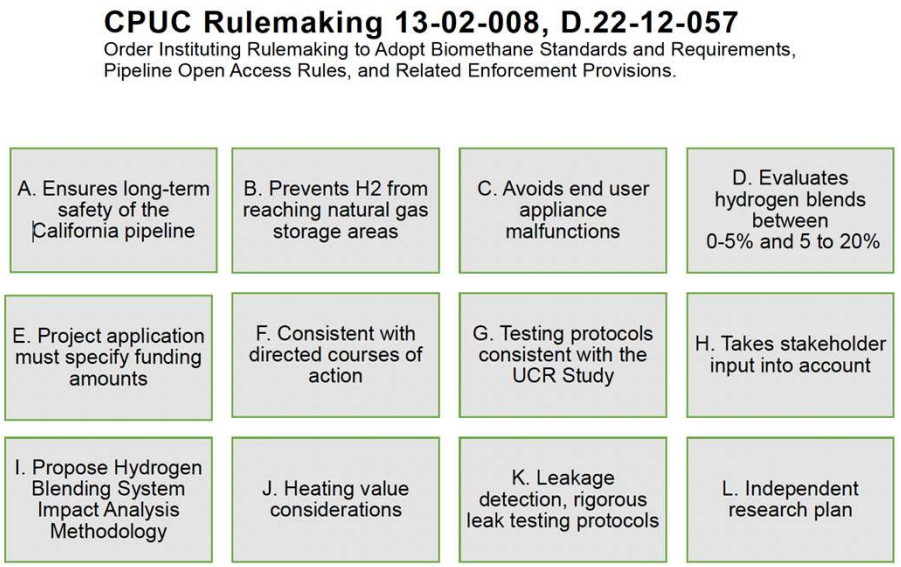


Hydrogen Blending: Study Conclusions

- The main recommendation of the study is to conduct real world demonstrations projects between 0.1 to 5% and 5 to 20% hydrogen blending to address safety and performance issues in California's pipelines.
- The study concludes that determining a single injection standard would have to consider the most susceptible conditions observed throughout all infrastructure. This systemwide blending injection scenario becomes concerning as hydrogen blending approaches 5% by volume.
- The body of literature reports that in relatively low hydrogen concentration (1 to 5% by volume) blending seems to be viable without significantly increasing risk factors in the storage, transmission, and utilization of hydrogen blends.
- The study highlights the potential for pipeline embrittlement and gas leakage at increasing volumes of hydrogen injected.

Hydrogen Blending Application Activity

- Filed as A.22-09-006 on September 8, 2022 by SoCalGas, SDG&E, and Southwest Gas.
- PG&E opted to pursue its Hydrogen to Infinity project separately.
- A previous iteration of a similar Application was dismissed without prejudice by the CPUC in 2021 (D.21-07-005) pending further research.
- D.22-12-057 ordered all four gas utilities to refine their approach to hydrogen blending and submit new or amended pilot programs within two years to test hydrogen blends ranging from 0.1% to 20%.
- Ordering Paragraph 7 of D.22-12-057 establishes 12 distinct criteria for future pilot programs relating to safety, cost, methodology, and stakeholder engagement.



Hydrogen Blending: IOU-Proposed Projects

The following proposed projects are subject to change, but reflect what California's four large utilities are currently interested in piloting to better understand blending's impacts.

Project Title	Live Blending Description	H2 Blends Considered	Pipeline Detail	End Use Equipment Detail	Location & Climate Detail	Project Costs
SoCalGas – UCI H2 Blending Pilot	Isolated portion of distribution system.	Up to 20% by volume	Medium Pressure Distribution Pipeline (Steel and Plastic)	Commercial and Residential	Irvine, CA; Moderate coastal conditions	$14.82 MM
SoCalGas – Open System Blending	"Open" portion of distribution system	Up to 5% by volume	TBD	Commercial and Residential	TBD	TBD
SDG&E – UCSD H2 Blending Pilot	Isolated portion of distribution system	Up to 20% by volume	Medium Pressure Distribution Pipeline (Polyethylene Pipe)	Fuel cell	La Jolla, CA; Moderate coastal conditions	$13.9 MM
Southwest Gas H2 Blending Pilot	Isolated portion of distribution system	Up to 20% by volume	Medium Pressure Distribution Pipeline (Polyethylene Pipe)	Commercial	Truckee, CA; Extremely cold weather conditions, high elevation	$10.21 MM
PG&E	Isolated, standalone, and new transmission system	Up to 30% by volume	High pressure (steel)	Power Plant and Fueling Station	City of Lodi, CA; Mediterranean climate	$90-330 M

