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FY 2021-2022 Proposed Natural Gas Research Initiatives

Stakeholders Workshop

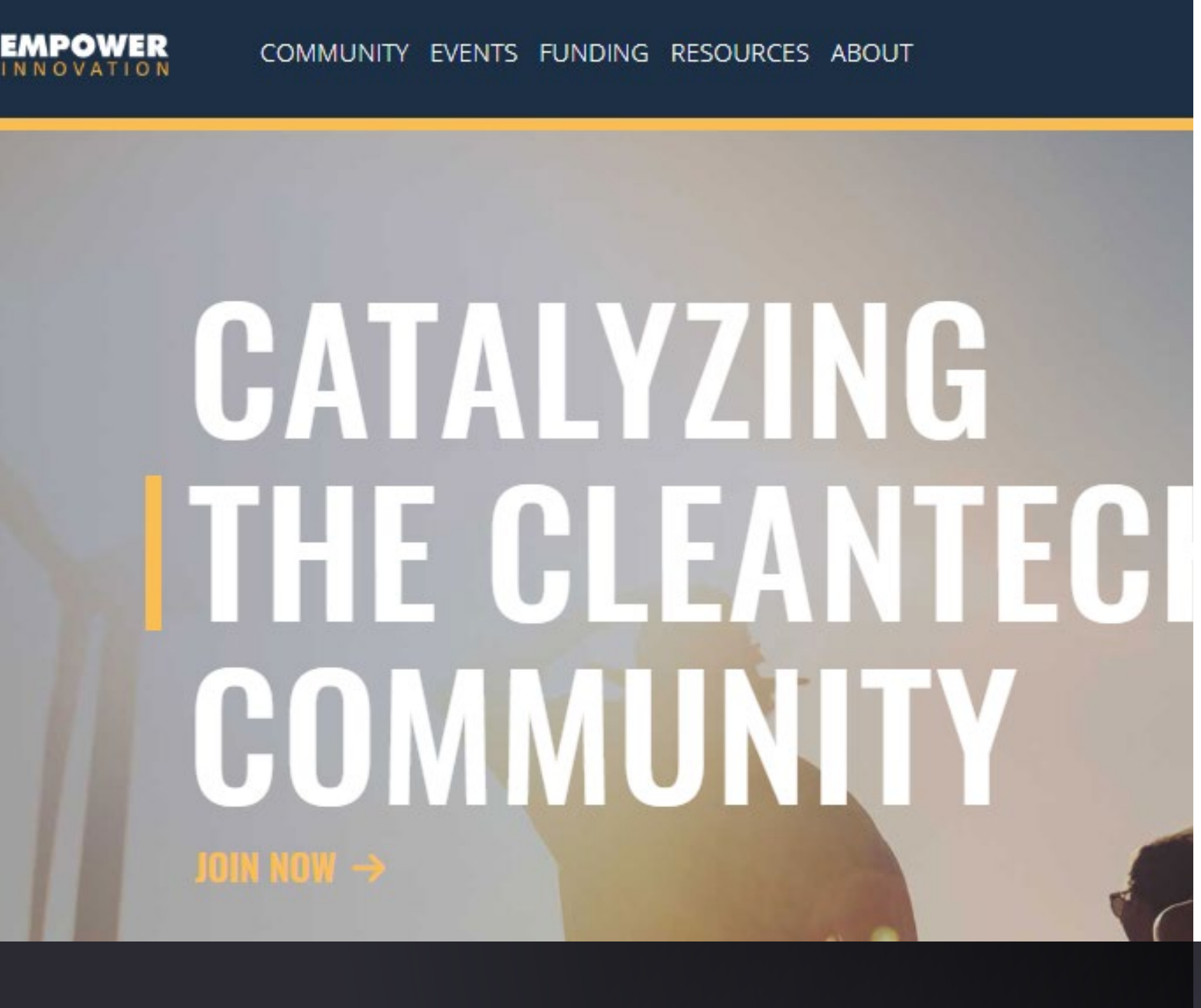
Energy Research and Development Division

Agenda

TIME	ITEM
10:00 am	Introduction and Purpose
10:30 am	Staff Presentations on Proposed Initiatives • Energy Efficiency • Natural Gas Infrastructure Safety and Integrity • Renewable Energy and Advanced Generation • Energy-Related Environmental Research • Transportation Research
11:30 pm	Public Comments

Announcements

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



Connect with Us

The Energy Commission can be found on most social media platforms, Facebook, YouTube, Twitter, and LinkedIn.

