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Gas Research, Development, & Demonstration Program

2026 Joint Research Plan Workshop

Presented: February 27, 2026

hosted by: MOMENTUM

Safety Orientation

Physical Environment & Ergonomics

- 30/30 Rule: Every 30 minutes, move and stretch for 30 seconds.
- Workspace Safety: Ensure cords are tucked and your seating is ergonomic.
- Environment: Know your local "drop, cover, and hold" spots.

Emergency Procedures

- Local Response: If an emergency occurs at your site, exit the meeting and call 911.
- Check-In: Ensure a colleague knows your physical location today.
- Exit Plan: Know your nearest exit and fire extinguisher location.

Psychological Safety

- Inclusive Space: Welcome new ideas and diverse perspectives.
- Mutual Respect: Look out for one another and speak up for safety.
- Self-Care: Take "bio-breaks" as needed to maintain focus.

Digital Safety & Planning

- Connectivity: Have the call-in number ready if your Wi-Fi fails.
- Data Security: Do not share sensitive infrastructure data in the chat.
- Plan: Update your personal emergency contact list today.

Workshop Logistics

- Each major topical session will end with an Environmental and Social Justice Panel and general comments. If time permits, we will also reserve 10 minutes at the end of the workshop for additional questions and comments.
- A recording of today's workshop as well as other related materials will be available for download at https://efiling.energy.ca.gov/Lists/DocketLog.aspx?docketnumber=23-ERDD-02
- To pose a question, please use the Q&A function in the Zoom controls.
- We encourage you to provide written comments following the workshop. Please submit them to admin@buildmomentum.io by **5 pm on March 11, 2026.**

Agenda

9:00 am Welcome Message, Safety Moment

9:05 am California Gas RD&D Program Overview

10:00 am 2026 Proposed Gas System Integrity Research Initiatives

Environmental and Social Justice Advisory Panel Feedback

General Audience Feedback

11:30 am 2026 Proposed Decarbonization Research Initiatives

Environmental and Social Justice Advisory Panel Feedback

General Audience Feedback

1:00 pm Adjourn

CPUC Opening Remarks

Joint Gas RD&D Administrator Public Workshop

February 27, 2026

Emma Maggioncalda

Gas RD&D Program Lead

CPUC Energy Division

California Public Utilities Commission

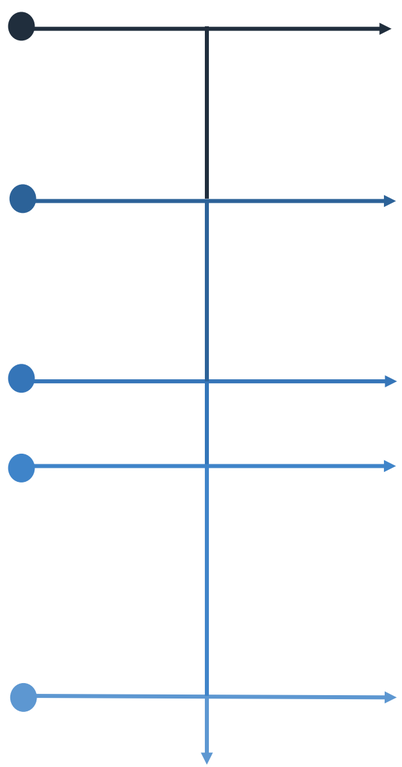
Ratepayer-Funded Gas Research, Development, and Demonstration (RD&D)

- Investments promote new and emerging technologies and solutions to support meeting California's climate, energy, and equity policy goals.
- CPUC guides and approves via Tier 3 advice letters Gas RD&D Program administrators' proposed Investment Plans to utilize authorized annual funding levels:

Administrator	Authorized Budget	Funding Source
California Energy Commission (CEC)	$24M	Public Purpose Program (PPP)
Southern California Gas (SoCalGas)	$18M	General Rate Case (GRC)
Pacific Gas & Electric (PG&E)	$8M	General Rate Case (GRC)

Annual Gas RD&D Plan Development Schedule

Early Coordination Promotes Alignment with CPUC Proceedings and Ratepayer Benefits



Summer - Fall 2025	Administrators coordinate proposed investment plans
December 2025	Administrators consult CPUC Subject Matter Experts (SMEs)
February 2026	**Administrators host joint public workshop**
March 2026	Administrators consult the Disadvantaged Communities Advisory Group (DACAG)
By June 1, 2026	Administrators submit proposed investment plans
	CPUC evaluates proposed investment plans

Gas RD&D Investment Criteria

CPUC evaluates proposed Gas RD&D Plan alignment with existing requirements and guidance:

1. **POLICY PRIORITY**: Alignment with and prioritization of critical gaps and needs identified in State goals and specific CPUC policies and proceedings.
2. **IDENTIFIED NEED**: Demonstration that RD&D complements but does not duplicate existing efforts, including electric RD&D funded via the Electric Program Investment Charge (EPIC)
3. **PROPOSED SOLUTION**: Clear outputs (pilots, studies, etc.) and pathways to scale results.
4. **ANTICIPATED IMPACTS**: Analyses to demonstrate ratepayer benefit.

