FY 2022-23 GAS R&D Initiatives

Energy Research and Development Division

Agenda – Session I

Approximate Time	Item
9:00 am	Welcome and Overview
9:10 am	Session I: Staff Presentations on Proposed Initiatives • Targeted Gas System Decommissioning • Decarbonization of Gas End Uses • Energy Efficiency • Entrepreneur Development
10:00 am	Session I: Questions and Discussion
10:55 am	5-minute break

Agenda – Session II

Approximate Time	Item
11:00 am	Session II: Contractor (Guidehouse) Presentation
11:40 am	Session II: Questions and Discussion

Announcements

- This workshop is being recorded and will be posted at: https://www.energy.ca.gov/event/workshop/2022-01/gas-rd-workshop
- Gas R&D Budget Plan documents and workshop materials, including this presentation, will be posted at: https://efiling.energy.ca.gov/Lists/DocketLog.aspx?docketnumber=16-PIER-01
- Participants will be muted during the presentation.
- Please type your comments and questions in the Q&A window.
- Sign up for updates on the "naturalgas" or "research" Listserv: https://ww2.energy.ca.gov/listservers/index_cms.html

Session I

California Energy Commission

FY 2022-23 Proposed Gas R&D Initiatives

Introduction

- Research and development to support the transition to clean energy, greater reliability, lower costs, and increased safety for Californians
  - Benefits California citizens, and
  - Not adequately addressed by competitive or regulated entities
- $24 million annual budget, funded by a surcharge on gas consumption in California

Gas R&D Program

- Focus on energy efficiency, renewable technologies, conservation, and environmental issues.
- Supports state energy policy.

Developing Initiatives

Informed by:

- Gas R&D Objectives
- CPUC Resolutions
- Equity considerations
- Discussion with stakeholders
  - Docket: https://efiling.energy.ca.gov/Lists/DocketLog.aspx?docketnumber=16-PIER-01

State Energy Policy Drivers

- **SB 32 (2016)**
  - Reduce GHG emissions to 40% below 1990 levels by 2030.
- **EO B-55-18**
  - Establishes statewide goal to achieve carbon neutrality as soon as possible and no later than 2045.
- **Integrated Energy Policy Report**
  - Policy recommendations that conserve resources, protect the environment, ensure energy reliability, enhance the state's economy, and protect public health and safety

CPUC Resolution G-3584

- Consider the findings from the Assembly Bill 3232 (Friedman, 2018) report.
- Consider the findings from the initiative: *Long-Term Technological Development Strategy to Meet Aggressive Statewide Decarbonization Goals*.

Diversity & Equity Commitment

To meet CECs commitment to diversity and equity, Energy Commission staff:

- Engage with disadvantaged and underrepresented groups throughout the state.
- Improve CECs application and grant management process to relieve administrative burdens.
- Continue to advance efforts in underresourced communities.

FY 2022-23 proposed research initiatives are framed around ***decarbonization***.

Initiative Themes:

- Targeted Gas System Decommissioning
- Decarbonization of Gas End Uses
- Energy Efficiency
- Entrepreneur Development

Initiative Theme: Targeted Gas System Decommissioning

Scaled-up Gas Decommissioning Pilots and Integrated Planning Tools

Presenters: Qing Tian & Susan Wilhelm

Scaled-Up Gas Decommissioning Pilots and Integrated Planning Tools

Purpose: Design a large-scale gas system decommissioning pilot and enhance a data-driven tool for identifying promising decommissioning sites and supporting gas system planning. Results will facilitate cost-effective, safe, and equitable decarbonization that is informed by community perspectives and priorities.

