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STAFF REPORT

Gas Research and Development Program

Proposed Budget Plan for Fiscal Year 2026–2027

Gavin Newsom, Governor

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PREFACE

The California Energy Commission (CEC) Energy Research and Development Division invests in cutting-edge research to support California's energy and greenhouse gas reduction goals through innovations that advance energy efficiency, renewable integration, clean generation, safe distribution and transmission, environmental protection, and climate resiliency. The division manages research funding programs for electric- and gas-related research and development.

In 2000, the California Legislature enacted Assembly Bill 1002 (Wright, Chapter 932, Statutes of 2000), requiring the California Public Utilities Commission (CPUC) to impose a surcharge on gas consumed in California to fund energy efficiency programs and public-interest research and development to benefit gas investor-owned utility ratepayers. In 2004, the CPUC issued Decision 04-08-010, designating the CEC as a research fund administrator. The CEC's Gas Research and Development (Gas R&D) Program invests \$24 million annually in innovation to support the clean energy transition, lower costs, increase reliability, and improve safety.

Through the Gas R&D Program, the CEC awards funding to advance progress toward the state's statutory energy goals, including affordability and equity, while supporting research that will deliver benefits to gas investor-owned utility ratepayers. Public-interest gas research is directed toward developing science or technology that benefits Californians and addresses gaps not met by the competitive market or regulated entities alone. Consistent with CPUC Decision 04-08-010, Gas R&D projects must:

- Focus on energy efficiency, renewable technologies, conservation, and environmental issues.
- Support state energy policy.
- Offer a reasonable probability of providing benefits to the public.
- Consider opportunities for collaboration and cofunding with other entities, such as federal and local agencies.

Consistent with these requirements, the CEC considers the following guiding principles in administering the Gas R&D Program and advancing benefits to gas investor-owned utility ratepayers: affordability, equity, safety, reliability, and environmental sustainability.

The CEC is committed to ensuring meaningful public participation in its research and development programs. For more information about the Energy Research and Development Division, please visit the Energy Research and Development Website (www.energy.ca.gov/research/) or contact the Energy Research and Development Division at ERDD@energy.ca.gov.

ABSTRACT

In 2000, the California Legislature enacted Assembly Bill (AB) 1002 (Wright, Chapter 932, Statutes of 2000), requiring the California Public Utilities Commission (CPUC) to add a surcharge on gas consumption in California. This surcharge funds various energy efficiency programs and public-interest research and development to benefit gas investor-owned utility ratepayers. AB 1002 also required the CPUC to designate an entity to administer the research component of the program. In 2004, the CPUC issued Decision 04-08-010, designating the California Energy Commission (CEC) as a research fund administrator.

This Gas Research and Development Budget Plan describes the CEC's proposed gas research and development initiatives for Fiscal Year 2026–27. The CEC's proposed initiatives align with CPUC-established themes of gas system integrity and decarbonization. The initiatives support state energy policies and goals and CPUC proceedings, with several initiatives directly benefiting disadvantaged and vulnerable communities. The proposed research funding for Fiscal Year 2026–27 is \$24 million. The budget plan covers July 1, 2026, through June 30, 2027. The budget plan was informed by input from representatives of the Disadvantaged Communities Advisory Group, investor-owned utilities' gas research and development program administrators, CPUC interagency coordination, California Native American tribes, and public workshop participants, among others.

Keywords: California Energy Commission, California Public Utilities Commission, gas, climate change, distributed generation, investor-owned utility, renewable generation, thermal energy networks, energy infrastructure, gas decommissioning, energy-related environmental research, building decarbonization, disadvantaged vulnerable communities, decarbonization, gas users, energy transition, industrial decarbonization, research and development, gas system integrity, decarbonization, seasonal energy storage

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TABLE OF CONTENTS

Acknowledgements	i
Preface.....	ii
Abstract	iii
Executive Summary.....	1
CHAPTER 1: Introduction	3
Gas Sector Transition to Meet Decarbonization Goals	3
Gas R&D Program Background.....	3
Fiscal Year 2026–2027 Budget Plan Priorities and Development	4
CHAPTER 2: Developing Gas R&D Initiatives for Fiscal Year 2026–2027	6
CPUC Decision 04-08-10: Support for State Policy	7
CPUC Resolution G-3555	8
CPUC Resolution G-3571	8
CPUC Resolution G-3584	9
CPUC Resolution G-3592	10
CPUC Resolution G-3603	11
Equitable Program Administration	11
Coordination and Strategic Partnerships	14
Cofunding Opportunities.....	17
Roadmaps and Long-Term Strategies.....	18
Foundational Principles for Uniform Impact Analysis.....	19
CHAPTER 3: Proposed Initiatives for Fiscal Year 2026–2027	22
Proposed Budget Overview.....	22
Proposed Research Initiatives	23
Initiative Theme: Gas System Integrity.....	23
Initiative Theme: Decarbonization.....	27
Equity Benefits of Proposed Initiatives.....	53
Next Steps.....	56
List of Terms/Glossary	57
APPENDIX A: Policies and Proceedings Supported by FY 2026–27 Gas R&D Program Theme and Initiative	A-1
APPENDIX B: CPUC Resolution G-3484 Funding Encumbrance — Unspent Funds	B-1
APPENDIX C: Engagement Summary, Feedback, Comments, and CEC Responses	C-1
APPENDIX D: List of Gas R&D Program Events March 2025 – May 2026	D-1
APPENDIX E: FY 2026–2027 Gas R&D Budget Plan Equity Framework Topic Definitions	E-1

APPENDIX F: Estimated Gas R&D Administrative Costs.....F-1

APPENDIX G: Gas Research Development & Demonstration Public Workshop G-1

LIST OF FIGURES

Figure 1: Summary of Key Input Activities for the Gas R&D Program Grant Solicitation and Agreement Management Process.....6

LIST OF TABLES

Table ES-1: Proposed FY 2026–27 Gas R&D Budget Plan.....1

Table 1: Proposed FY 2026–2027 Gas R&D Budget Plan.....22

Table 2: Related and Complementary Gas Research on Gas System Decommissioning25

Table 3: Related and Complementary Gas Research on Methane Emissions Monitoring and Analysis31

Table 4: Related and Complementary Gas Research on Seasonal Energy Storage37

Table 5: Related and Complementary Gas Research on Thermal Energy Networks.....43

Table 6: Related and Complementary Gas Research on Addressing Industrial Emissions.....47

Table 7: Related and Complementary Gas Research on Industrial Decarbonization51

Table 8: FY 2026–2027 Gas R&D Plan Equity Framework Matrix55

Table B-1: FY 2025–26 Gas R&D Updated Budget Plan (Proposed) B-2

Table B-2: FY 2024–25 Gas R&D Updated Budget Plan (Proposed) B-2

Table B-3: FY 2023–24 Gas R&D Program Project Updated Budget Plan..... B-3

Table B-4: FY 2023–24 Gas R&D Program Project Updated Supplemental Budget Plan..... B-4

Table B-5: FY 2022–23 Gas R&D Program Project Updated Budget Plan..... B-4

Table B-6: FY 2021–22 Natural Gas R&D Program Budget Plan..... B-5

Table B-7: FY 2020–21 Natural Gas R&D Program Budget Plan..... B-6

Table B-8: FY 2019–20 Natural Gas R&D Program Budget Plan..... B-7

Table B-9: FY 2019–20 Natural Gas R&D Program Supplemental Budget Plan..... B-8

Table B-10: FY 2018–19 Natural Gas R&D Program Project Budget Plan..... B-8

Table B-11: FY 2017–18 Natural Program Project Budget Plan..... B-9

Table B-12: FY 2016–17 Natural Gas R&D Program Project Budget Plan.....B-10

Table B-13: FY 2016–17 Natural Gas Program Supplemental Budget Plan.....B-12

Table B-14: FY 2015–16 Natural Gas R&D Program Project Budget Plan.....B-12
Table B-15: FY 2015–16 Natural Gas R&D Program Project Supplemental Budget Plan.....B-13
Table B-16: FY 2014–15 Natural Gas R&D Program Project Budget Plan.....B-14

EXECUTIVE SUMMARY

The California Energy Commission’s (CEC) Gas Research and Development (Gas R&D) Program supports an equitable and cost-effective transition of the gas sector in alignment with the state’s clean energy and climate goals. Research and development investments support reductions in fossil gas consumption to deliver public health, environmental, climate, and gas system safety benefits by advancing the production and use of renewable, low-carbon fuels and alternatives and by lowering the cost and improving the performance of associated technologies, infrastructure, and services.

Funding for these initiatives is requested from the FY 2026–2027 annual budget of \$24 million.

Table ES-1: Proposed FY 2026–27 Gas R&D Budget Plan

Category/Initiative Theme	Initiative Title	Proposed Budget
Gas System Integrity	Gas Network Decommissioning Pathways to Scale Infrastructure Retirement	\$3,000,000
Decarbonization	Advancing Cost-Effective Methane Emissions Monitoring for California’s Gas System	\$6,000,000
Decarbonization	Strategic Assessment of Cost-Effective Seasonal Energy Storage Pathways	\$1,600,000
Decarbonization	Optimizing Thermal Energy Networks for Decarbonization	\$2,000,000
Decarbonization	Cleaner Industry, Healthier Communities	\$8,000,000
Decarbonization	Studying Industrial Process Heat Decarbonization Pathways	\$1,000,000
Program Administration	N/A	\$2,400,000
TOTAL	N/A	\$24,000,000

Source: California Energy Commission

The CEC’s Energy Research and Development Division develops the Gas R&D Budget Plan based on:

- State energy policies, plans, and guidance.
- Analysis of research gaps.
- Coordination with the CPUC and other agencies.
- Input from investor-owned utility gas administrators, representatives of environmental and social justice organizations, and tribes.
- Input from other interested parties.

Key state policies, plans, and guidance include Executive Order B-55-18, Assembly Bill (AB) 1279 (Muratsuchi, Chapter 337, Statutes of 2022), Integrated Energy Policy Reports, and

direction from the California Public Utilities Commission (for example, proceedings, decisions, and resolutions), among others.

The proposed Fiscal Year (FY) 2026–2027 Gas R&D Budget Plan includes funding for six research and development initiatives aligned with the themes of gas system integrity and decarbonization (Table ES-1). The initiatives are intended to support California’s gas transition while advancing the state’s climate, air quality, and reliability goals. Collectively, they develop strategies to plan for the long-term evolution of gas infrastructure, including how portions of the gas system may be retired in a coordinated manner. They will also improve methane emissions monitoring and help inform more effective gas leak mitigation strategies while supporting consideration of health and equity impacts. In addition, the initiatives will assess a range of longer-duration and seasonal energy storage pathways – including mechanical, thermal, chemical, and electrochemical – that could support a clean energy future.

These initiatives will also explore community-scale alternatives such as thermal energy networks, which use shared infrastructure to move heating and cooling between buildings. They will also reduce harmful emissions from industrial sources within the next several years, and evaluate longer-term pathways to decarbonize industrial process heat, such as high-temperature heat used in cement and glass manufacturing. Together, these efforts aim to provide planning-level analysis, data, tools, and technical insights to help guide future decision-making and support a more reliable, cost-effective, and publicly beneficial energy transition for California.

The FY 2026–2027 Gas R&D Budget Plan benefited from input from the following groups:

- Representatives of the Disadvantaged Communities Advisory Group
- Environmental and social justice organizations
- California Native American tribes
- Investor-owned utilities
- California Public Utilities Commission

CHAPTER 1:

Introduction

Gas Sector Transition to Meet Decarbonization Goals

As California progresses toward achievement of its clean energy and climate goals, the state's energy infrastructure, role of the gas sector, and mix of fuels are evolving, driven by several key policies.¹ As fossil gas use is likely to remain significant for the near future, the transition of the system will continue to impact many Californians. The California Public Utilities Commission (CPUC) has instituted rulemakings (R.20-01-007, R.24-09-012) to advance decarbonization of the gas system in a way that supports equity, safety, and affordability while addressing reliability challenges, commodity price spikes, and other adverse outcomes.²

Furthermore, the California Air Resources Board (CARB) published a 2022 update to its Scoping Plan for achieving carbon neutrality by 2045.³ The Scoping Plan emphasizes the need for decarbonization in every sector and for the replacement of fossil fuels with renewable energy resources, including renewable and zero-carbon electricity, hydrogen produced from renewable sources, and biomethane. While these replacements hold significant promise for reducing emissions, further technology development will help improve technology performance and lower costs.

Gas R&D Program Background

The Gas Research and Development (Gas R&D) Program supports the gas sector transition and cost-effective achievement of the state's clean energy and climate goals. Research and development (R&D) investments can lower the cost and improve the performance of low- or zero-carbon technologies, infrastructure, and services. They also support reductions in fossil gas consumption; advance the use of renewable, low- and zero-carbon fuels; and deliver public health, environmental, and gas system safety benefits.

Recognizing the benefit of gas research to Californians, Assembly Bill (AB) 1002 (Wright, Chapter 932, Statutes of 2000) directed the CPUC to add a surcharge on gas consumed in California to fund R&D specific to the gas system. The 2004 CPUC Decision 04-08-010 designated the California Energy Commission (CEC) as the administrator for the Gas R&D Program. The CPUC allocates \$24 million annually for the CEC's Gas R&D Program and defines public-interest gas research activities as those "directed towards developing science or

¹ Key policies include but are not limited to the Building Energy Efficiency Standards — Title 24 (Energy Code), Appliance Efficiency Regulations — Title 20, Senate Bill (SB) 350 (De León, Chapter 547, Statutes of 2015), Senate Bill 100 (De León, Chapter 312, Statutes of 2018), and Senate Bill 1221 (Min, Chapter 602, Statutes of 2024), among others.

² California Public Utilities Commission. [Long-Term Gas System Planning Rulemaking](https://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M539/K683/539683149.PDF). <https://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M539/K683/539683149.PDF>.

³ California Air Resources Board. 2022. [2022 Scoping Plan for Achieving Carbon Neutrality](https://ww2.arb.ca.gov/sites/default/files/2023-04/2022-sp.pdf). <https://ww2.arb.ca.gov/sites/default/files/2023-04/2022-sp.pdf>.

technology, and 1) the benefits of which accrue to ratepayers, and 2) are not adequately addressed by competitive or regulated entities.”⁴ The decision also directs that R&D projects:

- Focus on energy efficiency, renewable technologies, conservation, and environmental issues.
- Support state energy policy.
- Offer a reasonable probability of providing benefits to the public.
- Consider opportunities for collaboration and cofunding with other entities, such as federal and local agencies.

In 2006, the California Legislature passed Senate Bill (SB) 1250 (Perata, Chapter 512, Statutes of 2006), which further outlined the goal of the Gas R&D Program to “develop, and help bring to market, energy technologies that provide increased environmental benefits, greater system reliability, and lower system costs, and that provide tangible benefits to electric utility customers.”⁵ In addition to these goals, the CPUC has issued resolutions providing further guidance for implementing the Gas R&D Program.⁶

In 2021, the California Legislature passed Assembly Bill 148 (Ting, Chapter 115, Statutes of 2021). This law authorizes continuous appropriation of funds in the CEC subaccount in the Public Interest Research, Development, and Demonstration Fund to the CEC for its costs of administering the Gas R&D Program. Although Gas R&D Program funds do not expire, the CEC strives to encumber, or reserve, these funds within two years and complete projects within a total of six years, when possible, in alignment with the original law. The CEC is also required to report to the Legislature on the outcomes, effects, and benefits of the program by October 31 of each year.

The Gas R&D Program has invested in R&D to develop and advance technologies, tools, and strategies that increase energy efficiency, lower energy costs, reduce air pollutants and greenhouse gas (GHG) emissions, and improve the safety of gas infrastructure. Recent program achievements are described the [Gas R&D Program 2025 Annual Report](#).⁷

Fiscal Year 2026–2027 Budget Plan Priorities and Development

This *Gas R&D Program Proposed Budget Plan for Fiscal Year (FY) 2026–2027* (2026–27 Gas R&D Budget Plan) continues to place emphasis on R&D areas that align with the state’s priorities for decarbonization. The proposed R&D initiatives support CPUC-identified themes of gas system integrity and decarbonization. The CEC Energy Research and Development Division

⁴ California Public Utilities Commission. 2004. [California Public Utilities Commission Decision 04-08-010](https://docs.cpuc.ca.gov/PublishedDocs/WORD_PDF/FINAL_DECISION/39314.PDF). https://docs.cpuc.ca.gov/PublishedDocs/WORD_PDF/FINAL_DECISION/39314.PDF.

⁵ California [Public Resources Code Sections 25620-25620.15](https://leginfo.ca.gov/faces/codes_displayText.xhtml?lawCode=PRC&division=15.&title=&part=&chapter=7.1.&article=). https://leginfo.ca.gov/faces/codes_displayText.xhtml?lawCode=PRC&division=15.&title=&part=&chapter=7.1.&article=.

⁶ California Public Utilities Commission. “[Energy Research, Development, and Deployment](https://www.cpuc.ca.gov/industries-and-topics/electrical-energy/infrastructure/energy-research-development-and-deployment).” <https://www.cpuc.ca.gov/industries-and-topics/electrical-energy/infrastructure/energy-research-development-and-deployment>.

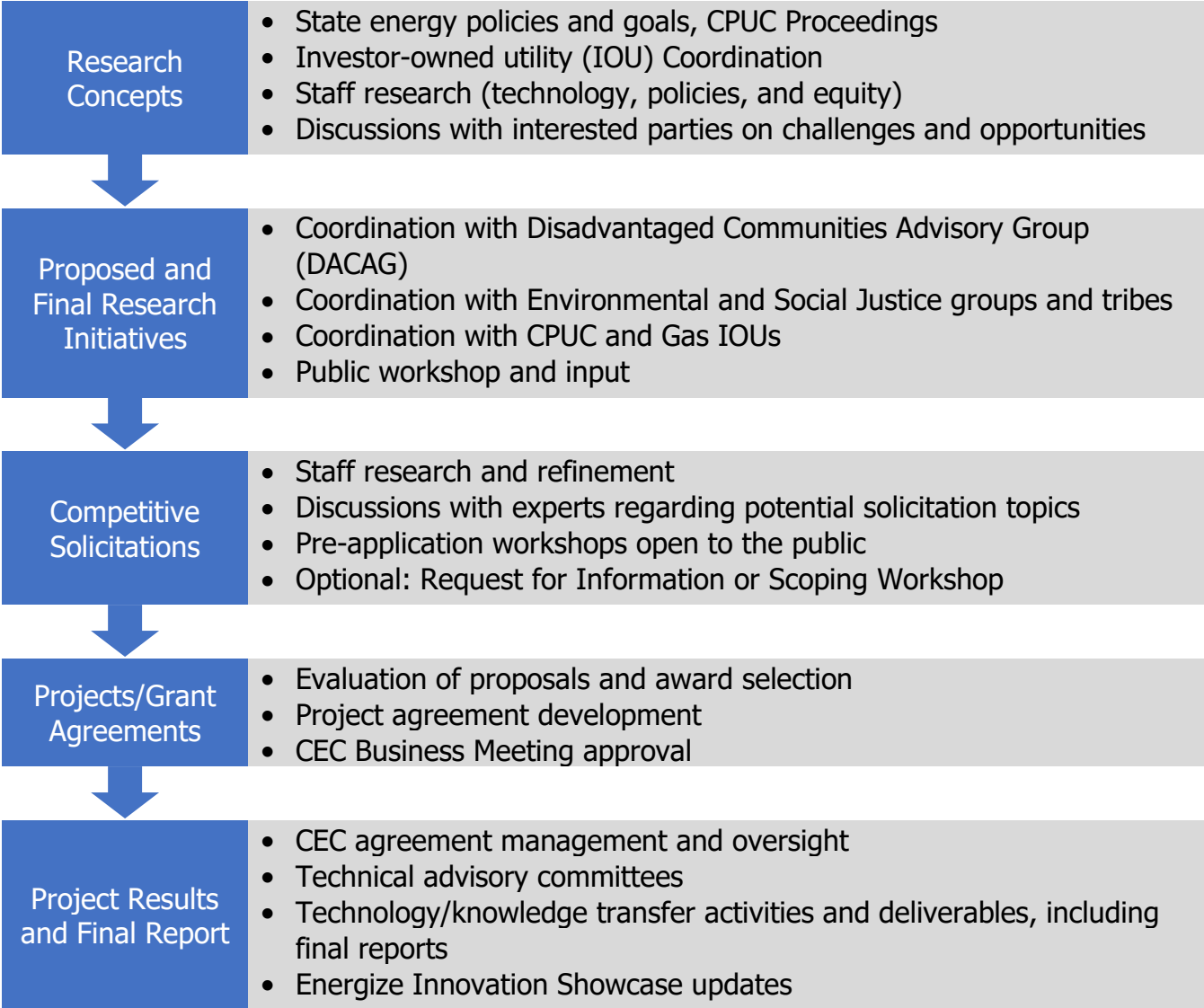
⁷ Chu, Ferris, Angel Moreno, Rebecca Avilés, Molly O’Hagan, and Misa Werner. 2026. [Gas Research and Development Program 2025 Annual Report](https://www.energy.ca.gov/publications/2026/gas-research-and-development-program-2025-annual-report). California Energy Commission. Publication Number: CEC-500-2026-005-CMF, <https://www.energy.ca.gov/publications/2026/gas-research-and-development-program-2025-annual-report>.

(ERDD) staff develops the Gas R&D Budget Plan based on state energy policies, plans, and guidance; analysis of research gaps; coordination with the CPUC and other agencies; and input from interested parties, as discussed in Chapter 2.

CHAPTER 2: Developing Gas R&D Initiatives for Fiscal Year 2026–2027

The research initiatives described in Chapter 3 of this report were informed by state policies, plans, and guidance, including CPUC proceedings and decisions. They were also shaped by public input, the CEC’s commitment to diversity and equity, and research roadmaps and strategies developed by state agencies, as discussed below and in Appendices A–F. Figure 1 provides a summary of the CEC’s process, including how and when interested parties (ranging from members of the public to technical experts) can provide input throughout the life cycle of Gas R&D Program activities.

Figure 1: Summary of Key Input Activities for the Gas R&D Program Grant Solicitation and Agreement Management Process



Source: California Energy Commission

CPUC Decision 04-08-10: Support for State Policy

As called for in CPUC Decision 04-08-010 issued in 2004, the Gas R&D Program supports several state energy policies and goals including:

- Senate Bill 32 (Pavley, Chapter 249, Statutes of 2016), which establishes the state’s goal for a 40 percent GHG emissions reduction below 1990 levels by 2030.
- Assembly Bill 1279 (Muratsuchi, Chapter 337, Statutes of 2022) and Executive Order B-55-18, which establish California’s goal of achieving economywide carbon neutrality by 2045.⁸
- Senate Bill 350 (De León, Chapter 547, Statutes of 2015), which advances California’s clean energy goals including the goal of doubling statewide energy efficiency savings by 2030.⁹
- The CEC’s Integrated Energy Policy Reports (IEPRs) and associated updates, which assess major energy trends facing California’s electricity, gas, and transportation fuel sectors and provide policy recommendations.¹⁰
- CARB’s Climate Change Scoping Plan, which underscores the role of innovative technologies in improving efficiency, increasing the production of renewable gas, and reducing leakage from gas infrastructure in meeting future climate change targets.¹¹
- The CPUC’s Long-Term Gas Planning Rulemakings (R.20-01-007, R.24-09-012), which promote decarbonization of the gas system in a way that supports equity, safety, and affordability and addresses reliability challenges, commodity price spikes, and other adverse outcomes.¹²

The FY 2026–2027 Gas R&D Budget Plan also addresses focus areas identified in CPUC Decision 04-08-010, including conservation, energy efficiency, and environmental issues. The conservation and energy efficiency focus area aligns with the proposed initiative on thermal energy networks for decarbonization. The environmental issues focus area aligns with proposed initiatives related to gas system decommissioning, methane emissions monitoring, industrial emissions reductions, and industrial process heat decarbonization.

Appendix A provides more detail on policies and proceedings relevant to each initiative.

⁸ California Office of the Governor. September 10, 2018. [Executive Order B-55-18 To Achieve Carbon Neutrality](https://www.ca.gov/archive/gov39/wp-content/uploads/2018/09/9.10.18-Executive-Order.pdf). <https://www.ca.gov/archive/gov39/wp-content/uploads/2018/09/9.10.18-Executive-Order.pdf>; Muratsuchi. 2022. [Assembly Bill 1279 The California Climate Crisis Act, 2022](https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=202120220AB1279). https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=202120220AB1279.

⁹ De León. 2015. [Senate Bill 350 Clean Energy and Pollution Reduction Act of 2015](https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201520160SB350). California State Legislature. https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201520160SB350.

¹⁰ California Energy Commission. “[Integrated Energy Policy Report](https://www.energy.ca.gov/data-reports/reports/integrated-energy-policy-report-iepr).” <https://www.energy.ca.gov/data-reports/reports/integrated-energy-policy-report-iepr>.

¹¹ California Air Resources Board. 2006. “[Assembly Bill 32 Climate Change Scoping Plan](https://ww2.arb.ca.gov/our-work/programs/ab-32-climate-change-scoping-plan).” <https://ww2.arb.ca.gov/our-work/programs/ab-32-climate-change-scoping-plan>.

¹² California Public Utilities Commission. [Long-Term Gas System Planning Rulemaking](https://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M539/K683/539683149.PDF). <https://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M539/K683/539683149.PDF>

CPUC Resolution G-3555

CPUC Resolution G-3555, issued in 2019, directs the CEC to enhance outreach and engagement with representatives of disadvantaged communities and to document this engagement in each budget plan moving forward. Consistent with this direction, the section below titled “Equitable Program Administration” describes CEC’s engagement with DACAG, California Native American tribes, representatives of environmental and social justice (ESJ) communities, and other interested parties. In addition, Appendix C summarizes the specific feedback received through the engagement process and the ways that feedback was considered in developing the initiatives.

Resolution G-3555 also directs the CEC, when requesting to use encumbered and unspent funds for new projects, to identify the research areas for which the CPUC originally authorized the funding. Consistent with this requirement, any CEC request to use such funds for new projects will identify the applicable originally authorized research area.

CPUC Resolution G-3571

CPUC Resolution G-3571, issued in 2020, requires that if the CEC is unable to obtain data it deems necessary to complete any of the projects proposed in the FY 2021–2022 Gas R&D Budget Plan, it must first consult with CPUC Energy Division (ED) staff overseeing this program before reallocating any funding. Neither the CEC nor its project recipients have yet required data to complete the projects in the FY 2021–2022 Gas R&D Budget Plan or projects proposed in a subsequent Gas R&D Budget Plan. However, the CPUC and CEC have an information-sharing agreement to support the Gas R&D Program and ensure that the confidentiality of exchanged information will be maintained. Should the CEC be unable to obtain needed data in the future, CEC staff will plan to consult with CPUC ED staff before reallocating any funding.

The resolution also calls for the CEC to consider “any research gaps that might emerge because of recent budget decreases or reallocations in response to coronavirus disease (COVID)-related economic impacts and potential co-funding opportunities that the Gas R&D program can provide to limit the impact of these gaps on California energy goals.” However, at this time, the CEC is not aware of any such budget decreases or reallocations that may result in research gaps.

For all Gas R&D Budget Plans, the CPUC ED asked CEC staff to coordinate with CPUC staff at least three weeks in advance of the CEC’s public workshop on the proposed budget plan. This helps ensure a coordinated use of funds across gas research programs. For this budget plan, the CEC staff initially presented CPUC staff with summaries of the proposed research initiatives at the EPIC Policy + Innovation Coordination Group (PICG) Research, Development, and Demonstration (RD&D) Meeting on December 5, 2025. CEC staff has shared further information with CPUC staff in subsequent meetings, as summarized in the “Additional Feedback and Coordination Discussions” section of Appendix C.

The CPUC also required that, for all Gas R&D budget plans, the CEC post the budget plans publicly on the CEC’s website before submitting an approval request to the CPUC and notify the CPUC of the web address when requesting approval. The CEC follows this practice by

posting Gas R&D budget plans on its web page for ERDD investment plans and annual reports.¹³

The CPUC directed the CEC to distribute all Gas R&D budget plans through the CEC's subscription lists and include the names of the lists served when requesting CPUC's approval of the plan. The CEC will follow this direction when it distributes this year's plan to the following lists:

- "Energy Research and Development"
- "PIER Pgm. Residential and Commercial Bldgs. Program Area"
- "Developing Regulations, Guidelines, and Policies for Implementing SB 350 and AB 802"
- "Renewable Energy Executive Order"
- "General Natural Gas and LNG Issues"
- "Disadvantaged Communities Advisory Group"

The resolution also calls for the CEC to consult with ED staff on which CPUC proceeding service lists should receive notice of the proposed plan.¹⁴ Moreover, the resolution asks that, for all Gas R&D budget plans, the CEC consult with the CPUC regarding the option to present the budget plan to the CPUC commissioners during a CPUC commissioner committee meeting. This request was revised via CPUC Resolution G-3592, and the CEC has responded accordingly.

CPUC Resolution G-3584

As directed by CPUC Resolution G-3584, issued in 2021, the CEC considered the AB 3232 (Friedman, Chapter 373, Statutes of 2018) report and the seven key strategies to decarbonize residential and commercial buildings outlined in the 2021 report, *California Building Decarbonization Assessment (Assessment)*¹⁵ while developing the FY 2022–23 Gas R&D Budget Plan. Several initiatives in this FY 2026–27 Gas R&D Budget Plan also support the recommended strategies.

For example, the proposed initiative "Gas Network Decommissioning Pathways to Scale Infrastructure Retirement" advances the strategies of the assessment related to electrification, decarbonizing the gas system, and equitable, well-planned implementation. The initiative aligns by evaluating how gas infrastructure retirement can be coordinated and scaled as reliance on fossil gas declines in the building sector. Building on prior gas transition work, this initiative aims to identify the technical, economic, regulatory, and community considerations

¹³ California Energy Commission. "[Energy Research and Development Investment Plans and Annual Reports](https://www.energy.ca.gov/data-reports/reports/energy-research-and-development-investment-plans-and-annual-reports)." <https://www.energy.ca.gov/data-reports/reports/energy-research-and-development-investment-plans-and-annual-reports>.

¹⁴ California Public Utilities Commission. Listservs include A1704028, A1806015, A1902015, A1907006, A1910012, A1908015, A2106021, A1710008, A1807024, I1911013, R1602007, R1803011, R1804019, R1807006, R1810007, R1812005, R1812006, R1901011, R1211005, R1910005, R1302008, R2001007, R1407002, R2005012, R1503010, R.1901011, R2008020, R1505006, R2011003.

¹⁵ Kenney, Michael, Nicholas Janusch, Ingrid Neumann, and Mike Jaske. California Energy Commission. 2021. [California Building Decarbonization Assessment](https://www.energy.ca.gov/publications/2021/california-building-decarbonization-assessment). Publication Number: CEC-400-2021-006-CMF. <https://www.energy.ca.gov/publications/2021/california-building-decarbonization-assessment>.

needed to support broader, coordinated infrastructure retirement in a manner that advances affordability, safety, reliability, and emissions reduction goals. Moreover, the proposed initiative “Optimizing Thermal Energy Networks for Decarbonization” supports the strategies of the assessment related to electrification, distributed energy resources, energy efficiency, and decarbonizing the gas system. The initiative evaluates neighborhood-scale thermal solutions that can provide clean and efficient heating, cooling, and hot water while reducing reliance on fossil gas.

CPUC Resolution G-3584 directs the CEC to consider the Long-Term Research Roadmap, *Recommendations for the Long-Term Gas Research Strategy to Achieve Aggressive Statewide Carbon Neutrality Goals* (Long-Term Research Roadmap) in future Gas R&D planning.¹⁶ That roadmap was submitted to the CEC on November 30, 2022, and presented at a public workshop on December 12, 2022. It includes 11 recommended research areas spanning communities, equity, and environment; gas end use; and the gas supply chain. The roadmap has helped guide subsequent Gas R&D Program planning by identifying longer-term research needs related to gas system transition planning, gas leakage detection and risk mitigation, community impacts, and gas-electric system interdependencies. These themes have provided useful context for developing and assessing proposed FY 2026–2027 Gas R&D initiatives, along with more recent policy direction and program priorities.

Resolution G-3584 also requires the CEC to review the unspent funds in the Public Interest Energy Research, Development, and Demonstration Fund CEC subaccount to identify research funds from FY 2014–2015 through the current Gas R&D Budget Plans that were encumbered within two years of budget approval (Appendix B includes a summary of encumbered and unspent funds through June 30, 2025).

CPUC Resolution G-3592

The CPUC Resolution G-3592, issued in 2023, added seven new administrative requirements for the FY 2023–2024 Gas R&D Budget Plan and beyond. The CEC addresses these requirements, which are summarized below, in the chapters and appendices of this budget plan noted in parentheses:

1. Engage with and include input from disadvantaged community parties, including the DACAG, to provide input on how to administer the program equitably (Chapters 2 and 3).
2. Offer a presentation of the budget plans to the CPUC commissioners (an offer to present the proposed budget plan was sent May 8, 2026).
3. Describe collaborative and cofunding opportunities considered (Chapters 2 and 3).
4. Summarize IOU coordination on the Gas R&D Budget Plan, and provide details on partnerships, costs, and cofunding for projects funded by the Gas R&D Program (Chapters 2 and 3).
5. Provide a detailed cost breakdown of Gas R&D Program administration (Appendix F).

¹⁶ California Energy Commission. 2022. “[Webinar on Long-Term Gas Research Strategy Recommendations](https://www.energy.ca.gov/event/webinar/2022-12/webinar-long-term-gas-research-strategy-recommendations).” <https://www.energy.ca.gov/event/webinar/2022-12/webinar-long-term-gas-research-strategy-recommendations>.

6. Summarize how the Long-Term Research Roadmap was considered in developing the budget plan (Chapters 2 and 3).
7. Identify unspent funds that had been proposed in previous budget plans and use them before using new or additional ratepayer funds (Appendix B).

CPUC Resolution G-3592, moreover, requires the CEC to apply the Electric Program Investment Charge (EPIC) impact analysis framework, once established, to Gas R&D projects and initiatives. While the framework has not yet been developed or adopted, the guiding principles of the framework have been approved, and the application in this budget plan is described in a subsequent section of this chapter, “Foundation Principles for Uniform Impact Analysis.”