CPUC Gas RD&D Program Contact

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Gas RD&D Program Lead
CPUC Energy Division

California Energy Commission
Gas Research and Development Program
FY 2026-2027 Budget Plan

February 27, 2026

PRIMARY FUNCTION OF THE

California Energy Commission

Advancing State Energy Policy

Investing in Energy Innovation

Developing Renewable Energy

Preparing for Energy Emergencies

Achieving Energy Efficiency

Transforming Transportation

Overseeing Energy Infrastructure

Intergovernmental Collaboration

Gas R&D Program Overview

$24 million annual budget; public interest research funded by a gas surcharge

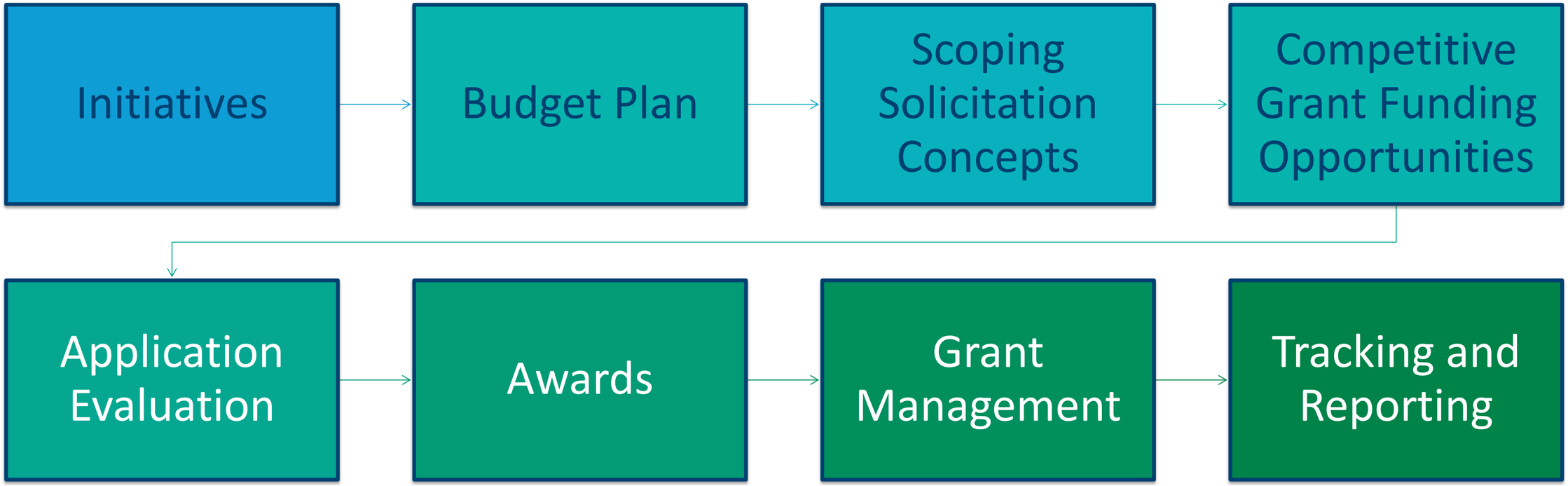
Offer a reasonable probability of providing benefits to ratepayers (e.g., improve affordability, enhance safety, strengthen reliability)

Focus on energy efficiency, renewable technologies, conservation, and environmental issues

Support state energy proceedings and policies

Consider opportunities for collaboration and co-funding partnerships with other entities

Program Administration Process



Coordination Across Gas Program Administrators

California Energy Commission – Pacific Gas & Electric Company – Southern California Gas Company