Empower Innovation collects and promotes resources for the cleantech community. It also provides access to our resource libraries, tools, and databases. A place to create favorites and share lists with others.

Commitment to Diversity

The Energy Commission adopted a resolution strengthening its commitment to diversity in our funding programs. We continue to encourage disadvantaged and underrepresented businesses and communities to engage in and benefit from our many programs.

To meet this commitment, Energy Commission staff conducts outreach efforts and activities to:

- Engage with disadvantaged and underrepresented groups throughout the state.
- Notify potential new applicants about the Energy Commission's funding opportunities.
- Assist applicants in understanding how to apply for funding from the Energy Commission's programs.
- Survey participants to measure progress in diversity outreach efforts.

We Want to Hear From You!

Please take the 1-Minute Survey to help us track demographic participation. Responses are anonymous and the information will help us enhance our outreach.

Please use the link provided in the chat.
(See chat window during workshop.)

Thanks!

FY 2021-22 Natural Gas R&D Plan

- Energy Commission R&D Program staff are holding this workshop seeking stakeholder comments on proposed natural gas research initiatives for the Natural Gas FY 2021-2022 budget plan.
- Specific "Questions for Stakeholders" will be posed during the workshop.

Introduction

- Research and development specific to natural gas done in the public interest to support the transition to clean energy, greater reliability, lower costs, and increased safety for Californians
- "Directed towards developing science or technology, and 1) the benefits of which accrue to California citizens, and 2) are not adequately addressed by competitive or regulated entities."
- $24 million annually, funded by a surcharge on natural gas consumption in CA

Natural Gas R&D Projects

Natural Gas R&D funded projects:

- Focus on energy efficiency, renewable energy and advanced clean generation, energy transmission and distribution, energy-related environmental protection, and transportation.
- Support state energy policy.
- Provide complementary communitywide benefits including, but not limited to, job creation, improved air quality, and economic stimulation.

Policy Drivers

Integrated Energy Policy Report

- "Develop energy policies that conserve resources, protect the environment, ensure energy reliability, enhance the state's economy, and protect public health and safety"

EO B-55-18

- Establishes statewide goal to achieve carbon neutrality as soon as possible and no later than 2045.

SB 32

- Reduce GHG emissions to 40% below 1990 levels by 2030.

SB 100

- Requires 100% of retail electricity sales be met by renewable and zero carbon resources.

SB 1250

- Public Goods Utilities surcharge to support public interest for research and development.

SB 1383

- Reduce emissions of short-lived climate pollutants, including those from dairies, organics disposal, and wastewater treatment plants below 2013 levels by 2030.

General Approach to Developing Initiatives

- Identify research gaps to address and propose initiatives through:
  - Discussion with utilities, public stakeholders, state and federal governmental agencies, other CEC programs;
  - Roadmaps;
  - Public meetings with industry and trade associations; and
  - Research ideas submitted by the public
- Energy research priorities are guided by policy directives and equity considerations
- Need clearly identified natural gas ratepayer benefits
- Research projects are selected through competitive solicitations

Natural Gas Research Initiative Development

FY 2021-22 proposed research initiatives are framed around ***decarbonization and equity***.

Primary areas:

- Indoor Air Quality
- Industrial Decarbonization
- Hydrogen
- Decommissioning
- Safety and Integrity

Research Initiative Feedback

Here at the California Energy Commission, we're always working to make our research initiatives have the greatest impact.

Now, that you're here we would like to hear your thoughts.

Research suggestions can be provided to our Natural Gas Docket at: https://efiling.energy.ca.gov/Ecomment/Ecomment.aspx?docketnumber=16-PIER-01

Presenter: David Stout

Energy Efficiency

Energy Efficiency Program Goals

- Conduct research, development, and demonstration to advance strategies and technologies to support decarbonization in the building and industrial sectors.
- Enhance outreach and demonstration opportunities with under-resourced communities.
- Increase energy efficiency while reducing operating costs, natural gas use and greenhouse gases and other air emissions (for example low NOx).
- Develop and demonstrate affordable energy-efficiency technologies, processes, and strategies.

Past research focused on using natural gas more efficiently in buildings and industries.