CPUC Resolution G-3603

CPUC Resolution G-3603, issued May 9, 2024, directs the CEC to be proactive and specific in articulating its coordination and collaboration with the IOUs and other Gas R&D parties, in advance of developing its plan. Likewise, to ensure that research plans are coordinated, consistent, and aligned with CPUC policies and proceedings, the CEC was ordered to coordinate with the CPUC ED and other CPUC staff. A subsequent section of this chapter, “Coordination and Strategic Partnerships,” articulates the CEC’s coordination with these and other interested parties.

The resolution also states that, once the EPIC Uniform Impact Analysis Framework is approved by the CPUC, the CEC shall use this framework to demonstrate the outcomes of achieving its proposed benefits. Additional discussion of how the CEC applies the guiding principles of the framework is described in a subsequent section of this chapter, “Foundational Principles for Uniform Impact Analysis.”

Equitable Program Administration

The CEC’s commitment to diversity and equity shapes the Gas R&D Program. California is a diverse state in both its people and geography. The CEC strives to expand opportunities for all Californians through its programs and advance equity through outreach, funding opportunities, and planning. In 2015, the CEC unanimously approved a formal Diversity Policy Resolution, consistent with state and federal law. The resolution seeks to improve fair and equal opportunities for small businesses; women-, disabled veteran-, minority-, and lesbian, gay, bisexual, transgender, and queer-owned businesses; and economically disadvantaged and underserved communities to participate in and benefit from CEC programs.¹⁷

This budget plan uses the term “Environmental and Social Justice (ESJ) communities,” defined by the CPUC’s *ESJ Action Plan 2.0* as predominantly communities of color or low-income communities that are:

- Underrepresented in the policy-setting or decision-making process.
- Subject to a disproportionate impact from one or more environmental hazards.

¹⁷ California Energy Commission. 2015. [Resolution 15-0408-3: Resolution Regarding Diversity Policy Statement](https://www.energy.ca.gov/sites/default/files/2020-07/diversity_policy_resolution_ada.pdf). https://www.energy.ca.gov/sites/default/files/2020-07/diversity_policy_resolution_ada.pdf.

- Likely to experience disparate implementation of environmental regulations and socioeconomic investments in their communities.

This definition is inclusive of:

- Disadvantaged communities, defined as census tracts that score in the top 25 percent of CalEnviroScreen,¹⁸ as well as those that score within the highest 5 percent of CalEnviroScreen Pollution Burden but do not receive an overall CalEnviroScreen score.
- All tribal lands.
- Low-income households (household incomes below 80 percent of the area median income).
- Low-income census tracts (census tracts where aggregated household incomes are less than 80 percent of area or state median income).¹⁹

Assembly Bill 865 (Alejo, Chapter 583, Statutes of 2015) provided additional direction, requiring the CEC to develop and implement a comprehensive outreach plan to broaden and diversify the applicant pool to CEC programs and track progress toward those objectives. The *2022 IEPR Update* included the adoption of the Justice Access Equity Diversity Inclusion (JAEDI) Framework, which reasserts the CEC's commitment to equity by outlining its vision, values, and best practices to advance equity in its programs.²⁰ In 2024, the CEC adopted the JAEDI Informational Proceeding with the goal of developing a comprehensive JAEDI Action Plan.²¹ In the ERDD, there are designated equity leads who work with the CEC's Office of the Public Advisor, Energy Equity, and Tribal Affairs (PAO+) to align the Gas R&D Program and other grant funding efforts with the JAEDI Framework.

To help advance equity and diversity in its programs, the CEC regularly seeks opportunities to improve its application and grant management processes to enhance accessibility and reduce administrative burdens for potential applicants. These improvements may be particularly beneficial for applicants from smaller organizations or who lack prior experience in preparing CEC grant applications, may not have substantial resources, or face greater challenges managing the costs and uncertainty of participating in funding opportunities. In collaboration with the CEC's grants ombudsman and PAO+, ERDD staff consistently obtains feedback from applicants and works to improve the grant application process.

¹⁸ California Office of Environmental Health Hazard Assessment. October 2021. "[California Communities Environmental Health Screening Tool: CalEnviroScreen 4.0](https://oehha.ca.gov/calenviroscreen/report/cal-enviroscreen-40)." <https://oehha.ca.gov/calenviroscreen/report/cal-enviroscreen-40>.

¹⁹ California Public Utilities Commission. April 7, 2022. [Environmental & Social Justice Plan, Verizon 2.0](https://www.cpuc.ca.gov/ESJactionplan/). <https://www.cpuc.ca.gov/ESJactionplan/>.

²⁰ Bailey, Stephanie, Jane Berner, David Erne, Noemí Gallardo, Quentin Gee, Akruiti Gupta, Heidi Javanbakht, Hilary Poore, John Reid, and Kristen Widdifield. 2023. "[Final 2022 Integrated Energy Policy Report Update](https://www.energy.ca.gov/publications/2022/2022-integrated-energy-policy-report-update)." California Energy Commission. Publication Number: CEC-100-2022-001-CMD, <https://www.energy.ca.gov/publications/2022/2022-integrated-energy-policy-report-update>.

²¹ California Energy Commission. "[JAEDI Proceeding Workshop](https://www.energy.ca.gov/event/workshop/2024-09/jaedi-proceeding-workshop)." <https://www.energy.ca.gov/event/workshop/2024-09/jaedi-proceeding-workshop>.

Examples of ongoing efforts to support diversity and equity include:

- Leveraging scoring criteria in solicitations to provide preference points for projects that demonstrate benefits to tribes and to disadvantaged and low-income communities. The criterion may consider factors such as economic impacts and the ability to improve access to clean energy within the community. Applications with letters of support demonstrating benefits to these communities and tribes are also considered.
- Continuing to advance efforts to address energy-related challenges and opportunities in ESJ communities by encouraging residents and interested members to participate and share perspectives in community meetings on CEC-funded projects.
- Continuing to track, monitor, and provide findings in the Gas R&D Annual Report on the participation of California-based entities; women-, minority-, and disabled-veteran-owned businesses; and small businesses as recipients of awards. Since FY 2016–2017, the Gas R&D Program has invested an estimated 46 percent of research funds in noncombustion demonstration projects in a disadvantaged community, low-income community, or both, with the aim of bringing benefits to those communities. Recent program investments in disadvantaged and low-income communities are included in the *Gas Research and Development Program 2025 Annual Report*.²²

More information about these and other CEC activities that support equity and diversity is available on the [CEC's website](https://www.energy.ca.gov/about/campaigns/equity-and-diversity) (<https://www.energy.ca.gov/about/campaigns/equity-and-diversity>).

Senate Bill 350 is a driving policy for advancing equity in California's clean energy transformation. As outlined in SB 350, the CEC coestablished the DACAG with the CPUC in 2018. The DACAG advises the CEC and the CPUC on ways to help ESJ communities and tribes benefit from proposed clean energy and pollution reduction programs, expand access to clean energy technologies, and receive affordable energy services.²³ The CEC DACAG and assistant tribal liaisons coordinate with the CEC's PAO+ and with DACAG members to advance energy equity and ensure that program implementation helps meet community and tribal needs.

In addition, the CEC DACAG liaisons support technical staff by helping inform research areas and identify outreach opportunities with the DACAG. These activities include providing staff updates and presentations on upcoming budget plans, programs, workshops, outreach events, and project final reports related to the group's priority areas in the DACAG monthly newsletter, public meetings, and smaller meetings with DACAG priority area subject-matter experts (SMEs).

²² Chu, Ferris, Angel Moreno, Rebecca Avilés, Molly O'Hagan, and Misa Werner. 2026. [Gas Research and Development Program 2025 Annual Report](https://www.energy.ca.gov/publications/2026/gas-research-and-development-program-2025-annual-report). California Energy Commission. Publication Number: CEC-500-2026-005-CMF, <https://www.energy.ca.gov/publications/2026/gas-research-and-development-program-2025-annual-report>.

²³ Scavo, Jordan, Suzanne Korosec, Esteban Guerrero, Bill Pennington, and Pamela Doughman. 2016. [Low-Income Barriers Study, Part A: Overcoming Barriers to Energy Efficiency and Renewables for Low-Income Customers and Small Business Contracting Opportunities in Disadvantaged Communities](https://www.energy.ca.gov/publications/2016/low-income-barriers-study-part-a-overcoming-barriers-to-energy-efficiency-and-renewables-for-low-income-customers-and-small-business-contracting-opportunities-in-disadvantaged-communities). California Energy Commission. Publication Number: CEC-300-2016-009-CMF, <https://efiling.energy.ca.gov/getdocument.aspx?tn=214830>.

CEC staff activities related to the CEC’s commitment to diversity and equity, specifically for the *FY 2026–2027 Gas R&D Program Proposed Budget Plan*, include:

- Briefing a DACAG SME on the initial list of proposed initiatives on October 9, 2025. The initiatives were subsequently revised, based on that feedback, presented to the full DACAG on March 20, 2026, and finalized with consideration of the input received.
- Presenting and soliciting feedback on the Gas R&D Program and the proposed initiatives at a Tribal Roundtable held February 10, 2026, with representatives from several California Native American tribes.
- Conducting a public Gas RD&D Workshop on February 27, 2026, that included two ESJ-focused panel discussions and solicited public feedback on how the proposed initiatives could better center equity.
- Routinely consulting with the CEC’s PAO+ and DACAG members to identify relevant ESJ community and tribal representatives and effective engagement approaches, and to seek input on ways to administer the program equitably throughout plan development and implementation.

A summary of comments received and CEC responses can be found in Appendix C.

Coordination and Strategic Partnerships

CEC staff engages with a variety of interested parties to develop a research portfolio that is responsive to the challenges and needs associated with transitioning the gas sector to a clean energy future. CEC staff engages in discussions with a wide range of experts to understand current and future challenges, emerging needs, and technological advancements within California’s gas system.

In parallel, effective coordination among the CEC, California’s gas IOUs, and the CPUC is essential to ensuring that California’s ratepayer-funded Gas R&D Program delivers public-interest benefits aligned with state energy policies, infrastructure planning, and goals for reliability and environmental sustainability. Early and ongoing scoping and coordination help establish clear research priorities and cultivate well-informed initiatives. An overview of engagement activities is provided below, and more detailed information on verbal and written feedback, along with CEC responses, is provided in Appendix C.

Once proposed research initiatives are approved by the CPUC, CEC staff will conduct in-depth research to refine the initiatives and develop proposed solicitation requirements. Throughout this process, CEC staff may consult with various experts and other interested parties, including those listed below, to explore research needs and shape future solicitations. However, once solicitations enter the development phase, the CEC does not collaborate with outside parties in drafting grant solicitations to ensure compliance with Public Resources Code Section 25620.5(a), which requires grant solicitations to be competitively selected and awarded.²⁴ These measures ensure fairness, transparency, and integrity throughout the solicitation process.

²⁴ Per Public Utilities Code Section 895(a), the CEC administers the Gas R&D Program under Public Resources Code Sections 25620–25620.15 and evaluates and selects projects based on merit through a competitive process.

The following collaborative efforts reflect the CEC’s coordination and strategic partnerships that support and guide Gas R&D planning:

- **IOU coordination:** CEC staff has continued to increase coordination with IOU gas administrators to help ensure that research planning and investments are coordinated, clearly differentiated, and not duplicative. These efforts include:
 - Biweekly meetings with Pacific Gas and Electric Company (PG&E), Southern California Gas Company (SoCalGas), and Southwest Gas to coordinate on topics relevant to the Gas R&D Program, including gas system needs, strategic planning, and applicable state energy goals, policies, and proceedings.
 - Presentation of the initial FY 2026–2027 Gas R&D initiative concepts to the IOU gas administrators on August 20, 2025, to gather early input that helped guide initiative development.
 - An SME-focused discussion with representatives from PG&E and SoCalGas on February 18, 2026, to coordinate on gas-related research and activities across each administrator’s respective portfolio and gather feedback on the proposed research initiatives.
 - Topically focused discussions with PG&E and SoCalGas on common areas of interest, including gas system decommissioning,²⁵ hard-to-decarbonize sectors (such as cement and glass manufacturing), and methane emissions and monitoring to further identify opportunities for coordination, complementarity, and information sharing.
 - Annual public workshops that foster coordination among gas administrators on gas innovation activities that benefit ratepayers and ESJ communities and tribes (consistent with CPUC Resolution G-3603 Ordering Paragraph 4). This coordination included jointly conducting the first public workshop with IOU gas administrators February 27, 2026, to present proposed research priorities and initiatives, solicit feedback, and highlight the complementary nature of the administrators’ proposed research efforts.
 - A joint DACAG meeting presentation with IOU gas administrators and the CPUC on March 20, 2026, to support coordinated engagement.
 - Project-level coordination with IOU gas administrators, which can include their participation on CEC project technical advisory committees, as members of project teams, and in demonstration activities, including as site hosts. These efforts support information sharing, strengthen coordination across research portfolios, and to help ensure projects are informed by utility system needs and operational considerations.

²⁵ Gas system decommissioning refers to retiring or discontinuing portions of the gas distribution system when infrastructure reaches the end of its useful life, is no longer needed due to electrification or other service options, or is deemed unsafe. In a defined decommissioned area non-gas energy solutions such as electrification can be used to maintain safe and reliable energy service to customers.

- **CPUC coordination:** CEC staff engages regularly with CPUC ED staff to ensure research efforts are well-aligned with CPUC proceedings and state policy needs and are designed to provide the greatest overall benefit to gas ratepayers. These efforts include:
 - Participating in monthly Gas R&D Working Group calls with CPUC ED staff. The working group is a venue for CEC and CPUC staff coordination on Gas R&D Program research projects, priorities, and connections with CPUC proceedings. Examples of relevant activities during these calls include:
 - Discussions to refine research initiative topics and focus, including advancing decommissioning, geothermal and thermal energy networks, and emissions research, germane to fostering a gas transition that aligns with affordability, ratepayer concerns, safety, and public health.
 - Coordination on data requests to IOUs and associated findings in support of long-term gas planning.
 - An exchange of preliminary results from ongoing and recently completed research related to gas system decarbonization to share knowledge and elicit feedback from the CPUC.
 - Conducting a presubmittal consultation with CPUC SMEs through participation in the EPIC 5 PICG RD&D Meeting on December 5, 2025. At this meeting, staff from the CEC and the IOU gas administrators presented an overview of their draft initiatives. CPUC staff and SMEs provided in-person and written comments that informed subsequent changes and refinements to the initiatives.
- **Other governmental agency coordination:** CEC staff participates in regular internal meetings with state and federal agency partners on topics related to gas sector challenges. Topics discussed include:
 - Gas system transition and long-term planning through the Joint Agency Working Group led by the CEC, CPUC, and CARB.
 - Methane emissions monitoring and mitigation through coordination discussions with CARB.
 - Application-driven climate science through efforts led by the National Oceanic and Atmospheric Administration.
 - Forest biomass through efforts led by the California Department of Forestry and Fire Protection.
 - Hydrogen research, including end-use and infrastructure issues, through efforts led by the California Governor’s Office of Business and Economic Development.
 - Geothermal and Thermal Energy Networks through the Geothermal Network Regulator Forum led by HEET.²⁶

²⁶ [HEET](https://www.heet.org/) is a nonprofit climate solutions organization that advances thermal energy transition strategies. <https://www.heet.org/>.

- **Working group meetings:** To provide a forum for key parties to engage in portfolio-level coordination and relationship building, CEC staff launched two working groups in 2022. These groups continue to meet periodically to help guide planning, execution, and knowledge transfer related to applied research:
 - The Climate Data and Analysis Working Group brings together industry, research, and state agency staff to participate in technical discussions to advance the integration of climate change into planning, research, and operations.
 - The Healthy, Equitable Energy Transition Working Group hosts discussions on analytical approaches, modeling tools, metrics, and demonstration efforts to advance clean energy policy and deployment strategies.
- **Public engagement:** The CEC holds an annual public workshop to solicit feedback on each year’s draft budget plan. For the proposed FY 2026–2027 Gas R&D Budget Plan, the workshop was held jointly on February 27, 2026, with the IOU gas research program administrators, PG&E and SoCalGas. Proposed initiatives across the CEC and the IOU administrators were presented to solicit public input. The workshop also included an ESJ panel that provided direct feedback on the proposed initiatives from an ESJ perspective. The CEC considered and responded to public comments received to develop and refine the budget plan. (See Appendices C and D for a summary of public comments and CEC responses and for the workshop presentation, respectively.)

The CEC engages a diverse set of parties in Gas R&D implementation. This engagement promotes program accountability, transparency, collaboration, and responsiveness. The CEC relies on strategic partnerships and broader public engagement to avoid duplication, build on previous R&D work, generate new ideas, maximize public and private investments, and drive a research portfolio that delivers tangible benefits to the state’s gas ratepayers. For example, the CEC uses input gathered through scoping workshops, project-specific engagement with local community partners, technical experts, and other interested parties to help inform research design, identify implementation considerations, and strengthen community and ratepayer benefits.

Other efforts include:

- Broadening the use of social media platforms to educate and inform.
- Collaborating with the CEC’s PAO+ to promote grant-funding opportunities.
- Meeting with community leaders, business leaders, and other interested members of the public.
- Distributing R&D informational materials at conferences, meetings, workshops, and public events. (A list of public events is provided in Appendix D.)

Cofunding Opportunities

The CEC leverages cofunding opportunities by requiring applicants under competitive solicitations to secure match funding, usually 10 to 20 percent. The CEC may also provide additional scoring preference for applications that exceed the minimum match funding requirement. Leveraging match funding helps maximize the impact of the Gas R&D Program

by increasing the value of ratepayer investments and enabling support for a broader range of research and demonstration activities. To support equitable access to funding opportunities, the CEC may also reduce or waive match funding requirements for ESJ organizations and tribes for whom match funding requirements may create a barrier to participation.

From program inception in 2004 through June 30, 2025, the cumulative match total was \$163.6 million.²⁷ Cumulative match investments and project successes of the program are summarized in the Gas R&D Program annual reports.

Roadmaps and Long-Term Strategies

Roadmaps and long-term strategies are types of planning mechanisms and prioritization tools that help establish a clear link between research and energy policy goals. Research roadmaps define the topic area, significant issues and barriers, data gaps, information needs, research priorities, and potential partnerships. Long-term strategies guide energy system planning by outlining pathways from the current system to future goals. CEC staff and a wide range of energy researchers and consumers participate in developing roadmaps and strategies to gather cutting-edge information that can help determine how to maximize the value of Gas R&D Program investments.²⁸

Public feedback during development of these roadmaps and strategies helps identify research needs that pertain to the Gas R&D Program. Collaborative thinking about energy solutions that cut across policy boundaries is integral to leveraging research dollars. Bringing gas and electricity parties together can support more coordinated planning, encourage creativity, and promote knowledge exchange.

For this budget plan, the gas decommissioning research initiative proposed drew from long-term strategies, such as the IEPR and the Gas Decarbonization Order Instituting Informational Proceeding (Gas Decarb OIIP).²⁹ Both IEPRs and the Gas Decarb OIIP highlight the need for long-term gas system planning, pointing to many uncertainties and evolving energy sector needs related to building decarbonization and gas decommissioning targets. Planning needs include:

- Coordinating gas system decommissioning with building decarbonization and changing weather patterns.
- Understanding and accounting for gas-electric system interdependencies.
- Ensuring safe, reliable, and affordable energy for Californians.
- Maintaining an adequate gas industry workforce.

²⁷ Chu, Ferris, Angel Moreno, Rebecca Avilés, Molly O'Hagan, and Misa Werner. 2026. [*Gas Research and Development Program 2025 Annual Report*](#).

²⁸ Various roadmaps can be found at the [Energy Commission's publications database](https://www.energy.ca.gov/energy-rd-reports-n-publications). <https://www.energy.ca.gov/energy-rd-reports-n-publications>.

²⁹ Jones, Melissa, Jennifer Campagna, Catherine Elder, and Stephanie Bailey. 2022. [*Final 2021 Integrated Energy Policy Report, Volume III: Decarbonizing the State's Gas System*](#). California Energy Commission. Publication Number: CEC-100-2021-001-V3, especially pp. 88–90, <https://www.energy.ca.gov/publications/2021/2021-integrated-energy-policy-report>.

- Exploring lower-carbon gas options.
- Reducing risks to communities, including disadvantaged and lower-income communities.

In 2024, CPUC, CEC, and CARB developed the *2024 Joint Agency Staff Paper: Progress Towards a Gas Transition* in support of the CPUC’s Long-Term Gas Planning Rulemaking (R.20-01-007).³⁰ This report establishes an interagency framework for reducing fossil gas demand and planning for the future of the pipeline system. The report acknowledges the need for thoughtful planning for the transition away from gas to achieve California’s climate goals while reducing rate and bill impacts, ensuring safe and reliable operation of the gas system, supporting public health, prioritizing disadvantaged communities, and advancing opportunities for the affected gas workforce. These priorities are reflected in this year’s initiatives by supporting research on coordinated gas infrastructure retirement, evaluating community-scale decarbonization approaches such as thermal energy networks, and assessing pathways to reduce emissions from hard-to-electrify industrial end uses.

The emphasis of the joint agency staff paper on public health, community impacts, and transition planning is also supported by proposed work to strengthen methane emissions monitoring and guide mitigation strategies, as well as efforts to reduce harmful industrial emissions in impacted communities.

Beginning in 2021, the CEC managed a contract that analyzed a long-term gas research strategy aligned with California’s aggressive carbon neutrality goals. The contactors used a combination of literature review, technology assessments, prioritization methods, and public input to produce recommendations for the Gas R&D Program. Interested party input included technical advisory committee meetings, several public workshops, and expert interviews.³¹ The analysis suggests opportunities for gas-related R&D investment across the gas supply chain and end-use sectors, except utility-scale power generation, spanning opportunities in hydrogen; renewable gas; gas decommissioning; gas safety; carbon capture, utilization, and storage (CCUS); health; and equity. The CEC considered this analysis in developing the FY 2026–2027 Budget Plan.

Foundational Principles for Uniform Impact Analysis

The Gas R&D Program, similarly to EPIC, is designed to provide benefits to ratepayers. A uniform impact analysis framework is under development in the CPUC’s EPIC Proceeding (R.19-10-005) to demonstrate the realized and potential impacts to electric ratepayers from R&D investments. CPUC Resolution G-3603 requires that, once this framework is established, the CEC shall demonstrate outcomes of achieving its proposed benefits for all research projects funded by EPIC and the Gas R&D Program.

³⁰ California Public Utilities Commission. February 22, 2024. [2024 Joint Agency Staff Paper: Progress Towards a Gas Transition: A White Paper Supporting the CPUC’s Long-Term Gas Planning Rulemaking R.20-01-007](https://docs.cpuc.ca.gov/PublishedDocs/Efile/G000/M525/K660/525660391.PDF). <https://docs.cpuc.ca.gov/PublishedDocs/Efile/G000/M525/K660/525660391.PDF>.

³¹ California Energy Commission. December 12, 2022. [“Workshop on Long-Term Gas Research Strategy Recommendations.”](https://www.energy.ca.gov/event/webinar/2022-12/webinar-long-term-gas-research-strategy-recommendations) <https://www.energy.ca.gov/event/webinar/2022-12/webinar-long-term-gas-research-strategy-recommendations>.

Decision 23-04-042, issued by CPUC on April 28, 2023, included the adoption of the following four foundational principles for development of a uniform impact analysis framework:

1. Each project should offer a reasonable probability of providing benefits to ratepayers, and the portfolio should demonstrably benefit ratepayers.
2. If a targeted group of ratepayers benefits from the output of a project, investments should result in scalable and replicable innovations.
3. Accurate and precise project and program impacts reporting is needed to ensure impacts are defensible and not overstated.
4. Lastly, clear and transparent methods of impact evaluation are required so other parties can verify results.

The decision emphasizes that benefits should be attributable to public investment and would not have otherwise occurred. The decision also directs the development of methods, metrics, and assumptions in the framework. The CEC is committed to integrating these principles, as well as the framework once adopted, into its Gas R&D planning and reporting.

The CEC's processes align with these principles in several ways, and the CEC's impact assessment efforts occur throughout the Gas R&D Program administration process. In the budget-planning phase, initiatives are scoped or evaluated to ensure replicable and scalable benefits to ratepayers, each considering expected outcomes and describing benefits using a consistent framing. Consultations with parties — including other Gas R&D administrators, CPUC SMEs, and interested members of the public — ensure that proposed initiatives will generate projects that fill an identified R&D gap, such that benefits to ratepayers would not otherwise have occurred.

Following the approval of a budget plan, the CEC develops competitive solicitations that advance the objectives of the proposed initiatives. Solicitations, which are more specific than initiatives, may describe the requirements for impact evaluation that are expected in the applications and any resulting projects. Applicants are also required to identify project performance metrics that demonstrate research or technology advancements by which to measure the project benefits and provide a description of the proposed project's benefits to California ratepayers. Once a project is underway, CEC grant managers require tracking and reporting of metrics and project benefits through multiple avenues, including program annual reports, project final reports, and the CEC's [Energize Innovation](#) web platform.

In the Gas R&D Program, as with EPIC, the expected impacts, benefits, and benefit assessment methods will differ by the type of project funded. Gas R&D projects can broadly be categorized as applied research studies, technology development, or demonstrations. Each project type provides distinct types of benefits. Applied research studies can strengthen the evidence base for future policy and investment decisions, reduce uncertainty and implementation risk, and identify cost-effective, scalable pathways for addressing energy challenges.

Technology development can advance emerging solutions by improving performance, validating feasibility, and increasing readiness for broader deployment. Demonstration efforts can provide more direct community benefits by testing technologies or strategies in real-world

settings while generating practical lessons learned to guide future replication and scale-up. A diverse research portfolio can enhance the effectiveness of the overall budget plan and program by exploring and preparing for several possible technological, policy, and social futures. Likewise, embedding flexibility in research initiatives further reduces risk and optimizes benefits by being responsive to emerging policy and technology needs.

The FY 2026–2027 Proposed Budget Plan contains initiatives that encompass several project types. Applied research project initiatives include:

- Gas Network Decommissioning Pathways to Scale Infrastructure Retirement.
- Optimizing Thermal Energy Networks for Decarbonization.
- Studying Industrial Process Heat Decarbonization Pathways.
- Strategic Assessment of Cost-Effective Seasonal Energy Storage Pathways.

The Advancing Cost-Effective Methane Emissions Monitoring for California’s Gas System initiative is a technology development initiative. Moreover, the Cleaner Industries, Healthier Communities initiative supports demonstrations.

As the Uniform Impact Analysis Framework is developed and adopted, the CEC will continue to integrate the framework and related principles into Gas R&D planning and program administration processes.

CHAPTER 3: Proposed Initiatives for Fiscal Year 2026–2027

Proposed Budget Overview

This proposed FY 2026–2027 Gas R&D Budget Plan includes funding for six initiatives aimed at addressing two CPUC research themes (Table 1):

- **Gas system integrity:** Research under the gas system integrity theme is intended to support the safe, reliable, and cost-effective operation and transition of the gas system as California reduces fossil gas use over time. This includes efforts to manage infrastructure risks, improve system planning, and guide orderly infrastructure retirement.
- **Decarbonization:** Research under the decarbonization theme is intended to support reductions in GHG emissions and harmful air pollutants associated with the gas sector through evaluation of cleaner technologies, alternative fuels and storage pathways, and other strategies that support an affordable, reliable, equitable, and safe gas transition.

These themes represent the overarching topical areas of study under which the research initiatives fall. Multiple initiatives can be proposed under a theme. Initiative descriptions provide more detail on the proposed research area and example activities.

Table 1: Proposed FY 2026–2027 Gas R&D Budget Plan

Category/Initiative Theme	Initiative Title	Proposed Budget
Gas System Integrity	Gas Network Decommissioning Pathways to Scale Infrastructure Retirement	\$3,000,000
Decarbonization	Advancing Cost-Effective Methane Emissions Monitoring for California’s Gas System	\$6,000,000
Decarbonization	Strategic Assessment of Cost-Effective Seasonal Energy Storage Pathways	\$1,600,000
Decarbonization	Optimizing Thermal Energy Networks for Decarbonization	\$2,000,000
Decarbonization	Cleaner Industry, Healthier Communities	\$8,000,000
Decarbonization	Studying Industrial Process Heat Decarbonization Pathways	\$1,000,000
Program Administration	N/A	\$2,400,000
TOTAL	N/A	\$24,000,000

Source: California Energy Commission

Proposed Research Initiatives

Initiative Theme: Gas System Integrity

Initiative Title: Gas Network Decommissioning Pathways to Scale Infrastructure Retirement

This initiative will develop operational strategies and define actionable pathways for scaling gas decommissioning beyond individual pilot projects. Drawing on data and lessons learned from pilot demonstrations, it will evaluate the technical, regulatory, economic, and community considerations needed to support coordinated, cost-effective gas infrastructure retirement. Near-term products may include a paper study, cross-pilot assessment, and planning guidance to support the future implementation of scalable, cost-effective gas infrastructure retirement strategies.

Policy Priority

This initiative directly supports and advances priority objectives in CPUC proceedings and state energy policy related to long-term gas planning and building decarbonization. It addresses a critical gap between pilot projects and broader implementation by translating the data and lessons learned from decommissioning pilots into practical, scalable strategies and frameworks for utilities, regulators, and other entities involved in gas system transition planning.

In alignment with the CPUC's Long-Term Gas Planning proceeding (R.24-09-012), this initiative supports long-term infrastructure management by providing planning frameworks and operational pathways for managed gas system post-pilot activities, including infrastructure prioritization, cost and savings assessment, and retirement sequencing. It advances the CPUC's Building Decarbonization proceeding (R.19-01-001) by developing scalable strategies and implementation frameworks for coordinated gas infrastructure retirement as building electrification efforts advance, informing more equitable pathways to reduce emissions from gas use in buildings and industry.

The initiative also complements Senate Bill 1221 (Min, Chapter 602, Statutes of 2024) by applying the objectives and lessons learned from gas decommissioning pilot programs to a broader, statewide context. Building on the neighborhood-scale pilot projects anticipated from implementing SB 1221, as well as the CEC's proposed Gas R&D Program decommissioning pilot investments, this initiative translates early demonstrations into standardized approaches for gas system retirement and the deployment of gas alternatives such as electrification, addressing the critical gap between pilot success and effective and coordinated large-scale implementation.³²

The resulting research embeds equity, affordability, safety, and customer impacts into core strategic planning, ensuring alignment with California's energy transition goals. Overall, it

³² Molin, Daphne and Jill Horing. 2025. Energy Research and Development Division. 2023. [Gas Research and Development Program Proposed Updated Budget Plan for Fiscal Year 2023-24](https://www.energy.ca.gov/publications/2023/gas-research-and-development-program-proposed-budget-plan-fiscal-year-2023-24). California Energy Commission. Publication Number: CEC-500-2023-020-REV. <https://www.energy.ca.gov/publications/2023/gas-research-and-development-program-proposed-budget-plan-fiscal-year-2023-24>.

Horing, Jill and Kaycee Chang. 2025. Energy Research and Development Division. 2025. [Gas Research and Development Program Proposed Budget Plan for Fiscal Year 2025-26](https://www.energy.ca.gov/publications/2025/gas-research-and-development-program-proposed-budget-plan-fiscal-year-2025-2026). California Energy Commission. Publication Number: CEC-500-2025-013-REV. <https://www.energy.ca.gov/publications/2025/gas-research-and-development-program-proposed-budget-plan-fiscal-year-2025-2026>.

serves as a critical bridge between legislation, regulatory proceedings, and on-the-ground deployment, improving and accelerating the transition from pilots to statewide strategy.

Identified Need

The initiative responds to key research gaps and needs identified in coordination with the CPUC, IOU gas administrators, and ESJ community members, including the DACAG. As directed by SB 1221, the CPUC will establish a voluntary decommissioning pilot program by July 1, 2026, aimed at promoting cost-effective decommissioning across priority neighborhoods statewide. Existing initiatives, like efforts supported in SB 1221, focus primarily on feasibility at prepilot and pilot scales, generating valuable data on technical, economic, and community considerations. However, critical gaps remain in how to apply these findings through practical, scalable frameworks that support broader deployment.

As pilot results begin to guide electrification strategies and targeted pipeline retirements, the need for standardized planning tools, operational guidance, and cost-effective scaling pathways will be imminent. Broader implementation of gas decommissioning is expected to accelerate supply chain development, expand retrofit markets, and increase volumes of retired infrastructure that will require management, maintenance, or reuse. This initiative addresses these emerging needs by providing the research, coordination strategies, and implementation frameworks necessary to support a systematic, equitable, and efficient statewide transition away from fossil gas.

Completed research from previous Gas R&D budget plans has helped establish the important technical, economic, and policy foundations for pilot-scale gas system transition efforts. As highlighted in Table 2, CEC-funded projects with Energy+Environmental Economics (E3), RAND, and DNV informed early regional decommissioning modeling, feasibility assessments, and data-driven planning tools. Together, these studies have created the analysis to support subsequent pilots.

Active and recently funded projects continue to improve understanding of the drivers and barriers influencing the transition away from gas end uses, with an emphasis on customer adoption behaviors, technology performance, and economic impacts associated with electrification and alternative solutions. Collectively, these efforts provide an important empirical foundation for pilot-scale transition strategies and strengthen insights into ways that transition pathways may affect customers and the broader energy system.

Building on this groundwork, this initiative is needed to distill findings from completed and active projects into integrated operational frameworks, scaling methods, and coordinated planning tools for broader gas decommissioning. This initiative leverages prior modeling, upcoming pilot data, and end-use transition research to synthesize lessons across projects and develop evidence-based strategies for systematic, large-scale gas infrastructure retirement. It supports planning that responds to evolving policy, infrastructure, and economic conditions.

Ratepayer funding is critical to advancing this work because the research is designed to guide public-interest decision-making related to affordability, efficiency, equity, and long-term infrastructure planning. These system-level benefits extend across utilities, regulators, customers, and communities, and the benefits will be more fully and equitably addressed through public investment.