Planning

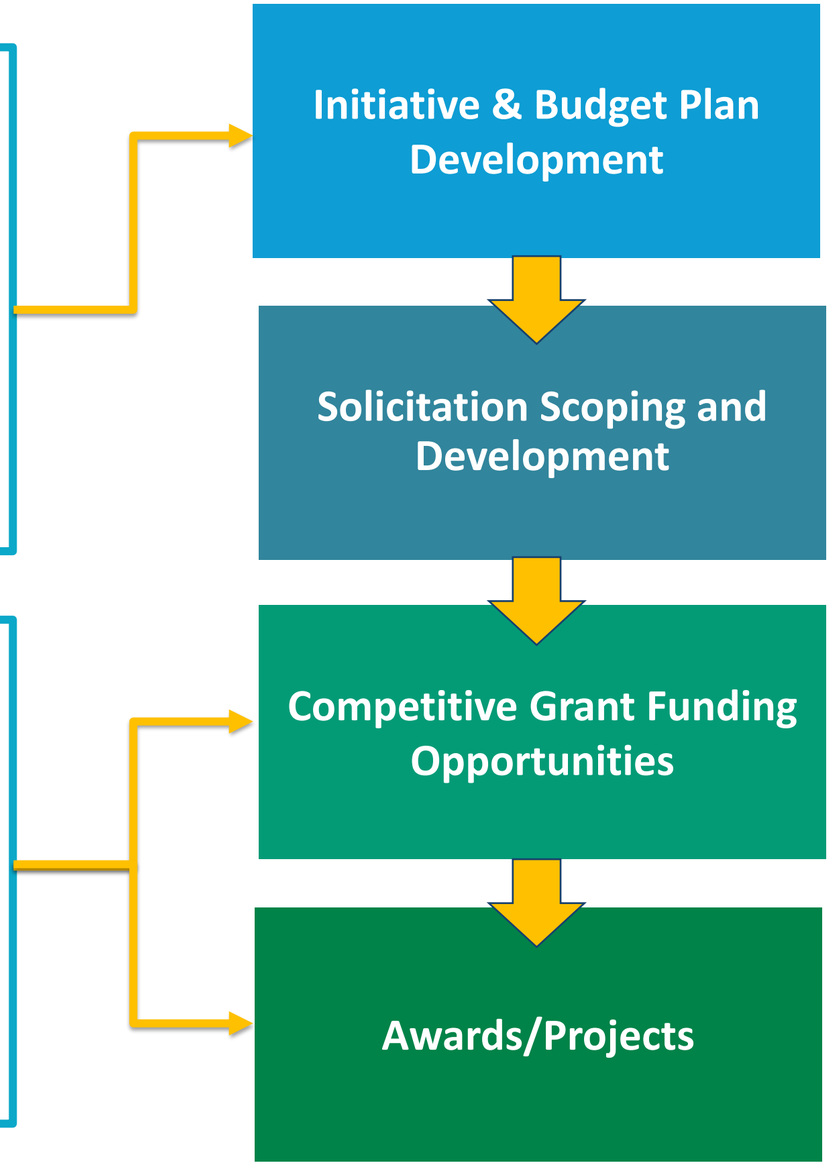
Early coordination on initiative development and alignment throughout the year:

- Bimonthly Administrative Coordination Meetings
- PICG Workshop
- Joint Public Workshop
- Topical SME discussions

Implementation

Gas investor-owned utilities often serve as:

- Project partners
- Demonstration site hosts
- Technical Advisory Committee members
- Match share contributors



Embedding Equity

- Engage with Disadvantaged Communities Advisory Group (DACAG), Environmental and Social Justice (ESJ) community representatives, and California Native American tribal representatives in initiative development
- Improve CEC's application and grant management process to relieve administrative burdens
- Provide preference points to grant applications that support benefits to disadvantaged and vulnerable communities and tribes

2025 Progress and Cumulative Impact

Funds Administered *(FY2024-2025)*

- $88.3 Million across 43 projects
  - $73.6 Million in Decarbonization
  - $14.6 Million in Gas System Integrity
- $39.7 Million in committed match

Ratepayer Benefits*

- Affordability
  - $500,000+ on-bill savings
- Adaptation
  - 375,000+ therms of fossil gas consumption avoided
- Environmental Sustainability
  - 2,000 metric tons of CO_2e emissions avoided
- Outreach and Engagement
  - 1,200 participants across 30+ community engagement events

*Self-reported via recipient survey in FY 2024-2025

Cumulatively By the Numbers

314
PROJECTS

$344.5 M
GAS R&D FUNDS INVESTED

$5.9 B
FOLLOW-ON PRIVATE FUNDING AFTER RECEIVING GAS R&D SUPPORT

46%
OF FUNDING IN DISADVANTAGED AND LOW-INCOME COMMUNITIES SINCE FY 2016-17 FOR NON-COMBUSTION PROJECTS

Outreach and Feedback to Date

Outreach to Date:

- Briefings with subject matter experts from IOU Gas Administrators, CPUC, DACAG
- Roundtable with California Native American Tribes
- Refined and refocused after each touchpoint

Initiative Refinements Based on Feedback:

- Sharpened concepts for optimal impact
- Refined framing to better align with Gas R&D priorities and CPUC policy direction
- Clarified scope and strengthened strategic focus
- Defined metrics for tracking progress and outcomes

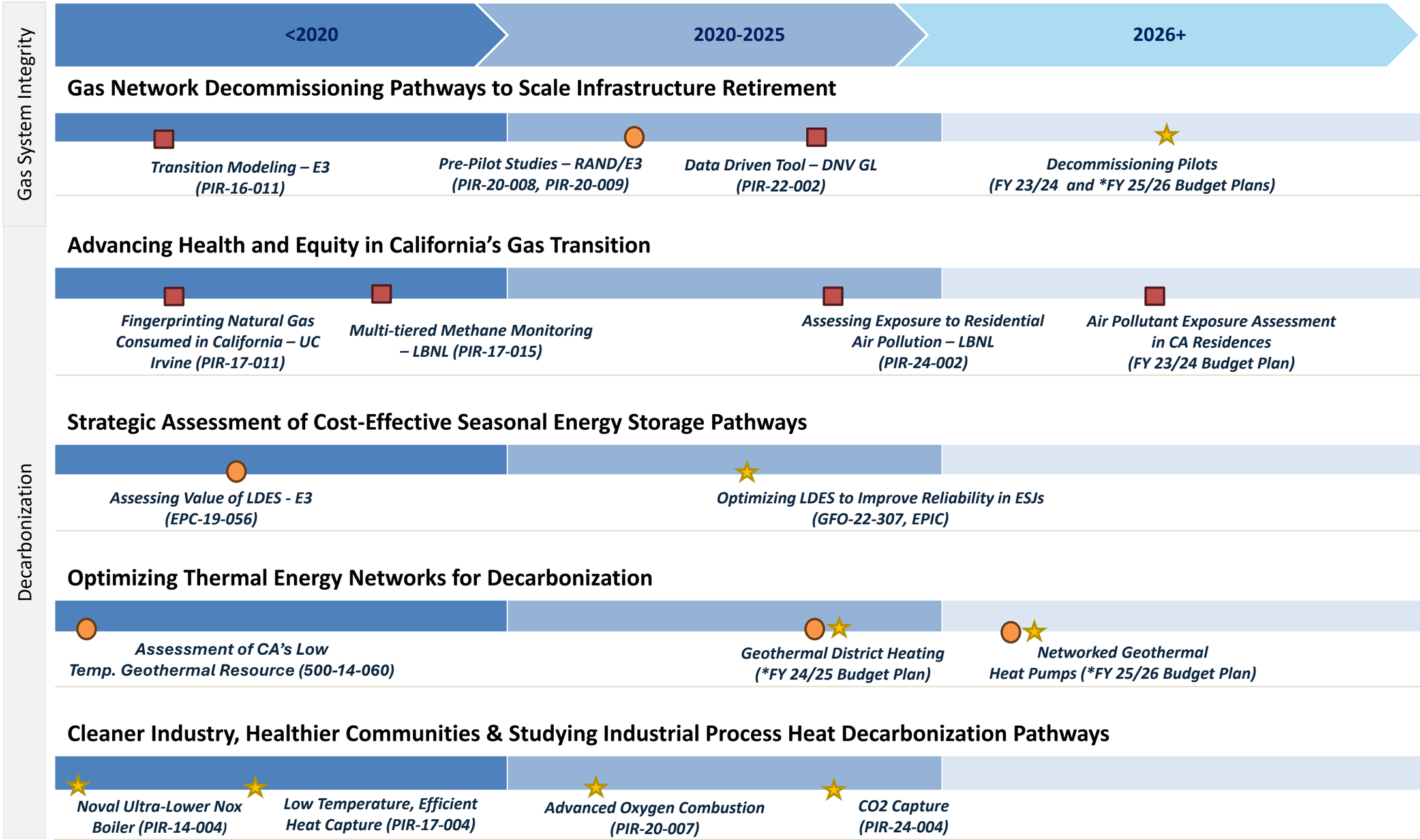
Outreach continues after public workshop