Proposed Research Initiatives

FY 2021-22 Energy Efficiency

Industrial Decarbonization Issues

- On an annual basis, California's industrial sector consumes over 35% of the state's natural gas consumption and is responsible for over 20% of the state's greenhouse gas emissions
- Process heat accounts for about 85% of industrial natural gas use
- Industrial heating such as calcination, smelting, curing, and forming is difficult and/or expensive to electrify because of high temperature of these processes

Proposed initiatives targets <u>two areas</u>:

- Hydrogen and natural gas blending for industrial end-use applications
- Industrial Carbon Capture and Utilization

Research Initiative #1

Hydrogen and Natural Gas Blending for Industrial End-Use Applications

Background:

- Hydrogen blended with natural gas could be used as a fuel in industrial applications
  - Reduce natural gas consumption
  - Reduce greenhouse gas emissions
  - Provide pathway for decarbonization
- End-use application combustion safety and stability without affecting product quality are critical for using hydrogen and natural gas blends

Research Purpose & Description

1) Hydrogen and Natural Gas Blending for Industrial End-Use Applications

Purpose

- Identify and demonstrate industrial applications and processes where natural gas use can be replaced with blended natural gas and green hydrogen.
- Gather sufficient data to characterize the potential impacts of hydrogen-blending to the state's climate and energy goals and effects on criteria pollutant emissions.
- Establish criteria to define "safe" use of blends.

Description of Research

- Laboratory experiments to determine the maximum upper limit (MUL) of hydrogen that can be safely blended.
- Explore equipment retrofits and identify specifications that could enable safe use of higher blends of hydrogen to increase the MUL (e.g., controls, burner modifications).
- Evaluate the effect of blending on criteria air pollutant emissions (NOx).
- Demonstrate at pilot or full-scale use of blends in industrial process equipment.

Projected Ratepayer Benefits

1) Hydrogen and Natural Gas Blending for Industrial End-Use Applications

Technology Potential.

- Increasing the amount of hydrogen replacing natural gas in industrial end-use applications may be a cost-effective way for industry to of reduce CO2 emissions.
- Replacing 5% of the natural gas used by California's industrial sector with green hydrogen would eliminate 2.2 million metric tons of carbon dioxide emissions annually.

Environmental Benefits.

- Reduce GHG emissions from natural gas fueled industrial process heating and high-temperature processes that are difficult or costly to electrify or otherwise decarbonize.
- Potential for criteria air pollutant reductions, for example NOx and CO, which are known to be harmful to human health and the environment.

Equity Considerations. Many industrial facilities are in under-resourced communities. Inform implementation of hydrogen blending to reduce or avoid increasing criteria air pollutants (NOx) and their associated health affects in these communities.

Questions for the Stakeholders

1) Hydrogen and Natural Gas Blending for Industrial End-Use Applications

- What should be the targeted industrial sectors and processes? Why?
- Are there sectors or process applications to avoid? Why?
- What are specific research needs in the area of natural gas and hydrogen blends in industrial end-use applications?
- What are non-technological barriers that hinder the use of hydrogen and natural gas blends?
- Are there examples of industries that have successfully used hydrogen natural gas blends? Please provide links.
- What air quality considerations for using blends should we be aware of?

Research Initiative #2

Industrial Carbon Capture & Utilization

Background:

- Certain industrial processes are unlikely to be electrified in the upcoming decade because of their high temperatures;
- Carbon capture can mitigate GHG emissions, but expenses are higher than price of captured $CO_{2;}$
- Utilization of CO_2 by conversion into high-value saleable commodities can offset the costs of carbon capture and;
- Efficient utilization of carbon dioxide could promote adoption of industrial carbon capture.
- Target major emitters of carbon dioxide identified by mandatory reporting and cap-and-trade programs that use high-temperature processes. These include glass, cement, metals, chemicals.

Research Purpose & Description

2) Industrial Carbon Capture and Utilization

Purpose

- Improve efficiency and economics of existing and emerging technologies that capture carbon dioxide and convert into high-value commodities
- Increase effectiveness of capturing carbon dioxide and its purification
- Develop novel chemical and biological conversion technologies and improve economics of the existing ones

Research Description

- Develop a roadmap for carbon capture and utilization in the industrial sector
- Establish an energy baseline of existing CCU technologies
- *Carbon Capture* – Develop and demonstrate (1) advanced materials and purification processes could improve efficiency of CO2 separation and removal of impurities (water, oxygen, SO2, NOx) and (2) Novel separation processes that could reduce energy required for CO2 separation
- *Carbon Utilization* – Develop and demonstrate (1) chemical and biological conversion technologies convert CO2 into various types of fuels, precursors for plastics, and other valuable products, including food, (2) processes for using CO2 to cure concrete, and (3) conversion into carbon nanotubes

Projected Ratepayer Benefits

2) Industrial Carbon Capture and Utilization

Technology Potential.