Table 2: Related and Complementary Gas Research on Gas System Decommissioning

Projects	Status
A Strategic Assessment of the Long-Term Role of Natural Gas in a Carbon-Constrained and Water-Efficient Future, E3 (PIR-16-011)	Completed
Strategic Pathways and Analytics for Tactical Decommissioning of Portions of Natural Gas Infrastructure in Southern California, RAND (PIR-20-008)	Completed
Strategic Pathways and Analytics for Tactical Decommissioning of Portions of Natural Gas Infrastructure in Northern California, E3 (PIR-20-009)	Completed
Mindful Decommissioning: A Data-Driven Tool for Prioritizing Strategic Gas Asset Decommissioning, DNV (PIR-22-002)	Completed
Transitioning Gas End Uses (PIR-25-002, PIR-25-003, PIR-25-004, PIR-25-005) ³³	Active
Decommissioning Pilots (FY 23–24 Budget Plan and FY 25–26 Budget Plan, proposed)	Planned
Equitable, Safe, and Cost-Effective Decarbonization of California’s Gas System (FY 24–25 Gas Budget Plan, proposed)	Planned
Sociotechnical Approaches to Gas Decommissioning (FY 25–26 Gas Budget Plan, proposed)	Planned

Source: CEC staff

Proposed Solution

Research studies will comprehensively synthesize and evaluate the data generated by pilot and decommissioning activities across utility borders to address operational, environmental, and air quality risks associated with gas system phasedown. This effort will aim to connect insights from diverse zonal pilot locations and translate them into updated protocols and standardized practices that support a safe, scalable, and actionable framework for statewide implementation of gas decommissioning. The initiative could address key risks such as:

- Pressure imbalances in remaining pipelines, which increase leak likelihood and safety hazards.
- Unexpected service disruptions.
- Emissions associated with decommissioning activities, such as purging and venting, in local communities.

This initiative complements and builds on zonal pilot studies by conducting post-pilot operational analyses on legacy gas infrastructure management, such as evaluation of pipeline retirement methods, system isolation practices, and long-term asset tracking. It seeks to establish clear approaches for managing infrastructure ownership, liability, and regulatory obligations following decommissioning, ensuring greater transparency and accountability as systems are retired. In addition, the initiative assesses financial considerations, including long-

³³ California Energy Commission. 2025. "[GFO-24-501 – Paving the Way for California's Gas Transition](https://www.energy.ca.gov/solicitations/2025-03/gfo-24-501-paving-way-californias-gas-transition)." <https://www.energy.ca.gov/solicitations/2025-03/gfo-24-501-paving-way-californias-gas-transition>.

term infrastructure abandonment versus repurposing scenarios, to identify strategies that maximize cost savings and minimize negative impacts across gas and electric systems.

Developing strategic and coordinated post-pilot decommissioning approaches will enable the capture and evaluation of critical performance metrics, data, and insights. These insights may include peak-load reduction, imbalanced gas pressure dynamics, maintenance and record-keeping protocols for retrofitted infrastructure, average upfront costs at household and neighborhood scales, customer satisfaction, and workforce needs. These findings will be helpful for guiding gas decommissioning implementation strategies that are technically sound, cohesive, and economically viable. Further evaluations of these outputs will support policy makers, utilities, and communities and guide future regulatory decisions, funding priorities, and decarbonization program design toward a coordinated and equitable statewide transition away from fossil gas.

Anticipated Impacts

The initiative supports statewide gas decommissioning by advancing cost-effective, coordinated decommissioning scale-up strategies to benefit California ratepayers and communities. While pilots are expected to help establish feasibility at the project scale, this initiative will build on those results to assess broader ratepayer and community impacts. Anticipated benefits include lower long-term utility costs through avoided continued investment in aging gas infrastructure, reduced operations and maintenance expenses, and improved management of retired infrastructure liabilities.

Collectively, these outcomes are expected to reduce overall gas system costs, resulting in downward pressure on ratepayer utility bills. Other health and social benefits from the reduced gas infrastructure and related combustion include improved public safety through enhanced leakage management and decommissioning protocols and better-coordinated alignment between gas system retirement and electric system readiness. Benefits will be measured using the EPIC Uniform Impacts Analysis Framework.³⁴

Some specific examples of benefits resulting from this initiative could include outcomes that:

- **Increase affordability:** Develops cost and rate impact assessment methods and infrastructure prioritization methods to help identify least-cost pathways for scaling gas decommissioning, avoid unnecessary capital investments in aging infrastructure, reduce operations and maintenance costs, and support effective gas system pruning to maximize overall cost savings from managing the system.
- **Improve safety:** Develops and evaluates methods for assessing infrastructure condition, analyzing maintenance records, managing pressure changes during decommissioning, and strengthening decommissioning protocols to help reduce risks associated with aging and underused pipelines. These products could help utilities systematically identify and reduce risks associated with aging and underused pipelines, resulting in reduced leak frequency, minimized methane emissions, and reduced safety incidents.

³⁴ California Public Utilities Commission. April 2, 2024. "[Electric Program Investment Charge \(EPIC\): Defining a Uniform Impact Analysis Framework Workshop](https://www.epicpartnership.org/resources/ImpactAnalysisKickoff_Beck.pdf)." https://www.epicpartnership.org/resources/ImpactAnalysisKickoff_Beck.pdf.

- **Increase reliability:** Analyzes lessons learned from pilots and assesses reliability risks associated with gas decommissioning, including potential service disruptions during decommissioning, to support a more coordinated transition between gas system retirement and electrification readiness by identifying where infrastructure retirement may require additional protections to maintain reliable energy services.
- **Improve equity:** Develops a community-centered transition assessment, engagement strategies, and equity screening approaches to prioritize disadvantaged vulnerable communities (DVCs) and renters during gas system transition planning.
- **Improve environmental sustainability:** Develops and evaluates protocols, assessment methods, and decision-support tools to reduce environmental risks associated with gas-system phase-down, including methane leakage, infrastructure retirement practices, and material disposal, while supporting long-term climate and sustainability goals.

Examples of key metrics include:

- Percentage reduction in gas system operations and maintenance costs.
- Cost per customer transitioned.
- Number of safety incidents reported pre- vs post-decommissioning.
- Frequency and duration of unplanned service disruptions.
- Percentage of participating households in DVCs.

Initiative Theme: Decarbonization

Initiative Title: Advancing Cost-Effective Methane Emissions Monitoring for California's Gas System

This initiative will fund applied research to advance cost-effective methane emissions monitoring and analysis across California's gas system. Anticipated near-term products could include field validation studies, integrated datasets combining satellite and ground-based measurements, advanced low-cost methane sensors, and technical guidance on scalable monitoring frameworks to support emissions reductions and system efficiency.

Policy Priority

This initiative supports California's climate and energy goals by improving the measurement, management, and reduction of methane emissions from the gas system. This initiative provides cost-effective R&D that aligns with the goals of CPUC's Methane Leak Abatement Proceeding (R.15-01-008) by advancing technologies and data integration approaches that improve leak detection, emissions quantification, and prioritization of repair activities, helping utilities reduce lost gas and improve safety in a cost-effective manner. It also aligns with the CPUC's priorities under the Long-Term Gas Planning Proceeding (R.24-09-012), which emphasizes reducing system costs, improving safety and reliability, and enabling a cost-effective transition away from fossil gas. By focusing on methane emissions detection and measurement, the initiative directly supports enhanced leak detection and repair strategies and improved system planning, both of which are critical to delivering tangible benefits to gas ratepayers.

Informed by coordination with CPUC staff, the IOUs, and CARB, the initiative further aligns with broader state policies aimed at reducing GHG emissions and addressing environmental justice concerns. Ongoing coordination with CARB and the IOUs helps ensure proposed efforts leverage and complement ongoing efforts in methane inventory development, satellite-based monitoring, and emissions reduction strategies. By strengthening the technical foundation for methane monitoring, this initiative helps translate policy goals into actionable, data-driven implementation pathways that improve system efficiency and reduce costs for ratepayers.

Identified Need

Methane emissions from California's gas system are difficult to measure accurately and vary widely by location and over time, creating challenges for cost-effective reduction and long-term system planning. A key issue identified by CARB and the broader research community is the persistent discrepancy between "top-down" methane emissions estimates, which are derived from atmospheric measurements such as satellites or aircraft, and "bottom-up" estimates, which are based on equipment-level inventories and emission factors. This gap reduces confidence in emissions inventories and limits the ability of regulators and utilities to prioritize reductions in a way that maximizes cost-effectiveness for gas ratepayers.³⁵

Recent advances in satellite-based methane detection, including efforts supported through CARB's satellite partnerships and external programs such as Carbon Mapper, have significantly improved the ability to detect large emission sources.³⁶ However, these datasets are often limited by practical spatial and temporal constraints — for example, while newer methane satellite systems can identify large emissions at relatively high spatial resolution, real-world localization uncertainty, revisit frequency, cloud cover, and meteorological conditions can still limit operational usability and continuous monitoring. As a result, these datasets require validation and refinement through ground-based measurements to support operational decision-making. At the same time, while emerging tools, such as methane risk-mapping approaches, highlight the potential to better understand emissions exposure and impacts,³⁷ these approaches are not yet fully integrated into a cohesive, multiscale monitoring framework that can support real-time or near-real-time mitigation.

Prior Gas R&D investments have advanced foundational understanding of methane emissions while revealing areas for continued improvement; this initiative is designed to address those areas. Research conducted by the University of California, Irvine, (PIR-17-011) improved understanding of inter- and intrabasin chemical and isotopic signatures of methane emissions

³⁵ Duren, R.M., Thorpe, A.K., Foster, K.T. et al. 2019. "[California's Methane Super-Emitters](https://doi.org/10.1038/s41586-019-1720-3)." *Nature*, 575, 180–184, <https://doi.org/10.1038/s41586-019-1720-3>.

Cui et al. 2019. "[A Multi-platform Inversion Estimation of Statewide and Regional Methane Emissions in California during 2014–2016](https://pubs.acs.org/doi/abs/10.1021/acs.est.9b01769)." *Environ. Sci. Technol.* 53, 9636–9645. <https://pubs.acs.org/doi/abs/10.1021/acs.est.9b01769>

Zeng, ZC., Pongetti, T., Newman, S. et al. 2023. "[Decadal decrease in Los Angeles methane emissions is much smaller than bottom-up estimates](https://doi.org/10.1038/s41467-023-40964-w)". *Nat Commun* 14, 5353. <https://doi.org/10.1038/s41467-023-40964-w>

³⁶ California Air Resources Board (CARB). "[California Satellite Methane Project](https://ww2.arb.ca.gov/our-work/programs/california-satellite-methane-project)." <https://ww2.arb.ca.gov/our-work/programs/california-satellite-methane-project>.

Carbon Mapper Coalition. "[Carbon Mapper](https://carbonmapper.org/)." <https://carbonmapper.org/>. Carbon Mapper is a data portal that uses satellite and remote-sensing data to make identify methane and carbon dioxide super-emitters.

³⁷ PSE Healthy Energy. "[Methane Risk Map](https://mrm.psehealthyenergy.org/)." <https://mrm.psehealthyenergy.org/>. The Methane Risk Map calculates concentrations of hazardous air pollutants associated with methane emission events that would otherwise go unaccounted for, empowering decision-makers and the public to act.

and demonstrated the potential for these methods to validate satellite observations.³⁸ This work also highlighted opportunities to better characterize emissions from a climate and environmental justice perspective, including implications for community exposure and health impacts near gas production areas.

Similarly, the CEC's ongoing Super eMitters of Methane Detection Using Aircraft, Towers, and Intensive Observational Network (SUMMATION) Gas R&D project, conducted by Lawrence Berkeley National Laboratory (PIR-17-015), has demonstrated the value of multiscale methane monitoring approaches and identified the importance of continuous, high-frequency measurements to capture intermittent emission events.³⁹ The current body of Gas R&D-funded work has made the need for targeted, cost-effective monitoring strategies increasingly clear. These strategies include developing low-cost methane sensors and evaluating whether methane can serve as a proxy for co-emitted pollutants such as benzene, ethylbenzene, toluene, and xylene, which are directly relevant to community health impacts.

Due to these advances, significant technical and operational gaps are now ready to be tackled. A growing body of literature evaluating low-cost methane sensors indicates that while these technologies show promise for expanding monitoring coverage, the performance of these technologies is often limited by sensitivity to environmental conditions such as temperature and humidity, calibration challenges, and sensor drift over time.⁴⁰ Many sensors that perform well under controlled laboratory conditions exhibit degraded or inconsistent performance in real-world field deployments.

In addition, low-cost sensors typically have limited ability to measure emissions accurately without additional modeling, and they may exhibit cross-sensitivity to other gases, introducing measurement uncertainty. Coordination with SoCalGas further underscored the need for standardized approaches to evaluate low-cost monitoring technologies, including metrics that normalize cost by coverage area, such as dollars per square foot, while accounting for detection limits, distance from source, and field conditions. There is also a lack of standardized protocols for sensor validation, deployment, and data interpretation, which limits comparability across studies and reduces confidence in use for decision-making.⁴¹

³⁸ PIR-17-011, funded by the CPUC-approved Gas R&D FY 2016-17 Plan Initiative "Chemical and Isotopic Fingerprints of Natural Gas Basins to Support Full Fuel Cycle Accounting."

³⁹ PIR-17-015, funded by the CPUC-approved Gas R&D FY 2016-17 Supplemental Budget Plan Initiative "Strategic Comparison of the Cost-Effectiveness of Sensor Systems for Methane Emission Detection and Measurement."

⁴⁰ Riddick, S. N., et al. June 2020. "[The Calibration and Deployment of a Low-Cost Methane Sensor](https://www.sciencedirect.com/science/article/abs/pii/S1352231020301771)." *Atmospheric Environment*, 230, <https://www.sciencedirect.com/science/article/abs/pii/S1352231020301771>.

Kiplimo, S., et al. October 2024. "[Addressing Low-Cost Methane Sensor Calibration With Machine Learning](https://doi.org/10.3390/atmos15111313)." *Atmosphere*, 15(11). <https://doi.org/10.3390/atmos15111313>.

⁴¹ Collier-Oxandale, A., et al. 2018. "[Assessing a Low-Cost Methane Sensor Quantification System for Use in Complex Rural and Urban Environments](https://doi.org/10.5194/amt-11-3569-2018)." *Atmospheric Measurement Techniques*. <https://doi.org/10.5194/amt-11-3569-2018>.

Lin, J. C., et al. 2023. "[Laboratory and Field Evaluation of a Low-Cost Methane Sensor and Key Environmental Factors for Sensor Calibration](https://doi.org/10.1039/d2ea00100d)." *Environmental Science: Atmospheres*. <https://doi.org/10.1039/d2ea00100d>.

Torres, V. M., et al. March 2022. "[Field Inter-Comparison of Low-Cost Sensors for Monitoring Methane Emissions From Oil and Gas Production Operations](https://doi.org/10.5194/amt-2022-24)." *Atmospheric Measurement Techniques*. <https://doi.org/10.5194/amt-2022-24>.

In addition to improving sensor performance, the integration of diverse measurement approaches into a cohesive monitoring system would advance the field and increase benefits to ratepayers. Existing efforts focus primarily on individual components — such as satellite observations, mobile surveys, or fixed monitoring sites — rather than on developing integrated, multiscale frameworks that combine these data streams. This development limits the ability to achieve high spatial coverage and high temporal resolution, both necessary to detect intermittent emissions, track trends over time, and support timely mitigation actions. Prior research has demonstrated the importance of high temporal resolution data, including semi-daily or continuous measurements,⁴² but achieving this level of monitoring at scale will remain cost-prohibitive without advances in low-cost sensing and system design improvements.

Research that advances not only individual technologies but also the integration of satellite, ground-based, and low-cost sensing approaches into cost-effective, scalable monitoring frameworks will significantly improve emissions detection and measurement. These advances will reduce uncertainty in methane inventories and enable more targeted and efficient mitigation strategies that, in turn, reduce costs borne by ratepayers. Public-interest ratepayer-funded research is necessary to advance these system-level improvements because they involve public-good data, cross-sector coordination, and long-term infrastructure planning efforts that are not well-suited to private investment.

Moreover, Gas R&D Program funding can support larger-scale, integrated, and application-oriented research that builds on and complements related efforts such as those being conducted by CARB as well as the IOUs. Table 3 highlights complementary and related efforts. CARB's Strategic Research Plan identifies key needs related to advancing remote sensing technologies and improving the frequency and accuracy of GHG measurements, while its in-house research focuses on targeted, high-resolution monitoring and emissions tracking.⁴³ IOU administrators' focus is on monitoring and repairing leaks from their specific infrastructure, with an emphasis on the distribution system.

This initiative extends those efforts by integrating satellite and ground-based data, advancing cost-effective monitoring approaches, and translating measurement capabilities into actionable insights for gas system operations and planning across a suite of potential emissions sources that extend beyond the distribution system. By improving the accuracy, coverage, and cost-effectiveness of methane monitoring, research under this initiative can provide direct value to gas ratepayers by reducing lost gas (due to leaks, venting, or measurement uncertainty). The research will also guide prioritization of maintenance and infrastructure investments and

Furuta, R., et al. 2024. "[Design and Evaluation of A Low-Cost Sensor Node for Near-Ambient Methane Monitoring.](https://amt.copernicus.org/articles/17/2103/2024/)" *Atmospheric Measurement Techniques*, 17(7). <https://amt.copernicus.org/articles/17/2103/2024/>.

⁴² Duren, R. M., et al. 2019. "[California's Methane Super-Emitters.](https://www.nature.com/articles/s41586-019-1720-3)" *Nature*. <https://www.nature.com/articles/s41586-019-1720-3>

Cusworth, D. H., et al. 2021. "[Intermittency of Large Methane Emitters in the Permian Basin.](https://pubs.acs.org/doi/10.1021/acs.estlett.1c00173)" *Environmental Science & Technology Letters*. <https://pubs.acs.org/doi/10.1021/acs.estlett.1c00173>.

SUMMATION Project (PIR-17-015), Lawrence Berkeley National Laboratory, ongoing.

⁴³ California Air Resources Board. August 2025. "[Five-Year Strategic Research Plan for Fiscal Years 2025 to 2030.](https://ww2.arb.ca.gov/resources/documents/strategic-research-plans)" <https://ww2.arb.ca.gov/resources/documents/strategic-research-plans>.

enhance the state’s ability to manage the transition of California’s gas system in a cost-effective, equitable, and environmentally responsible manner.

Table 3: Related and Complementary Gas Research on Methane Emissions Monitoring and Analysis

Projects	Status
Developing a Methodology to Determine Chemical and Isotopic Composition of Natural Gas Consumed in California, UC Irvine (PIR 17-011)	Completed
Multi-Tiered Greenhouse Gas Emissions Measurements of California’s Natural Gas-Powered Industrial and Fueling Infrastructure, Electric Power Research Institute (PIR-16-014)	Completed
Characterizing Emissions from California Biomethane Facilities, Electric Power Research Institute (PIR-19-009)	Completed
The California Methane Survey, California Institute of Technology (500-15-004)	Completed
Airborne Remote-Sensing Surveys of Methane Emissions in California, CARB-funded, awarded to Carbon Mapper, Inc (22RD001)	Completed
Airborne Remote-Sensing Surveys of Methane Emissions in California: Fall 2020 Campaign, CARB-funded, awarded to University of Arizona (20RD011)	Completed
SoCalGas Emerging Technology Research & Demonstration: Low-cost sensor embedded in gas infrastructure (not yet citable, patent pending per conversation with SoCalGas 5/6/2026)	Completed
SUPer eMitters of Methane Detection Using Aircraft, Towers, and Intensive Observational Network (SUMMATION), Lawrence Berkeley National Lab (PIR-17-015)	Active
California Residential Methane Emissions Characterization, Lawrence Berkeley National Lab (PIR-21-008)	Active
Airborne Methane Emission Flux Measurement Survey (Phase III): Landfill Emissions Monitoring, CARB-funded, awarded to ChampionX (23RD002)	Active
CARB’s Five-Year Strategic Research Plan for 2025-2030: Research on Measurement Systems on Local and Statewide Scales ⁴⁴	Planned

Source: CEC staff

Proposed Solution

This initiative will develop and demonstrate an integrated, multiscale methane monitoring and analysis framework that combines satellite observations, ground-based measurements, and low-cost sensing technologies to improve emissions detection and quantification across California’s gas system. Through three distinct yet coordinated efforts, the research is designed to bridge the gap between emerging measurement technologies and related practical application in operational and regulatory contexts, enabling more accurate, timely, and cost-effective methane emissions management.

⁴⁴ CARB’s Proposed Five-Year Strategic Research Plan was approved September 25, 2025. The priorities established in the plan are expected to guide the selection of annual research projects from 2025 through 2030.

The first component of the research will focus on integrating satellite-based methane observations with ground-based methane measurements collected from tower networks, mobile platforms, and distributed sensors. This integration will improve the ability to detect high-emitting sources cost-effectively, characterize spatial and temporal variability, and reconcile differences between top-down and bottom-up emissions estimates. It will also enable measurements at finer spatial scales (for example, subregional or facility-level) and shorter time intervals (for example, daily to subdaily), compared to current satellite-only approaches. In addition, it will support more sustained monitoring over time, which is critical for capturing temporal variability and intermittent emission events.

Building on this integrated dataset, the research will develop a novel analytical scoring framework that combines emissions data with spatial and demographic information to generate dynamic “climate” and “environmental justice” scores. These scores will help identify locations across the gas supply chain where emissions pose the greatest risks to the climate and to communities, particularly those that are disproportionately impacted. This approach is intended to support prioritization of mitigation actions by linking emissions intensity with potential exposure and vulnerability. While IOUs’ efforts focus on distribution assets, for which leaks are too small to be detected by satellites, the proposed effort would address high-impact, intermittent sources relevant to ratepayers (for example, behind-the-meter industrial customers, storage).

The second research component will advance the development and validation of low-cost methane sensors and monitoring systems. While SoCalGas’s current low-cost sensor work is focused on a specific distribution-infrastructure application, this initiative would advance the broader development and validation of low-cost methane sensors and monitoring systems by addressing key technical challenges that currently limit large-scale deployment, including calibration under a variety of real-world environmental conditions, long-term sensor drift, emissions quantification, and standardized approaches for deployment and data interpretation across diverse monitoring contexts. Field deployments will be used to assess sensor performance across diverse conditions and to develop best practices to optimize deployment, quality assurance, and data interpretation. This effort will enable more scalable and cost-effective monitoring networks that can expand coverage across California, including in areas that are under-monitored.

The third component will build on the SUMMATION project to enhance existing monitoring frameworks by integrating multiple data streams and advancing a cost-effective system design. This complements the “snapshot” efforts undertaken by SoCalGas by providing ongoing measurements that are needed to capture intermittent sources, specifically by developing approaches to maintain high temporal resolution measurements, such as semi-daily or continuous monitoring at subcounty scales, while reducing operational costs through automation, modular system design, and sensor fusion. By improving the coordination and efficiency of monitoring systems, this work will enhance the ability to detect leaks, track emissions over time, and support timely and targeted mitigation actions.

Together, these efforts will advance a coordinated, scalable, and well-integrated methane monitoring system that supports technology transfer and guides utility operations, regulatory decision-making, and long-term gas system planning. Moreover, the efforts will leverage and

harmonize with complementary state efforts, including coordination with CARB and other agencies, delivering measurable benefits to California gas ratepayers.

Anticipated Impacts

This initiative will deliver net incremental benefits to California gas ratepayers and communities by improving methane emissions detection, reducing system losses, and enabling more cost-effective and data-driven gas system management. By advancing integrated monitoring approaches that combine satellite, ground-based, and low-cost sensing technologies, the research will improve the accuracy, coverage, and timeliness of methane emissions data.

These improvements will directly support earlier leak detection, more targeted maintenance, and better-informed infrastructure planning decisions, thereby reducing unnecessary operational and capital costs that would otherwise be borne by ratepayers. These benefits are unlikely to occur at the same scale without Gas R&D Program funding, as existing efforts remain fragmented across technologies and institutions and lack coordinated integration into operational frameworks. In addition, these benefits will be delivered cost-effectively for ratepayers because the proposed research will be closely coordinated with the IOUs and CARB, enabling it to complement and leverage CARB's Methane Satellite Program.

All projects funded under this initiative will be evaluated using the EPIC Uniform Impacts Analysis Framework to ensure transparent and consistent measurement of ratepayer benefits. The initiative aligns with guiding principles⁴⁵ by supporting affordability, safety, reliability, equity, and environmental sustainability through improved data, tools, and strategies that enable a more efficient and informed gas system transition.

Examples of benefits under this initiative include outcomes that:

- **Increase affordability:** Reduces system costs passed down to ratepayers associated with lost gas, inefficient monitoring, and reactive maintenance practices. Improved methane detection and measurement will enable utilities to identify and repair leaks earlier, reducing gas loss and associated costs. Enhanced data integration will support more targeted infrastructure investments and help avoid unnecessary capital expenditures driven by uncertainty or incomplete information.
- **Improve safety:** Improves the ability to detect and respond to methane leaks and high-emission events before they escalate into hazardous conditions. High temporal resolution monitoring and improved spatial coverage will enable earlier identification of system vulnerabilities, supporting proactive mitigation strategies that reduce risks and the associated costs for the system and ratepayers.
- **Increase reliability:** Improves system visibility and enables more proactive maintenance, supporting enhanced reliability of the gas system. Continuous and integrated monitoring will reduce the likelihood of unexpected failures and service disruptions by identifying issues earlier in development. Improved data will also support planning decisions that maintain system performance as the gas system evolves.

⁴⁵ The CEC considers the following guiding principles in administering the Gas R&D Program and advancing benefits to gas IOU ratepayers: affordability, equity, safety, reliability, and environmental sustainability. These principles were developed for EPIC and have been adapted for application to the Gas R&D Program.

- **Improve equity:** Expands methane monitoring coverage to include rural communities and DVCs that are often under-monitored and therefore may experience greater harm. Improved data on emissions and associated co-pollutants will help identify and address disproportionate impacts on DVCs, supporting more equitable mitigation strategies and aligning with Goal 2 of the CPUC Environmental & Social Justice Action Plan.
- **Improve environmental sustainability:** Improves the detection, quantification, and reduction of methane emissions. By enabling more accurate emissions inventories and more effective mitigation strategies, the research supports reductions in methane and associated copollutants, improving air quality and public health outcomes.

Examples of key metrics include:

- Reductions in estimated lost gas (for example, therms per year).
- Avoided or deferred operations and maintenance expenditures.
- Number of detected and mitigated high-emission events and estimated reductions in methane emissions (for example, metric tons of methane per year).
- Improved detection frequency of intermittent emissions (for example, number of emission events detected per unit time).
- Proportion of monitoring deployments in DVCs.

Initiative Title: Strategic Assessment of Cost-Effective Seasonal Energy Storage Pathways

This initiative conducts a broad, system-level analysis to evaluate seasonal energy storage technologies as cost-effective, equitable alternatives to fossil gas for meeting California’s seasonal reliability needs. Deliverables include a comparative technology assessment, grid integration modeling, and integrated resource plan (IRP)-ready outputs to inform coordinated gas-electric transition planning.

Policy Priority

This initiative directly responds to active CPUC proceedings and state decarbonization goals. As California’s gas demand declines, fixed infrastructure costs are likely to be concentrated on fewer customers, including rental or low-income housing residents in hard-to-retrofit buildings and industrial process-heat users. At the same time, electricity demand is projected to grow 76 percent over the next two decades, driven by electrification and population growth.⁴⁶ Once renewables exceed 80 percent of supply, which is expected in the early 2030s, the grid will benefit greatly from seasonal storage to maintain reliability and absorb surplus generation.⁴⁷

This initiative provides critical analytical support to the Long-Term Gas Planning proceedings (R.24-09-012 and R.20-05-003) by directly connecting seasonal storage to gas decommissioning planning, a technical linkage that both proceedings require but no existing study has addressed. This initiative addresses scoping questions under Issue Area 1 (Long-

⁴⁶ CARB. 2022. [CARB 2022 Scoping Plan](https://ww2.arb.ca.gov/our-work/programs/ab-32-climate-change-scoping-plan/2022-scoping-plan-documents/). <https://ww2.arb.ca.gov/our-work/programs/ab-32-climate-change-scoping-plan/2022-scoping-plan-documents/>.

⁴⁷ Omar J. Guerra, Joshua Eichman and Paul Denholm. 2021. “[Optimal Energy Storage Portfolio for High and Ultrahigh Carbon-Free and Renewable Power Systems](https://pubs.rsc.org/en/content/articlelanding/2021/ee/d1ee01835c#!divCitation).” *Energy & Environmental Science*. <https://pubs.rsc.org/en/content/articlelanding/2021/ee/d1ee01835c#!divCitation>.

Term Gas Transition Planning) and Issue Area 2 (Opportunities for Interim Action).⁴⁸ The comparative technology assessment and cost modeling will supply inputs that utilities could use to show how gas infrastructure use and rate impacts change as seasonal storage is deployed, and will quantify how storage deployment reduces the fixed-cost burden on remaining gas customers, particularly low-income households in hard-to-retrofit buildings. In addition, grid integration modeling helps identify near-term geographies where seasonal storage can enable pipeline retirement or consolidation.

This initiative also responds to IRP procurement questions by generating seasonal storage inputs for IRP planning to sustain reliability while reducing peak gas use and renewable curtailment. The comparative technology assessment will evaluate the readiness of seasonal storage technologies and identify which pathways can achieve a credible deployment path by the early 2030s, directly guiding the CPUC's long-lead-time procurement decisions.⁴⁹

This initiative complements electrification and distributed energy resource investments of EPIC (R.19-10-005) by addressing the seasonal supply-demand gap that shorter-duration distributed energy resource investments cannot bridge. The grid integration modeling directly quantifies curtailment reduction potential and the cost-effectiveness of seasonal storage technologies.

This initiative also advances the Environmental & Social Justice Action Plan (ESJ Action Plan)⁵⁰ and DACAG priorities.⁵¹ It seeks to quantify rate burden reductions for hard-to-electrify customers (often rental or low-income housing in hard-to-retrofit buildings) and identify seasonal storage configurations that reduce fixed infrastructure costs, supporting the ESJ Action Plan goal that decarbonization not disproportionately burden those least able to electrify.

Identified Need

California faces two compounding structural challenges. Declining gas demand is concentrating fixed infrastructure costs. Under the CEC's High Building Electrification Scenario, residential gas delivery rates could rise about 80 percent by 2030 and about 480 percent by 2050.⁵² Without proactive planning, utilities will maintain infrastructure that exceeds future demand, creating stranded assets and deepening rate inequities.

Secondly, renewable surplus and seasonal mismatch are straining the electric grid. In 2024, California ISO curtailed 3.4 million megawatt-hours (MWh) of solar and wind energy — a 29

⁴⁸ See R.24-09-012, Issue Area 1 (Long-Term Gas Transition Planning) and Issue Area 2 (Opportunities for Interim Action), including questions (a), (b)(iv), (j), and (k).

⁴⁹ See R.20-05-003, Procurement Track Question Q5, see also R.25-06-019.

⁵⁰ California Public Utilities Commission. April 7, 2022. [Environmental & Social Justice Action Plan](https://www.cpuc.ca.gov/-/media/cpuc-website/divisions/news-and-outreach/documents/news-office/key-issues/esj/esj-action-plan-v2jw.pdf). <https://www.cpuc.ca.gov/-/media/cpuc-website/divisions/news-and-outreach/documents/news-office/key-issues/esj/esj-action-plan-v2jw.pdf>.

⁵¹ California Public Utilities Commission. March 2026. [DACAG Consolidated Priority Areas](https://www.cpuc.ca.gov/-/media/cpuc-website/divisions/disadvantaged-communities-advisory-group/documents/2026-dacag-priority-areasapproved-032026.pdf). <https://www.cpuc.ca.gov/-/media/cpuc-website/divisions/disadvantaged-communities-advisory-group/documents/2026-dacag-priority-areasapproved-032026.pdf>.

⁵² Aas, Dan, Amber Mahone, Zack Subin, Michael Mac Kinnon, Blake Lane, and Snuller Price. 2020. [The Challenge of Retail Gas in California's Low-Carbon Future: Technology Options, Customer Costs and Public Health Benefits of Reducing Natural Gas Use](https://www.energy.ca.gov/sites/default/files/2021-06/CEC-500-2019-055-F.pdf). California Energy Commission. Publication Number: CEC-500-2019-055-F, <https://www.energy.ca.gov/sites/default/files/2021-06/CEC-500-2019-055-F.pdf>.

percent increase over 2023 levels. While California's total storage capacity has surged to nearly 17 gigawatts (GW) as of mid-2025, this fleet is comprised overwhelmingly of 4-hour lithium-ion systems.⁵³ These resources are increasingly effective at shifting solar to the evening peak but remain insufficient for multiday or seasonal balancing.⁵⁴ California is projected to need between 2 and 11 GW of long-duration energy storage (LDES) by 2030 and up to 55 GW by 2045,⁵⁵ with only about 510 megawatts of LDES contracted through 2035 as of late 2022.⁵⁶

Some incumbent LDES options, such as pumped hydro, are highly constrained in California due to limited suitable geography, long development timelines, and permitting and environmental constraints, limiting the ability to scale significantly beyond existing resources.⁵⁷ Ongoing efforts continue to refine estimates of LDES needs and system value under evolving grid conditions. While technologies continue to evolve and prices decline, gaps remain in evaluating seasonal storage within California's gas transition context.⁵⁸

Limited coordination between electric and gas planning could increase the risk of overbuilding and strain reliability. A CEC-commissioned study by E3 and Form Energy found that 2024 LDES needs range from 5 GW, if gas plants are retained, to 37 GW under full gas retirement, illustrating how gas transition decisions directly influence storage needs.⁵⁹

Most existing LDES studies focus on 8-hour or peak-day balancing. None have evaluated seasonal technologies specifically in California's gas decommissioning context, with California-specific rates, grid conditions, community outcomes, and infrastructure compatibility as core criteria. This Gas R&D initiative would conduct research distinct from prior studies in that it is proposed to directly link seasonal storage with California gas transition strategies and ratepayer benefits.

Private investment alone is insufficient. Many seasonal storage technologies are precommercial or early-stage, involve complex infrastructure compatibility questions tied to regulated gas

⁵³ California Energy Commission. "[California Energy Storage System Survey](https://www.energy.ca.gov/data-reports/energy-almanac/california-electricity-data/california-energy-storage-system-survey)." July 31, 2025, <https://www.energy.ca.gov/data-reports/energy-almanac/california-electricity-data/california-energy-storage-system-survey>.

⁵⁴ U.S. Energy Information Administration (EIA). May 28, 2025. "[Solar and Wind Power Curtailments Are Increasing in California](https://www.eia.gov/todayinenergy/detail.php?id=65364)." <https://www.eia.gov/todayinenergy/detail.php?id=65364>.