Proposed Research Initiatives

Initiative Theme	Initiative Title	Proposed Allocation*	Budget
Gas System Integrity	Gas Network Decommissioning Pathways to Scale Infrastructure Retirement	$2-3M	
Decarbonization	Advancing Health and Equity in California's Gas Transition	$10-12M	
	Strategic Assessment of Cost-Effective Seasonal Energy Storage Pathways	$1-1.5M	
	Optimizing Thermal Energy Networks for Decarbonization	$1-2M	
	Cleaner Industry, Healthier Communities	$5-8M	
	Studying Industrial Process Heat Decarbonization Pathways	$1M	
		Total Plan Budget	$21.6M

*Proposed allocations are estimates and will be finalized following further refinement and prioritization of initiatives.

Building on Prior Investments



PG&E Gas RD&D Program Overview

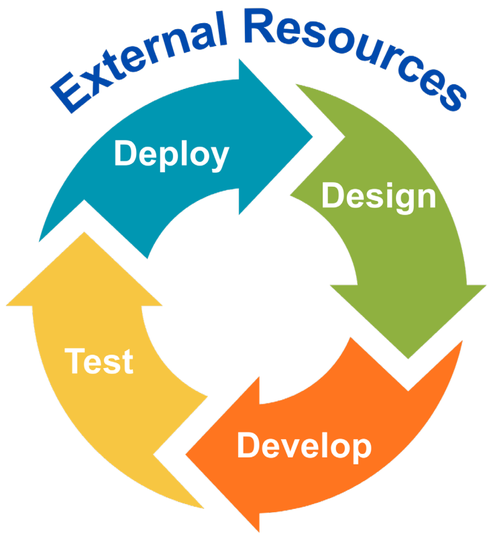
February 27, 2026

Together, Building a Better California

Gas RD&D Overview

Mission Statement

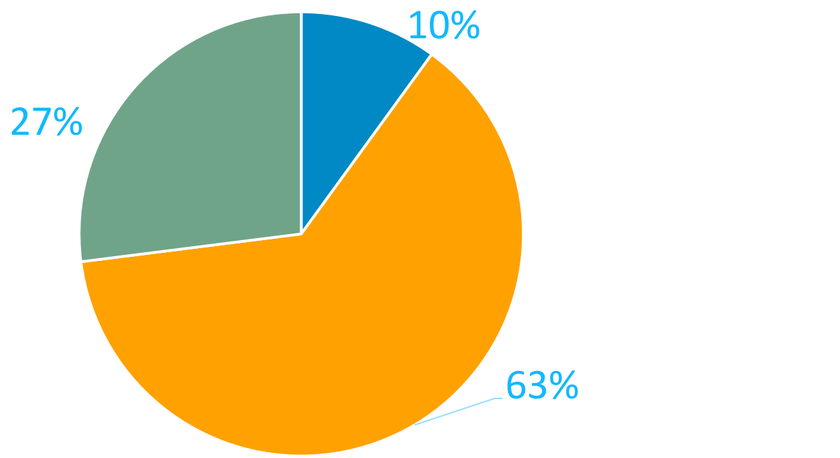
To detect, adapt, qualify and implement innovative solutions in the Gas Operations business to improve its performance measured in public and work safety, customer satisfaction, cost effectiveness, environmental impact, regulatory compliance, and communications.