Background

- Replacement costs and stranded assets associated with aging gas infrastructure.
- Number of customers expected to decline in gas system transition
- Strategic planning enables meeting decarbonization goals while containing cost and addressing equity and safety concerns
- Informed by ongoing CPUC-CEC coordination

Innovations

- Design a large-scale pilot for decommissioning segments of the gas system that delivers cost, environmental, health, and equity benefits.
  - Collect data on infrastructure condition, capacity for electrification, etc.
  - Assess opportunities for gas system pruning and implications for operation of the remaining system.
  - Under-resourced communities will be prioritized in site selection.
  - Leverage insights from stakeholders and previous work.
- Enhance a data-driven tool to support gas system planning.
  - Facilitate planning across a range of time horizons.
  - Consider cost impacts of gas and electricity system interactions.
  - Analyze potential roles of emerging zero-carbon energy sources.
  - Assess consumer and community-level energy choices.

Benefits

- **Safety:** Address aging infrastructure and limit stranded assets.
- **Affordability:** Manage costs and rates throughout the transition.
- **Environmental Sustainability:** Decrease end-use emissions, methane leakage, and health impacts from in-home pollution from gas appliances.
- **Equity:** Reduce costs to vulnerable communities and others.

Questions for Stakeholders

1. What emerging zero-carbon fuels should be considered by the planning tool?
2. What are potential challenges to large-scale pilots?
3. What are the best practices in customer engagement on gas-to-electricity transition?
4. What are the recommendations on minimizing cost impacts and supporting equity?

Topic Area: Decarbonization of Gas End Uses

Large-volume Hydrogen Storage for Targeted Use Cases

Presenter: Qing Tian

Large-volume Hydrogen Storage for Targeted Use Cases

Purpose: Assess technical and cost feasibility and inform decision-making to support the safe and efficient implementation of geological hydrogen storage in California for targeted use cases.

Background

- Hydrogen is a potential low carbon fuel replacement for fossil gas for dispatchable power generation and high-temperature industrial processes.
- Geological storage may be a low-cost solution with significant storage capacity but requires research on safety and economic performance.
- Proposed research will inform greenhouse gas emission reduction strategies.

Innovations

- Identify main options for the geological storage of hydrogen in California that match the needs of hydrogen industry applications.
- Investigate the technical requirements and collect operational and techno-economic insights for large-volume, geological storage opportunities.
- Develop mitigation strategies associated with technical and operational risk and evaluate emerging technologies to enable safe and reliable hydrogen storage.

Ratepayer Benefits

- **Safety:** Support the safe operation of geologic hydrogen storage.
- **Affordability:** Identify cost-effective storage options at scale, leading to stable and affordable costs for consumers.
- **Environmental Sustainability:** Facilitate renewable hydrogen usage in California for hard-to-decarbonize applications.

Questions for Stakeholders

1. What are the promising use cases and suitable geological storage opportunities in California?
2. What types of requirements should inform geological storage decision-making?
3. Recommendations on research approach(es)?

Industrial Clusters for Clean Hydrogen Utilization

Presenter: Ilia Krupenich

Industrial Clusters for Clean Hydrogen Utilization

Purpose: Identify and characterize optimal co-location of industries ("clusters") to share hydrogen infrastructure. Considerations include the number of industries to be co-located, the most promising locations, the industrial sectors most compatible for regional hydrogen deployments in California, and safety for neighboring communities.

Background

- Renewable hydrogen can decarbonize high-temperature industrial processes, which accounts for approximately 20 million metric tons of carbon dioxide equivalent emissions per year.
- High production and transportation costs for hydrogen could be alleviated by strategic sharing of hydrogen infrastructure.
  - Accelerate learning
  - Reduce capital costs
  - Improve economies of scale
  - Leverage beneficial by-products

Innovations

- Evaluate technical advancements needed for using hydrogen in industrial applications.
- Identify potential locations for clustering hydrogen-using industrial facilities and engage stakeholders to identify, demonstrate, and assess opportunities.
- Identify the feasibility and cost savings opportunities from repurposing segments of existing gas infrastructure compared to new infrastructure.