⁵⁵ California Energy Storage Alliance (CESA). December 8, 2020. "[California Needs up to 55 Gigawatts of Long Duration Energy Storage by 2045 to Meet Climate Targets and Maintain Reliable Electric Sector](https://storagealliance.org/news/california-needs-up-to-55-gigawatts-of-long-duration-energy-storage-by-2045-to-meet-climate-targets-and-maintain-reliable-electric-sector-0)." Press release, <https://storagealliance.org/news/california-needs-up-to-55-gigawatts-of-long-duration-energy-storage-by-2045-to-meet-climate-targets-and-maintain-reliable-electric-sector-0>.

⁵⁶ California Public Utilities Commission, Energy Division Staff with Support from Energy and Environmental Economics (E3). April 2024. "[Analysis for Centralized Procurement of Specified Long Lead-Time Resources](https://www.cpuc.ca.gov/-/media/cpuc-website/divisions/energy-division/documents/integrated-resource-plan-and-long-term-procurement-plan-irp-ltpp/ab1373/need-determination-analysis-centralized-procurement-of-specified-lt-resources.pdf)." <https://www.cpuc.ca.gov/-/media/cpuc-website/divisions/energy-division/documents/integrated-resource-plan-and-long-term-procurement-plan-irp-ltpp/ab1373/need-determination-analysis-centralized-procurement-of-specified-lt-resources.pdf>.

⁵⁷ Shan, Rui, Jeremiah Reagan, Sergio Castellanos, Sarah Kurtz, and Noah Kittner. 2022. "[Evaluating Emerging Long-Duration Energy Storage Technologies](https://www.sciencedirect.com/science/article/pii/S1364032122001630?via%3DIihub)." *Renewable and Sustainable Energy Reviews*, 159. <https://www.sciencedirect.com/science/article/pii/S1364032122001630?via%3DIihub>.

⁵⁸ Go, Roderick, Jessie Knapstein, Sam Kramer, Amber Mahone, Arne Olson, Nick Schlag, John Stevens, Karl Walter, and Mengyao Yuan. 2024. [Assessing the Value of Long-Duration Energy Storage in California](https://www.energy.ca.gov/publications/2024/assessing-value-long-duration-energy-storage-california). California Energy Commission. Publication Number: CEC-500-24-003. <https://www.energy.ca.gov/publications/2024/assessing-value-long-duration-energy-storage-california>.

⁵⁹ Ibid.

assets, and carry equity considerations that market actors likely do not internalize. Ratepayer-funded gas R&D is the appropriate vehicle to generate the objective California-specific analyses needed to support informed regulator and utility decision-making. This initiative builds on prior and ongoing funded LDES efforts while addressing a distinct gap in evaluating seasonal storage within California’s gas-electric transition context.

Table 4: Related and Complementary Gas Research on Seasonal Energy Storage

Projects	Status
Evaluating the Value of LDES in California, UC Merced (EPIC, EPC-19-060)	Completed
Assessing the Value of LDES in California, E3 (EPIC, EPC-19-056)	Completed
Demonstrating an Aqueous Air-Breathing Energy Storage System for Multi-Day Resiliency, Form Energy (EPC-19-041)	Completed
Long-Duration Energy Storage Demonstration with Viejas Tribe, Indian Energy LLC (LDS-22-001)	Active
Evaluation of Long Duration Energy Storage Technologies, Sandia National Laboratories (LDS-23-001)	Active
Hoopa Valley Critical Facilities Microgrid, Schatz Energy Research Center (LDS-25-001)	Planned

Source: CEC staff

Proposed Solution

This initiative will support system-level modeling and strategic assessment efforts to evaluate seasonal energy storage technologies as alternatives to fossil gas for seasonal reliability while supporting a managed gas-electric transition. All analyses proposed under this initiative will aim to produce planning-level, scenario-based outputs to inform the strategic assessment of seasonal energy storage pathways. The key metrics identified to track progress under this initiative are modeled system-level estimates intended to support strategic evaluation and comparative analysis across scenarios. These metrics could help characterize directional system-level economic, environmental, and equity impacts associated with different seasonal energy storage pathways. These metrics are not intended to reflect engineering design specifications, ratemaking determinations, or available resources.

This initiative is organized around a Comparative Technology Assessment (Objective 1), which is intended to help identify and prioritize the most promising technologies and pathways for further evaluation. Depending on findings from Objective 1 and available resources, the initiative may support additional work under Objectives 2–4 for the highest-performing pathways identified through the assessment process. This approach would allow findings from Objective 1 to inform the scope, sequencing, and prioritization of subsequent research activities under Objectives 2–4, as applicable.

- **Objective 1: Comparative Technology Assessment** — Conduct a planning-grade comparative screening and evaluation of major seasonal energy storage categories under California-specific grid and climate scenarios to identify the most reliable and

promising pathways for further system-level assessment. Major seasonal energy storage categories could include:

- Mechanical storage (for example, compressed air energy storage).
 - Chemical storage (for example, ammonia synthesis and re-electrification) or methane production. Note: Hydrogen-based pathways that extend fossil gas combustion are out of scope.
 - Electrochemical storage (for example, flow batteries).
 - Thermal storage (for example, molten salt thermal energy systems).
 - Emerging technologies aligned with state decarbonization goals (for example, CO₂ batteries).
 - Hybrid configurations of the abovementioned technologies.
- **Objective 2: Scenario-Based Gas-Electric Transition Analysis** — Generate scenario-based analytical outputs by translating results from Objective 1 into structured assessments of seasonal energy storage performance within California’s evolving gas-electric transition context, including the degree of reliance on fossil gas generation and seasonal balancing needs.

This effort could support coordinated transition analysis, including seasonal reliability contributions during periods of reduced renewable availability or extreme weather conditions, curtailment reduction from excess renewable generation, electrification-driven load growth and transmission expansion, declining fossil gas utilization, and the related implications for peak system adequacy.

- **Objective 3: Integrated Gas-Electric Planning Framework** — Develop IRP-ready outputs by translating results from Objective 1 and Objective 2 into a coordinated long-term gas transition planning output, potentially including assessment of existing gas infrastructure utilization conditions under declining demand and electrification-driven transition pathways.

The framework could include cost modeling (for example, capital expenditures and system costs), life-cycle GHG emissions assessments, gas system decommissioning scenarios with stranded-cost risk analysis, and assessment of infrastructure compatibility and reuse potential across existing gas and electric systems.

- **Objective 4: Equity and Community Resilience Analysis** — Evaluate distributional and resilience considerations associated with seasonal energy storage pathways identified in Objective 1, and potentially evaluated in Objectives 2 and 3, with emphasis on equity and reliability outcomes within a scenario-based, planning-level analytical framework supporting California’s gas transition.

This effort could systematically assess modeled ratepayer impacts across customer classes, including low-income households, renters, and other harder-to-electrify households. It could also assess distributional implications of declining gas demand for remaining gas customers and community resilience performance under extended grid

stress conditions (for example, prolonged periods of reduced renewable availability or extreme weather conditions).

Anticipated Impacts

By establishing a technical and economic foundation for seasonal storage deployment, this initiative enables a more affordable, reliable, equitable, and decarbonized energy system for California ratepayers. These benefits are unlikely to be realized without CEC's public-interest Gas R&D funding, as existing EPIC and private-sector research projects do not integrate seasonal storage analysis with gas transition planning at the California system level.

Initiative outputs could provide direct inputs to future CPUC decision-making in R.24-09-012 and R.20-05-003. Within the next several years, the successful deployment of pathways identified by this research will support planned gas infrastructure decommissioning, replace costly peaker power plants with clean seasonal storage, and shift reliability costs to the electric grid, where they will be distributed across a broader ratepayer base. Success will be measured using the EPIC Uniform Impacts Analysis Framework and tracked through metrics such as the planning-level, scenario-based example metrics identified below.

Examples of benefits under this initiative include outcomes that:

- **Increase affordability:** Reduces stranded gas assets and stabilizes delivery rates by supporting planned infrastructure decommissioning and shifting reliability costs to a broader ratepayer base.
- **Improve safety:** Assesses safety risks, leakage potential, and material durability for seasonal storage systems that may repurpose existing gas infrastructure. Supports orderly gas system pruning by identifying safe decommissioning sequences and nonpipeline alternatives, reducing risks from maintaining underused and aging infrastructure.
- **Increase reliability:** Reduces reliance on gas peaker plants by shifting surplus renewables across seasons, enhancing system reliability during prolonged stress events such as low-wind periods, low solar output due to wildfire smoke, and winter supply gaps.
- **Improve equity:** Lowers pollution and affordability burdens for DVCs and tribes. Supports geotargeted electrification and helps ensure the gas phaseout is planned and equitable for hard-to-electrify households, consistent with the ESJ Action Plan and DACAG priorities.
- **Improve environmental sustainability:** Displaces fossil gas generation, reduces life-cycle GHG emissions, and lowers criteria air pollutant emissions. Enables faster renewable integration by capturing otherwise curtailed solar and wind and deploying it during high-demand winter months.

Examples of planning-level, scenario-based key metrics include:

- Seasonal reliability contribution (gigawatt-hours shifted or equivalent seasonal adequacy duration in days/hours of firm capacity).
- Curtailment reduction under modeled grid conditions (MWh per year or hours per year).

- Fossil gas displacement under modeled system operation (therms per year or percent reduction in gas-fired seasonal balancing).
- System cost or cost of service impacts (\$/MWh or \$/year).
- Distributional and equity impacts across customer classes (for example, rate impacts \$/year or percentage change, including benefits to DVCs).

Initiative Title: Optimizing Thermal Energy Networks for Decarbonization

This initiative will assess the feasibility and technoeconomic benefits of modular thermal energy networks (TENS). These networks enable thermal storage and recovery and reuse of waste heat from large facilities, supporting delivery of efficient, clean heating, cooling, and hot water to surrounding communities. Anticipated near-term products include:

- A California-specific feasibility study that incorporates technoeconomic, geospatial, load modeling, and environmental impact analyses.
- A comparative assessment of potential TEN configurations.
- An open-source site screening tool and design guide.

Policy Priority

This initiative is strongly aligned with California’s long-term gas system planning, community-scale decarbonization, and affordability priorities. It is particularly relevant to the CPUC’s Long-Term Gas Planning Proceeding (R.24-09-012) and implementation of SB 1221, which together are helping shape neighborhood-scale decarbonization strategies and evaluate alternatives to continued investment in aging gas infrastructure. This initiative expands that suite of solutions. By assessing the costs, benefits, and implementation barriers of connecting TENS to large facilities with high-yield waste heat sources, this initiative will help inform practical pathways for replacing end-of-life gas systems with cost-effective, zero-emission thermal energy solutions for communities.

This research supports the CPUC’s Building Decarbonization Proceeding (R.19-01-011) by examining how TENS may help address challenges associated with partial or phased gas decommissioning efforts, including when building electrification conversions may be delayed or phased in over time. In these contexts, TENS can provide community-scale, noncombustion thermal energy solutions for heating, cooling, and hot water that support more coordinated transition strategies. In addition, the research complements the building- and community-scale decarbonization work (R.19-10-005) of EPIC by exploring thermal approaches that can reduce emissions while lessening electricity demand.

More broadly, this initiative is responsive to CPUC SME-identified priorities related to water heating and space conditioning,⁶⁰ which collectively represent a substantial share of building energy use in California. By focusing on scalable thermal solutions that can serve both needs at the community level, this initiative will conduct relevant research to guide planning, program design, and implementation.

⁶⁰ CPUC SMEs identified water heating and space conditioning as priority area needs for Gas R&D investment at the PICG RD&D Meeting held December 5, 2025.

Identified Need

California has a significant opportunity to recover low-grade waste heat from commercial and industrial sources, including in areas where those same sectors also drive concentrated electricity demand that strains the local electricity grid. This dynamic is becoming more pronounced with the rapid growth of data centers and other large-load facilities, which are power- and water-intensive⁶¹ and typically expel excess heat into the community. A scalable, community-based approach is needed to convert these challenges into beneficial outputs for ratepayers. To that end, this initiative seeks to convert unused heat resources into reliable, affordable space conditioning and domestic hot water for nearby buildings. Communities benefit from reduced waste heat, less strain on the grid, reduced peak demand, avoided gas combustion, cost efficiencies, and better local air quality and health outcomes.

Unlike most building-by-building heat pump installations, TENs connect multiple buildings and thermal resources through a shared system. This shared system allows energy to be transferred, stored, and used highly efficiently across diverse loads and applications, from small residential to multifamily, mixed-use, and commercial and institutional buildings. By linking energy sources to various types of loads — including cooling, hot water, thermal storage, and waste heat — TENs can enable load balancing, increase heat pump efficiency, and make better use of storage and heating, ventilation, and air-conditioning equipment compared to standalone building systems.

TENs established nationally and worldwide have successfully demonstrated district-scale heat reuse with heat pumps distributed throughout the network to raise recovered water temperatures to levels suitable for district heating, offering a proven model that can be adapted for California neighborhoods, as applicable.

This research is critical, as California lacks the analytical tools and technoeconomic analyses needed to evaluate where and how TENs can be deployed to deliver space and water heating effectively, affordably, and equitably. Developing these findings is especially important to communities facing growing electric loads, utility infrastructure constraints, and challenges associated with transitioning the gas system. Furthermore, this research will assess the varying network configurations, system performance, community-scale costs and benefits, environmental impacts, and implementation considerations specific to California communities.

This initiative will help address several statewide challenges by making use of waste heat emitted from large commercial and industrial facilities to benefit nearby communities, reducing fossil gas use for space conditioning and hot water, and assessing the value of TENs as a strategic tool in advancing zonal electrification. California-specific research to evaluate technical feasibility, costs, environmental impacts, grid integration, and use case opportunities will be critical to optimizing the potential benefits of TENs for California ratepayers. Use of ratepayer funding for this research supports an independent, transparent, public-interest

⁶¹ Besic, Ashley. July 2024. [Building Decarbonization Meets Water Conservation: The Potential of Thermal Energy Networks to Cool Buildings & Save Water](https://buildingdecarb.org/resource/water-smart-building). Building Decarbonization Coalition. <https://buildingdecarb.org/resource/water-smart-building>.

assessment that builds on efforts in the United States⁶² and internationally⁶³ while producing California-specific, publicly accessible design standards and tools.

This initiative will build on earlier proposed CEC Gas R&D research related to geothermal and TEN systems while seeking to complement and advance those efforts. For example, the Networked Geothermal Heat Pumps Initiative proposed in the CEC's FY 2025–26 Gas Budget Plan⁶⁴ focuses on shallow ground temperature geothermal loops for space heating and cooling. This initiative complements that proposed effort by focusing on waste heat recovery from large facilities, higher-temperature loops, water heating, and, in addition to geothermal borefields, other thermal storage methods. Key areas of research under this initiative may cover:

- **Dual-loop configurations:** Research could assess systems that combine a low-temperature geothermal loop (as studied in the FY 25–26 proposal referenced above) with a higher-temperature reclaimed heat loop, particularly for applications such as domestic hot water and certain thermal industrial loads.
- **Multi-resource networks:** Research could evaluate network designs that combine multiple thermal resources, such as geothermal and waste heat. Various operating strategies could also be explored to optimize load diversity, appropriately size borefields or capacity of other storage methods, reduce heat pump temperature lift requirements, and expand use-case and siting opportunities, including with DVCs.

⁶² Con Edison projects in New York, the Chelsea and Rockefeller Center projects, are both TEN projects in early design phases that do not include borefields (geothermal), while the Mount Vernon project has incorporated water heating into the design concept. Maryland's BGE proposed project consists of multifamily residential buildings, two community centers, and an ice rink. Eversource's Framingham project is a modular TEN with borefields as the storage method and has showcased great cost improvements in its phased expansion approach.

Con Edison. "[Chelsea Thermal Energy Network](https://www.coned.com/en/our-energy-future/our-energy-vision/where-we-are-going/thermal-energy-networks/chelsea)." <https://www.coned.com/en/our-energy-future/our-energy-vision/where-we-are-going/thermal-energy-networks/chelsea>.

Con Edison. "[Rockefeller Center Thermal Energy Network](https://www.coned.com/en/our-energy-future/our-energy-vision/where-we-are-going/thermal-energy-networks/rockefeller-center)." <https://www.coned.com/en/our-energy-future/our-energy-vision/where-we-are-going/thermal-energy-networks/rockefeller-center>.

Con Edison. "[Mount Vernon Thermal Energy Network](https://www.coned.com/en/our-energy-future/our-energy-vision/where-we-are-going/thermal-energy-networks/mount-vernon-thermal-energy-network)." <https://www.coned.com/en/our-energy-future/our-energy-vision/where-we-are-going/thermal-energy-networks/mount-vernon-thermal-energy-network>.

BGE Communications. August 8, 2025. "[BGE Taps Into an Earth-Friendly Energy Source Proposing a Networked Geothermal System Pilot](https://www.bge.com/news/news-releases/bge-taps-into-an-earth-friendly-energy-source-proposing-a-networked-geothermal-system-pilot)." <https://www.bge.com/news/news-releases/bge-taps-into-an-earth-friendly-energy-source-proposing-a-networked-geothermal-system-pilot>.

Ashmore, Tim and Eric Bosworth. [Eversource Geothermal Framingham Pilot Project](https://ashraeboston.org/images/downloads/Presentations/framingham_geothermal_pilot.pdf). Eversource and CDM Smith. https://ashraeboston.org/images/downloads/Presentations/framingham_geothermal_pilot.pdf.

⁶³ Mijwater 2.0 in Heerlen, the Netherlands, is a district TEN built around a two-pipe spine system with simultaneous warm and cool loops and bidirectional energy exchange.

Brummer, Nichol and Joyce Bongers. July 2019. [Mijwater Heerlen: Roadmap to 2040, Direct Heating and Cooling Grid Parkstad Limburg](https://vb.nweurope.eu/media/10451/heatnetnw_heerlen-transition-roadmap_district-heating.pdf). Interreg North-West Europe, https://vb.nweurope.eu/media/10451/heatnetnw_heerlen-transition-roadmap_district-heating.pdf.

⁶⁴ Horing, Jill and Kaycee Chang. 2025. Energy Research and Development Division. 2025. [Gas Research and Development Program Proposed Budget Plan for Fiscal Year 2025–26](#).

Table 5: Related and Complementary Gas Research on Thermal Energy Networks

Projects	Status
Assessment of California’s Low Temperature Geothermal Resources: Geothermal Heat Pump Efficiencies by Region (2012) ⁶⁵	Completed
Geothermal District Heating (FY 23–24 Budget Plan)	Planned
Networked Geothermal Heat Pumps (FY 25–26 Budget Plan, proposed)	Planned

Source: CEC staff

Proposed Solution

This initiative will evaluate modular thermal energy networks and related potential to provide large-scale space conditioning and water heating through a detailed study, focusing on products such as:

- **A feasibility study and design guide:** A feasibility study and design guide will aim to measure recoverable waste heat near sites with high concentrations of energy use — such as commercial and industrial facilities, data centers, arenas, hospitals, and university and corporate campuses — and evaluate the potential to serve nearby neighborhood demand for space heating, space cooling, and domestic hot water. The guide will establish interface standards for integrating commercial and industrial facilities into TENs. The research will also include:
 - Network architecture evaluation of:
 - Single-loop configurations.
 - Dual-loop configurations that combine a low-temperature ambient or geothermal loop with a high-temperature reclaimed heat loop for domestic hot water and possibly space heating.
 - Other configurations and use cases.
 - Technoeconomic and grid impact analyses to:
 - Evaluate capital and operational costs.
 - Determine the levelized cost of heat for domestic hot water compared with baseline gas and electric hot water systems.
 - Estimate the value of avoided gas line investments in areas identified for long-term transition planning.
 - Assess the potential for peak demand reduction and quantify the related reliability and resilience improvements associated with thermal storage and modular network designs.

The feasibility study will be aligned with the cost-effectiveness requirements established in state law and regulatory proceedings. The study will publicly document how the approach

⁶⁵ Glassley, William, Adam Asquith, Tucker Lance, and Elise Brown. 2012. [Assessment of California’s Low Temperature Geothermal Resources: Geothermal Heat Pump Efficiencies by Region](https://www.energy.ca.gov/2014publications/CEC-500-2014-060/CEC-500-2014-060.pdf). California Energy Commission. Publication Number: CEC-500-2014-060, <https://web.archive.org/web/20190228013024/https://www.energy.ca.gov/2014publications/CEC-500-2014-060/CEC-500-2014-060.pdf>.

avoids duplication with, and is complementary to, the CEC's Networked Geothermal Heat Pumps Initiative, if approved.

- **Site screening tool:** Research funded by this initiative may develop open-source site screening tools that could provide a comprehensive method to identify and evaluate locations that are suitable for TENs. This work could include developing a geographic information systems (GIS)-based tool to score potential sites for thermal energy networks. The tool could consider waste heat availability, feasibility of ambient and geothermal sources, suitability of dual loop configurations, routing considerations, support for DVCs, and opportunities for inclusive community engagement.
- **Technology transfer and market facilitation:** Technology transfer and market facilitation activities will help ensure that the findings of the initiative can be readily adopted by utilities, local governments, community partners, and other implementation partners. This effort could include:
 - Publishing clear technical specifications and procurement templates that support pilots authorized under the state's long-term gas system planning efforts.
 - Hosting design workshops with utilities and local government agencies to build shared understanding and readiness.
 - Identifying workforce readiness considerations needed to support future deployments.

Anticipated Impacts

This initiative will evaluate the net incremental benefits of turning otherwise wasted heat from large commercial and industrial facilities in California into low-carbon thermal services for hot water and space conditioning for priority neighborhoods, particularly where waste heat sources and community demand are colocated. By assessing the potential for California pilot projects, the study will examine the prospects for bill savings, reliability, and resilience benefits for ratepayers. It will also provide to utilities and local governments in California a replicable playbook to deploy TENs that reduce gas distribution investments and electric peak demand.

Benefits will be measured using the EPIC Uniform Impacts Analysis Framework to help attribute impacts to this initiative and track how outputs, such as a design guide and screening tool, support measurable outcomes.

Examples of benefits under this initiative include outcomes that:

- **Increase affordability:** Captures and uses heat that would otherwise be wasted, thereby reducing the need for additional energy procurement and new generation. Community-scale shared thermal infrastructure can enhance efficiencies and lessen energy bill impacts for households, businesses, and other connected customers such as schools, hospitals, or community buildings. Additional savings can be realized when gas distribution investments can be avoided or delayed in neighborhoods that are transitioning away from gas service under long-term planning efforts, lowering ongoing operation and maintenance expenses, and helping keep overall system costs down for all customers.

- **Improve safety:** Reduces combustion inside buildings and lowers reliance on aging gas distribution mains, thereby decreasing the likelihood of leaks, fires, and other combustion-related hazards.
- **Increase reliability:** Provides California-specific analysis of how thermal storage and diversified network configurations, such as dual-loop designs, can reduce peak electrical demand; relieve local grid stress; strengthen overall system resilience in high-load areas, such as those with concentrations of data centers; and support more efficient use of existing energy infrastructure. The research will also identify where and under what conditions TENs may provide the greatest reliability benefits to guide future planning and infrastructure decisions.
- **Improve equity:** Assesses how TENs could support households, businesses, and communities, including expanding access to decarbonized heating, cooling, and hot water, while helping limit additional strain on energy and water systems in neighborhoods that already face high environmental burdens or rapid growth. This approach also promotes more equitable community development by enabling buildings and residents to benefit from efficient shared resources and resilient load diversity.
- **Improve environmental sustainability:** Lowers GHG emissions, reduces harmful air pollutants, and decreases overall water use when compared with conventional heating, cooling, and hot-water technologies. By capturing and reusing waste heat that large facilities release into the environment, TENs can also reduce the amount of water consumed in cooling towers, which are widely used to expel excess heat in industrial and commercial settings. At the community scale, replacing combustion-based methods for producing domestic hot water with efficient alternatives provides a significant reduction in localized emissions and contributes to cleaner air and healthier living conditions for surrounding neighborhoods.

Examples of key metrics include:

- Levelized cost of heat/cooling vs. gas/electric baselines (\$ per million British thermal unit).
- Avoided infrastructure investments (\$ per mile of gas line replacement avoided).
- Utility bill savings.
- Proportion of benefits accruing to DVC customers (percent of total customers in TEN communities).
- Estimated cooling tower water use avoided (gallons of water used per year).

Initiative Title: Cleaner Industry, Healthier Communities

This initiative will advance and demonstrate copollutant removal technologies at existing industrial facilities to reduce criteria air pollutants and deliver measurable near-term public health benefits. Anticipated outputs within the next few years include pilot deployments, performance evaluations, and deployment-relevant data to inform industrial emissions reduction strategies.

Policy Priority

This initiative aligns with CPUC proceedings and California state policies addressing industrial decarbonization, public health, and the energy system transition while filling a critical near-term need. Relevant to the IRP Proceeding (R.20-05-003), the initiative supports evaluation of near-term criteria air pollutant emissions reduction strategies for industrial processes that are difficult to electrify, helping address impacts while electrification pathways mature.

Electrification remains the most promising long-term pathway for industrial decarbonization, but deployment at scale may take decades. This initiative supports the CPUC's Long-Term Gas System Planning Proceeding (R.24-09-012) by providing insights into retrofit-ready criteria air pollutant emissions reduction options for facilities likely to remain on the gas system in the next several years. By focusing on the removal of copollutants, such as particulate matter, sulfur oxides (SO_x), and oxides of nitrogen (NO_x), the work informs cost-effective strategies that improve air quality without extending the useful life of fossil infrastructure.

In addition, the initiative is consistent with California statutes addressing carbon management and emissions reduction pathways, including Senate Bill 905 (Caballero, Chapter 359, Statutes of 2022) and Assembly Bill 209 (Committee on Budget, Chapter 251, Statutes of 2022). It also aligns with CARB's 2022 Scoping Plan, which recognizes a role for point-source carbon management technologies in hard-to-electrify sectors. While this initiative does not fund or advance CO₂ capture itself, many industrial facilities prioritize such approaches because of operational and economic considerations, and this initiative will pair well with these CO₂ management technologies to provide supplemental benefits.

Industrial operators are typically risk-averse, prioritizing uninterrupted operations. As a result, many facilities place point-source CO₂ capture on their decarbonization roadmaps rather than electrification technologies that may require more significant process changes and higher operating costs. This initiative will leverage equipment installed for decarbonization purposes, such as CO₂ capture systems, to enable or integrate with copollutant removal approaches that improve local air quality, aligning climate and public health benefits. During the period while electrification solutions scale and mature, copollutant removal technologies will provide a practical pathway to deliver near-term community health benefits in industrial subsectors that are challenging to electrify.

Overall, the initiative addresses a key policy gap: the lack of deployable, near-term solutions to reducing localized industrial criteria air pollutant emissions while long-term decarbonization pathways continue to scale.

Identified Need

Industrial pollution continues to disproportionately affect DVCs, particularly near heavy industry facilities in the hardest-to-decarbonize industrial subsectors such as cement, steel, and chemicals. These subsectors face technical and economic barriers to rapid electrification, and gas use is expected to persist through at least 2045 under current transition pathways.⁶⁶ While electrification is widely recognized as the most promising long-term decarbonization pathway, rapid adoption is particularly challenging in certain subsectors — such as those

⁶⁶ Neutel, J., A. Berson, S. Saltzer, A. Brandt, J. Weyant, F. Orr, and S. Benson. January 2026. "[What Will It Take to Get to Net-Zero Emissions in California](https://www.sciencedirect.com/science/article/pii/S0301421525003556)." *Energy Policy*, 208. <https://www.sciencedirect.com/science/article/pii/S0301421525003556>.

involving high heat — given technical constraints and the higher cost of electricity compared to that of the fossil gas currently in use for many industrial processes.

Industrial facilities typically make near-term capital investment decisions within 5- to 10-year planning cycles, creating a time-sensitive opportunity to deploy retrofit solutions that can deliver near-term air-quality benefits. Without targeted intervention, these decisions may proceed without incorporating emissions mitigation that can greatly reduce criteria air pollutants (NO_x, SO_x, particulate matter), impacting local air quality. A key need exists in the current R&D landscape to quickly advance retrofit-ready copollutant removal technologies that can be deployed at existing facilities without major redesign. Accordingly, this initiative centers on deployment-ready add-on technologies, low-capital integration into existing systems, and near-term localized air quality benefits.

Importantly, the initiative is intended to support pathways to decarbonization by improving air quality in the hardest-to-electrify subsectors during the clean energy transition while not extending the lifetime or use of fossil-powered infrastructure. It is differentiated from existing IOU and CEC R&D efforts by focusing specifically on copollutant removal as a supplemental strategy to industrial decarbonization and carbon capture, reflecting the need to continue benefitting industry-adjacent communities during the gas transition.

Ratepayer funding is well-aligned with the initiative because it will deliver direct, near-term benefits to individuals and communities through improved air quality and reduced public health burdens. These activities are unlikely to be undertaken by industry alone. For example, while many industrial facilities are deploying carbon dioxide (CO₂) capture systems, they are typically not colocating them with criteria air pollutant removal technologies. This is because these technologies do not directly generate revenue and are not part of compliance requirements. Therefore, this initiative is well-suited for public-interest R&D.

Table 6: Related and Complementary Gas Research on Addressing Industrial Emissions

Projects	Status
Novel Ultra-Low NO _x Boiler, GTI Energy (PIR-14-004)	Completed
Low-Temperature, Efficient Heat Capture, Element 16 Technologies (PIR-17-004)	Completed
Advanced Oxygen Combustion, GTI Energy (PIR-20-007)	Completed
CO ₂ Capture, Mass Energy Works (PIR-24-004)	Active

Source: CEC staff

Proposed Solution

The initiative advances retrofit-ready copollutant removal technologies at existing hardest-to-electrify industrial facilities to reduce NO_x, SO_x, and particulate matter. It targets California’s climate transition by piloting deployable near-term solutions to reduce localized criteria air pollutant emissions from facilities expected to continue operating using gas combustion until later stages of the shift to clean energy. By focusing on add-on criteria air pollutant emissions control systems, the initiative enables emissions reductions without redesigning major processes, extending fossil infrastructure, or requiring expensive upgrades.

The objectives are to identify and demonstrate promising copollutant removal technologies; evaluate criteria air pollutant emissions reduction performance, operational feasibility, and cost-effectiveness; and generate deployment-relevant data for regulators and industry. The initiative is designed not only to validate copollutant removal technologies through pilot demonstrations, but enable broader commercial adoption by reducing performance, cost, and operational uncertainty for industrial operators, regulators, and technology providers. It will demonstrate that copollutant removal technologies can be applied to existing and future systems to improve air quality, thereby strengthening the overall value proposition for the adoption of the technologies.

Near-term outputs could include pilot demonstrations, generation of performance data, and cost analyses. These outputs will support informed decision-making and improve market confidence. This approach ensures that criteria air pollutant emissions control investments made today remain compatible with future decarbonization strategies and can help maximize overall environmental and public health benefits as the energy system evolves.

Over time, successful demonstrations are expected to unlock broader adoption, as reduced uncertainty and validated performance minimize the perceived risk and foster industry-driven deployment. This transition from ratepayer-supported pilots to market-led scaling is a central objective of the initiative. At scale, these deployments could deliver meaningful reductions in cumulative pollution exposure in industry-adjacent communities, improving air quality and public health while complementing long-term decarbonization pathways.

Anticipated Impacts

The initiative delivers net incremental benefits to California gas ratepayers by enabling near-term reductions in harmful criteria air pollutants at the hardest-to-electrify industrial facilities, which are expected to remain on the gas system until the later stages of the clean energy transition. Impacts will be evaluated consistent with the EPIC Uniform Impacts Analysis Framework, as well as guiding principles, including cost-effectiveness, ratepayer benefits, system reliability, public health protection, and support for a prudent and just gas system transition.

The initiative prioritizes low-cost, retrofit-ready solutions that avoid long-lived capital investments and reduce the risk of stranded assets while maintaining uninterrupted industrial operations and producing near-term benefits for local communities. In addition, the initiative generates deployment-relevant performance and cost data to guide regulatory and infrastructure planning while helping catalyze market adoption at scale.

Consistent with Gas R&D Program objectives, the initiative advances cost-effective innovation, equity, and environmental benefits, with success measured by high-efficiency criteria air pollutant emissions reductions and demonstrated pathways for scalable deployment.

Examples of benefits under this initiative include outcomes that:

- **Increase affordability:** Advances cost-effective retrofit solutions that reduce criteria air pollutant emissions without requiring major capital investments or infrastructure changes. By avoiding new system buildout in the near term, the initiative supports prudent, cost-conscious transition planning for ratepayers.

- **Improve safety:** Improves industrial criteria air pollutant emissions control performance and reduces harmful pollutant exposure in surrounding communities while ensuring safe integration into existing operations.
- **Improve equity:** Prioritizes criteria air pollutant emissions reductions in DVCs, including communities identified by CalEnviroScreen and other environmental justice tools, reducing disproportionate pollution burdens and improving local air quality and health outcomes.
- **Improve environmental sustainability:** Delivers near-term reductions in harmful criteria air pollutants while supporting California’s long-term climate goals. The initiative complements industrial and community decarbonization strategies.

Examples of key metrics include:

- Reductions in criteria air pollutants (NO_x, SO_x, particulate matter, tons per year, and percent reduction relative to baseline).
- Number of facilities retrofitted and technologies deployed.
- Cost-effectiveness (\$ per ton of pollutants reduced).
- Reductions in criteria air pollutant exposure in DVCs measured using modeled changes in ambient concentrations and/or population exposure metrics.

Initiative Title: Studying Industrial Process Heat Decarbonization Pathways

This initiative will conduct a paper study to evaluate pathways to decarbonizing medium- and high-temperature industrial process heat and will develop a statewide industrial heat load database to support long-term gas transition planning. Together, these outputs can provide California-specific, decision-relevant insights into costs, infrastructure implications, and system impacts to guide coordinated gas-electric planning and infrastructure investment decisions.

Policy Priority

This initiative aligns with and addresses critical gaps identified in CPUC proceedings and state policy priorities by providing decision-relevant, California-specific analysis needed to support long-term gas transition planning and coordinated gas-electric system decision-making. This initiative directly supports CPUC’s Long-Term Gas Planning Proceeding (R.24-09-012) by evaluating nonpipeline industrial heating alternatives and providing data-driven insights to inform interim actions, long-term transition strategies, and SB 1221 implementation. By developing a statewide industrial heat load database and conducting comparative pathway analysis, the initiative helps operationalize gas system transition planning and supports the identification of priority decarbonization zones and infrastructure strategies.