Proposed 2026 Plan Budget

$8.27M

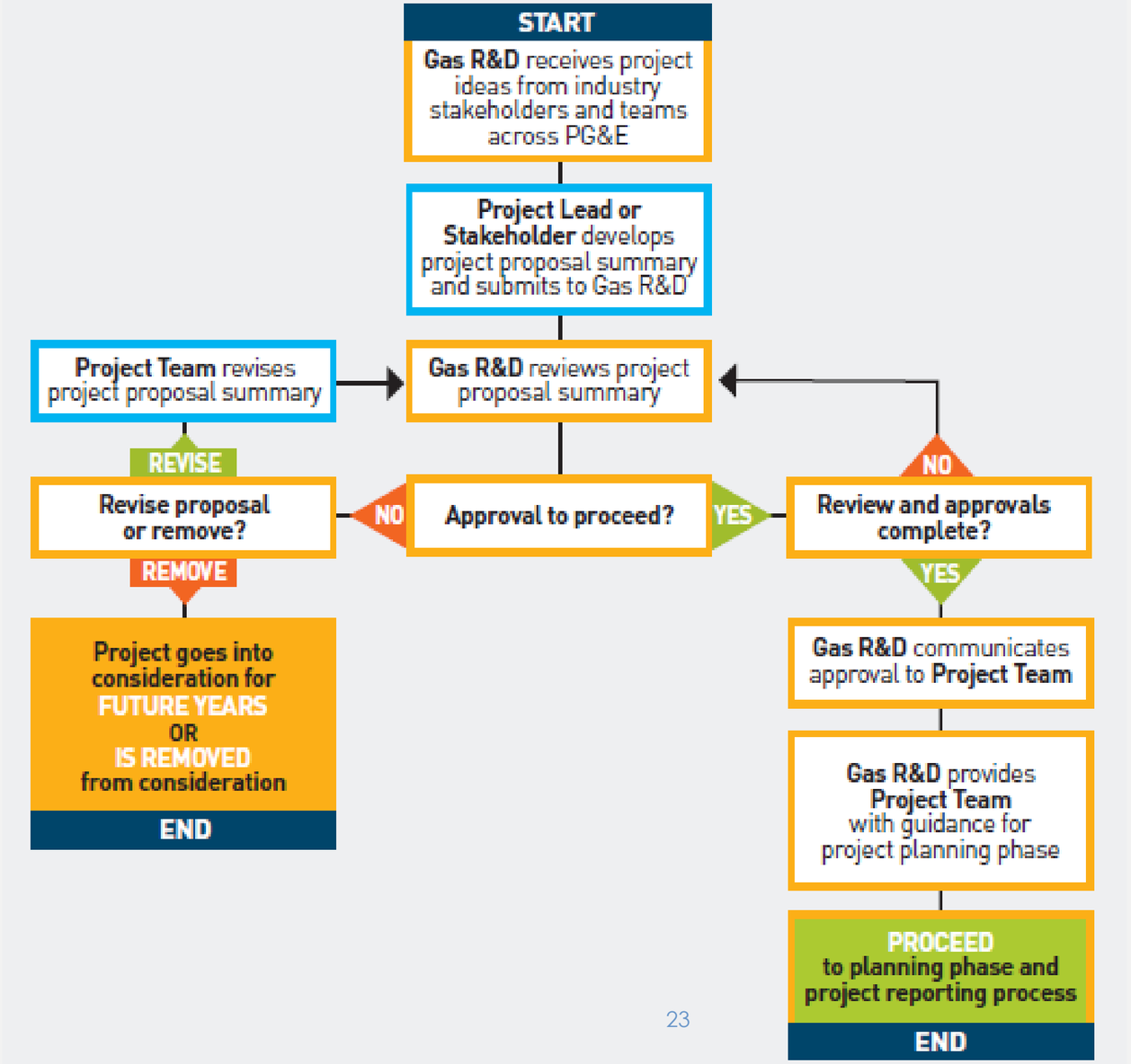
Budget Allocations



Benefits

- Reliability
- Safety
- Equity
- Operational Efficiency
- Improved Affordability
- Reduced GHG Emissions
- Improved Air Quality

Project Selection Process



IDEAS

Can be submitted at:

Innovation@pge.com

Gas RD&D Research Areas

PG&E Gas RD&D invests time, technical resources, and funding in projects across two main research areas:

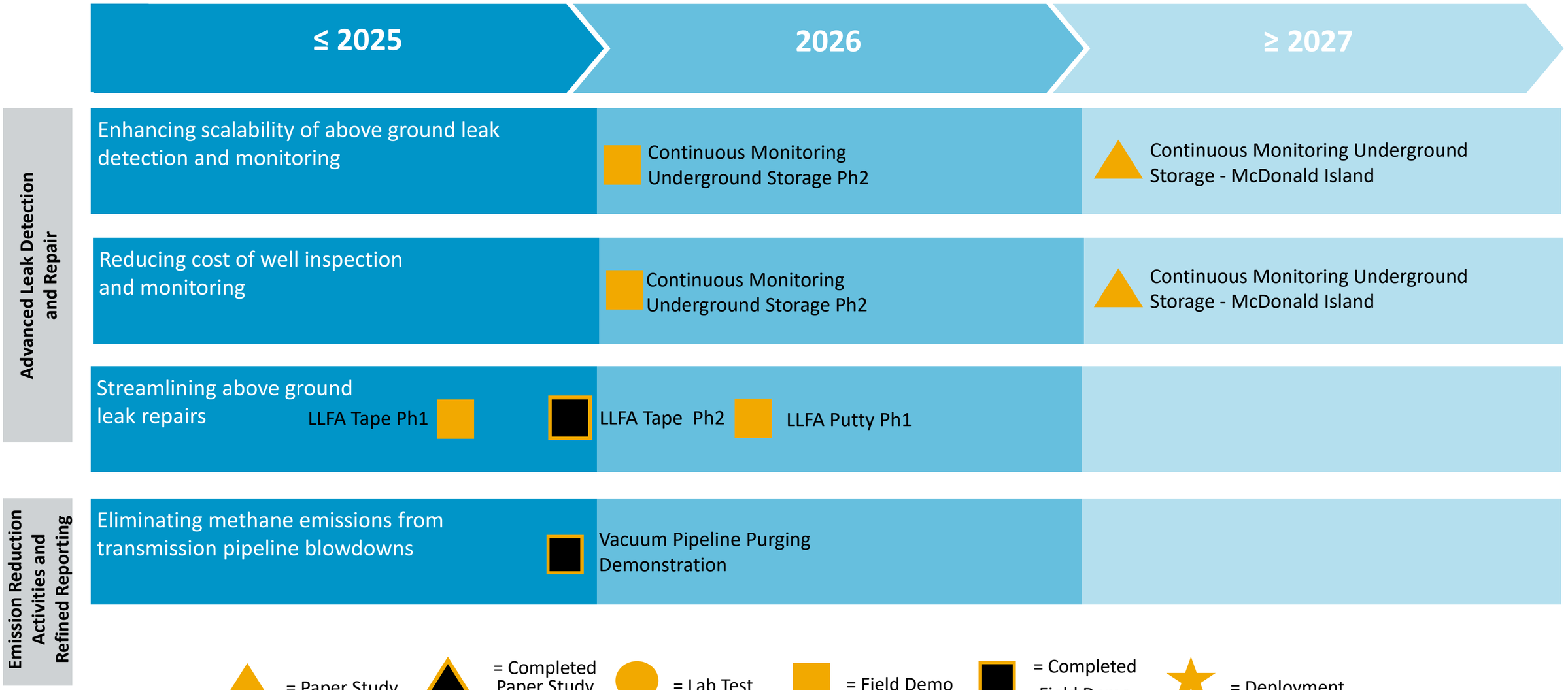
Gas System Integrity	These projects support R&D aimed at maintaining and increasing the safety, reliability, and affordability of the gas system—including for ESJ communities—while also developing and advancing technologies that, if widely deployed, would reduce methane emissions and decarbonize PG&E's gas system.
Decarbonization	These projects support R&D that develops or advances technologies that, if deployed widely, would decarbonize PG&E's gas system.

Proposed Budget Allocations

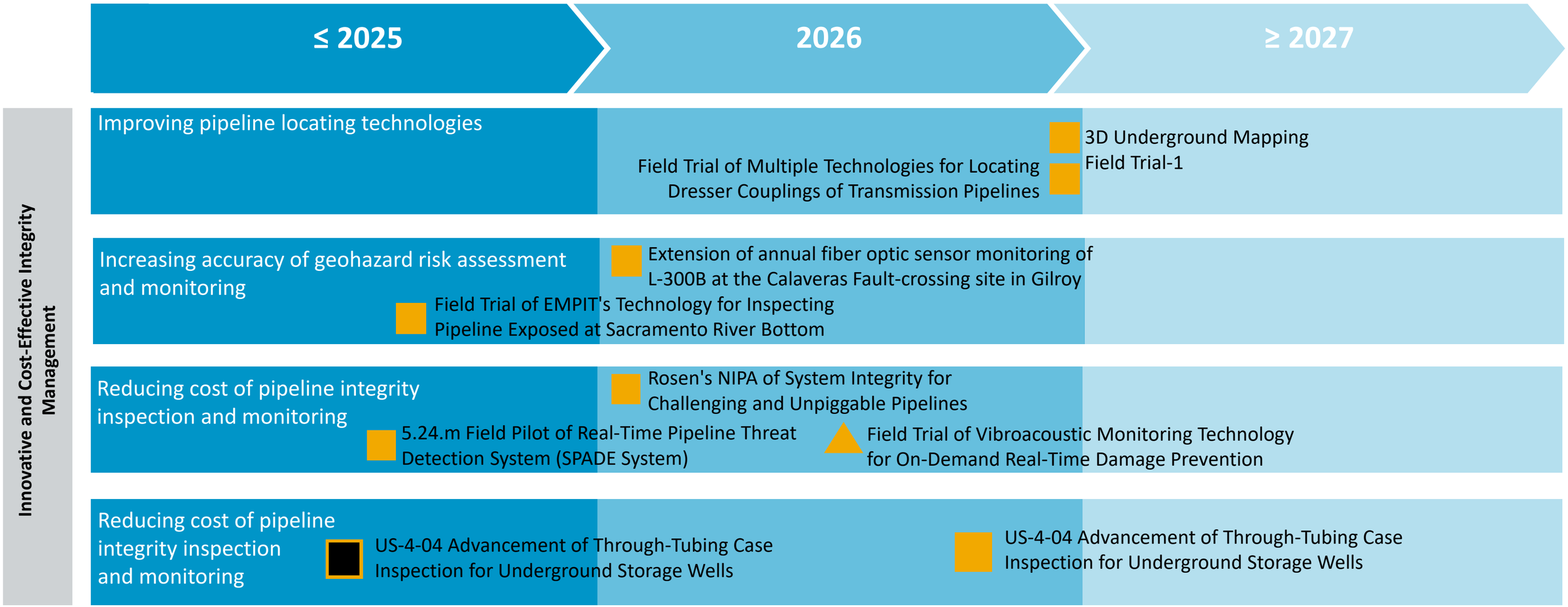
Theme	Initiative	Allocations	2026 Budget
Gas System Integrity	Proactive Geohazard Risk Management	10%	70%
	Innovative and Cost-Effective Integrity Management	20%	
	Advanced Leak Detection and Repair	20%	
	Emission Reduction Activities and Refined Reporting	20%	
Decarbonization	Clean Fuels Integration	30%	30%
		TOTAL PLAN BUDGET*	**$7.4M**