Ratepayer Benefits

- **Affordability:** Drive down the cost of hydrogen, making it more affordable for industries to reduce greenhouse gas emissions.
- **Environmental Sustainability:** Replacing fossil gas with renewable hydrogen could reduce greenhouse gas and criteria air pollutant emissions.
- **Equity:** Examine strategies for ensuring safety, lowering pollution burden, and providing economic opportunities for local communities.

Questions for Stakeholders

1. What are key criteria when determining what industries to cluster and where?
2. What California industries would benefit most from clustering of hydrogen infrastructure?
3. Are there relevant examples of similar clustering efforts nationally or internationally?
4. What are some resources that can help inform this research initiative?
5. What approaches should be considered when deploying hydrogen infrastructure?

Mitigate Criteria Air Pollutants in Hydrogen-Based Power Generation

Presenter: Kaycee Chang

Mitigate Criteria Air Pollutants in Hydrogen-Based Power Generation

Purpose: Mitigate criteria air pollutants from the combustion of high hydrogen blends in power generation applications.

Background

- Hydrogen-based generation technologies can reduce the consumption of fossil gas and its emission footprint.
- Building on FY 2021-2022 hydrogen-blending initiative to further focus on emissions from power generation technologies that can run efficiently on high blends of hydrogen.
- Emissions from combustion-based generation can disproportionately impact local communities.
- Adapting existing NOx reduction methods to work with hydrogen blends has technical challenges especially as the hydrogen percentage is increased.

Innovations

- Improve stationary system pre-intake and combustor control strategies (e.g., optimizing air fuel ratio, integrating water and steam injection).
- Improve aftertreatment technologies (e.g., improving catalyst design and performance).
- Measure and quantify air quality improvements and public health benefits of adopting advanced pollutant mitigation technologies.

Ratepayer Benefits

- **Affordability:** Increase market adoption of high hydrogen blends and reduce the cost of air quality mitigation in hydrogen power generation.
- **Environmental Sustainability:** Support the adoption of hydrogen blends in the fuel mixture of gas systems, potentially reducing statewide consumption of fossil gas in power generation.
- **Equity:** Improve air quality in under-resourced communities by decreasing criteria air pollutants emissions generated from hydrogen combustion.

Questions for Stakeholders

1. What are the most promising energy innovations that could drive down cost of mitigation technologies?
2. What are suggested target metrics for the mitigation technologies?
3. What types of demonstrations are needed to expand deployment of these technologies in the future?
4. Are there technology development opportunities to accommodate both higher blends of hydrogen and emission reductions simultaneously?

Advanced Hydrogen Refueling Infrastructure Solutions for Heavy Transport

Presenter: Peter Chen

Advanced Hydrogen Refueling Infrastructure Solutions for Heavy Transport

Purpose: Improve the cost effectiveness and performance of hydrogen refueling infrastructure technologies for heavy transport:

- Heavy-duty trucks
- Off-road agricultural and construction equipment
- Cargo handling equipment
- Rail and marine (at ports and other in-state facilities)

Augment the FY2021-22 transportation initiative with additional funds.

Background

- Adoption of hydrogen fuel cells as a zero-emission alternative for heavy transport is limited by the lack of a robust hydrogen refueling infrastructure network in California.
- R&D can address performance, cost, and logistical barriers such as:
  - High delivery and refueling costs
  - Reliability
  - High flow rates for fast refueling of larger vehicles
  - Lack of practical access to typical on-road refueling stations for off-road, rail, and marine applications
- Bridge the technology gap between DOE's low technology readiness level (TRL) research and CEC's Clean Transportation Program investments in high TRL deployments.

Innovations

- Improve efficiency and reliability of station components and designs:
  - Advanced compressors, cryopumps, and chillers;
  - Innovative configurations to reduce footprint and increase utilization;
  - Integrated on-site renewable hydrogen production.
- Develop high flow rate systems to support public access heavy-duty truck stations and larger rail and marine applications.
- Address barriers to enabling high capacity, flexible hydrogen mobile refueler solutions.