Current Status of Hydrogen Blending Applications

The four gas utilities are currently retooling their pilot programs and will present their revised pilots for CPUC consideration as part of A.22-09-006 in Q4 of 2023. PG&E will be brought into A.22-09-006 despite not being part of the initial filing.

Key Considerations Moving Forward

Is injection of hydrogen into the methane system a good environmental solution? The CPUC, research institutions, the gas utilities, and other stakeholders will need to assess the extent to which clean renewable hydrogen can help California decarbonize. Special attention will need to be given to whether – and to what extent – hydrogen should be procured vis-à-vis biomethane, as well as how to ensure that such procurement doesn't undermine building electrification efforts.

Is the risk worth the reward? Additional testing is necessary to determine whether embrittlement risks and leakage concerns are small enough to merit procurement and injection of hydrogen without posing any undue risk to the public.

How do test scenarios translate to broader system impact? It remains to be seen to what extent testing on small closed-loop segments of the gas distribution system translates into broader system-wide injection and usage implications.

Eligible Hydrogen

Both the Angeles Link project (if built) and the Hydrogen Blending pilots (if approved) are required to transport only "clean renewable hydrogen."

The CPUC currently defines "clean renewable hydrogen" as follows:

- "Hydrogen which is produced through a process that results in a lifecycle (i.e., well-to-gate) greenhouse gas emissions rate of not greater than 4 kilograms of CO2e per kilogram of hydrogen produced and does not use fossil fuel as either a feedstock or production energy source."
- The term "fossil fuel" is consistent with the definition found in Pub. Util. Code Section 2806. The prohibition on the use of fossil fuel does not apply to an eligible renewable energy resource that uses a de minimis quantity of fossil fuel, as allowed under Pub. Util. Code Section 399.12 (h)(3).

Future refinement of this eligibility standard will be considered following the issuance of the SB 1075 report.

Discussion/ Questions

Appendix

Angeles Link: Phase 2 Proposal (Not Approved)

Cost: $92 million, **Duration:** 18-24 months

Goal: Identify a preferred option and conducted refined design, engineering, and environmental studies, including a FEED study:

- Identification of a preferred option through:
  - Validation of constraints and requirements for basis of design and for safety and reliability requirements.
  - Refined analysis of hydrogen storage options to facilitate system operability, processing, and reliability.
  - Identification of a preferred route(s) (geographical and environmental considerations).
  - Desktop evaluation of environmental issues.
  - Analysis of land rights and permitting strategy and alternatives.
  - Option analysis and preferred option selection.
- Upon identification of a preferred option, completion of refined engineering and implementation plans:
  - A preliminary Project Execution Plan, including a contracting strategy, risk register, and material procurement plan.
  - A FEED study for the preferred system design.
  - Refined environmental impact analyses and refined cost and schedule estimates (Class 4 cost estimate or better).
  - Identification of supplier diversity opportunities. Development and execution of a Project Outreach and Communication Plan.
  - Stakeholder meetings and engagement.

Angeles Link Phase 3 Proposal (Not Approved)

Cost: "Several hundreds of millions of dollars," **Duration:** 18-30 months

Goal: Prepare permit applications, including an application to the CPUC for a Certificate of Public Convenience and Necessity (CPCN), as well as other long-lead permit applications:

- Further refined Project design and engineering drawings, specifications, costs and timelines.
- An updated Project Execution Plan and a refined climate impacts analysis.
- Updated safety requirement implementation plan for construction, operation, and maintenance.
- Development of a CPCN application.
- Development of a Proponent's Environmental Assessment.
- Preparation of other long-lead permit applications, if necessary.
- Stakeholder meetings and engagement.

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