- Improved efficiency and economics of carbon capture and utilization will promote wide adoption of these technologies
- Potential to enable use of Direct Air Capture technologies

Environmental Benefits.

- High potential for industrial GHG emissions reduction
- Carbon capture processes remove criteria air pollutants that are known to be harmful, including SO2, NOx and particulate matter because they need to be removed for technical reasons.

Equity Considerations. Many industrial facilities are in under-resourced communities, reductions in GHG emissions and criteria air pollutants and particulates would improve the air quality and reduce associated health affects in these communities.

Questions for the Stakeholders

2) Industrial Carbon Capture and Utilization

- What are CO2 utilization technologies with highest market potential?
- What technologies have highest potential for on-site conversion of CO2 at the industrial facilities?
- What are specific research needs for industrial carbon capture and utilization in California?
- What are non-technological barriers that hinder adoption of carbon capture and utilization?
- What industries in California have most potential for carbon capture and utilization?
- What are examples of industrial carbon capture and utilization that would be helpful in our research?
- What are anticipated co-benefits of carbon capture on air quality (criteria air pollutants and particulates)? Links to supporting literature?

Natural Gas Infrastructure Safety & Integrity

Presenter: Qing Tian

Natural Gas Infrastructure Safety & Integrity Program Goals

- Conduct research in natural gas infrastructure (pipelines and storage) to increase public safety, system integrity, and climate resiliency
- Enhance transmission and distribution capabilities of the natural gas system
- Address issues not adequately addressed by the regulatory and competitive markets

Proposed Research Initiatives

FY 2021-22 Natural Gas Infrastructure Safety & Integrity

- Technologies for Monitoring Ground Movement Around Pipelines and Mitigating Natural Force Damages
- Technology Development and Demonstration for Plastic Pipeline Repair and Integrity Improvement

Research Initiative #3

Technologies for Monitoring Ground Movement Around Pipelines and Mitigating Natural Force Damages

Background:

- Natural force damages contribute to 12.8% transmission incidents and 9% distribution incidents between 2005 and 2018
- Natural force damages can sometimes result in catastrophic failures and release large volumes of natural gas
- Existing patrol programs only observe surface conditions on and adjacent to the pipeline right-of-way but can’t reveal changes on mechanical properties in real-time

Research Purpose & Description

3) Technologies for Monitoring Ground Movement Around Pipelines and Mitigating Natural Force Damages

Purpose

- Identify potential risk in vulnerable areas
- Continuously monitor natural force threats and assess pipeline conditions
- Take appropriate action concerning changes in pipeline conditions
- Facilitate emergency responses

Research Description

- Development and demonstration of remote sensing and monitoring technologies
- Development of mitigation strategies to reduce the risk of potential damages
- A "whole system approach" from data collection to integration with utility integrity management system and risk assessment tools
- Advancing technology and commercial readiness level by optimizing device performance, improving cost effectiveness, and demonstrating the technologies at full-scale in the field

Projected Ratepayer Benefits

3) Technologies for Monitoring Ground Movement Around Pipelines and Mitigating Natural Force Damages

- **Energy Sector.** With the state-of-the-art remote sensing and monitoring technologies, pipeline operators can monitor ground movement around pipelines and develop mitigation strategies to reduce the risk of natural force damages and service disruption.
- **Technology Potential.** These technologies will enable utilities to conduct real-time, continuous, and comprehensive monitoring at geodetic monitoring points to track potential ground movement.
- **Market Connection.** Sectors and user groups of interest in the proposed initiative include natural gas utilities, pipeline owners and operators, and pipeline inspectors and surveyors.
- **Environmental Benefits.** Reducing damages to pipelines helps decrease direct and indirect greenhouse gas (GHG) emissions.
- **Equity Considerations.** Under-resourced communities are usually more vulnerable to natural disasters. This research will pilot and put engineering measures in place to protect these communities from being negatively impacted by natural force damages.