The initiative supports the IRP Proceeding (R.25-06-019) by evaluating reliable and cost-effective pathways for decarbonizing industrial heat, including impacts on resource adequacy, infrastructure needs, and gas-electric coordination. Outputs will be structured for direct use by the CPUC, CEC, California ISO, and IOUs in planning and regulatory processes.

More broadly, the initiative advances California’s statutory climate goals under Assembly Bill 32 (Núñez, Chapter 488, Statutes of 2006), SB 32, SB 100 (de León, Chapter 312, Statutes of

2018), and the Cap-and-Invest extension⁶⁷ by identifying viable pathways to reduce industrial fossil gas use and associated emissions, particularly in high-temperature applications that are not easily electrified. It also aligns with legislative direction under Assembly Bill 1172 (Calderon, Chapter 360, Statutes of 2023) and Senate Bill 80 (Caballero and McNerney, Chapter 334, Statutes of 2023) and the CEC's mandate under Public Resources Code, § 25401 to evaluate a broad range of energy resources.

Consistent with CPUC SME feedback, this effort is structured as a technology-neutral comparative planning study that evaluates a full range of pathways, including electrification, hydrogen, bioenergy with carbon capture, CCUS-enabled systems, and advanced nuclear technologies (fission and fusion).

This initiative provides direct ratepayer benefits by reducing uncertainty in near-term and long-term infrastructure investment decisions, supporting cost-effective transition strategies, and minimizing the risk of stranded gas and electric assets. California is making long-lived gas and electric system planning decisions, creating a time-sensitive need for integrated analysis that ensures affordability, reliability, and public health outcomes are centered.

Identified Need

The industrial sector consumes roughly one-third of California's fossil gas, relying on it for roughly 90 percent of the sector's heating demand.⁶⁸ Decarbonizing medium- and high-temperature industrial heat (roughly above 300°C) remains one of the most complex challenges in the state's energy transition. Multiple decarbonization pathways exist, including electrification, hydrogen, clean fuels, CCUS, and advanced nuclear technologies. However, there is no comprehensive, California-specific comparative analysis that evaluates these options across cost, infrastructure requirements, scalability, technology readiness, system impacts, and associated public health and environmental impacts.

Existing studies typically focus on individual technologies or provide high-level national or sectoral assessments; they do not link technology pathways to California-specific industrial heat demand, infrastructure constraints, and gas system transition planning needs. This lack of a link creates a critical gap for decision-makers responsible for coordinated gas-electric planning.

In parallel, California is making near-term infrastructure and investment decisions that will shape the energy system for decades. Without integrated, location-specific analysis, there is a risk of inefficient infrastructure investments, misalignment between gas and electric system planning, increased costs to ratepayers, and constraints on future decarbonization pathways. This initiative helps address this gap by developing a statewide industrial heat load database

⁶⁷ Assembly Bill 1207 (Irwin, Chapter 117, Statutes of 2025) and Senate Bill 840 (Limón, Chapter 121, Statutes of 2025) extended California's Cap-and-Invest Program through 2045.

⁶⁸ Aryafar, Hamarz, Karthik Nithyanandam, and Parker Wells. 2024. [Low-Temperature, Efficient Heat Capture to Reduce Natural Gas Consumption in the Industrial Sector](https://www.energy.ca.gov/publications/2025/low-temperature-efficient-heat-capture-reduce-natural-gas-consumption-industrial). California Energy Commission. Publication Number: CEC-500-2025-005. <https://www.energy.ca.gov/publications/2025/low-temperature-efficient-heat-capture-reduce-natural-gas-consumption-industrial>.

Dominguez, J., Umed Paliwal, and Amol Phadke. December 2025. [Integrating Renewable Energy into Industrial Heat Demand: Working Paper \(Draft\)](https://gspp.berkeley.edu/archived/files/page/Integrating_Renewable_Energy_with_Industrial_Heat_Demand_-_V20250101.pdf). https://gspp.berkeley.edu/archived/files/page/Integrating_Renewable_Energy_with_Industrial_Heat_Demand_-_V20250101.pdf.

with sufficient spatial resolution. This database will help identify clusters of industrial facilities that could share infrastructure as well as regions where electrification may be slower to scale.

This initiative is innovative because it evaluates multiple decarbonization pathways within a unified, system-level planning framework that links technology options to infrastructure and geographic characteristics. It complements existing R&D efforts focused on technology development and demonstration by providing the analytical tools and datasets required for coordinated planning and decision-making. The study is technology-neutral and does not advocate for specific decarbonization pathways. Instead, it aims to provide objective, comparative analysis to support informed policy and investment decisions.

This initiative is distinct from and not duplicative of IOU-led efforts, including SoCalGas’s proposed industrial decarbonization research initiative. This initiative is analytical and strategic, focused on conducting a comparative, system-level evaluation of decarbonization pathways for high-temperature industrial process heat to guide long-term planning and policy decisions. In contrast, the SoCalGas initiative is primarily technology-specific and demonstration-oriented, with an emphasis on developing and piloting equipment, controls, and emissions-reduction solutions at the facility level. This initiative provides complementary value to the SoCalGas initiative by generating the foundational datasets, comparative analysis, and planning-focused insights helpful for guiding future infrastructure and investment decisions, while SoCalGas’s efforts focus on near-term technology development and deployment.

Depending on the relative timing of the two efforts, findings from this study could help inform prioritization and scaling of technology development and deployment. Conversely, insights from the SoCalGas initiative could inform and strengthen the comparative analysis. The CEC plans to coordinate with SoCalGas on implementing these initiatives.

Public-interest ratepayer funding is appropriate because this type of cross-sector, system-level planning analysis is unlikely to be undertaken by private industry, as it does not generate direct commercial returns and requires coordination across multiple public agencies and interested parties. The initiative directly supports CPUC and IOU planning processes, enabling more cost-effective and reliable infrastructure decision-making.

Table 7: Related and Complementary Gas Research on Industrial Decarbonization

Projects	Status
Novel Ultra-Low NOx Boiler, GTI Energy (PIR-14-004)	Completed
Low Temperature, Efficient Heat Capture, Element 16 Technologies (PIR-17-004)	Completed
Advanced Oxygen Combustion, GTI Energy (PIR-20-007)	Completed
CO2 Capture, Mass Energy Works (PIR-24-004)	Active

Source: CEC staff

Proposed Solution

To address the gaps discussed above, this initiative will conduct a structured comparative planning study of multiple technology pathways for serving and decarbonizing medium- and high-temperature industrial process heat needs. The study will evaluate decarbonization pathways, including electrification, clean fuels (such as biofuels and hydrogen), CCUS-enabled

systems, bioenergy with carbon capture, and advanced nuclear fission and fusion technologies, within a consistent, technology-neutral analytical framework. The analysis will explicitly evaluate trade-offs across pathways in terms of cost, infrastructure requirements, scalability, technology readiness, system impacts, and associated public health and environmental impacts.

A core component of the initiative is the development of a statewide industrial heat load database that maps facility locations, temperature requirements, and sector-specific demand characteristics. The database will provide sufficient resolution to identify industrial clusters that may enable shared infrastructure and cost reductions, and regions where electric grid constraints (at the generation, transmission, or distribution level) may limit electrification pathways. The database will also enable analysis of industrial heat demand in relation to DVCs, supporting assessment of localized community and public health impacts.

The study will evaluate cost-effectiveness and system impacts across pathways, including infrastructure implications for gas and electric systems; impacts on electric load growth, peak demand, and system reliability; implications for renewable integration and system reliability; and environmental justice and community-level impacts. The initiative is designed to produce decision-support outputs, not just analysis. Results will be structured for direct applicability to CPUC proceedings, IOU planning, and state agency coordination, including identification of priority decarbonization zones, infrastructure constraints and needs, and scenarios for sequencing investments across sectors. The study will also help identify candidate pathways and locations for future demonstration or deployment programs, providing a bridge between planning and implementation.

Anticipated Impacts

This initiative indirectly provides net incremental benefits to California gas ratepayers by generating foundational, decision-relevant data and analysis for industrial heat decarbonization that would not occur without Gas R&D Program funding. Impacts will be consistent with Gas R&D Program priorities, including cost-effectiveness, ratepayer benefits, system reliability, and public and environmental health protection. Deliverables will provide support for a prudent and just gas system transition, and benefits will be measured using the EPIC Uniform Impacts Analysis Framework. By developing a statewide industrial heat load database and conducting a comparative pathway analysis, the initiative will enable more informed and coordinated gas-electric system planning.

The intent of this initiative to advance affordability, reliability, environmental sustainability, and equity through data-driven planning insights further aligns with the guiding principles as well. The initiative supports more cost-effective infrastructure planning by identifying least-cost pathways and helping avoid unnecessary or misaligned investments, reducing the risk of stranded gas and electric assets.

Examples of benefits under this initiative include outcomes that:

- **Increase affordability:** Enables identification of least-cost decarbonization pathways and helps to avoid inefficient infrastructure investments. By informing coordinated gas-electric planning, the initiative helps minimize near- and long-term costs to ratepayers.

- **Improve safety:** Prioritizes safer system configurations by informing gas system transition strategies that reduce reliance on aging infrastructure and enable more strategic system planning.
- **Increase reliability:** Supports coordinated planning to maintain reliable energy service during the transition by evaluating how different pathways affect electric load growth, peak demand, and system resilience.
- **Improve equity:** Informs equitable transition planning by assessing localized air quality and public health benefits associated with different decarbonization pathways, particularly in DVCs near industrial facilities.
- **Improve environmental sustainability:** Advances sustainability by identifying pathways that reduce fossil gas use, GHG emissions, and criteria air pollutants, supporting California’s long-term climate and air quality goals.

Examples of key metrics include:

- Priority decarbonization zones and industrial clusters suitable for shared infrastructure development identified, measured by related geographic extent (for example, count of zones or clusters and mapped acreage or facility density).
- Estimated avoided or optimized infrastructure investments under alternative decarbonization pathways, measured in dollars (for example, avoided or deferred capital expenditures).
- Modeled reductions in fossil gas use (for example, million British thermal units or therms) and associated emissions (for example, metric tons of CO₂e emissions) under different scenarios.
- Modeled impacts on electric load growth (for example, peak demand in megawatts and annual consumption in MWh) and system reliability (for example, reserve margins (percentage) or load variability) under different scenarios.
- Number of linkages of the database and analytical outputs into CPUC, IOU, CEC, and California ISO planning processes.

Equity Benefits of Proposed Initiatives

The DACAG developed an Equity Framework to ensure that equity is centered in climate-related policies and programs administered by the CEC and CPUC.⁶⁹ The CEC applies the DACAG Equity Framework across its research programs to help guide R&D investments and program implementation in a manner that advances equity. Table 8 shows the application of the DACAG Equity Framework in CEC Gas R&D initiatives by illustrating the potential direct and indirect benefits of the initiatives. The framework outlines the key equity-related considerations for state investments and interventions, including (1) nonenergy benefits; (2) affordability; (3) access, outreach, and education; (4) community engagement; (5) health and safety; (6) financial benefits and economic development; and (7) workforce development. (See

⁶⁹ California Disadvantaged Communities Advisory Group. [California Disadvantaged Communities Advisory Group \(DACAG\) Equity Framework: 2024 Update](https://www.cpuc.ca.gov/-/media/cpuc-website/divisions/energy-division/documents/infrastructure/disadvantaged-communities/2024-dacag-equity-framework.pdf). <https://www.cpuc.ca.gov/-/media/cpuc-website/divisions/energy-division/documents/infrastructure/disadvantaged-communities/2024-dacag-equity-framework.pdf>.

Appendix E for definitions of these considerations.) Direct impacts are expected as a direct result of project implementation, whereas indirect impacts are expected from research and technology innovation advancements more broadly.

The equity framework also includes consumer protection, which is not applicable to the Gas R&D Program and is therefore not reflected in the table. Metrics, evaluation, and accountability are also in the framework and apply across all initiatives. Each initiative in the budget plan includes examples of metrics for consideration, which will be refined through the solicitation development process and incorporated, as appropriate, during agreement development and project administration. Transparency and accountability are advanced by establishing a basis for monitoring and evaluating whether intended equity benefits are achieved.

Table 8: FY 2026–2027 Gas R&D Plan Equity Framework Matrix

R&D Initiative	Gas Network Decommissioning Pathways to Scale Infrastructure Retirement	Advancing Cost-Effective Methane Emissions Monitoring for California’s Gas System	Strategic Assessment of Cost-Effective Seasonal Energy Storage Pathways	Optimizing Thermal Energy Networks for Decarbonization	Cleaner Industry, Healthier Communities	Studying Industrial Process Heat Decarbonization Pathways
Non-Energy Benefits	Indirect	Direct	Indirect	Indirect	Direct	Indirect
Affordability	Indirect	Indirect	Indirect	Indirect	Indirect	Indirect
Access, Outreach, and Education	Direct	Direct	Direct	Direct	Direct	Direct
Community Engagement	Direct	Direct	Indirect	Direct	Indirect	Indirect
Health and Safety	Indirect	Direct	Indirect	Indirect	Direct	Indirect
Financial Benefits and Economic Development	Indirect	Indirect	Indirect	Indirect	Indirect	Indirect
Workforce Development	Indirect	Indirect	Indirect	Indirect	Indirect	Indirect

Source: CEC staff

Next Steps

Upon CPUC review and approval of this Proposed 2026–27 Gas R&D Budget Plan, CEC staff will begin conducting additional research scoping. Scoping activities may include, but are not limited to, hosting public workshops, conducting literature reviews, and engaging with interested parties to further develop the approved initiatives into competitive grant solicitations.⁷⁰ A public preapplication workshop will be held for each solicitation to discuss and clarify the purpose, eligibility, project requirements, and scoring criteria with potential applicants. Once projects are selected through the solicitation process, CEC staff will present the prospective awards for approval at a CEC business meeting. Project summaries will be maintained for public access on CEC’s Energize Innovation website, and final reports for completed projects will be published on CEC’s publication website.⁷¹

⁷⁰ California Energy Commission. “[Solicitations](https://www.energy.ca.gov/funding-opportunities/solicitations),” <https://www.energy.ca.gov/funding-opportunities/solicitations>.

⁷¹ Energize Innovation. “[Project Showcase](https://www.energizeinnovation.fund/projects).” California Energy Commission, <https://www.energizeinnovation.fund/projects>.

California Energy Commission. “[Energy Commission Publications](https://www.energy.ca.gov/resources/publications/energy-commission-publications),” <https://www.energy.ca.gov/resources/publications/energy-commission-publications>.

List of Terms/Glossary

Term	Definition
AB	Assembly Bill
California ISO	California Independent System Operator
CARB	California Air Resources Board
CCAC	Central California Asthma Collaborative
CCUS	Carbon capture, utilization, and storage
CEC	California Energy Commission
CO ₂	Carbon dioxide
COVID	Coronavirus disease
CPUC	California Public Utilities Commission
DACAG	Disadvantaged Communities Advisory Group
DVC(s)	Disadvantaged Vulnerable Community(ies)
ED	Energy Division (CPUC)
EPIC	Electric Program Investment Charge
ERDD	Energy Research and Development Division
ESJ	Environmental and Social Justice
IRP	Integrated resource plan
FY	Fiscal year
Gas Decarb OIIP	CEC's Gas Decarbonization Order Instituting Informational Proceeding
GHG	Greenhouse gas
GW	Gigawatt
IEPR	Integrated Energy Policy Report
IOU	Investor-owned utility
JAEDI	Justice Access Equity Diversity Inclusion
LDES	Long-duration energy storage
MWh	Megawatt-hour
NO _x	Oxides of nitrogen
PAO+	Office of the Public Advisor, Energy Equity, and Tribal Affairs
PG&E	Pacific Gas and Electric
PICG	Policy + Innovation Coordination Group
PIER	Public-Interest Energy Research
PSRLA	Physicians for Social Responsibility Los Angeles

Term	Definition
R&D	Research and development
RD&D	Research, development, and demonstration
TEN(s)	Thermal energy network(s)
SB	Senate Bill
SME	Subject-matter expert
SoCalGas	Southern California Gas Company
SOx	Sulfur oxides

For additional information on commonly used energy terminology, see the following industry glossary links:

- [California Air Resources Board Glossary](https://ww2.arb.ca.gov/about/glossary), available at <https://ww2.arb.ca.gov/about/glossary>
- [California Energy Commission Energy Glossary](https://www.energy.ca.gov/resources/energy-glossary), available at <https://www.energy.ca.gov/resources/energy-glossary>
- [California Public Utilities Commission Glossary of Acronyms and Other Frequently Used Terms](https://www.cpuc.ca.gov/glossary/), available at <https://www.cpuc.ca.gov/glossary/>

California Native American tribes: Per Public Resources Code, § 21073: “California Native American Tribe means a Native American Tribe located in California that is on the contact list maintained by the Native American Heritage Commission.” The Native American Heritage Commission maintains a list of contacts among California Native American tribes for Chapter 905 of the Statutes of 2004 and the California Environmental Quality Act.⁷²

Carbon capture, utilization, and storage (CCUS): The capturing carbon dioxide, either from a concentrated stream or from the atmosphere, then containing it for further use or storage.

Carbon dioxide (CO₂): A naturally occurring gas, CO₂, also referred to as carbon, is also a by-product of burning fossil fuels (such as oil, gas, and coal), burning biomass, land-use changes, and industrial processes (for example, cement production). It is the principal anthropogenic GHG that affects the Earth’s radiative balance. It is the reference gas against which other GHGs are measured and therefore has a global warming potential of 1.

Carbon dioxide equivalent (CO₂e) emissions: The amount of CO₂ emissions that would cause the same integrated radiative forcing or temperature change, over a given time horizon, as an emitted amount of another GHG or a mixture of GHGs. There are several ways to compute such equivalent emissions and choose appropriate time horizons. Most typically, the CO₂e emission is obtained by multiplying the emission of a GHG by the respective global warming potential for a 100-year time horizon. For a mix of GHGs, it is obtained by summing the CO₂e emissions of each gas.

⁷² California Energy Commission. February 2024. [California Energy Commission Tribal Consultation Policy](https://www.energy.ca.gov/publications/2024/california-energy-commission-tribal-consultation-policy). <https://www.energy.ca.gov/publications/2024/california-energy-commission-tribal-consultation-policy>.

Carbon neutrality: Carbon dioxide and other GHG emissions generated by sources such as transportation, power plants, and industrial processes must be less than or equal to the amount of carbon dioxide that is stored, both in natural sinks such as forests and mechanical sequestration such as carbon capture and sequestration. Executive Order B-55-18 established a target for California to achieve carbon neutrality by 2045 and maintain net negative emissions thereafter. For more information, see the CARB Carbon Neutrality web page.

Climate: Climate is the average course or condition of the weather at a place, usually over a period of years, as exhibited by temperature, wind velocity, and precipitation. The classical period for averaging these variables is 30 years, as defined by the World Meteorological Organization. Climate, in a wider sense, is the state, including a statistical description, of the climate system.

Climate change: Climate change refers to a change in the state of the climate that can be identified (for example, by using statistical tests) by changes in the mean or variability (or both) of its properties and that persists for an extended period, typically decades or longer. Climate change may be due to natural internal processes or external forcings such as modulations of the solar cycles, volcanic eruptions, and persistent anthropogenic (human-induced) changes in the composition of the atmosphere or in land use. Anthropogenic climate change is defined by the human impact on Earth's climate, while natural climate changes are the natural climate cycles that have been and continue to occur throughout Earth's history. Anthropogenic climate change is directly linked to the amount of fossil fuel burning, aerosol releases, and land alteration from agriculture and deforestation.

Decarbonization: The process by which countries, individuals, or other entities aim to reduce or achieve zero fossil carbon emissions. This process typically refers to a reduction of the carbon emissions associated with electricity, industry, and transport. Decarbonization involves increasing the share of no- or low-carbon energy sources (renewables such as solar and wind) and decreasing the use of fossil fuels.

Decommissioning: Retiring portions of fossil gas infrastructure to reduce the costs and environmental impact of maintaining and operating the fossil gas system.

Demand flexibility: The ability of customers to reduce or increase load in response to grid conditions, usually through a proxy price signal or system operator or utility signal and facilitated by automation.

Disadvantaged community: Disadvantaged communities refer to the areas throughout California that most suffer from a combination of economic, health, and environmental burdens. These burdens include poverty, high unemployment, air and water pollution, the presence of hazardous wastes, as well as a high incidence of asthma and heart disease. One way that the state identifies these areas is by collecting and analyzing information from communities all over the state. CalEnviroScreen, an analytical tool created by the California Environmental Protection Agency, combines different types of census tract-specific information into a score to determine which communities are the most burdened or "disadvantaged." For more information, see the California Office of Environmental Health Hazard Assessment's CalEnviroScreen web page.

Disadvantaged Vulnerable Community: In the climate adaptation context, the CPUC defines disadvantaged vulnerable communities as those in the 25 percent highest scoring census tracts according to the California communities Environmental Health Screening Tool (CalEnviroScreen); as well as all California tribal lands, census tracts with median household incomes less than 60 percent of state median income; and census tracts that score in the highest 5 percent of Pollution Burden within CalEnviroScreen, but do not receive an overall CalEnviroScreen score due to unreliable public health and socioeconomic data.

Disadvantaged Communities Advisory Group (DACAG): The Clean Energy and Pollution Reduction Act of 2015 (also known as Senate Bill [SB] 350) called upon the CPUC to help improve air quality and economic conditions in disadvantaged communities by, for example, changing the way the state plans the development and future operations of power plants and rethinking the location of clean energy technologies to benefit burdened communities. In addition, SB 350 required the CPUC and the CEC to create a group representing disadvantaged communities to advise the agencies in understanding how energy programs impact these communities and could be improved to benefit these communities. For more information, see the CEC and CPUC DACAG web pages.⁷³

Distributed energy resource(s): Distributed energy resources are any resource with a first point of interconnection of a utility distribution company or metered subsystem.

Distributed energy resources include:

- Demand response, which has the potential to be used as a low-GHG, low-cost, price-responsive option to help integrate renewable energy and provide grid-stabilizing services, especially when several distributed energy resources are used in combination and opportunities to earn income make the investment worthwhile.
- Distributed renewable energy generation, primarily rooftop photovoltaic energy systems.
- Vehicle-grid integration, or all the ways plug-in electric vehicles can provide services to the grid, including coordinating the timing of vehicle charging with grid conditions.
- Energy storage in the electric power sector to capture electricity or heat for use later to help manage fluctuations in supply and demand.

Electric Program Investment Charge (EPIC): The CEC's EPIC Program invests in scientific and technological research to accelerate the transformation of the electricity sector to meet the state's energy and climate goals. Investments of about \$150 million annually support research and development in renewable energy, energy storage, electric system resilience, and electric technologies for buildings, businesses, and transportation. For more information, see the CEC EPIC web page and the CPUC Energy Research, Development, and Deployment web page.

End use: Final applications for which energy is ultimately used, such as heating, power generation, or transportation, or a combination.

⁷³ California Energy Commission. "[Disadvantaged Communities Advisory Group \(DACAG\)](https://www.energy.ca.gov/about/campaigns/equity-and-diversity/disadvantaged-communities-advisory-group)." <https://www.energy.ca.gov/about/campaigns/equity-and-diversity/disadvantaged-communities-advisory-group>.

Environmental and Social Justice (ESJ) Communities: Term defined by CPUC’s ESJ Action Plan 2.0 as predominantly communities of color or low-income communities that are underrepresented in the policy setting or decision-making process, subject to a disproportionate impact from one or more environmental hazards, and are likely to experience disparate implementation of environmental regulations and socioeconomic investments in their communities. This definition targets Disadvantaged Communities, defined as census tracts that score in the top 25 percent of CalEnviroScreen 3.0, all tribal lands, low-income households, and low-income census tracts.

Energy efficiency: Energy efficiency means adapting technology to meet consumer needs while using less energy. The CEC adopts energy efficiency standards for appliances and buildings, which reduces air pollution and saves consumers money. The CPUC regulates ratepayer-funded energy efficiency programs and works with the investor-owned utilities, other program administrators, and vendors to develop programs and measures to transform technology markets within California using ratepayer funds. For more information, see the CEC Energy Efficiency web page and the CPUC Energy Efficiency web page.

Equity (energy equity): Energy equity is the principle of fairness in burden sharing and is a basis for understanding how the impacts and responses to climate change, including costs and benefits, are distributed in and by society in more or less equal ways. It is often aligned with ideas of equality, fairness, and justice and applied with respect to equity in the responsibility for, and distribution of, climate impacts and policies across society, generations, and gender, and in the sense of who participates and controls the processes of decision-making.

Gas end uses: Final applications of gas for energy use, such as heating, power generation, or transportation, or a combination.

Gas system decommissioning: Gas system decommissioning refers to retiring or discontinuing portions of the gas distribution system when customers in a defined area can be served by non-gas energy solutions such as electrification, while maintaining safe and reliable energy service.

Greenhouse gas (GHG): GHGs are those gaseous constituents of the atmosphere, natural and anthropogenic, that absorb and emit radiation at specific wavelengths within the spectrum of terrestrial radiation emitted by the Earth’s surface, the atmosphere itself, and clouds. This property causes the greenhouse effect. Water vapor, carbon dioxide, nitrous oxide, methane, and ozone are the primary GHGs in the Earth’s atmosphere. Moreover, there are several entirely human-made GHGs in the atmosphere, such as the halocarbons and other chlorine- and bromine-containing substances, dealt with under the Montreal Protocol. Besides carbon dioxide, nitrous oxide, and methane, the Kyoto Protocol deals with the GHGs sulfur hexafluoride, HFCs, and perfluorocarbons. In response to Assembly Bill 32 (California Global Warming Solutions Act of 2006), the definition of GHGs defined in Health and Safety Code Section 38505 includes nitrogen trifluoride in addition to those defined under the Montreal and Kyoto Protocols.

Investor-owned utility (IOU): Investor-owned utilities provide transmission and distribution services to all electric and/or gas customers in their service territory. For electric service, the utilities also provide generation service for “bundled” customers, while “unbundled” customers receive electric generation service from an alternate provider, such as

a community choice aggregator. California's large IOUs include: Pacific Gas and Electric, Southern California Edison, San Diego Gas & Electric, Southern California Gas, and Southwest Gas.

Low-income communities: Communities within California census tracts with median household incomes at or below either of the following levels: 1) 80 percent of the statewide median income or 2) the applicable low-income threshold listed in the state income limits updated by the Department of Housing and Community Development and filed with the Office of Administrative Law under subdivision (c) of Section 50093 of the Health and Safety Code.

Methane: Methane, also known as CH₄, is one of the six GHGs to be mitigated under the Kyoto Protocol and is the major component of natural gas. Methane emissions also occur as a result of dairy and livestock operations and disposal of organics in landfills. Methane is considered a short-lived climate pollutant because it remains in the atmosphere for a shorter period than carbon dioxide. Unlike carbon dioxide, which lasts for about 100 years in the atmosphere, reductions of methane can create a relatively quick reduction in global warming.

Sustainability: A dynamic process that guarantees the persistence of natural and human systems equitably.

Thermal energy networks: Thermal energy networks, or TENs, use a shared network of water-filled pipes that transfer heat in and out of buildings. These neighborhood-scale systems allow buildings to exchange heat with a number of energy sources, such as lakes and rivers, energy-intensive buildings, wastewater systems, or the stable temperature of the earth (Source: Building Decarbonization Coalition)

Utility: An organization supplying the community with electricity, gas, water, or sewerage.



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APPENDIX A: Policies and Proceedings Supported by FY 2026–27 Gas R&D Program Theme and Initiative

June 2026 | CEC-500-2026-014

APPENDIX A:

Policies and Proceedings Supported by FY 2026–27 Gas R&D Program Theme and Initiative

Theme: Gas System Integrity

Initiative: Gas Network Decommissioning Pathways to Scale Infrastructure Retirement

- [California Public Utilities Commission \(CPUC\) Long-Term Gas Planning Rulemakings](#) (R.20-01-007, R.24-09-012) establish policies, processes, and rules to ensure safe and reliable gas systems in California and to perform long-term gas system planning. The [2024 Joint Agency Staff Paper: Progress Towards a Gas Transition](#) (2024) identifies a role for coordinated zonal electrification and gas decommissioning as part of managing the gas transition.
- [CPUC Rulemaking on Building Decarbonization](#) (R.19-01-011) examines policies, programs, rules, and rates needed to advance building decarbonization. Coordinated large-scale gas infrastructure decommissioning can help align declining gas demand with electrification.
- [CPUC Rulemaking on Renewal of the Electric Program Investment Charge Program](#) (R.19-10-005) establishes strategic objectives for the EPIC Program, including the coordinated role of gas, which can be informed by identifying where and how gas infrastructure can be retired cost-effectively as electrification expands and gas demand declines.
- [Senate Bill 1221 \(Min, Chapter 602, Statutes of 2024\)](#) requires the CPUC to designate priority neighborhood decarbonization zones on the gas distribution system and to establish a voluntary program to facilitate the cost-effective decarbonization of priority neighborhood decarbonization zones, not to exceed 30 pilot projects across the state.
- [Assembly Bill 3232 \(Friedman, Chapter 373, Statutes of 2018\)](#) directed the California Energy Commission (CEC) to develop a [California Building Decarbonization Assessment](#) (2021), which analyzes scenarios to reduce greenhouse gas (GHG) emissions by at least 40 percent by 2030 and identifies several strategies that will lead to significant GHG emission reductions.
- [SB 350 \(de León, Chapter 547, Statutes of 2015\)](#) is a driving policy for advancing equity in California’s clean energy transformation. As outlined in SB 350, the CEC co-established the Disadvantaged Communities Advisory Group (DACAG) with the CPUC to advise the CEC and the CPUC on ways to help environmental and social justice communities benefit from proposed clean energy and pollution reduction programs, expand access to clean energy technologies, and receive affordable energy services.

Theme: Decarbonization

Initiative: Advancing Cost-Effective Methane Emissions Monitoring for California's Gas System

- [CPUC Methane Leak Abatement Rulemaking](#) (R.15-01-008) adopted rules and procedures for CPUC-regulated gas pipeline facilities to minimize natural gas leaks, reduce safety hazards, and advance greenhouse gas emissions goals.
- [CPUC Long-Term Gas Planning Rulemakings](#) (R.20-01-007, R.24-09-012) establish policies, processes, and rules to ensure safe and reliable gas systems in California and to perform long-term gas system planning. The [2024 Joint Agency Staff Paper: Progress Towards a Gas Transition](#) (2024) outlines interagency coordination to develop strategic plans for reducing fossil gas demand and planning for the future of the gas system by evaluating actions that can reduce rate and bill impacts while also ensuring safe and reliable operation of the gas system, supporting public health, and prioritizing disadvantaged communities.
- [Assembly Bill 1496 \(Thurmond, Chapter 604, Statutes of 2015\)](#) requires the state to monitor methane hotspots.
- [CPUC Rulemaking on Building Decarbonization](#) (R.19-01-011) examines policies, programs, rules, and rates needed to advance building decarbonization. Coordinated large-scale gas infrastructure decommissioning can help align declining gas demand with electrification.
- [California Air Resources Board's \(CARB's\) Short-Lived Climate Pollutant Reduction Strategy](#) recommends actions to reduce emissions of short-lived climate pollutants, including from dairies, organics disposal, and wastewater.
- [Senate Bill 1371 \(Leno, Chapter 525, Statutes of 2014\)](#) requires reporting and mitigation of emissions from CPUC-regulated gas pipeline facilities. The bill requires gas corporations to file a report summarizing utility leak management practices, a list of new gas leaks by grade, a list of open leaks that are being monitored or are scheduled to be repaired, and a best estimate of gas loss due to leaks.
- [Senate Bill 1383 \(Lara, Chapter 395, Statutes of 2016\)](#) requires reductions in statewide emissions of methane by 40 percent, hydrofluorocarbon gases by 40 percent, and anthropogenic black carbon by 50 percent below 2013 levels by 2030.
- [2022 Scoping Plan for Achieving Carbon Neutrality](#) by the CARB lays out a plan to achieve carbon neutrality by 2045 and identifies renewable hydrogen produced through electrolysis or from biomethane as an alternative to fossil fuels in the transportation, buildings, industry, and electricity sectors.
- [Assembly Bill 32 \(Nuñez, Chapter 488, Statutes of 2006\)](#) established California's overarching framework for reducing statewide GHG emissions and [Senate Bill 32 \(Pavley, Chapter 249, Statutes of 2016\)](#) extended that framework by setting a 2030 target of 40 percent below 1990 emissions levels. Improving measurement and

mitigation of methane emissions will support statewide climate targets and reduce short-lived climate pollutants.

Initiative: Strategic Assessment of Cost-Effective Seasonal Energy Storage Pathways

- [CPUC Long-Term Gas Planning Rulemakings](#) (R.20-01-007, R.24-09-012) establish policies, processes, and rules to ensure safe and reliable gas systems in California and to perform long-term gas system planning. Identifying seasonal storage pathways can accelerate the gas transition through strengthening electric-gas coordination, reducing reliance on gas for seasonal reliability, and minimizing stranded costs.
- [Integrated Resource Planning and Long-Term Procurement Plan](#) (R.20-05-003, R.25-06-019) guides electric procurement planning to maintain reliability and achieve GHG reductions cost-effectively. Integrating seasonal storage into planning can sustain reliability while reducing peak gas use.
- [CPUC Rulemaking on Renewal of the Electric Program Investment Charge Program](#) (R.19-10-005) establishes strategic objectives for the EPIC Program. Addressing seasonal supply-demand gaps can complement EPIC's electrification and distributed energy resource investments by informing opportunities to improve long-term system cost-effectiveness.
- CPUC's [Environmental and Social Justice Action Plan](#) calls for the CPUC to prioritize disadvantaged communities in clean energy planning and investment and the [DACAG Priorities](#) both emphasize ensuring that disadvantaged communities benefit from clean energy programs with particular attention to affordability, access, health, and safety. Assessing seasonal energy storage technologies and pathways this initiative can help identify options that support reliable, cost-effective decarbonization while informing equitable long-term planning for communities that are often most vulnerable to energy cost increases and system reliability risks.
- [Senate Bill 100 \(de León, Chapter 312, Statutes of 2018\)](#) requires 60 percent of retail sales of electricity be generated from eligible renewable energy resources by 2030 and all retail sales of electricity be renewable or zero-carbon by 2045, underscoring the need to identify seasonal storage solutions that can help balance renewable variability and maintain reliability as electrification expands.