Ratepayer Benefits

- **Affordability:** Reducing costs of delivering and refueling hydrogen will lower the price of hydrogen at the pump for transportation end uses.
- **Environmental Sustainability:** Improving the feasibility of adopting hydrogen fuel cells for heavy transport will lead to greenhouse gas and air pollutant emission reductions.
- **Equity:** Accelerating a transition to zero-emission alternatives for heavy transport will benefit under-resourced communities located near ports, rail yards, warehouses, and highways.

Questions for Stakeholders

1. Are there additional barriers or innovations that should be targeted or prioritized?
2. What recommendations do you have on research approaches or performance metrics to target?
3. How beneficial is the funding augmentation approach for potential applicants?

Initiative Theme: Energy Efficiency

Analysis of Residential Hot Water Distribution Designs

Presenter: Amir Ehyai

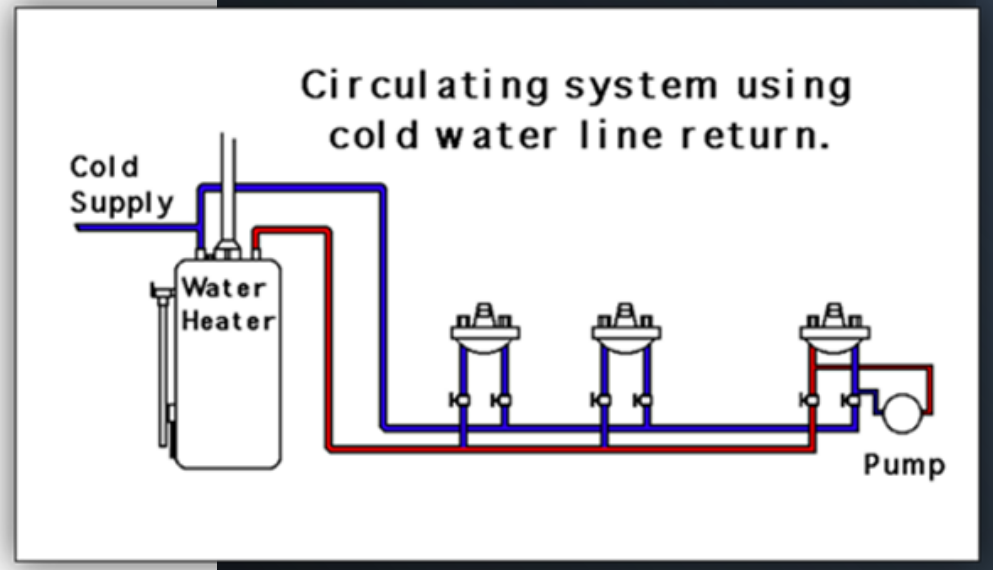
Analysis of Residential Hot Water Distribution Designs

Purpose

- Identify technological advancements to on-demand hot water recirculation system, such as use of smart controls and electronically commutated motors, to reduce energy and water use in existing and new single-family homes.
- Demonstrate real-world energy and water savings.
- Inform future energy code.

Background

- Research on hot water recirculation systems is dated.
- Many circulator pumps currently sold on the market are uncontrolled continuous recirculation pumps.
- Other sales are timer-based which typically operate 16 hours per day.
- On-demand circulator pumps offer similar convenience and water-saving benefits and save substantial energy compared to standard models.
- On-demand models make up less than 5% of sales.



Innovations

- Identify technological advancements for on-demand recirculation systems that can reduce energy and water use compared to standard systems.
- Demonstrate technically advanced recirculating systems on various water heater types in new and existing single-family homes.
- Compare value proposition of advanced recirculating systems to other water and energy saving distribution designs.
- Provide technical and economic data to inform changes to appliance standards and energy code.

Ratepayer Benefits

- **Affordability:** On-demand circulator pumps are an easy and cost-effective retrofit option and have an expected useful life of 15 years.
- **Environmental Sustainability:** Recirculation systems can save an estimated 1,100 gallons of water per person annually; and when compared to continuous operation, demand activated pumps can save significant electricity and natural gas.