Questions for the Stakeholders

3) Technologies for Monitoring Ground Movement Around Pipelines and Mitigating Natural Force Damages

- What are the most desirable improvements on current technologies or practices for plastic pipelines?
- Which components of plastic pipeline systems are more vulnerable to aging, degradation or risks, so that the safety enhancements can focus more on these components?
- Are there any additional research areas of interest to improve the overall integrity of plastic pipeline systems?

Research Initiative #4

Technology Development and Demonstration for Plastic Pipeline Repair and Integrity Improvement

Background:

- Plastic pipelines accounted for 72.7% of US natural gas services, and CA has 55,000+ miles of plastic pipeline mains for natural gas distribution
- The safety and integrity of plastic pipelines are impacted by third-party damages, natural hazards, material aging, repair degradation, etc.
- Plastic pipe repair practices are costly and inefficient, since they involve pipe excavation and gas service interruption

Research Purpose & Description

4) Technology Development and Demonstration for Plastic Pipeline Repair and Integrity Improvement

Purpose

- Implement Federal Pipeline Safety Regulations on plastic piping systems
- Further enhance plastic pipeline safety and adopt innovative technologies
- Advance the overall integrity of plastic pipelines in California

Research Description

- Technologies for early notification of potential risks
- Robotic internal inspection and repair technologies
- New and cost-effective technologies to repair plastic pipe damages
- Technologies to measure the performance of repaired plastic pipe systems
- Emerging technologies that minimize or avoid natural gas service interruption during pipeline repair

Projected Ratepayer Benefits

4) Technology Development and Demonstration for Plastic Pipeline Repair and Integrity Improvement

- **Energy Sector.** The technologies developed and demonstrated in this initiative are intended to improve the safety and integrity of natural gas plastic pipelines and prevent pipe failures and gas service interruption.
- **Technology Potential.** The deployment of the technologies would help to assess, repair, and prevent damages to plastic pipes widely used in natural gas mains and service lines.
- **Energy and Cost Savings.** The use of the technologies from this initiative will reduce plastic pipeline failures and decrease natural gas system down time and associated costs. Improved repair technologies for plastic pipes can further bring down the cost of pipeline system maintenance.
- **Environmental Benefits.** Integrity improvement of natural gas mains and service lines reduces fugitive methane emissions.
- **Equity Considerations.** The research will enhance the safety, reliability and resiliency of gas service including in disadvantaged and low-income communities, which are more vulnerable to natural gas incidents such as gas leaks, pipe ruptures and explosions.

Questions for the Stakeholders

4) Technology Development and Demonstration for Plastic Pipeline Repair and Integrity Improvement

- What are the most desirable improvements on current technologies or practices for plastic pipelines?
- Which components of plastic pipeline systems are more vulnerable to aging, degradation or risks, so that the safety enhancements can focus more on these components?
- Are there any additional research areas of interest to improve the overall integrity of plastic pipeline systems?

Presenter: Rizaldo Aldas

Renewable Energy & Advanced Generation

Renewable Energy & Advanced Generation Program Goals

Overcome barriers and enable deployment of renewable energy, and reduce dependence on fossil natural gas by:

- Accelerating efficient and cost-competitive production of renewable gas –biomethane and renewable hydrogen – and demonstrating its diversified applications for clean and advanced power generation.
- Developing cost-effective, fuel-flexible, energy-efficient, low-emission, and hybrid energy generation systems and technologies.
- Advancing the development and market availability of clean and efficient distributed generation and renewable combined heating, cooling, and power technologies.

Research Initiative #5

Developing and Demonstrating Hydrogen-Based Power Generation Systems

Background:

- Hydrogen-based generation technologies – paired with advanced hydrogen production methods – can reduce the use of and emissions from natural gas in power generation.
- One promising pathway to reduce greenhouse gas emissions in natural gas-fired power generation is through blending of low-carbon hydrogen into the fuel mixture of gas generators.
- Although adding hydrogen to natural gas on end-use systems holds promise, use of hydrogen for power generation has not been commercially demonstrated in California.

Research Purpose & Description

5) Developing and Demonstrating Hydrogen-Based Power Generation Systems

Purpose

- Increasing hydrogen blends in natural gas requires modifications or changes on power generation technologies, with safety and material integrity implications.
- Better understand challenges, and identify solutions, in using higher blends of hydrogen in power generation.
- Demonstrate hydrogen-fueled power generation at a site that produces renewable gas as a source for hydrogen-rich fuel.
- Support demonstration of emerging technologies for producing hydrogen-rich fuel from renewable gas and emerging generation technologies.