Initiative: Optimizing Thermal Energy Networks for Decarbonization

- [CPUC Long-Term Gas Planning Rulemakings](#) (R.20-01-007, R.24-09-012) and [Joint Agency Staff Paper: Progress Towards a Gas Transition](#) (2024) outline interagency coordination to develop strategic plans for reducing fossil gas demand and planning for the future of the gas system.
- [Senate Bill 1221 \(Min, Chapter 602, Statutes of 2024\)](#) directs the CPUC to evaluate the costs and benefits of thermal energy networks and identify potential implementation barriers. Additionally, it authorizes CPUC to relieve the gas utilities' obligation to serve locations where a zero-emission energy alternative (including thermal energy network)

pilot project has been implemented if CPUC determines that adequate substitute energy service is reasonably available to support the energy end uses of affected gas customers.

- [Assembly Bill 3232 \(Friedman, Chapter 373, Statutes of 2018\)](#) directed the CEC to develop a [California Building Decarbonization Assessment](#) (2021), which analyzes scenarios to reduce GHG emissions by at least 40 percent by 2030 and identifies several strategies that will lead to significant GHG emission reductions.
- [Integrated Energy Policy Report Volume 1: Building Decarbonization](#) (2021) includes recommendations to accelerate decarbonization of buildings in California.
- [The California Energy Code](#) (Title 24, Part 6) is a component of the California Building Standards Code, updated every three years through the collaborative efforts of state agencies, including the California Building Standards Commission and the CEC. The Code ensures that new and existing buildings achieve energy efficiency and preserve outdoor and indoor environmental quality through the use of the most energy-efficient technologies and construction.
- [Senate Bill 1477 \(Stern, Chapter 378, Statutes of 2018\)](#), titled Low-Emissions Buildings and Sources of Heat Energy, requires the CPUC to develop, in consultation with the CEC, two programs (Building Initiative for Low-Emissions Development [BUILD] and Technology and Equipment for Clean Heating [TECH]) aimed at reducing GHG emissions associated with buildings.

Initiative: Cleaner Industry, Healthier Communities

- [Integrated Resource Planning and Long-Term Procurement Plan](#) (R.20-05-003, R.25-06-019) guides electric procurement planning to maintain reliability and achieve GHG reductions cost-effectively. This initiative explores non-electrification technologies for industrial emission reduction, reducing renewable energy demand.
- [CPUC Rulemaking on Renewal of the Electric Program Investment Charge Program](#) (R.19-10-005) establishes strategic objectives for the EPIC Program, including the coordinated role of gas which can complement EPIC industrial decarbonization investments by reducing the GHG and health impacts of processes where direct electrification is currently not feasible and continued gas use is anticipated.
- [Senate Bill 905 \(Caballero, Chapter 359, Statutes of 2022\)](#) establishes California's Carbon Capture, Removal, Utilization, and Storage Program. This initiative aligns by supporting deployment of industrial emissions-control technologies and generating information on emissions, air quality, public health, and community impacts relevant to broader strategies to reduce pollution from industrial sources.
- [Assembly Bill 209 \(Committee on Budget, Chapter 251, Statutes of 2022\)](#) establishes CEC Clean Energy Programs, including programs supporting industrial decarbonization and grid benefits.

- [2022 Scoping Plan for Achieving Carbon Neutrality](#) by the California CARB lays out a plan to achieve carbon neutrality by 2045 and indicates a clear need for point source carbon capture for the hardest to abate industrial emissions.

Initiative: Studying Industrial Process Heat Decarbonization Pathways

- [CPUC Long-Term Gas Planning Rulemakings](#) (R.20-01-007, R.24-09-012) and [Joint Agency Staff Paper: Progress Towards a Gas Transition](#) (2024) outline interagency coordination to develop strategic plans for reducing fossil gas demand and planning for the future of the gas system, including the use of non-pipeline alternatives.
- [Integrated Resource Planning and Long-Term Procurement Plan](#) (R.20-05-003, R.25-06-019) guides electric procurement planning to maintain reliability and achieve GHG reductions cost-effectively. Evaluating reliable and cost-effective industrial heat pathways, including electrification and clean firm resources, can inform long-term resource planning.
- [Assembly Bill 209 \(Committee on Budget, Chapter 251, Statutes of 2022\)](#) establishes CEC Clean Energy Programs, including programs supporting industrial decarbonization and grid benefits.
- [Assembly Bill 32 \(Nuñez, Chapter 488, Statutes of 2006\)](#) established California’s overarching framework for reducing statewide GHG emissions and [Senate Bill 32 \(Pavley, Chapter 249, Statutes of 2016\)](#) extended that framework by setting a 2030 target of 40 percent below 1990 emissions levels. These targets may be advanced by identifying viable pathways to reduce industrial gas use and decarbonize high-temperature process heat.
- [Assembly Bill 1172 \(Calderon, Chapter 360, Statutes of 2023\)](#) directs CEC to assess fusion energy’s potential contribution to California’s power supply and [Senate Bill 80 \(Caballero and McNERney, Chapter 334, Statutes of 2025\)](#) establishes the Fusion Research and Development Innovation Initiative to help advance fusion development in California.
- [Assembly Bill 1207 \(Irwin, Chapter 117, Statutes of 2025\)](#) extends and updates California’s market-based GHG reduction framework through 2045 and [Senate Bill 840 \(Limon, Chapter 121, Statutes of 2025\)](#) establishes additional planning and study requirements for Greenhouse Gas Reduction Fund priorities.



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APPENDIX B: CPUC Resolution G-3484 Funding Encumbrance — Unspent Funds

June 2026 | CEC-500-2026-014

APPENDIX B: CPUC Resolution G-3484 Funding Encumbrance — Unspent Funds

Per the California Public Utilities Commission’s (CPUC) request in Resolution G-3592 and consistent with Resolution G-3484, Appendix B identifies Gas R&D Program research funds from FY 2014–15 to FY 2025–26 budget plans that were **encumbered and unspent as of June 30, 2025**. Each budget plan approved by the CPUC describes estimated allocations of funding among the Gas R&D Program research areas.

The CEC’s Gas R&D Program budget process allocates funding to CPUC-approved research areas or research initiatives that are subsequently acted upon by developing specific projects selected through competitive solicitations. “Encumbered funds” refers to funds that are committed to a specific project that has been approved at a CEC business meeting and for which the agreement (contract or grant) package has been executed (signed by both parties). “Unspent funds” refers to funds that have not been encumbered to an executed agreement, or previously encumbered funds that become unencumbered because the agreement has been canceled or due to other reasons. Following CPUC’s request in Resolution G-3555, the CEC will ensure that any request to use encumbered and unspent funds for new projects will identify the respective research areas or research initiatives for which the CPUC originally authorized the funding.

Table B-1: FY 2025–26 Gas R&D Updated Budget Plan (Proposed)

Research Investment Theme/Research Initiative Theme	CPUC Proposed Budget Plan (millions)	Current Budget Plan (millions)	Total Funds Encumbered (millions)	Total Funds Unspent (millions)	Actual or Anticipated Solicitation Release or Encumbrance
Environmental and Social Research/ Gas Decommissioning	\$3.00	\$3.00	\$0.00	\$3.00	Anticipated solicitation release TBD.
Gas System Integrity/ Gas Decommissioning	\$6.00	\$6.00	\$0.00	\$6.00	Anticipated solicitation release TBD.
Decarbonization/ Building Decarbonization	\$12.60	\$12.60	\$0.00	\$12.60	Anticipated solicitation release TBD.
Total	\$21.60	\$21.60	\$0.00	\$21.60	

Amounts shown in this table are rounded to the nearest \$10,000. The FY 2025–26 Gas R&D Program Updated Budget Plan was submitted to the CPUC through Advice Letter 10-G-A in October 2025 and is pending approval.

Source: California Energy Commission

Table B-2: FY 2024–25 Gas R&D Updated Budget Plan (Proposed)

Research Investment Theme/ Research Initiative Theme	CPUC Approved/ Modified Budget Plan (millions)	Current Budget Plan (millions)	Total Funds Encumbered (millions)	Total Funds Unspent (millions)	Actual or Anticipated Solicitation Release or Encumbrance
Environmental and Social Research/ Gas Decommissioning	\$7.60	\$7.60	\$0.00	\$7.60	Anticipated solicitation release TBD.
Gas System Integrity/ Gas System Safety	\$7.82	\$7.82	\$0.00	\$7.82	Anticipated solicitation release TBD.
Decarbonization/ Renewable Generation	\$6.00	\$6.00	\$0.00	\$6.00	Anticipated solicitation release TBD.

Research Investment Theme/ Research Initiative Theme	CPUC Approved/ Modified Budget Plan (millions)	Current Budget Plan (millions)	Total Funds Encumbered (millions)	Total Funds Unspent (millions)	Actual or Anticipated Solicitation Release or Encumbrance
Database Development	\$0.18	\$0.18	\$0.00	\$0.18	Anticipated solicitation release TBD.
Total	\$21.60	\$21.60	\$0.00	\$21.60	

Amounts shown in this table are rounded to the nearest \$10,000. The FY 2024–25 Gas R&D Program Updated Budget Plan was submitted to the CPUC through Advice Letter 12-G in August 2026 and is pending approval.

Source: California Energy Commission

Table B-3: FY 2023–24 Gas R&D Program Project Updated Budget Plan

Research Investment Theme/ Research Initiative Theme	CPUC Approved/ Modified Budget Plan (millions)	Current Budget Plan (millions)	Total Funds Encumbered (millions)	Total Funds Unspent (millions)	Actual or Anticipated Solicitation Release or Encumbrance
Environmental and Social Research/ Building Decarbonization	\$7.00	\$7.00	\$2.00	\$5.00	Anticipated solicitation release TBD.
Decarbonization/ Building Decarbonization	\$5.64	\$5.64	\$0.00	\$5.64	Anticipated solicitation release TBD.
Gas System Integrity/ Targeted Gas System Decommissioning	\$8.00	\$8.00	\$0.00	\$8.00	\$1.5 Anticipated solicitation to be released FY 2025–26 Q2.
Comprehensive Programmatic Evaluation, Under G-3592	\$0.96	\$0.96	\$0.00	\$0.96	Anticipated solicitation release TBD.
Total	\$21.60	\$21.60	\$2.00	\$19.60	

Amounts shown in this table are rounded to the nearest \$10,000. The FY 2023–24 Gas R&D Program Budget Plan was partially approved and modified (Resolution G-3603, May 9, 2024). CPUC approved an updated budget plan through Advice Letter 11-G-A in January 2026.

Source: California Energy Commission

Table B-4: FY 2023–24 Gas R&D Program Project Updated Supplemental Budget Plan

Research Investment Theme/ Research Initiative Theme	CPUC Approved/ Modified Budget Plan (millions)	Current Budget Plan (millions)	Total Funds Encumbered (millions)	Total Funds Unspent (millions)	Actual or Anticipated Solicitation Release or Encumbrance
Decarbonization/ Building Decarbonization	\$2.41	\$2.41	\$0.00	\$2.41	Anticipated solicitation release TBD.
Gas System Integrity/ Targeted Gas System Decommissioning	\$4.13	\$4.13	\$0.00	\$4.13	Anticipated solicitation release TBD.
Total	\$6.54	\$6.54	\$0.00	\$6.54	

Amounts shown in this table are in millions and rounded to the nearest \$10,000. The FY 2023–24 Gas R&D Program Budget Plan was partially approved and modified (Resolution G-3603, May 9, 2024). CPUC approved an updated budget plan through Advice Letter 11-G-A in January 2026.

Source: California Energy Commission

Table B-5: FY 2022–23 Gas R&D Program Project Updated Budget Plan

Research Initiative Theme	CPUC-Approved/ Modified Budget Plan (millions)	Current Budget Plan (millions)	Total Funds Encumbered (millions)	Total Funds Unspent (millions)	Actual or Anticipated Solicitation Release or Encumbrance
Targeted Gas System Decommissioning	\$4.10	\$4.10	\$0.00	\$4.10	\$2.7 million (GFO-24-501) Paving the Way for California’s Gas Transition. Anticipate encumbering funds by June 2026. \$1.4 million anticipated solicitation to be released FY 2025–26 Q4.
Decarbonization of Gas End Uses	\$13.00	\$13.00	\$11.09	\$1.91	Anticipated solicitation release TBD.

Research Initiative Theme	CPUC-Approved/ Modified Budget Plan (millions)	Current Budget Plan (millions)	Total Funds Encumbered (millions)	Total Funds Unspent (millions)	Actual or Anticipated Solicitation Release or Encumbrance
Energy Efficiency	\$1.50	\$1.50	\$0.00	\$1.50	\$1.5 million anticipated solicitation to be released FY 2026–27 Q1.
Gas Pipeline Safety and Integrity	\$3.00	\$3.00	\$2.99	\$0.01	Anticipated solicitation release TBD.
Total	\$21.60	\$21.60	\$14.08	\$7.52	

Amounts shown in this table are rounded to the nearest \$10,000. The FY 2022–23 Gas R&D Budget Plan was approved in part and modified (Resolution G-3592, March 16, 2023). CPUC approved an updated budget plan through Advice Letter 4G in June 2023.

Source: California Energy Commission

Table B-6: FY 2021–22 Natural Gas R&D Program Budget Plan

Research Area	CPUC Approved Budget Plan	Current Budget Plan	Total Funds Encumbered	Total Funds Unspent	Actual or Anticipated Solicitation Release or Encumbrance
Energy Efficiency	\$6.10	\$6.10	\$4.00	\$2.10	\$2.1 (GFO-23-502) Industrial Carbon Dioxide Utilization for Value Added Products. Encumber these funds by Mar 2026.
Energy-Related Environmental Research	\$3.50	\$3.50	\$2.00	\$1.50	\$0.9 (GFO-24-501) Paving the Way for California’s Gas Transition. Encumber these funds by Apr 2026. \$0.6 Anticipated solicitation release TBD.
Gas RD Infrastructure Safety and Integrity	\$4.00	\$4.00	\$4.00	\$0.00	

Research Area	CPUC Approved Budget Plan	Current Budget Plan	Total Funds Encumbered	Total Funds Unspent	Actual or Anticipated Solicitation Release or Encumbrance
Gas RD Transportation	\$4.00	\$4.00	\$4.00	\$0.00	
Renewable Energy and Advanced Generation	\$4.00	\$4.00	\$4.00	\$0.00	
Total	\$21.60	\$21.60	\$18.00	\$3.60	

Amounts shown in this table are in millions and rounded to the nearest \$10,000.

Source: California Energy Commission

Table B-7: FY 2020–21 Natural Gas R&D Program Budget Plan

Research Area	CPUC Approved Budget Plan	Current Budget Plan	Total Funds Encumbered	Total Funds Unspent	Actual or Anticipated Solicitation Release or Encumbrance
Energy Efficiency	\$3.00	\$3.00	\$1.77	\$1.23	Unspent funds of \$1.23 from solicitation GFO-21-503. These funds were reallocated to the FY 2023–24 Gas R&D Program Supplemental Budget Plan.
Energy-Related Environmental Research	\$1.50	\$1.50	\$1.50	\$0.00	
Gas RD Infrastructure Safety and Integrity	\$9.10	\$9.10	\$9.10	\$0.00	
Gas RD Transportation	\$4.00	\$4.00	\$4.00	\$0.00	
Renewable Energy and Advanced Generation	\$4.00	\$4.00	\$4.00	\$0.00	
Total	\$21.60	\$21.60	\$20.37	\$1.23	

Amounts shown in this table are in the millions and rounded to the nearest \$10,000.

Source: California Energy Commission

Table B-8: FY 2019–20 Natural Gas R&D Program Budget Plan

Research Area	CPUC Approved Budget Plan	Current Budget Plan	Total Funds Encumbered	Total Funds Unspent	Actual or Anticipated Solicitation Release or Encumbrance
Energy Efficiency*	\$9.00	\$9.63	\$3.64	\$5.99	Unspent funds of \$418,433 from terminated project PIR-19-014; Unspent funds of \$5,573,860 from terminated project PIR-20-006. These funds have not been reallocated and do not currently have an anticipated solicitation release.
Gas RD Infrastructure Safety and Integrity*	\$2.00	\$1.58	\$1.58	\$0.00	
Gas RD Strategic Planning Research (Cross-Cutting)	\$1.00	\$1.00	\$1.00	\$0.00	
Gas RD Transportation*	\$6.60	\$6.50	\$6.50	\$0.00	
Renewable Energy and Advanced Generation*	\$3.00	\$2.89	\$2.41	\$0.49	Unspent funds of \$485,418 from terminated project PIR-20-004. These funds have not been reallocated and do not currently have an anticipated solicitation release.
Total	\$21.60	\$21.60	\$15.12	\$6.48	

Amounts shown in this table are in millions and rounded to the nearest \$10,000.

Source: California Energy Commission

**The CEC reallocated \$630,000 from the Renewable Energy and Advanced Generation, Gas Infrastructure Safety and Integrity, and Transportation research areas to Energy Efficiency due to strong proposals in high-priority research areas.*

Table B-9: FY 2019–20 Natural Gas R&D Program Supplemental Budget Plan

Research Area	CPUC Approved Budget Plan	Current Budget Plan	Total Funds Encumbered	Total Funds Unspent	Actual or Anticipated Solicitation Release or Encumbrance
Energy Efficiency	\$1.00	\$1.00	\$1.00	\$0.00	
Energy-Related Environmental Research	\$2.00	\$2.00	\$2.00	\$0.00	
Gas RD Infrastructure Safety and Integrity	\$2.00	\$2.00	\$2.00	\$0.00	
Gas RD Small Grants Program (Cross-Cutting)	\$2.29	\$2.29	\$0.00	\$2.29	Unspent funds of \$2,290,000 from cancelled project 500-20-004. These funds have not been reallocated and do not currently have an anticipated solicitation release.
Total	\$7.29	\$7.29	\$5.00	\$2.29	

Amounts shown in this table are in millions and rounded to the nearest \$10,000.

Source: California Energy Commission

Table B-10: FY 2018–19 Natural Gas R&D Program Project Budget Plan

Research Area	CPUC Approved Budget Plan	Current Budget Plan	Total Funds Encumbered	Total Funds Unspent	Actual or Anticipated Solicitation Release or Encumbrance
Energy Efficiency*	\$6.00	\$9.32	\$8.44	\$0.88	Unspent funds of \$880,430 from terminated project PIR-19-014. These funds have not been reallocated and do not currently have an anticipated solicitation release.

Research Area	CPUC Approved Budget Plan	Current Budget Plan	Total Funds Encumbered	Total Funds Unspent	Actual or Anticipated Solicitation Release or Encumbrance
Energy-Related Environmental Research**	\$3.00	\$4.36	\$4.36	\$0.00	
Gas RD Infrastructure Safety and Integrity	\$5.60	\$5.60	\$5.60	\$0.00	
Gas RD Transportation*	\$4.00	\$2.31	\$2.31	\$0.00	
Renewable Energy and Advanced Generation*/**	\$3.00	\$0.00	\$0.00	\$0.00	
Total	\$21.60	\$21.60	\$20.72	\$0.88	

Amounts shown in this table are in millions and rounded to the nearest \$10,000.

Source: California Energy Commission

*The CEC reallocated \$3.32M from the Renewable Energy and Advanced Generation and Transportation research areas to Energy Efficiency due to strong proposals in high-priority research areas.

**The CEC reallocated \$1.36M from the Renewable Energy and Advanced Generation research area to Energy-Related Environmental Research due to strong proposals in high-priority research areas.

Table B-11: FY 2017–18 Natural Program Project Budget Plan

Research Area	CPUC Approved Budget Plan	Current Budget Plan	Total Funds Encumbered	Total Funds Unspent	Actual or Anticipated Solicitation Release or Encumbrance
Energy Efficiency*	\$6.60	\$4.57	\$4.57	\$0.00	
Energy-Related Environmental Research*	\$3.00	\$3.46	\$3.46	\$0.00	
Gas RD Infrastructure Safety and Integrity*	\$5.00	\$5.82	\$5.82	\$0.00	
Gas RD Transportation*	\$3.00	\$3.75	\$2.89	\$0.87	Unspent funds of \$865,642 from terminated project PIR-17-008. These funds have not

Research Area	CPUC Approved Budget Plan	Current Budget Plan	Total Funds Encumbered	Total Funds Unspent	Actual or Anticipated Solicitation Release or Encumbrance
					been reallocated and do not currently have an anticipated solicitation release.
Renewable Energy and Advanced Generation	\$4.00	\$4.00	\$4.00	\$0.00	
Total	\$21.60	\$21.60	\$20.73	\$0.87	

Amounts shown in this table are in millions and rounded to the nearest \$10,000.

Source: California Energy Commission

**The CEC reallocated \$2.03M from Energy Efficiency to Gas Infrastructure Safety and Integrity, Transportation, Energy-Related Environmental Research areas due to strong proposals in high-priority research areas.*

Table B-12: FY 2016–17 Natural Gas R&D Program Project Budget Plan

Research Area	CPUC Approved Budget Plan	Current Budget Plan	Total Funds Encumbered	Total Funds Unspent	Actual or Anticipated Solicitation Release or Encumbrance
Energy Efficiency*	\$7.10	\$5.20	\$3.48	\$1.72	Unspent funds of \$1,175,266 from terminated project PIR-17-005. These funds have been reallocated to the FY 2023 Gas R&D Program Supplemental Budget Plan. Unspent funds of \$543,673 from amendment PIR-17-017 decreased agreement budget. These funds have not been reallocated and do not currently have an anticipated solicitation release.

Research Area	CPUC Approved Budget Plan	Current Budget Plan	Total Funds Encumbered	Total Funds Unspent	Actual or Anticipated Solicitation Release or Encumbrance
Energy-Related Environmental Research	\$2.60	\$2.69	\$2.69	\$0.00	
Gas RD Infrastructure Safety and Integrity*	\$4.00	\$3.87	\$3.87	\$0.00	
Gas RD Transportation	\$3.50	\$4.82	\$2.19	\$2.63	Unspent funds of \$900,000 from terminated project PIR-16-026; Unspent funds of \$634,358 from terminated project PIR-17-008; Unspent funds of \$1,087,237 from terminated project PIR-17-016; Unspent funds of \$9,281 from solicitation GFO-16-507. These funds have been reallocated to the FY 2023–24 Gas R&D Program Supplemental Budget Plan.
Renewable Energy and Advanced Generation	\$4.40	\$5.02	\$5.02	\$0.00	
Total	\$21.60	\$21.60	\$17.25	\$4.35	

Amounts shown in this table are in millions and rounded to the nearest \$10,000.

Source: California Energy Commission

**The CEC reallocated \$.62M from Energy Efficiency, Environmental, Gas Infrastructure Safety and Integrity and Transportation research areas to Renewable Energy and Advanced Generation due to strong proposals in high-priority research areas.*

Table B-13: FY 2016–17 Natural Gas Program Supplemental Budget Plan

Research Area	CPUC Approved Budget Plan	Current Budget Plan	Total Funds Encumbered	Total Funds Unspent	Actual or Anticipated Solicitation Release or Encumbrance
Energy Efficiency*	\$0.91	\$0.00	\$0.00	\$0.00	
Energy-Related Environmental Research	\$2.70	\$2.70	\$2.70	\$0.00	
Gas RD Infrastructure Safety and Integrity*	\$1.70	\$2.61	\$2.61	\$0.00	
Total	\$5.31	\$5.31	\$5.31	\$0.00	

Amounts shown in this table are in millions and rounded to the nearest \$10,000.

Source: California Energy Commission

*The CEC reallocated \$.91M from Energy Efficiency to Gas Infrastructure Safety and Integrity research area due to strong proposals in high-priority research areas.

Table B-14: FY 2015–16 Natural Gas R&D Program Project Budget Plan

Research Area	CPUC Approved Budget Plan	Current Budget Plan	Total Funds Encumbered	Total Funds Unspent	Actual or Anticipated Solicitation Release or Encumbrance
Energy Efficiency	\$7.10	\$7.10	\$7.10	\$0.00	
Energy-Related Environmental Research	\$3.30	\$3.30	\$3.30	\$0.004	Unspent funds of \$3,785 have been reallocated to the FY 2019–20 Gas R&D Program Supplemental Budget Plan.
Gas RD Infrastructure Safety and Integrity	\$1.00	\$1.00	\$1.00	\$0.00	
Gas RD Transportation	\$4.40	\$4.40	\$2.90	\$1.50	Unspent funds of \$1,500,000 from terminated project PIR-16-018 have

Research Area	CPUC Approved Budget Plan	Current Budget Plan	Total Funds Encumbered	Total Funds Unspent	Actual or Anticipated Solicitation Release or Encumbrance
					been reallocated to the FY 2023-24 Gas R&D Program Supplemental Budget Plan.
Renewable Energy and Advanced Generation	\$5.80	\$5.80	\$4.62	\$1.18	Unspent funds of \$1,183,341 from cancelled project PIR-16-006 have been reallocated to the FY 2019–20 Gas R&D Program Supplemental Budget Plan.
Total	\$21.60	\$21.60	\$18.91	\$2.69	

Amounts shown in this table are in millions and rounded to the nearest \$10,000.

Source: California Energy Commission

Table B-15: FY 2015–16 Natural Gas R&D Program Project Supplemental Budget Plan

Research Area	CPUC Approved Budget Plan	Current Budget Plan	Total Funds Encumbered	Total Funds Unspent	Actual or Anticipated Solicitation Release or Encumbrance
Energy-Related Environmental Research*	\$2.10	\$2.10	\$2.10	\$0.00	
Gas RD Infrastructure Safety and Integrity*	\$1.50	\$1.50	\$1.50	\$0.00	
Total	\$3.60	\$3.60	\$3.60	\$0.00	

Amounts shown in this table are in millions and rounded to the nearest \$10,000.

Source: California Energy Commission

**In Resolution G-3507 (June 25, 2015), the CPUC directed the CEC to prioritize gas research and development projects on climate change, drought, and gas safety. The CEC funded high-priority research areas when strong research proposals were received.*

Table B-16: FY 2014–15 Natural Gas R&D Program Project Budget Plan

Research Area	CPUC Approved Budget Plan	Current Budget Plan	Total Funds Encumbered	Total Funds Unspent	Actual or Anticipated Solicitation Release or Encumbrance
Energy Efficiency*	\$8.60	\$7.48	\$7.01	\$0.47	Unspent funds of \$467,842 from terminated project PIR-15-011; Unspent funds of \$873.
These funds have not been reallocated and do not currently have an anticipated solicitation release.					
Energy-Related Environmental Research**	\$3.00	\$3.62	\$3.62	\$0.00	
Gas RD Infrastructure Safety and Integrity*	\$2.50	\$4.68	\$4.68	\$0.00	
Gas RD Transportation**	\$4.00	\$3.34	\$3.34	\$0.00	
Renewable Energy and Advanced Generation*/**	\$3.50	\$2.48	\$2.48	\$0.00	
Total	\$21.60	\$21.60	\$21.13	\$0.47	

Amounts shown in this table are in millions and rounded to the nearest \$10,000.

Source: California Energy Commission

**The CEC reallocated \$2.18m from Energy Efficiency and Renewable Energy and Advanced Generation research areas to Gas Infrastructure Safety and Integrity research area due to strong proposals in high-priority research areas.*

***The CEC reallocated \$.62m from Transportation and Renewable Energy and Advanced Generation research areas to Energy-Related Environmental research area due to strong proposals in high-priority research areas.*



California
ENERGY COMMISSION



ENERGY RESEARCH AND DEVELOPMENT DIVISION

APPENDIX C: Engagement Summary, Feedback, Comments, and CEC Responses

June 2026 | CEC-500-2026-014

APPENDIX C:

Engagement Summary, Feedback, Comments, and CEC Responses

The California Energy Commission (CEC) appreciates the feedback, comments, and questions received during, and in response to, meetings with the Disadvantaged Communities Advisory Group (DACAG); Environmental Social Justice (ESJ) community leaders and other attendees at the 2026 Joint Gas Research, Development, and Demonstration public workshop; California Native American tribal representatives; California Public Utilities Commission (CPUC) subject matter experts (SMEs); investor-owned utility (IOU) Gas Research and Development (Gas R&D) Program administrators; and others on proposed initiatives for the fiscal year (FY) 2026–27 Gas R&D Program Budget Plan. The engagement outreach events to support and inform the development of this budget plan included the following:

- On August 20, 2025, CEC staff met with IOU Gas R&D administrators, including representatives from Southern California Gas (SoCalGas) and Pacific Gas and Electric (PG&E), to present and gather feedback on a broad set of potential initiative concepts.
- On October 9, 2025, CEC held a DACAG SME meeting to present and gather feedback on initiative concepts.
- On December 5, 2025, CEC staff participated in the Electric Program Investment Charge (EPIC) Policy + Innovation Coordination Group Meeting, in which subject matter experts from CEC, CPUC, SoCalGas, and PG&E convened to discuss and coordinate on Gas R&D research investments.
- On February 10, 2026, CEC staff conducted a Tribal Roundtable to present and solicit feedback on draft initiatives.
- On February 27, 2026, CEC staff, along with staff from PG&E and SoCalGas, held a joint public workshop to present and discuss the proposed research initiatives. The workshop included an ESJ discussion panel, and written public comments were invited.
- On March 20, 2026, CEC staff, along with staff from PG&E and SoCalGas, joined a meeting of the full DACAG to present and solicit feedback on the proposed budget plan.
- Throughout the budget plan development process, CEC staff also engaged in additional targeted coordination meetings with agency and utility partners on specific proposed initiatives, including IOU Gas R&D administrators as well as the California Air Resources Board (CARB).

A summary of the comments and CEC staff responses is provided in the sections below.

IOU Coordination and Feedback

At the August 20, 2025 meeting with IOUs, CEC presented early initiative concepts, answered clarifying questions, and received utility perspectives on research needs that informed CEC’s

selection and development of the proposed initiatives. As the IOUs were in earlier stages of initiative development for their upcoming budget plans, it was difficult to clearly identify duplication or opportunities for coordination outside of previous plans that had been filed. However, the meeting allowed CEC staff and the IOUs to identify potential areas where the CEC's initiatives were complementary to the IOUs' work and could help inform IOU initiative development. The comments and CEC responses are summarized by initiative below:

1. Supporting Healthy and Equitable Gas System Decarbonization

Feedback: The IOUs sought clarification on the intent of this initiative as it relates to direct gas system emissions decarbonization versus a broader assessment of emissions (including external sources). IOUs suggested modifying the initiative title to reflect the initiative more accurately.

CEC Response: CEC staff clarified that the initiative would not be limited to infrastructure-related emissions but was initially intended to lay a scientific foundation with the development of a public-facing decision-making tool and monitoring capabilities to support more equitable and health-protective decommissioning. The initiative was re-titled *Advancing Health and Equity in California's Gas Transition* to better reflect the broader scope of the initiative.

Following additional feedback received during the initiative development process, the final scope of this initiative was revised to focus more narrowly on the development of low-cost methane sensor technology and emissions monitoring frameworks.

2. Scaling Up Gas Network Decommissioning: Post-Pilot Strategic Pathways to Infrastructure Segment Retirement

Feedback: The IOUs were supportive of this initiative. PG&E recommended that CEC staff coordinate with its operations team in addition to its research team, because the operations team is more directly involved in decommissioning efforts. SoCalGas made an observation that this initiative is the only one focused on system operations.

CEC Response: Staff appreciated the coordination with PG&E on this initiative and engaged in subsequent discussions on decommissioning opportunities. For example, on March 5, 2026, PG&E and CEC SMEs met to discuss how this proposed initiative may align with decommissioning research PG&E is interested in pursuing. They met again on May 27, 2026, to discuss recently awarded gas decommissioning awards under CEC's solicitation, "Paving the Way for California's Gas Transition" (GFO-24-501).

3. Cleaner Industry, Healthier Communities

Feedback: The IOUs asked whether this initiative would include onsite conversion of renewable gas to hydrogen for onsite consumption. SoCalGas noted that carbon capture was disallowed in its 2023–24 plan per CPUC resolution, but the 2024–25 plan included some point-source capture. SoCalGas also noted that they generally consider point-source capture an important tool in supporting decarbonization. PG&E expressed interest in the carbon capture element of this initiative.

CEC Response: Staff clarified that hydrogen, including onsite conversion of renewable gas to hydrogen, is not within the scope of this initiative. In addition, development of carbon capture technologies is not included in the current scope. The initiative is focused exclusively on co-pollutant removal technologies at existing industrial facilities to reduce criteria air pollutants and deliver near-term public health benefits while facilities transition to cleaner, more electrified systems.

4. Advancing Circular Methanation for Grid Resilience, Equity, and Cost-Effective Seasonal Energy Storage

Feedback: The IOUs were generally supportive of this concept but flagged that anything that reintroduces methane back into the system (expanding the system and/or prolonging use) can raise environmental questions and concerns. The IOUs noted that they see this work as a bridge technology to get where we want to be.

CEC Response: Although this initiative was originally focused on circular methanation, the scope was revised in response to feedback received through the engagement process. The revisions shifted the focus of the initiative toward addressing the need for seasonal storage and energy imbalance. As revised, the initiative will conduct a comparative assessment of seasonal storage technologies to identify the most practical and cost-effective options for meeting California's multi-day peak demand and firm clean power needs through 2045. Staff does not intend for this initiative to support expansion of the existing gas system and instead views this concept as an effort to evaluate whether existing infrastructure could play a limited role in seasonal storage.

5. Assessing the Role of Green Hydrogen in California's Hardest to Electrify Processes

Feedback: IOUs asked if this initiative would include on-site conversion of renewable gas to hydrogen for on-site consumption. PG&E commented that it has proposed work pending with the CPUC that may include some overlap with this initiative. SoCalGas noted its 2025 plan included some renewable hydrogen, decarbonization, point-source capture, and storage.

CEC Response: Staff explained that the initiative could have included some onsite hydrogen conversion and consumption, depending on system design and application. In drafting this initiative, staff had limited the scope to "green" hydrogen technologies.¹ As initially proposed, the initiative would have examined the viability of hydrogen use in industrial processes and could have also considered the feasibility of repurposing existing gas infrastructure and evaluating end-use appliance performance. As a follow-up, staff reviewed PG&E's proposed research and determined that the industry-specific focus, together with the broader range of potential hydrogen applications and end uses within the CEC's scope, suggested that the initiative would likely not be duplicative of PG&E's proposed research.