Questions for Stakeholders

1. What research is needed to reduce cost of on-demand circulator pumps?
2. Are there technological advancements to increase uptake of on-demand recirculation systems?
3. How can research overcome any technical limitations to use of these devices on heat pump water heaters, tankless and other water heaters?

Topic Area: Entrepreneur Development

California Sustainable Energy Entrepreneur Development (CalSEED) - Low-Carbon Gas

Presenter: Michael Ferreira

CalSEED – LCG

Purpose: Provide entrepreneurs starting capital to develop their ideas into proof-of-concepts to decarbonize existing uses of fossil gas by funding the recently-established CalSEED-Low-Carbon Gas program.

Background

- Modeled after EPIC-funded CalSEED program, administered by New Energy Nexus.
- CalSEED receives 200 – 400 applications annually with only 25-28 selected for award.
- 91 start-ups have received $37 million in public funding and $28 million in private investment.
- 2017 CalSEED recipient Cuberg received subsequent investment from NSF, U.S. Army, U.S. Air Force, Boeing. Acquired by Northvolt in 2021.

Innovations

Technology areas of focus may include carbon capture; hard-to-electrify end-uses such as industrial process heating and medium- and heavy-duty transportation and producing low-carbon alternatives to fossil gas such as green hydrogen and biogas.

Ratepayer Benefits

- **Safety:** Projects developing innovations to improve gas pipeline safety, including solutions that can predict, detect, and repair infrastructure threats and vulnerabilities.
- **Affordability:** Projects developing innovations that can cost-effectively decarbonize existing uses of fossil gas.
- **Environmental Sustainability:** Improved air quality from the development of fossil gas alternatives.

Questions for Stakeholders

1. What technologies are being developed by start-ups that can support safe decarbonization of existing uses of fossil gas?
2. What intellectual property is being developed at research institutions to support safe decarbonization of the fossil gas sector that is ready to spin out into commercial ventures?

Public Comments

- Please submit your question or comment in the **Question and Answers** window or raise your hand, and you will be called on to unmute yourself. *(Feature found under the Participants panel.)*
  - First, we will call on participants with raised hands for verbal comments/questions.
  - Next, we will turn to the Q&A window for typed comments/questions.
- Please remember to introduce yourself by stating your name and affiliation.
- Please keep questions or comments under 3 minutes to allow time for others.

Recap: Session I
Proposed Research Initiatives

Targeted Gas System Decommissioning

- Scaled-Up Gas Decommissioning Pilots and Integrated Planning Tools

Decarbonization of Gas End Uses

- Large Volume Hydrogen Storage for Targeted Use Cases
- Industrial Clusters for Clean Hydrogen Utilization
- Mitigate Criteria Air Pollutants in Hydrogen-Based Power Generation
- Advanced Hydrogen Refueling Infrastructure Solutions for Heavy Transport

Energy Efficiency

- Analysis of Residential Hot Water Distribution Designs

Entrepreneur Development

- California Sustainable Energy Entrepreneur Development (CalSEED) – Low Carbon Gas

Feedback

The California Energy Commission would like to hear your thoughts on the proposed initiatives.

Comments can be provided to the PIER Gas Docket until ***January 31, 2022:*** https://efiling.energy.ca.gov/Ecomment/Ecomment.aspx?docketnumber=16-PIER-01

These comments will be considered while developing the *FY 2022-23 Gas R&D Proposed Budget Plan.*

Connect with Us

- The Energy Commission can be found on most social media platforms, Facebook, YouTube, Twitter, and LinkedIn.
- Energize Innovation provides access to the CEC R&D project resource libraries, tools, and databases.

Break

Stretch, grab a snack/beverage and see you in 5 minutes…

Session II

Contractor Presentation

Establishing a Long-Term Natural Gas Research Strategy to Achieve Aggressive Statewide Carbon Neutrality Goals