Research Description

- Development and demonstration of power generation technologies that can run efficiently on high blends of hydrogen in the fuel stream.
- Advance and demonstrate generation system efficiency, emissions reductions (greenhouse gases and NOx), and safe operation (e.g., operating without leaks, maintaining system integrity); with applications for small-scale to large-scale systems
- Demonstrate integrated production of hydrogen-rich fuel from renewable gas and power generation.

Projected Ratepayer Benefits

5) Developing and Demonstrating Hydrogen-Based Power Generation Systems

- **Energy Sector.** The proposed technology development and demonstration would increase hydrogen adoption, potentially reducing statewide consumption of fossil-based natural gas in power generation.
- **Energy and Cost Savings.** Technology advancements that enable use of hydrogen blends in power generation systems could reduce consumption of fossil-based natural gas (and potentially other fuels) and associated costs.
- **Environmental Benefits.** Reducing fossil-based natural gas consumption and developing power generation applications for low-carbon hydrogen supports California's greenhouse gas emission reduction goals.
- **Equity Considerations.** Fossil fuel generators are typically in under-resourced communities. Hydrogen-based power generation systems will contribute to the state's clean electricity goals and provide opportunities to improve local air quality through reductions of nitrogen oxide (NOx) emissions and other natural gas combustion byproducts that present health risks.

Questions for the Stakeholders

Developing and Demonstrating Hydrogen-Based Power Generation Systems

- Are we effectively targeting research and technological development needs to support California's decarbonization goals and provide natural gas ratepayer benefits?
- What are the technological and non-technological barriers to deploying hydrogen power generation that should be prioritized?
- Do you have suggestions for research and development needed to improve the technical and economic aspects of the proposed technologies?
- What air quality considerations or benefits using blends should we be aware of?

Energy-Related Environmental Research

Presenter: Susan Wilhelm

Energy-Related Environmental Research Program Goals

Program Goals:

- Develop cost-effective approaches to evaluating and resolving environmental and human health impacts of energy production, delivery, and use in California;
- Explore how strategic planning and management can help California meet its energy and environmental goals;
- Support climate adaptation and resilience planning for California's energy system.

Proposed Research Initiatives

Energy-Related Environmental Research

- Quantify Exposures to Indoor Pollutants in Multi-Family Homes that Cook with Natural Gas or Alternatives
- Location-Specific Analysis of Decommissioning to Support Long-Term Gas Planning

Research Initiative #6

Quantify Exposures to Indoor Pollutants in Multi-Family Homes that Cook with Natural Gas or Alternatives

Background:

- Prior research, including prominent contributions funded by the Natural Gas R&D program, has demonstrated that residential cooking with natural gas appliances generates pollutants that degrade indoor air quality (IAQ).
- In indoor residential settings with gas cooking, health damaging pollutants such as NO_2 and $PM_{2.5}$ can exceed health-based thresholds set for ambient air quality.
- Field measurements of actual exposures to indoor air pollution in California kitchens-- particularly in small multi-family homes-- as well as the nature of indoor PM2.5 is limited.

Research Purpose & Description

6) Quantify Exposures to Indoor Pollutants in Multi-Family Homes that Cook with Natural Gas or Alternatives

Research Issue

- Smaller homes—including apartments typically occupied by low-income residents— are typically associated with higher pollutant concentrations. While research funded by the Natural Gas R&D program is supporting development of Title 24 Building Energy Efficiency standards that will protect human health through ventilation requirements for new homes, the issue of exposures to vulnerable populations in existing homes requires further exploration to support appropriate interventions.

Research Purpose and Description

- Address critical gaps in our understanding of health impacts of cooking with residential natural gas and possible benefits of electric cooking appliances, including:
  - Exposure assessment of California residents to NO2 in residential environments;
  - Assessment of indoor exposures to PM2.5 associated with cooking episodes, as well as characterization of the chemical constituents, size distribution, or other attributes that factor into health impacts.
- Inform a more realistic assessment of health implications from exposures to health-damaging pollutants associated with residential cooking. May inform low-cost strategies for monitoring PM in residential kitchens.
- Responsive to CPUC's Resolution G-3571.