¹ Using a CPUC definition, "a process that results in a lifecycle (i.e., well-to-gate) GHG 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." See: California Public Utilities Commission. Decision D.22-12-057.

Following subsequent feedback received during the engagement process, CEC staff ultimately decided to withdraw this initiative from consideration for the FY 26–27 Gas R&D Program Budget Plan.

6. Optimizing Thermal Energy Networks for Waste Heat Recovery, Storage, and Decarbonization

No comments received.

DACAG Subject Matter Expert Feedback

On October 9, 2025, CEC presented the draft initiatives to DACAG’s SME on gas research. CEC staff had revised the initiatives following IOU and other feedback and added a new initiative on industrial decarbonization for consideration.

1. Advancing Health and Equity in California's Gas Transition

Feedback: The DACAG SME was supportive of this initiative and expressed interest in seeing it advance. Feedback suggested that the proposed interactive tool should be inclusive of both indoor and outdoor air quality. Additional suggestions included exploring, if possible, how the research could support more integrated home decarbonization analysis and benefits, as well as whether a one-stop shop connecting users to available incentives and resources could be considered. It was also noted that New Jersey recently released a one-stop shop tool that may be worth looking at as a potential model.

CEC Response: Staff confirmed that the proposed interactive tool would consider both indoor and outdoor air impacts associated with residential decarbonization interventions, including reductions in indoor air pollutants like NO₂, PM_{2.5}, and volatile organic compounds, and account for outdoor impacts from reduced venting and improved local air quality.

Staff also clarified that the development of a one-stop-shop platform would not be a direct deliverable under this initiative. Instead, the initiative would produce research outputs (e.g., data, methods, frameworks, and tools) that implementers or state agencies could use to build such a platform. These research outputs, including data, tools, and non-energy impacts, could also support longer-term gas transition planning, including decommissioning and strategic retirement planning.

These comments helped inform the development of the initiative. However, based on subsequent feedback received during the broader outreach process, the scope of this initiative was later revised to focus more narrowly on methane emissions sensing technologies and monitoring.

2. Scaling Up Gas Network Decommissioning: Post-Pilot Strategic Pathways to Infrastructure Segment Retirement

Feedback: The DACAG SME was supportive of this initiative and expressed appreciation that CEC is looking at how the SB 1221 pilots can inform larger decommissioning strategies.

CEC Response: Staff appreciated the positive feedback and acknowledgement that lessons learned from the SB 1221 (Min, Chapter 602, Statutes of 2024) pilots could help inform broader decommissioning strategies.

3. Cleaner Industry, Healthier Communities

Feedback: It was noted that some industries do not have near- or mid-term alternative solutions, and in those cases, the CEC should consider opportunities to reduce emissions. It was also emphasized that, if refineries are included in the research scope, concerns would likely be raised about prolonging fossil fuel use in environmentally overburdened communities.

CEC Response: Staff agrees that this initiative should focus on the industrial sector, particularly the hardest-to-electrify industries that currently lack immediate electrification solutions and could benefit from near-term co-pollutant reductions. This initiative is intended as a measure to reduce harmful co-pollutant emissions while full electrification continues to develop and scale. Its intent is not to extend or promote continued fossil gas use but instead reduce near-term public health impacts during the transition. Staff also clarified that refineries are not included in the scope of this initiative.

4. Advancing Reversible Methanation for Grid Resilience, Equity, and Cost-Effective Seasonal Energy Storage

Feedback: The DACAG SME raised concerns that the proposed pathway has a very low round-trip efficiency and may not represent the best use of renewable energy compared with other end-use options. They asked how the reversible methanation pathway compares to other energy storage options in terms of cost and performance. The DACAG SME also raised concerns that continued reliance on gas infrastructure could spread maintenance costs across a shrinking customer base, potentially increasing the risk of underfunded maintenance, aging pipelines, and higher leakage rates.

CEC Response: Staff appreciated the points raised during this discussion. In response, staff re-focused the initiative to assess seasonal energy storage pathways more broadly. Instead of supporting a reversible methanation demonstration, the current initiative is proposed to conduct a comparative assessment of seasonal storage technologies to identify the most practical and cost-effective options for meeting California's multi-day peak demand and firm clean power needs through 2045. The analysis would explore reversible methanation and other available or potential seasonal storage options, focusing on solutions that support equity, reliability, and the strategic use of existing infrastructure. The change in focus resulted in retitling the initiative to "Strategic Assessment of Cost-Effective Seasonal Energy Storage Pathways."

5. Assessing the Role of Green Hydrogen in California's Hardest-to-Electrify Processes

Feedback: Feedback included concerns about the upfront energy demand needed to produce hydrogen and the potential impacts on the speed and scale of meeting decarbonization goals. The DACAG SME also raised concerns about whether using renewable energy to produce hydrogen is the best use of that energy compared to other alternatives, given the efficiency

losses. Additional feedback noted public health concerns related to the continued use of gas infrastructure, potential policy uncertainty around the use of biofuels for hydrogen production, and environmental justice considerations associated with biomethane production.

CEC Response: CEC staff appreciated the feedback and ultimately decided to withdraw this initiative from consideration for the FY 26–27 Gas R&D Program Budget Plan.

6. Optimizing Thermal Energy Networks for Waste Heat Recovery, Storage, and Decarbonization

Feedback: The DACAG SME expressed support for this proposed initiative and requested clarification on whether the initiative would focus on the end users or on the development of the system itself for the waste heat recovery. The DACAG SME also asked whether this initiative could be combined with geothermal energy networks.

CEC Response: Staff clarified that the initiative is focused primarily on assessing the development and optimization of thermal energy network configurations that can recover and distribute waste heat from large facilities. End users of recovered waste heat can vary in size depending on community needs, available loads, and system design. Staff also clarified that the initiative may consider different types of thermal energy storage, including subsurface tank storage or shallow geothermal systems, where appropriate. However, the intent is not to limit storage or network solutions at the initiative level. Specific eligible technologies, configurations, and project requirements may be further defined during solicitation scoping and development.

7. Studying Advanced Nuclear Reactors for Industrial Decarbonization

Feedback: The DACAG SME raised reservations about the community benefits, impacts, and risks, including who determines how risk is evaluated, who may be exposed to risk, how decisions are made, and who has the opportunity to weigh in. The feedback emphasized that these considerations extend beyond technical risk and should include community decision-making. The DACAG SME recommended framing the analysis around the opportunity cost of advanced nuclear, including development and deployment timelines, permitting requirements, and how advanced nuclear compares to pursuing other options (for example, how much faster could the targeted sectors or facilities transition to other alternatives).

CEC Response: Staff appreciated this feedback and affirmed the sensitivities surrounding this topic, including the meaningful involvement of local communities when evaluating technologies with potential localized impacts and decision-making. Staff clarified that this initiative does not propose any development or deployment efforts. Instead, it focuses on an analytical comparison paper study. As part of this analysis, the study will incorporate evaluation of social acceptance, community risk considerations, and governance frameworks, including how different pathways may impact Disadvantaged Vulnerable Communities. The initiative is specifically designed to address the opportunity-cost question raised by comparing advanced nuclear technologies with other decarbonization pathways in terms of development timelines, permitting

requirements, cost trajectories, and system-level impacts such as reliability and infrastructure needs.

In response to feedback received, staff broadened the scope of this initiative. The revised scope of the initiative now compares multiple decarbonization pathways, rather than focusing narrowly on nuclear, including electrification, clean fuels such as biofuels and hydrogen, and carbon capture approaches that may offer reliable and cost-effective industrial heating alternatives.

CPUC Subject Matter Expert Feedback

Following the DACAG SME meeting, six initiatives remained for review at the EPIC Policy + Innovation Coordination Group RD&D Meeting held on December 5, 2025. CEC presented the draft initiatives to the CPUC SMEs and spoke to the initiatives' alignment with CPUC policies and proceedings, along with the coordinated role of gas for the upcoming EPIC 5 investment plan development. The CPUC SMEs provided feedback on the proposed initiatives verbally at the meeting and then followed up with written comments. The CEC appreciates the helpful comments and recommendations provided by CPUC staff.

1. Gas Network Decommissioning Pathways to Scale Infrastructure Retirement

Note: This initiative was previously titled "Scaling Up Gas Network Decommissioning: Post-Pilot Strategic Pathways to Infrastructure Segment Retirement." The title was shortened based on early CPUC feedback.

Feedback: CPUC SMEs noted that this initiative appeared aligned with some policy priorities, including long-term gas decommissioning and building decarbonization, but requested clarity on how other elements align with other CPUC policies and proceedings. They also requested clearer articulation of the proposed solutions, including which phase-down risks and air quality issues would be considered. Additional feedback requested more clarity on how the initiative would build on existing work, avoid duplication with ongoing efforts, and justify the need for additional Gas R&D funding. CPUC SMEs also noted a potential gap in affordability and impact metrics.

CEC Response: The proposed initiative aligns with CPUC policy priorities related to long-term gas planning, gas infrastructure retirement, building decarbonization, and implementation of SB 1221 by supporting the development of scalable approaches for coordinated gas system decommissioning. While existing and planned studies and pilots are helping to evaluate the feasibility of targeted or zonal decommissioning, this initiative is intended to synthesize lessons learned across those efforts and translate them into a broader planning framework, operational protocols, and implementation pathways that can support future infrastructure retirement decisions.

The research will evaluate risks and air quality considerations that may arise as portions of the gas system are maintained, retrofitted, or retired. This may include leakage mitigation, pressure management, pipeline safety, emergency response planning, and workforce training needs for retrofitted or partially retired infrastructure. These efforts

are intended to help identify protocols and planning considerations that reduce safety risks, avoid operational gaps, and support more coordinated implementation.

This initiative will build on, rather than duplicate, existing work. Current and planned efforts are primarily focused on individual pilot design, feasibility assessments, or implementation at the pre-pilot and pilot scale. This initiative will provide additional value by assessing data across zonal pilot programs and SB 1221 implementation activities to identify common needs, barriers, and scalable practices. These findings will support updated protocols and an actionable framework for broader gas infrastructure planning retirement.

The initiative will clearly address affordability by evaluating opportunities to reduce costs for impacted gas users, avoid stranded asset costs, and support coordinated implementation across jurisdictions. It will also include impact metrics to help assess affordability, safety, reliability, equity, and system-level outcomes for ratepayers.

2. Advancing Health and Equity in California's Gas Transition

Feedback: CPUC SMEs stated that the initiative seems somewhat aligned but does not articulate the CPUC's goal of removing the last 10 percent of greenhouse gas (GHG) reductions. They were uncertain how non-energy benefits (NEBs) would be tracked to show data on these impacts and improve program cost-effectiveness. CPUC SMEs also noted a need for a clearer description of what the core research questions are for this initiative.

CEC Response: This initiative supports CPUC's goal of addressing the "last 10 percent" of GHG reductions by targeting hard-to-decarbonize gas end uses and emissions in California's transition away from fossil gas. It does so through low-cost methane monitoring innovations that improve detection and mitigation of fugitive emissions, a key component of residual gas system emissions.

By focusing on where gas use persists, who is most affected, and what mitigation strategies are most cost-effective and equitable, this initiative seeks to provide the applied science and tools necessary to strategically reduce California's remaining GHG emissions.

The initiative includes embedded tracking and quantification of NEBs such as improved indoor air quality, reduced methane and co-pollutant exposure, enhanced health outcomes (e.g., respiratory health), and community co-benefits. These will be tracked through the development and deployment of low-cost methane sensors and the enhancement of high-temporal-resolution monitoring networks to provide ongoing, geographically resolved emissions data. This enables cost-effective identification of emission hotspots and quantification of reductions in pollution exposure in vulnerable communities.

Based on subsequent feedback received through the engagement process, including input from CPUC leadership, the CEC later revised the scope of this initiative to focus more clearly on addressing methane emissions from the gas system through low-cost sensing technologies and improved monitoring frameworks. These revisions are

reflected in the final proposed initiative, "Advancing Methane Emissions Monitoring for California's Gas System."

3. Cleaner Industry, Healthier Communities

Feedback: CPUC SMEs indicated decarbonization of industrial and other hard-to-decarbonize sectors remains a high priority for Gas RD&D. However, they noted that this initiative, as framed, was misaligned with how ratepayer funds should be used, particularly with respect to direct air capture and similar approaches that are largely supported by non-ratepayer funding sources. To be appropriate for Gas RD&D, the initiative would need to be restructured to better align with CPUC priorities and relevant proceedings, clearly define what types of industrial decarbonization activities are suitable for ratepayer funding, and demonstrate how RD&D investments accelerate solutions that would not otherwise occur. CPUC SMEs also emphasized the need to clearly differentiate this work from existing projects, coordinate with related EPIC RD&D and Gas RD&D Administrator efforts, and demonstrate how the initiative enhances ongoing work rather than duplicating efforts already underway.

CEC Response: Based on CPUC SME feedback, the initiative was revised to (1) remove carbon capture from the scope to address the concerns raised about direct air capture, and (2) shift the focus to advancing co-pollutant removal technologies (PM, SO_x, and NO_x) that can be deployed as retrofit solutions at existing industrial facilities.

This initiative addresses a critical gap in the current gas research landscape: the lack of near-term, deployable solutions to reduce localized air pollution from industrial sources that are projected to remain dependent on fossil gas during the transition. While existing programs primarily focus on long-term decarbonization pathways, this initiative is differentiated by focusing on retrofit-ready emissions controls that deliver immediate public health benefits without requiring major process redesign or infrastructure investment.

The initiative aligns with the CPUC proceedings, Long-Term Gas System Planning (R.24-09-012), SCE Building Electrification (A.21-12-009), and Building Decarbonization (R.19-01-011), by providing transition-relevant insights for facilities expected to remain on the gas system in the near- and potentially mid-term, including cost-effective emissions reduction options that support prudent system planning. It complements, rather than duplicates, market-driven activities by focusing on near-term co-pollutant removal solutions that are not currently available, widely adopted, or supported through existing market drivers. While industrial facilities are currently under significant pressure to reduce CO₂ emissions, co-pollutant removal is often treated as a secondary benefit and lacks strong market or regulatory drivers for adoption, which is why supporting this initiative with ratepayer funds is critical to advancing near-term public health outcomes.

4. Strategic Assessment of Cost-Effective Seasonal Energy Storage Pathways

Feedback: CPUC SMEs recommended proceeding forward with this initiative, provided that the proposed research is clearly aligned with Integrated Resource Plan (IRP) requirements and reflects current CPUC guidance, including the removal of hydrogen from the IRP. CPUC SMEs emphasized that the work should be explicitly coordinated with existing Gas RD&D and EPIC

projects focused on long-duration energy storage and should enhance, rather than duplicate, analyses already underway through IRP consultant studies. They also stated that articulation of how this initiative builds on and adds value to existing IRP and other CPUC work will be essential for advancing under Gas RD&D.

CEC Response: In response to CPUC feedback and to be consistent with IRP, staff removed hydrogen from the scope of this initiative. Staff also refined the initiative language to better articulate how the research aligns with the current IRP framework, including applicable definitions, assumptions, and performance metrics. The intent of the assessment is to produce IRP-ready outputs (for example, technology attribute tables) that can be directly incorporated into IRP discussions and related analyses. In addition, the initiative is designed to add value and avoid duplication of existing CPUC, Gas R&D, and EPIC efforts. Based on currently available information, the proposed scope does not duplicate existing efforts. As part of the research, an upfront gap assessment will be conducted to identify relevant and ongoing work and ensure the final scope of the study remains additive to ongoing efforts.

5. Optimizing Thermal Energy Networks for Waste Heat Recovery, Storage, and Decarbonization

Feedback: CPUC SMEs indicated uncertainty that this initiative demonstrates alignment with Gas R&D priorities and noted that the solutions did not seem well articulated; additionally, they noted the need to demonstrate how the proposed research builds on and is coordinated with initiatives in the FY 23–24 and pending FY 25–26 Gas R&D Budget Plans. CPUC SMEs requested a clearer explanation of how the proposed work is uniquely different from existing or already funded efforts.

CEC Response: Staff appreciated CPUC SME feedback and acknowledged the need to more clearly explain the initiative’s alignment with Gas R&D Program priorities, its proposed solution, and how it differs from related proposed CEC efforts. In response, CEC staff clarified how the initiative is aligned with Gas R&D priorities, including CPUC SME-identified priority areas related to water heating and heating, ventilation, and air conditioning. This initiative will evaluate thermal energy networks that enable shared waste heat recovery and delivery, thermal storage, and delivery of low-carbon heating, cooling, and hot water while improving system efficiency, supporting load shifting, and potentially reducing infrastructure costs.

This initiative will include a feasibility and technoeconomic assessment, evaluation of cost-effectiveness, identification of potential alternatives, and characterization of conditions under which future pilots may (or may not) be warranted. The intent is to provide decision-support insights that help prioritize the most cost-effective pathways and inform future funding and program investments.

This initiative is designed to complement geothermal initiatives in the CEC’s approved FY 23–24 and proposed FY 25–26 Gas R&D Budget Plans. The FY 23–24 initiative focuses on geothermal district heating, which uses mid-depth geothermal resources to provide heating for large commercial buildings or facilities that are served by central

plants or designed to serve a single end user. The proposed FY 25–26 Budget Plan includes an initiative on networked geothermal heat pumps, which use shallow geothermal resources in a networked system to provide heating and cooling for multiple end users. This proposed FY 26–27 initiative explores the integration of thermal energy networks paired with waste heat recovery to meet heating, cooling, and hot water needs for multiple end users efficiently and cost-effectively.

Capturing and reusing waste heat is unique to this initiative and offers added value through converting otherwise wasted energy into a usable resource, thereby accelerating decarbonization, reducing operating costs, and improving system efficiency. However, integrating waste heat recovery and storage at a large scale into networked systems presents distinct technical and economic questions, including those related to variable temperature management, operational coordination, sizing, valuation, and community-scale costs and benefits. These questions warrant focused research and are not addressed by previous research initiatives.

6. Studying Advanced Nuclear Reactors for Industrial Decarbonization (Retitled: Studying Industrial Process Heat Decarbonization Pathways)

Feedback: CPUC SMEs did not recommend moving forward with this initiative under the Gas R&D Program. Their perspective was that the proposed use of ratepayer funds was not aligned with CPUC or broader state priorities and did not represent an appropriate or cost-effective use of ratepayer dollars. Given the lack of alignment with CPUC direction and uncertain ratepayer benefit, CPUC SMEs were not supportive of advancing the initiative.

CEC Response: In response to CPUC SME feedback, staff significantly revised and clarified the scope and framing of this initiative. Under the revised scope, this initiative will evaluate industrial decarbonization pathways and firm, non-combustion heat alternatives in the context of increasing electrification and long-term gas demand uncertainty. This initiative is now framed as a comparative study of multiple technology pathways to serve medium- and high-temperature (>300°C) industrial process heat needs, including options such as electrification, clean fuels, nuclear energy, and carbon capture, utilization, and storage. Study outputs will include data on locations of industrial high heat facilities and temperatures of process heat loads, as well as a cost-effectiveness assessment of technology pathways for serving these industrial heat needs in California. These outputs will help inform long-term gas planning by identifying where industrial gas use may be served by viable non-pipeline alternatives and where continued gas service, alternative fuels, or other firm heat resources may need further evaluation.

The revised scope is intended to align more clearly with CPUC and broader state priorities by supporting analysis of industrial demand, potential transition pathways, and the conditions under which different decarbonization strategies may be technically feasible, cost-effective, and supportive of California’s long-term decarbonization goals. Study outputs are directly relevant to the Long-Term Gas Planning Order Instituting Rulemaking.

Additionally, this study is an appropriate and cost-effective use of public research ratepayer dollars as it would represent a relatively modest investment within the Gas R&D Program while addressing policy-relevant questions for a sector that represents a significant share of gas use in California. The resulting analysis could provide ratepayer value by informing the CPUC, IOUs, and other decision-makers as they evaluate industrial process heat needs, consider how these facilities fit into long-term system planning, and identify potential strategies to support a cost-effective and orderly gas transition for some of the hardest-to-decarbonize end uses, reflected in the last 10 percent.

This proposed study is timely as long-term gas planning, future IRP cycles, and California's 2045 decarbonization goal all require an improved understanding of industrial transition options. While some technologies may be deployable sooner than others, the study would not assume deployment of any specific pathway. Instead, it would assess relevant technology maturity, timeframes, feasibility, and tradeoffs to inform future planning decisions.

Tribal Roundtable Feedback

On February 10, 2026, CEC staff held a tribal roundtable with representatives from several California Native American tribes. While the feedback shared during the roundtable is not publicly available, the feedback was considered when revising the proposed initiatives.

Gas R&D Public Workshop

The CEC appreciated the thoughtful and helpful public comments received at the joint Gas R&D Program public workshop held on February 27, 2026. The format of the joint workshop included a Gas R&D Program overview by the CPUC; presentations by CEC, PG&E, and SoCalGas; and an ESJ panel discussion. The six initiatives presented by the CEC were:

1. Gas Network Decommissioning Pathways to Scale Infrastructure Retirement
2. Advancing Health and Equity in California's Gas Transition
3. Strategic Assessment of Cost-Effective Seasonal Energy Storage Pathways
4. Optimizing Thermal Energy Networks for Decarbonization
5. Cleaner Industry, Healthier Communities
6. Studying Industrial Process Heat Decarbonization Pathways

The ESJ panel included representatives from the Greenlining Institute, Physicians for Social Responsibility Los Angeles (PSRLA), and the Central California Asthma Collaborative (CCAC). Public comments were received during the workshop, with an additional opportunity to submit written comments following the workshop. Initiative-specific feedback was not offered for every initiative. This section summarizes feedback most relevant to the CEC's proposed initiatives and broader Gas R&D planning while excluding comments specific to the IOU administrators and utility-led initiatives. The public comments and ESJ feedback are grouped separately for clarity.

Public Comments and CEC Responses

Comments submitted during the workshop:

1. Public Comment: Are clean energy companies headquartered outside of California, but that intend to manufacture and produce in Southern California, eligible for Energy Commission grants?

CEC Response: Generally, individuals, as well as public and private entities within the United States, are eligible to apply for Gas R&D funding. Specific eligibility requirements will be listed in individual solicitation materials. Any agreement resulting from a solicitation will include terms and conditions that recipients are required to abide by. Failure to agree to these terms and conditions will result in disqualification of the application. These terms and conditions are available on the CEC's [website](https://www.energy.ca.gov/funding-opportunities/funding-resources) at: <https://www.energy.ca.gov/funding-opportunities/funding-resources>.

Any entities that conduct intrastate business in California and are required to register with the California Secretary of State must be registered and in good standing prior to entering into an agreement with the CEC. Information on registration can be found on the Secretary of State's [website](http://www.sos.ca.gov/) at: <http://www.sos.ca.gov/>.

2. Public Comment: EPIC provides cost share for federal clean energy grants through the solicitation "Cost-Share for Federal Clean Energy Funding Opportunities" (GFO-21-901). Will the Gas R&D Program create a similar federal cost-share opportunity to support, for example, Advanced Research Projects Agency–Energy (more commonly known as ARPA-E) scale-up or other Department of Energy projects?

CEC Response: The CEC does not currently have plans for a federal cost-share solicitation under the Gas R&D Program similar to GFO-21-901. However, stakeholders are encouraged to provide feedback if they see value in establishing a similar approach for the Gas R&D Program.

3. Public Comment: Given the preference for California-based entities and national labs to do research, how does CEC ensure the pool of eligible research providers has the best expertise needed to meet the research needs? There are other collaborative organizations, for example, Gas Technology Institute, Pipeline Research Council International, or Gas Machinery Research Council, which have broader access to higher-level expertise.

CEC Response: The CEC recognizes the value of specialized technical expertise from other research organizations and consortia. Such organizations may be eligible to participate in Gas R&D projects either as the applicant or as project partners or subcontractors, provided the proposed work complies with solicitation requirements.

4. Public Comment: Do all three administrators seek proposals from the public or just the CEC?

CEC Response: The CEC accepts proposals from the private and public communities, and the solicitation process is primarily done through competitive grant funding opportunities.

5. Public Comment: Is the Gas R&D Program planning to have follow-on funding opportunities for the Hydrogen Blending and Lower Oxides of Nitrogen Emissions in Gas-Fired Generation (HyBLOX) grant?

CEC Response: HyBLOX was a 2023 solicitation focused on testing renewable hydrogen blends for power generation; it resulted in three funded projects. There are currently no plans for a follow-on HyBLOX solicitation. A related initiative, Fuel Flexible Distributed Generation, is included in the CEC's FY 24–25 Gas R&D Budget Plan, which is currently under consideration for approval by the CPUC. That initiative proposes to examine additional renewable fuels. While related in topic, it is not a direct follow-up to HyBLOX.

6. Public Comment: Where can we find reporting and lessons learned from gas decommissioning pilots?

CEC Response: Gas system decommissioning is still in its early stages, so limited information is available. PG&E has completed a number of small projects, but community-scale efforts are just beginning. SB 1221 requires the CPUC to establish a community-scale decommissioning pilot program by July 1, 2026. The CEC has also proposed funding for neighborhood-scale pilots, pending budget plan approval. Overall, activity in this area is expected to increase later this year. Once available, reports from the CEC-funded projects, along with all other Gas R&D Program publications, can be accessed on the [CEC Publications](https://www.energy.ca.gov/data-reports/all-publications/energy-commission-publications?combine=&field_publication_classification_target_id=All&field_publication_program_target_id=53&field_keywords_target_id=) webpage (https://www.energy.ca.gov/data-reports/all-publications/energy-commission-publications?combine=&field_publication_classification_target_id=All&field_publication_program_target_id=53&field_keywords_target_id=).

7. Public Comment: When it comes to research, the lowest-cost method to conduct research in advanced topics like safety, affordability, integrity, leak detection, and reporting is through a collaborative model, aligning with all the other operators who are doing similar research. Because industry is moving ahead in these areas, it is the lowest-cost option to partner with them intentionally and leverage the discoveries that they make and the advancements to make sure that they are implementable and implemented where applicable in California.

CEC Response: The CEC appreciates the comment and agrees that a collaborative approach can be an effective way to leverage technical expertise, reduce duplication, and support cost-effective research on advanced gas system topics. Collaboration is a core aspect of the Gas R&D Program, including engagement with a diverse set of parties, such as utilities, researchers, technology developers, public agencies, and community partners, in its implementation. This engagement promotes program accountability, transparency, collaboration, and responsiveness. The CEC relies on strategic partnerships to avoid duplication, build upon previous R&D work, generate new ideas, leverage public and private investments, and ultimately ensure the research portfolio delivers tangible benefits to the state's gas ratepayers.

8. Public Comment: Forest fires are a serious concern for the safety of gas pipeline infrastructure. The CEC has funded projects to upgrade forest biomass waste to clean fuels such as renewable natural gas, hydrogen, and liquid fuels. What is the plan to deploy these technologies to create a win-win solution for safety and decarbonization?

CEC Response: The projects referenced likely come from the CEC’s Clean Transportation Program, which is separate from the Gas R&D Program. While that program has historically funded forest biomass-to-fuels projects, the focus has more recently shifted toward electric vehicles and charging infrastructure. Other state programs may be relevant to this topic, including the Department of Conservation’s Forest Biomass to Carbon Negative Biofuels Program. The CEC also has a [Clean Hydrogen Program](https://www.energy.ca.gov/programs-and-topics/programs/clean-hydrogen-program) with remaining funding (<https://www.energy.ca.gov/programs-and-topics/programs/clean-hydrogen-program>), and EPIC had previously supported biomass-to-electricity projects. In addition, the Governor’s Wildfire Task Force — specifically its Wood Utilization Working Group — may offer opportunities for engagement. Finally, the Fuel Flexible Distributed Generation initiative in the CEC’s proposed FY 24–25 Gas R&D Budget Plan, which is currently under review by the CPUC, could potentially support forest waste conversion technologies, though that is not its primary focus.

9. Public Comment: Is the Gas R&D Program planning to have new solicitations on developing technologies like a micro-combined heat and power that uses renewable natural gas and renewable propane that do not exclude internal combustion engines?

CEC Response: Not currently. While the CEC’s Gas R&D Program has funded micro-combined heat and power in the past, there are no current plans for funding this technology. Various parties have raised concerns about combustion systems, including internal combustion engines.

10. Public Comment: Supportive of CEC’s proposed research on thermal energy networks and recommend CEC staff look at the pilots conducted by National Grid in New York to leverage any lessons learned. SoCalGas, PG&E, and CEC together have supported some advanced heat recovery technology, and it is strongly encouraged to continue that support as it represents low-hanging fruit. When natural gas is burned, about 25 percent is wasted. That corresponds to the emissions released. Recovering that wasted heat for reuse is a direct benefit. Exploring opportunities to reuse wasted heat should be considered a high priority.

CEC Response: Staff appreciates the support shown for the thermal energy network initiative and agrees that California has a significant opportunity to recover and reuse low-grade waste heat generated from large facilities. Additionally, staff is tracking similar efforts in other states and elsewhere, including the National Grid work in New York, and plans to leverage data and lessons learned as applicable.

11. Public Comment: Supportive of advanced nuclear research as part of the “all-of-the-above” strategy presented by CEC. Fuel disposal concerns are real, but research is needed to address those waste stream issues, and we should not be trying to pick winners or losers before conducting research. Research should be conducted and serve as a guide.

CEC Response: Staff appreciates the comment. The Studying Industrial Process Heat Decarbonization Pathways Initiative is designed to take a technology-neutral “all-of-the-above” approach by evaluating multiple industrial heat pathways within a comparative framework. The intent is not to prioritize or advance any single technology but rather to generate objective data in areas such as waste management, safety, and feasibility to inform future decision-making.

12. Public Comment: The proposed Industrial Process Heat Decarbonization Study is important and addresses major gaps, but any scenario modeling or planning should be constrained to meet the state’s health-based air quality goals. Our most polluted air basins cannot attain federal or state standards without a broad transition to zero-emission technologies for large and small stationary sources. This means combustion-based process heat will not be feasible if we are to meet National Ambient Air Quality Standards. It would be a poor use of CEC resources to model scenarios that are inconsistent with established state health policy.

CEC Response: Staff agrees that alignment with state and federal health-based air quality goals is critical. This initiative is designed to evaluate industrial heat pathways within a comparative, policy-informed framework, including consideration of emissions and air quality impacts. The intent is not to promote combustion-based solutions but to assess pathways against multiple criteria, including consistency with National Ambient Air Quality Standards and California’s air quality and climate goals, so that planning decisions are grounded in both technical and policy contexts.

13. Public Comment: Is the use of hydrogen as an alternative fuel still on the agenda for CPUC, CEC, PG&E, and SoCalGas? It was a hot topic a year ago.

CEC Response: The CEC is not proposing any initiatives that use hydrogen in its FY 26–27 Gas R&D Budget Plan. For potential hydrogen-related opportunities from the CEC, staff recommends exploring the CEC’s [Clean Hydrogen Program](https://www.energy.ca.gov/programs-and-topics/programs/clean-hydrogen-program) (<https://www.energy.ca.gov/programs-and-topics/programs/clean-hydrogen-program>) or [Clean Transportation Program](https://www.energy.ca.gov/programs-and-topics/programs/clean-transportation-program) (<https://www.energy.ca.gov/programs-and-topics/programs/clean-transportation-program>).

14. Public Comment: What is the timeline for permitting and construction of the necessary [industrial] facilities to 100 percent electrify? What is the relative cost of 100 percent electrification versus the current hybrid gas-electric approach? Those in the lowest economic tier are disproportionately impacted by energy cost increases. Is gas needed as a backup to green electricity? It seems like gas will have to be around for quite a while.

CEC Response: The timeline for permitting and construction to fully electrify industrial heat would likely be long — on the order of years to decades — depending on the sector and location. Large-scale electrification will require significant upgrades to transmission and distribution infrastructure, as well as facility-level modifications and

permitting processes, all of which involve substantial lead times. In terms of cost, fully electrified pathways currently involve higher upfront capital and infrastructure costs, particularly due to grid upgrades and equipment replacement. Hybrid gas-electric approaches, on the other hand, may offer lower near-term costs and more gradual transition pathways, but could have different long-term implications for emissions and system planning.

More broadly, while electrification is widely considered the primary pathway for decarbonization, it may take decades for hard-to-electrify sectors such as cement, glass, steel, and chemical processing to transition. These facilities face challenges, including high electricity costs, reliability concerns, and the need for significant process redesigns. This is why the industrial process heat decarbonization pathways study evaluates both fully electrified and hybrid pathways both to better understand tradeoffs across cost, infrastructure requirements, timelines, and reliability and to support informed long-term planning rather than assume a single outcome.

Written Comments Submitted:

One written comment was submitted via email to SoCalGas after the joint workshop from a SoCalGas ratepayer. The contents of the letter did not provide any direct feedback to the CEC or its proposed initiatives but rather included broader commentary on the Gas R&D Program. As such, there is no need for a CEC response, but a summary of the letter is provided for completeness of this feedback section.

15. Public Comment (Written): The letter expressed that ratepayer-funded RD&D programs are essential for innovation within regulated utilities, where companies are otherwise not incentivized to invest in unproven technologies. It argued that current CPUC regulatory processes create excessive delays, resulting in lost purchasing power and reduced research impact, and urged the CPUC to streamline approvals, finalize or suspend the Uniform Impact Analysis Framework requirement, and remove overly burdensome review steps such as Tier 3 Advice Letters. The letter also encouraged expanded RD&D research into cleaner gas appliances and non-EV transportation options, noting that full electrification is not feasible for all households.

ESJ Panel Feedback and CEC Responses

Feedback on Gas System Integrity Initiatives:

1. ESJ Representative Comments:

From the economic equity lens, regarding the Gas Network Decommissioning Pathways to Scale Infrastructure Retirement Initiative, one issue is the risk of a shrinking rate base as higher-income customers electrify first, with remaining gas customers being disproportionately low-income. How does a project like this prevent the escalating fixed cost on a smaller, low-income customer base? Connected to that is “stranded cost.” Who ultimately pays for legacy assets, and what can be done to make sure they’re not negatively impacting the already overburdened communities? (*Greenlining Institute*)

The Gas R&D Program should focus RD&D on supporting a rapid and efficient clean energy transition that will shift the benefits and burdens in ways that promote equity and ensure safeguards for vulnerable populations, meaning populations that include workers, tenants, and frontline communities living near the fossil fuel infrastructure. Gas System Integrity is important, but it's only important until a truly clean energy transition can occur. *(PSRLA)*

CEC Response: CEC staff appreciates the thoughtful comments that highlight the critical equity and affordability considerations that must guide California's transition away from the gas system. The Gas Network Decommissioning Pathways to Scale Infrastructure Retirement Initiative is designed specifically to address these concerns by developing planning frameworks and operational strategies that prevent disproportionate cost burdens on low-income households as system usage declines. By creating tools for assessing rate and cost impacts, identifying least-cost decommissioning pathways, and sequencing infrastructure retirements responsibly, the initiative helps mitigate the shrinking-rate-base risk identified by the Greenlining Institute and supports a transition that avoids unnecessary reinvestment in aging gas assets.