Projected Ratepayer Benefits

6) Quantify Exposures to Indoor Pollutants in Multi-Family Homes that Cook with Natural Gas or Alternatives

- **Energy Sector**. Provides empirical basis for understanding the health implications of cooking with various fuels in multi-family homes as well as associated ventilation needs.
- **Energy and Cost Savings.** Quantification of pollutant exposures as well as improved characterization of health-damaging pollutants generated by cooking with natural gas or gas substitutes provides a basis for quantifying health-related benefits associated with energy- and cost-saving cooking and ventilation technologies.
- **Environmental Benefits**. Provides a foundation for addressing indoor air pollution in multi-family homes and assessing the health benefits of building decarbonization measures.
- **Equity Considerations:** The proposed research will focus on quantification of health-damaging pollutants in multi-family homes in low income and disadvantaged communities, with an emphasis on capturing exposures of those most vulnerable to air pollution exposures (e.g., children, elderly).

Questions for Stakeholders

6) Quantify Exposures to Indoor Pollutants in Multi-Family Homes that Cook with Natural Gas or Alternatives

- How should the study population be defined? (e.g., multi-family households that include residents vulnerable to air pollution exposures, low-income single-family homes, etc.)
- How to foster cost-effective recruitment of the study population to ensure the research benefits the intended stakeholders?
- Are there ongoing efforts that could be leveraged or otherwise provide fruitful partnerships?

Research Initiative #7

Quantify Exposures to Indoor Pollutants in Multi-Family Homes that Cook with Natural Gas or Alternatives

Background:

Prior research funded by the Natural Gas R&D Program established that *a strategic, long-term planning strategy for California's retail natural gas system is imperative* to meeting the state's decarbonization goals while containing cost, addressing equity concerns, and managing infrastructure safety considerations.

Responding to this urgent need, the FY 2020-2021 R&D Funding Plan provided funding to *develop a data-driven, actionable tool to support strategic and equitable natural gas decommissioning*.

Research Purpose & Description

7) Location-Specific Analysis of Decommissioning to Support Long-Term Gas Planning

Purpose

- To complement identification of potential sites for decommissioning and electrification based largely on physical assets, location-specific analysis of operational issues is needed to assess the implications of decommissioning for remaining segments of the gas system.
- Bridge the gap between high-level gas system planning and local decommissioning pilots, providing CPUC, local governments, IOUs, and other stakeholders with a valuable tool for assessing the technical and economic feasibility of decommissioning specific segments of the gas system.

Research Description

- Deliver location-specific analysis of promising candidate sites for decommissioning (e.g., those with known pipe integrity and corrosion issues or other factors such as seismic risk and natural gas supply vulnerability), examining the implications of decommissioning on the remaining gas system.
  - Opportunities for examining natural gas decommissioning and electrification opportunities in low-income and disadvantaged communities will be prioritized.
- Initiative to be informed by CEC workshop in collaboration with CPUC, engaging IOUs and other key stakeholders on data needs, continued stakeholder engagement process, equity considerations, etc.
- Scope and approach to inform reliable, effective, equitable implementation of strategic pruning.

Projected Ratepayer Benefits

7) Location-Specific Analysis of Decommissioning to Support Long-Term Gas Planning

- **Energy Sector**. Provide direct support for state energy policy through research not adequately addressed by competitive or regulated entities, the benefits of which accrue to California citizens.
- **Market Connection**. This initiative provides insight into maintaining a reliable, stable market for natural gas ratepayers, with an emphasis on low-income ratepayers to help address equity considerations and promote participation in the early stages of gas system transition.
- **Energy and Cost Savings**. Operational analyses that support reliable operations will lead to cost savings by avoiding disruptions to service, which have direct impacts on natural gas ratepayers as well as indirect impacts – through natural gas power generation – on electricity ratepayers.
- **Equity Considerations:** The proposed analysis will focus on examination of natural gas decommissioning opportunities in low income and disadvantaged communities. The overarching goal is to inform an equitable and cost-effective gas system transition.

Questions to the Stakeholders

7) Location-Specific Analysis of Decommissioning to Support Long-Term Gas Planning

- How can California's natural gas IOUs be effectively engaged in this study? What synergies with IOU priorities and planning could be leveraged to enhance the study?
- What other natural gas sector stakeholders (e.g., other state agencies, CCAs, community-based organizations, jurisdictions with electrification ordinances) could serve important roles in ensuring the study delivers useful results?
- What collaboration opportunities with related efforts could be most fruitful?