Consistent with PSRLA's comments, equity, safety, and community protection, particularly for workers, tenants, and frontline communities located near fossil fuel infrastructure, will be embedded throughout the research design. The purpose of the initiative is to integrate pilot learnings, legislative direction, and on-the-ground implementation to ensure that, as California moves toward a clean energy future, the benefits are shared equitably, and vulnerable populations are protected throughout every stage of the transition.

2. ESJ Representative Comments:

CEC's Gas Network Decommissioning Pathways to Scale Infrastructure Retirement Initiative addresses the kind of difficult questions we need to be solving. Scarce RD&D investments should be prioritized for things that solve the deeper challenges of maintaining safety and affordability while decommissioning our gas infrastructure. Moving away from investments that sustain or reinforce a system is something that ultimately PSRLA would like to see replaced. The bulk of the funding should go more towards decarbonization. *(PSRLA)*

Regarding the balance of how the funds are split between the two priority areas of gas system integrity and decarbonization, there has been some important work on improving our gas system integrity, but research and development should be more forward-thinking and look at where we're trying to go. The definition of decarbonization is broader than electrification. The overall mix of prioritizing more of the funding into the decarbonization theme, the way the CEC has it laid out, is something that CCAC supports. *(CCAC)*

CEC Response: Staff appreciates the acknowledgement of how CEC proposed funding is allocated between the Gas System Integrity and Decarbonization themes. The driving factor in how the budget plan is shaped comes from the R&D areas that are best aligned with state policies and ratepayer interests. The proposed Gas R&D initiatives are based on state energy policies, proceedings, plans, and guidance; analysis of research gaps; coordination with the CPUC and other agencies; and input from a wide range of

interested parties. The result is an emphasis on investments in decarbonization to help make progress toward California’s climate goals.

3. ESJ Representative Comment:

Recommend adding an affordability or equity proof requirement to show that there is no cost shifting at all to low-income customers or renters. For each of the initiatives, it would be good to see an affordability or energy burden analysis requirement. *(Greenlining Institute)*

CEC Response: Staff agrees with the recommendation and would like to highlight that the Gas Network Decommissioning Pathways to Scale Infrastructure Retirement Initiative is expected to offer an increased affordability benefit through the development of cost and rate impact assessment methods and infrastructure prioritization methodologies. Some examples of key affordability metrics may include cost per customer transitioned and percent reduction in gas system operation and maintenance costs. These metrics could help to identify least-cost pathways and avoid unnecessary capital investments in aging infrastructure.

4. ESJ Representative Comment:

Consider a requirement that analyzes the potential for any further harm to the affordability of a given community that may be impacted. For example, this could include creating a scoring criterion that looks at transparency and is not biased toward underinvestment or overexpansion of gas in marginalized communities. Essentially, funding should be connected to a project’s ability to prioritize lowering the energy burden, as opposed to it being neutral or worsening it. *(Greenlining Institute)*

CEC Response: The CEC’s Gas R&D project selection process incorporates several of these considerations through its competitive grant proposal evaluation process. Each proposal is scored and ranked according to established criteria, including the project’s potential impacts and benefits to California and to gas ratepayers. Depending on the solicitation, this may include consideration of affordability impacts, impacts to ESJ communities, and whether the proposed work could help reduce burdens or avoid unintended adverse impacts in affected communities, ensuring there is a clear benefit to communities. The CEC also recognizes the importance of transparency and community-informed project design, often requiring the participation of a local community-based organization on the project team in project proposals.

5. ESJ Representative Comment:

Encourage the proposed research to look beyond decarbonization and consider other impacts such as air pollutants resulting from any projects or pilots, safety concerns, financial concerns, and traffic considerations that may emerge. Also, recommend robust stakeholder engagement to think through those types of issues and to determine the best approach for any given community. *(PSRLA)*

CEC Response: CEC agrees with the concerns raised and affirms that gas decommissioning projects must consider a range of community impacts beyond decarbonization, including air quality, safety, affordability, construction-related

disruptions, and other community-specific concerns. Gas decommissioning projects can also improve our understanding of other drivers and barriers influencing the transition away from gas end uses. In particular, additional information on customer adoption behaviors, local air impacts, safety considerations, traffic or access disruptions, and economic impacts associated with electrification and alternative solutions can offer critical insights into how transition pathways may affect customers and the broader energy system.

As such, the CEC's initiative under the Gas System Integrity theme could help address these concerns by supporting community-informed research and tracking key metrics such as frequency and duration of unplanned service disruptions, potential cost savings, and other local impacts identified through community engagement.

6. ESJ Representative Comments:

Many organizations are very short-staffed, and R&D is a very complex issue that requires a lot of time. In the review process, procedural equity is needed, meaning engagement with ESJ organizations is intentional and sincere and it gives them the time to engage productively. This means allowing sufficient time to engage coalition members, residents, and community members. *(Greenlining Institute)*

Engaging with the local community and allowing that community itself to determine if a project would benefit them is most important. Deep community engagement is costly and expensive, but that's how to get R&D projects that communities will be proud of. *(PSRLA)*

Disadvantaged communities do not appreciate being a guinea pig for new technologies if it's unproven or the impacts are unknown. The CEC is at the forefront in requiring consultation or inclusion of community-based organizations or communities in proposals. Would the R&D program be able to require demonstrated early engagement with impacted communities or community-based organizations before a project is selected? There is the principle: "Nothing about us without us." CCAC recommends creating a Community Advisory Board or Citizens Advisory Board, a critical or required component throughout the process. The advisory boards should be resourced, even for highly technical projects that can serve as a learning opportunity. *(CCAC)*

CEC Response: Staff appreciates the feedback emphasizing the importance of early, meaningful, and adequately resourced community engagement, particularly for projects that may affect ESJ or disadvantaged communities. The CEC recognizes that effective engagement requires sufficient time for community-based organizations, community members, and other local partners to provide input and help shape project design. As noted by CCAC, to support meaningful community engagement and participation, the CEC often requires or encourages the inclusion of community-based organizations on project teams. The CEC also continues to consider engagement approaches such as community partnerships, advisory groups, and project-specific outreach to support transparency, information sharing, and ongoing feedback throughout project implementation. Additionally, the CEC is continually seeking to strengthen community

engagement through solicitation requirements, evaluation criteria, and implementation practices and is open to continued input and feedback.

Decarbonization Panel feedback:

7. ESJ Representative Comment:

Reiterated ideas related to the economic impacts of the different initiatives and how the results would show whether those impacts are real. In the different IOU presentations, energy burden was identified as a priority, which was good to see; however, there were not many solutions identified to address it. It would help to see how exactly these different ideas will lower bills for the community members who will be impacted. It would also be good to see more ideas around how that priority [energy burden] becomes actual solutions. The saying is “if you can’t measure it, it doesn’t exist.” So, it is important to be able to measure what these energy burdens are. (*Greenlining Institute*)

CEC Response: Staff appreciates the feedback emphasizing the importance of clearly identifying how proposed initiatives could affect energy affordability and energy burden for impacted communities. The CEC’s proposed initiatives are intended to provide ratepayer benefits by informing cleaner, safer, healthier, and more cost-effective pathways for transitioning the gas system and avoiding unnecessary investments in aging or underused gas infrastructure. Over time, these efforts are expected to help reduce system costs that are ultimately borne by ratepayers, including costs associated with unnecessary infrastructure investments, operations and maintenance, repairs and replacement, inefficient energy use, and methane leaks.

Staff also agrees on the importance of measuring these impacts where feasible. Project-specific metrics will be developed as appropriate; examples may include projected percent reduction in gas system operation and maintenance costs, avoided or deferred infrastructure investments, changes in customer energy costs or energy burden, or cost per leak detected. These metrics can help evaluate the degree to which proposed research activities support measurable benefits for ratepayers and communities.

8. ESJ Representative Comments:

The Advancing Health and Equity in California's Gas Transition Initiative is something that PSRLA would be highly supportive of. PSRLA has been working with the CEC to develop and implement the Equitable Building Decarbonization Program, and this type of research can help advance cost-effective residential decarbonization. PSRLA appreciates that the initiative explores non-energy benefits. (*PSRLA*)

There could be a significant opportunity within the residential sector, but it was not discussed in detail. The research could build on programs like the Equitable Building Decarbonization Program to evaluate the non-energy benefits while conducting pilots or rolling out state programs focused on whole-home retrofits. CCAC has conducted research funded by the U.S. Department of Housing and Urban Development and through the CEC, including the Cooking Electrification and Ventilation Improvements for Children’s Asthma Study. However, there is

more opportunity to research the health impacts and air quality impacts of decarbonization. *(CCAC)*

CEC Response: Staff appreciates the thoughtful comments and strong support for the Advancing Health and Equity in California’s Gas Transition Initiative. Staff also appreciates the continued partnership through efforts such as the CEC’s Equitable Building Decarbonization Program and related research, including studies like Cooking Electrification and Ventilation Improvements for Children’s Asthma. Staff also agrees that there is significant value in advancing research on residential decarbonization, particularly in understanding non-energy benefits, such as indoor air quality and health outcomes, and in supporting education and decision-making for residents.

In response to feedback received from the CPUC following the workshop, staff revised this initiative to better align with direct gas ratepayer benefits. Specifically, the revised initiative now focuses exclusively on methane emissions monitoring and analysis, including integration of satellite and ground-based measurements, development of low-cost methane sensors, and enhancement of existing monitoring frameworks, building on projects such as SUpper-eMitters of Methane detection using Aircraft, Towers, and Intensive Observational Network (SUMMATION), PIR-17-005.

9. ESJ Representative Comment:

Low-income communities and disadvantaged community households often face structural barriers that affect energy use rather than behavioral challenges. Research on interventions to lower energy use at home should account for those structural causes and avoid approaches that make residents feel like they’re being blamed for behavioral choices, such as having their air conditioning on in the Central Valley. Research should center on the day-to-day experience of the people on the ground and include them in discussions. *(Greenlining Institute)*

CEC Response: Staff appreciates this feedback and agrees that structural conditions in residential buildings are a major factor influencing household energy use, affordability, and comfort. Staff also recognizes the importance of avoiding approaches that place responsibility on residents for energy use driven by building conditions. The Gas R&D Program will continue to consider how proposed research can account for structural barriers, incorporate resident and community perspectives, and support improved understanding of health and air quality impacts of decarbonization.

10. ESJ Representative Comment:

Appreciate the framing around health and equity that the CEC put forward, but in the details, there are some red flags in the Cleaner Industry, Healthier Communities Initiative; carbon dioxide removal is not something the program should be investing in. *(CCAC)*

CEC Response: Staff agrees that health and equity considerations are foundational to the Gas RD&D Program. The Cleaner Industry, Healthier Communities Initiative does not propose any work on carbon dioxide removal or carbon capture technologies. In response to feedback, the scope has been further clarified to elevate the focus on co-pollutant removal technologies at existing industrial facilities. The initiative is intended

to evaluate and demonstrate retrofit-ready emissions-control solutions that reduce criteria air pollutants such as NO_x, SO_x, and particulate matter, delivering near-term public health benefits, particularly in disadvantaged and vulnerable communities. Staff would like to emphasize that all technologies evaluated under this initiative will be subject to health, safety, and equity screens and that the work is limited to research, demonstration, and data generation to inform decision-making.

11. ESJ Representative Comment:

For the Studying Industrial Process Heat Decarbonization Pathways Initiative, PSRLA would have strong objections to advanced nuclear reactors being included in the study. There are a lot of questions around nuclear waste and safety that would need to be addressed before PSRLA would be supportive. Instead of taking an all-of-the-above approach, PSRLA recommends prioritizing the safest, cleanest, and most equitable solutions. *(PSRLA)*

CEC Response: Staff agrees that nuclear waste and safety are extremely important concerns. The initiative's scope is limited to a paper research study, not deployment, and would evaluate advanced nuclear-related risks and requirements, including waste management, safety, and equity considerations, alongside other industrial decarbonization pathways to better inform potential decision-making. The study takes a technology-neutral, comparative approach and does not pre-select or endorse any one pathway. All pathways would be evaluated against multiple criteria, including public health, environmental, and equity considerations, to ensure alignment with state policy goals.

12. ESJ Representative Comments:

We're very interested in the decarbonization area and are likely going to follow up with many of the participants today. We have so much that we can start with and start to talk about. There are conversations happening for non-energy benefits, where we can get even more ideas. *(Greenlining Institute)*

It is a priority for PSRLA to help think through what the gas transition will look like. Our goal is not to obstruct, but to help build a future that we all deserve, and so we are happy to be supportive of research that is getting us closer to that goal. I appreciate being able to share my perspective from the public health side of things, but I know there are so many folks who are deeply involved and have tons of expertise. Maybe there are ways we can set up meetings with our coalitions to give a briefing on some of these. We could be sharing information with the people who really need it in a condensed and efficient way. *(PSRLA)*

If possible, it would be good to incorporate the California Air Resources Board if an advisory board is developed, as they are funding very similar research and projects on satellite methane emissions. *(CCAC)*

CEC Response: Staff appreciates the recommendation and notes that interagency coordination, including with the California Air Resources Board, is ongoing and will be thoroughly considered for any advisory functions. Additionally, staff would welcome further coordination with members of the ESJ panel, their colleagues, and other ESJ representatives.

DACAG Meeting Comment Summary and CEC Response

On March 20, 2026, the CEC and the IOU gas administrators presented a joint presentation at a DACAG meeting. The CEC staff's presentation included an overview of how equity is embedded across the administration of the Gas R&D Program, detailed the coordination with the IOU administrators, and provided an overview of the six proposed initiatives. The CEC appreciates the helpful questions and comments from DACAG members. Below is a summary of DACAG member comments and CEC staff responses. The comments shown here include the CEC-specific and all administrator comments and exclude the utility-specific feedback.

1. Feedback: The DACAG SME who previously provided feedback on early initiative concepts expressed appreciation that staff incorporated several recommendations, particularly those related to concerns around an advanced nuclear study and reverse methanation.

CEC Response: Staff appreciated the DACAG SME's early engagement and found the feedback provided was valuable in shaping and better defining the scope of the initiative concepts.

2. Feedback: Do these initiatives have to be approved by the CEC or CPUC before they are implemented?

CEC Response: Yes, the CEC undertakes an extensive internal review process and then submits its budget plan initiatives, as required, to the CPUC for approval prior to any of the research being conducted.

Additional Feedback and Coordination Discussions

Additional Feedback from CPUC

In additional meetings, CPUC staff and leadership expressed concerns about two of the CEC's proposed initiatives: (1) Studying Industrial Process Heat Decarbonization Pathways and (2) Advancing Health and Equity in California's Gas Transition. The concerns were related to how the CEC's industrial decarbonization initiative compared with SoCalGas' proposed industrial decarbonization research and uncertainty surrounding the clear ratepayer benefits for the health and equity transition initiative. The CPUC feedback and CEC responses are summarized below.

1. Studying Industrial Process Heat Decarbonization Pathways

Feedback: CPUC requested clarification on the differences between the SoCalGas and CEC initiatives focused on decarbonizing hard-to-electrify industries.

CEC Response: The CEC initiative, Studying Industrial Process Heat Decarbonization Pathways, is focused on conducting a comparative study of decarbonization pathways for high-temperature industrial process heat, with the purpose of evaluating and comparing a range of potential approaches to better understand their relative opportunities, constraints, and applicability for hard-to-decarbonize industrial processes. As proposed, this initiative is analytical and strategic in nature and intended to support long-term planning and decision-making. By contrast, SoCalGas has proposed research that is more focused on developing and demonstrating specific technologies and

applications, such as heating equipment, energy management systems, thermal energy recovery and storage, smart building controls, and emissions-reduction measures for equipment and facility systems.

Generally, CEC's initiative is longer-term and more study-focused, while SoCalGas's proposal is more near-term, technology-specific, and demonstration-oriented. Depending on implementation timing, there is the potential that the SoCalGas research could help to inform the CEC's study. Both teams plan to continue coordinating on this topic moving forward to help ensure alignment across portfolios.

2. Advancing Health and Equity in California's Gas Transition

Feedback: CPUC questioned the project's direct benefits to ratepayers, its added value beyond existing tools like CalEnviroScreen, and the feasibility of producing accurate statewide bill or health-impact estimates. The CPUC raised concerns about the project drifting into CARB's jurisdiction and emphasized that CARB must be involved early, especially for any enforcement-related uses. Additionally, there was doubt surrounding the proposed methane-monitoring approach and whether gas ratepayer funds are appropriate for parts of the work. Overall, the CPUC urged clearer justification, closer coordination with CARB, and a more exploratory framing when engaging interested parties.

CEC Response: Staff appreciated this feedback. To help address the CPUC concerns raised regarding ratepayer benefits and project scope, the initiative was significantly revised, and the scope was reduced. Specifically, staff removed the public-facing tool component and centered the focus on a unified methane emissions monitoring and analysis research theme, including satellite-ground data integration (with the former "scoring system" reframed as part of this broader analysis), low-cost sensor development and validation, and enhancing the existing SUMMATION monitoring framework. In addition to regular meetings to coordinate on the methane portfolio, staff met with CARB following the CPUC feedback on this initiative to discuss the revised scope, support coordination, and avoid duplication. Staff will continue regular coordination with key points of contact to ensure early and continued alignment. Given these changes, the initiative was re-titled to better reflect the more focused scope of the updated initiative: Advancing Cost-Effective Methane Emissions Monitoring for California's Gas System.

Topically Focused Coordination Discussions

In addition to regular coordination meetings, the CEC held focused discussions with CARB and the IOU Gas RD&D Program administrators on topics of shared interest, including gas system decommissioning, industrial decarbonization and emissions reductions, and methane emissions monitoring. These discussions helped inform initiative development by ensuring the proposed research is complementary and additive to ongoing efforts, avoids duplication, and identifies opportunities for coordination. Brief summaries of these discussions are provided below.

1. Gas Network Decommissioning Pathways to Scale Infrastructure Retirement

On March 5, 2026, and May 27, 2026, staff met with PG&E SMEs to coordinate on decommissioning research efforts. These discussions focused on alignment, avoiding duplication, and identifying where each administrator is best positioned to advance complementary research. The discussions clarified further that CEC’s proposed research is not duplicative of PG&E’s planned work. While CEC’s proposed decommissioning portfolio focuses on statewide, regional, and pilot-level research, PG&E is focused on translating upstream research and policy direction into utility-specific modeling and risk analysis. Additionally, CEC staff provided an overview of the Paving the Way for California’s Gas Transition solicitation (GFO-24-501) and the resulting projects proposed for award.

2. Studying Industrial Process Heat Decarbonization Pathways

On March 17, 2026, and April 20, 2026, staff met with both PG&E and SoCalGas to coordinate on research focused on hard-to-decarbonize sectors. As described in the above section, “Additional Feedback from CPUC,” CEC and SoCalGas clearly differentiated their proposed research scopes in this space and confirmed that efforts would be complementary and not duplicative. While PG&E did not have specific industrial decarbonization research proposed at the time, it was discussed that, generally, utilities may be best positioned to address system-specific and near-term operational needs for hard-to-decarbonize customers, while the CEC could take a leading role in broader, sector-wide road mapping and emerging technologies that can inform future decarbonization pathways.

3. Advancing Cost-Effective Methane Emissions Monitoring for California’s Gas System.

On March 30, 2026, staff met with representatives from CARB’s Research Division and Industrial Strategies Division to discuss the revised scope of the initiative Advancing Cost-Effective Methane Emissions Monitoring for California’s Gas System (formerly Advancing Health and Equity in California’s Gas Transition). Staff provided an overview of the proposed research, and CARB shared helpful background and context on ongoing and complementary efforts, including satellite-based methane observations (e.g., Carbon Mapper) and associated data characteristics, such as spatial resolution considerations. In addition, CARB highlighted ongoing discrepancies between top-down and bottom-up methane emissions estimates, highlighting the need that CARB staff see for improved measurement, integration, and validation approaches — areas directly aligned with this initiative. CARB also appreciated that this type of research could further complement and support their leak detection and repair efforts and expressed a desire to contribute to scoping a future solicitation under this initiative.

On May 7, 2026, staff met with SoCalGas SMEs to discuss the revised scope of this initiative. This discussion clarified that the proposed research is not duplicative of SoCalGas’s ongoing emissions work, as the efforts focus on different applications and monitoring needs. While SoCalGas’s emissions work focuses primarily on distribution assets, this initiative focuses on high-impact intermittent emission sources such as behind-the-meter industrial customers and storage facilities. This research will also complement SoCalGas’s snapshot-based monitoring by improving calibration methods under real-world environmental conditions and supporting

ongoing measurements needed to detect and characterize intermittent emissions. In parallel, SoCalGas identified an ongoing project to integrate sensors into pipeline markers. Given the prohibitive cost of commercially available technologies, the two work streams will enable complementary and coordinated efforts to advance low-cost sensor technologies, with the CEC's proposed initiative leveraging those outcomes to improve the efficacy and transparency of tracking intermittent emissions. Staff will continue coordinating with SoCalGas to ensure any related research is appropriately scoped to address remaining gaps, target emerging needs, and complement existing efforts rather than duplicating work underway.

On May 11, 2026, staff met with PG&E SMEs to discuss the revised scope of this initiative and to better understand how the initiative could complement existing utility efforts. PG&E staff were generally supportive of the initiative and indicated that the proposed work appeared complementary to ongoing utility activities rather than duplicative. Discussion focused on the distinction between utility operational leak detection efforts, which are primarily focused on distribution infrastructure, and the proposed CEC research activities, which emphasize integrated, multi-scale methane monitoring and analysis approaches. Key discussion points included the potential value of focusing portions of the research on emissions sources beyond traditional utility distribution assets, including storage infrastructure and behind-the-meter industrial or customer-side emissions, where aerial and broader atmospheric monitoring approaches may provide additional value. PG&E staff also noted that development and validation of low-cost methane sensors and monitoring systems could be particularly useful, especially for monitoring applications associated with meter and regulation stations and other facilities where utilities currently rely heavily on emissions factors and periodic measurements. Staff also discussed the importance of improving integration across multiple measurement approaches, including aerial surveys, atmospheric monitoring, and ground-based sensing technologies, to support more effective methane emissions characterization and long-term system planning.



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ENERGY RESEARCH AND DEVELOPMENT DIVISION

APPENDIX D: List of Gas R&D Program Events March 2025 – May 2026

June 2026 | CEC-500-2026-014

APPENDIX D:

List of Gas R&D Program Events March 2025 – May 2026

March 2025:

- [Preapplication Workshop - GFO-24-501 - Paving the Way for California's Gas Transition](#). California Energy Commission (CEC) staff held a Pre-Application Workshop to discuss this solicitation with potential applicants.

September 2025:

- [Ribbon Cutting Event](#). Sierra Northern Rail, together with GTI Energy, unveiled its new hydrogen fuel cell switcher locomotive at a ribbon-cutting event in West Sacramento, with state and local leaders participating (PIR-20-001).

October 2025:

- [Scoping Workshop: Funding to Advance Integrated Planning of Gas System Decommissioning](#). CEC hosted a scoping workshop to share staff's proposed concept for funding research to advance integrated planning to support gas system decommissioning and to elicit public input on the proposed research concept.
- [Public Webinar: Showcasing the Tool for Screening for Promising Sites for Gas Decommissioning](#). Led by DNV and supported by UCLA's The Center for Sustainable Communities (PIR-22-002).
- Internal (CEC/California Public Utilities Commission) Webinar (PIR-22-002). Led by DNV and supported by the UCLA Center for Sustainable Communities on October 28, 2025. This webinar provided a hands-on, in-depth explanation of the tool, geared for CEC and California Public Utilities Commission staff to understand and explore the different layers of the tool as it was built in ArcGIS.

November 2025:

- [Webinar: BioVind's Rapid Field Detection of Microbial Corrosion — A New Frontier in Pipeline Integrity and Climate Resilience](#). SoCalGas hosted a webinar in which commonly used microbial testing approaches were discussed. The webinar also highlighted a novel DNA-based platform designed for on-site microbial identification developed by BioVind, Inc. (PIR-22-004).
- Public Workshop: Perspectives on Natural Gas Use. GTI, in collaboration with UCLA, held a public engagement and outreach workshop as part of their CEC-funded project titled "Plastic Pipeline Deficiency Inspection for Pipeline Integrity Management" (PIR-23-005). The purpose was to provide an overview of the project and to facilitate a

discussion aimed at gaining insights into local perspectives on natural gas use, including community views on consequences, safety, and risk.

February 2026:

- [Gas Research, Development, and Demonstration Workshop](#). CEC hosted a joint remote-access workshop with the Investor-Owned Utilities and the California Public Utilities Commission to discuss proposed energy-related gas research initiatives for their respective gas research program plans.
- [Pre-Application Workshop — GFO-25-304: “Modeling and Monitoring Air Quality and Co-Benefits of Energy Interventions.”](#) CEC staff held one pre-application workshop to discuss this solicitation with potential applicants.



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APPENDIX E: FY 2026–2027 Gas R&D Budget Plan Equity Framework Topic Definitions

June 2026 | CEC-500-2026-014

APPENDIX E:

FY 2026–2027 Gas R&D Budget Plan Equity Framework Topic Definitions

The Disadvantaged Communities Advisory Group (DACAG) developed an Equity Framework to ensure that equity is centered in climate-related policies and programs administered by the California Energy Commission (CEC) and the California Public Utilities Commission.¹ The FY 2026–27 Gas R&D Budget Plan includes the application of the Equity Framework, as updated in 2024. The equity-related considerations identified in the framework have been adapted to apply to the Gas R&D Program and Electric Program Investment Charge (EPIC) Program.

Non-Energy Benefits

Non-energy benefits (NEBs) are project benefits that extend beyond direct energy benefits, such as improved health, safety, and comfort.² Additionally, these can be benefits that “accrue to society at large,” including local job creation, increased community resilience, improved air quality, and other environmental benefits, such as reduced water use and water quality improvements. In administering its research programs, the CEC considers NEBs through program planning, solicitation development, and project oversight to help ensure that these broader public interest and community benefits are considered and valued in research investments. This supports a more complete understanding of project impacts and helps inform decisions in ways that can reduce disproportionate impacts and enhance community benefits.

Affordability

Affordability refers to the extent to which investments support clean, safe, and reliable energy services without imposing unreasonable costs on ratepayers or disproportionately burdening ESJ communities and tribes. For CEC, affordability considerations may include whether research helps identify cost-effective pathways, reduces long-term infrastructure or operating costs, lowers customer energy burdens, or informs strategies that can help avoid inequitable cost impacts. The 2024 DACAG framework specifically emphasizes maintaining or enhancing affordability for disadvantaged communities.

Access, Outreach, and Education

Accessibility, outreach, and education is the extent to which cleantech products, services, information, and opportunities are available and accessible to people from the widest range of backgrounds and capabilities. The CEC strives to remove barriers to clean energy technology

1 California Disadvantaged Communities Advisory Group. [CA Disadvantaged Communities Advisory Group \(DACAG\) Equity Framework: 2024 Update](https://www.cpuc.ca.gov/-/media/cpuc-website/divisions/energy-division/documents/infrastructure/disadvantaged-communities/2024-dacag-equity-framework.pdf). <https://www.cpuc.ca.gov/-/media/cpuc-website/divisions/energy-division/documents/infrastructure/disadvantaged-communities/2024-dacag-equity-framework.pdf>.

2 The term “non-energy benefits” used in the DACAG Equity Framework is generally consistent with the CEC’s use of the term “non-energy impacts” to describe broader outcomes beyond direct energy-related effects.

adoption, as identified in the SB 350 Barriers Report and by relevant stakeholders. This is accomplished through technology demonstration and deployment in ESJ communities and tribal lands, addressing community priorities, supporting relationship-building and partnerships among diverse members of the public, ensuring meaningful community engagement with community-based organizations as key project partners, and investing in diverse businesses. CEC will address access, outreach, and education through projects and program administration by (1) enhancing inclusivity by focusing on targeted outreach, meaningful engagement, and knowledge dissemination; (2) ensuring that technologies are applicable to community interests and responsive to local needs; and (3) supporting the sharing of culturally relevant and sensitive project information and educational materials for participating communities. Tracking and evaluating progress of such efforts will ensure that these interventions are successful.

Community Engagement

Community engagement encompasses the meaningful, sustained, and inclusive involvement of communities in the development, implementation, and assessment of investments that may affect them. The CEC strives to incorporate early and ongoing engagement to better understand local priorities, needs, conditions, and concerns, support clear communication throughout the process, and provide a feedback loop on how community input is reflected in program and project design and implementation.

Health and Safety

CEC will direct investments to optimize the health and well-being of California's most vulnerable communities by advancing clean energy technologies that lead to health benefits and positive impacts, build resiliency, address climate change vulnerabilities, and reduce climate and air-quality-related healthcare costs. For example, advancements in building envelopes and low-carbon cooling technologies will reduce exposure to climate change impacts, such as wildfire and extreme heat. Disadvantaged communities will benefit from reduced emissions from advancements in transportation electrification, as well as innovations in load flexibility that can reduce and eliminate the need to run fossil fuel-powered peaker plants.

Financial Benefits and Economic Development

CEC investments will lead to technological advancements that generate financial benefits and cost savings while centering affordability and rate impacts. For example, improved energy efficiency and load flexibility will result in gas and electric bill savings; advancements in resilience from energy storage technologies will help reduce financial impacts to ratepayers facing grid reliability issues; and manufacturing advancements will reduce the costs and accelerate the scaling of clean energy technologies. In addition, CEC EPIC and Gas R&D funding has a solid history of expanding community investment by attracting significant additional public and private funding and building capacity for future clean energy project developments and affordability and other benefits. CEC Gas R&D and EPIC investments will

prioritize financial benefits in ESJ communities and tribal lands to improve energy equity. CEC investments further support economic development by:

- Funding applicants who are committed to diversity, equity, and inclusion and local workforce development.
- Investing in manufacturing, entrepreneurship, job creation, and training that support workforce development pathways to high-quality careers in California.
- Encouraging hiring for low-income, disadvantaged, and under-represented populations (including women, re-entry, veterans, EJ communities, among many others). Supporting small and diverse business development and contracting.

For example, through support of the entrepreneurial ecosystem, the CEC seeks to grow the Gas R&D and EPIC-relevant talent pool and provide critical support at all stages of the technology development pipeline to accelerate and expand clean energy benefits.

Workforce Development

Workforce development focuses on the extent to which investments support access to quality jobs, training, and career pathways. For CEC research programs, workforce development may be most relevant where research helps identify workforce needs associated with emerging technologies or transition pathways, develops or informs training pathways, or supports longer-term workforce opportunities. Technology demonstration and deployment projects and manufacturing initiatives support job growth, on-the job training, and workforce development and include opportunities in regions facing high rates of unemployment and underemployment.

Consumer Protection

As a technology R&D program, the Gas R&D program does not directly address consumer protection; thus, consumer protection was not included in the Equity Matrix (Chapter 2). Rather, through investments that work to advance clean energy technologies, the Gas R&D program is supporting consumer protection by demonstrating, de-risking, scaling, and accelerating the affordability, accessibility, and other benefits from the adoption of emerging clean energy technologies.

Metrics, Evaluation, and Accountability

Metrics, evaluation, and accountability involve the use of measurable indicators and assessment approaches to track progress, assess outcomes, and evaluate whether intended benefits are achieved. CEC research program initiatives include examples of metrics for consideration, which are further refined through the solicitation development process and incorporated, as appropriate, during agreement development and project administration. Together, these elements support transparency, evaluation, and accountability by establishing a basis for monitoring and evaluating whether intended equity benefits are achieved.

Direct and Indirect Benefits

Direct impacts are expected as a result of project implementation. For example, occupant health benefits are expected due to indoor air quality improvements from technology demonstration and deployment projects that include the electrification of gas appliances. Similarly, economic development benefits are expected from geothermal energy projects that hire local workers and support workforce development.

Indirect impacts are expected more broadly outside of project implementation. For example, indirect health benefits are expected from a project that funds the technological advancements of an induction cooktop that will improve indoor air quality but does not include a demonstration.



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ENERGY RESEARCH AND DEVELOPMENT DIVISION

APPENDIX F: Estimated Gas R&D Administrative Costs

June 2026 | CEC-500-2026-014

APPENDIX F:

Estimated Gas R&D Administrative Costs

Based on analyses conducted on the FY 2025–2026 Gas R&D Program administration, an estimated breakdown of Gas R&D Program administration costs is provided below.

Program Administrative Cost Budget Item	Fiscal Year 2025–2026 (\$)
Investment Plan Development	\$229,670
Project Planning and Initiation	\$490,000
Project Oversight and Governance	\$665,281
Stakeholder Communication, Engagement, and Outreach	\$102,455
Regulatory Support Compliance	\$229,670
Internal Management Coordination	\$81,250
Program and Process Coordination and Improvement	\$66,121
Administrative Activities	\$89,996
Supervision and Personnel	\$273,427
Training and Development	\$172,130
Total	\$2,400,000



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ENERGY RESEARCH AND DEVELOPMENT DIVISION

APPENDIX G: Gas Research Development & Demonstration Public Workshop

June 2026 | CEC-500-2026-014

APPENDIX G: Gas Research Development & Demonstration Public Workshop

On February 27, 2026, the California Energy Commission hosted a joint remote-access public workshop with Pacific Gas and Electric Company and Southern California Gas Company to discuss proposed energy-related gas research initiatives for their respective Gas Research, Development, and Demonstration (Gas RD&D) Program budget plans.

Workshop materials are available on the Gas RD&D Public Workshop event page, including the notice and agenda, transcript, presentation materials, and event recording.

[Gas RD&D Public Workshop Event Page](https://www.energy.ca.gov/event/workshop/2026-02/gas-rdd-workshop)

<https://www.energy.ca.gov/event/workshop/2026-02/gas-rdd-workshop>