Presenter: Peter Chen

Transportation Research

Transportation Research Program Goals

Program Goals:

- Improve the energy efficiency and performance of gaseous fueled vehicles to reduce emissions and improve competitiveness.
- Increase the use of renewable gas to reduce GHG emissions from the transportation sector.
- Improve fueling infrastructure technology capabilities to promote the further adoption of low-carbon gaseous fueled vehicles.

Research Initiative #8

Advanced Hydrogen Refueling Infrastructure Solutions for Heavy Transport

Background:

- Hydrogen has potential to serve as a zero-carbon energy resource across multiple sectors.
- Hydrogen fuel cell-electric vehicles (FCEVs) are an attractive zero-emission technology for heavy transport due to their high payload carrying capacity, fast refueling times, and long range.
- Hydrogen delivery and refueling costs make up around 80% of the cost of hydrogen at the dispenser.

Research Purpose & Description

8) Advanced Hydrogen Refueling Infrastructure Solutions for Heavy Transport

Purpose

- Develop advanced hydrogen refueling station components and systems for high-capacity stations to support heavy transport applications transitioning to hydrogen fuel cell technology.

Research Description

- Promote infrastructure compatibility and standardization across multiple heavy-duty FCEV types including trucks, buses, and off-road vehicles.
- Increase station efficiency, reliability, capacity, and operational flexibility.
- Reduce station capital and operating costs to accelerate progress towards total cost of ownership parity with diesel.
- Possible research includes, but is not limited to developing and/or demonstrating:
  - High-capacity mobile refueler that can deliver and dispense hydrogen on-demand to heavy-duty FCEVs.
  - Innovative station designs with dedicated hydrogen production matched to fuel demand, integrated hydrogen use with other sectors to drive scale, and/or use of chemical hydrogen carriers to reduce distribution costs.
  - Improved hydrogen infrastructure components and interfacing technologies to reduce dispensing costs, increase fill rates to support larger vehicles, and improve reliability.

Projected Ratepayer Benefits

8) Advanced Hydrogen Refueling Infrastructure Solutions for Heavy Transport

- **Energy Sector.** Increase availability of low-cost hydrogen to help decarbonize difficult-to-abate end-uses including the natural gas system, industrial processes, and heavy transport.
- **Market Connection.** Enabling reliable, low-cost, and high-capacity hydrogen fueling infrastructure will improve the business case for heavy-duty FCEV adoption and station deployment in California.
- **Environmental Benefits.** Reduce air pollutant and greenhouse gas emissions by supporting a transition away from diesel engines to zero-emission hydrogen fuel cell technology.
- **Equity Considerations.** Reducing costs and expanding availability of hydrogen fueling infrastructure will improve air quality and zero-emission transportation accessibility, especially in under-resourced communities that are heavily impacted by these mobile sources.

Questions for the Stakeholders

8) Advanced Hydrogen Refueling Infrastructure Solutions for Heavy Transport

- Given the limited research funds, what specific barriers should be prioritized to reduce the cost of high-capacity hydrogen fueling infrastructure for heavy transport?
- What are some opportunities for this research to inform development of codes and standards to create replicable solutions?
- How can this research supplement private sector and other public investments in hydrogen fueling infrastructure research, demonstration, and deployment?

Feedback

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

Also, research suggestions can be provided to our Natural Gas Docket until ***February 08, 2021*** at: https://efiling.energy.ca.gov/Ecomment/Ecomment.aspx?docketnumber=16-PIER-01

These comments will be considered while developing the *FY 2021-22 Natural Gas Proposed Budget Report.*

Public Comments

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: Proposed Research Initiatives

Energy Efficiency

1) Hydrogen and natural gas blending for industrial end-use applications
2) Industrial Carbon Capture and Utilization

Natural Gas Infrastructure Safety & Integrity

3) Technologies for Monitoring Ground Movement Around Pipelines and Mitigating Natural Force Damages
4) Technology Development and Demonstration for Plastic Pipeline Repair and Integrity Improvement

Renewable Energy and Advanced Generation

5) Developing and Demonstrating Hydrogen-Based Power Generation Systems

Energy-related Environmental Research

6) Quantify Exposures to Indoor Pollutants in Multi-Family Homes that Cook with Natural Gas or Alternatives
7) Location-Specific Analysis of Decommissioning to Support Long-Term Gas Planning

Transportation

8) Advanced Hydrogen Refueling Infrastructure Solutions for Heavy Transport