*The stated amount excludes an administration fee of $826,700. When administration costs are included, the total program budget amounts to $8.27 million. The 2026 theme budget is derived from the 2025 Plan allocation.

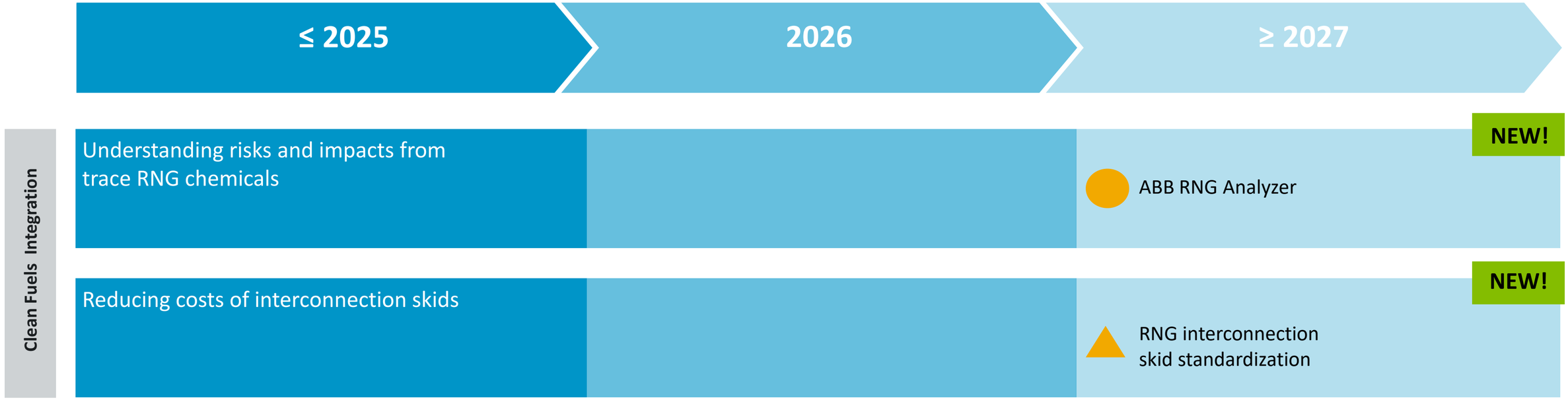
Roadmap: Gas System Integrity



Roadmap: Gas System Integrity, cont.



Roadmap: Decarbonization



= Paper Study
= Completed Paper Study
= Lab Test
= Field Demo
= Completed Field Demo
= Deployment

The Gas RD&D Team

Jeannette Lindemann

Senior Manager
Gas RD&D
PG&E

Aaron Rezendez

Gas Engineer
Gas RD&D
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Monique Montague

Gas Engineer
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Ari Fischer

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David Xu

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Stephanie Ka

Program Manager
Gas RD&D
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GAS RESEARCH, DEVELOPMENT, & DEMONSTRATION

2026 & 2027 Research Plans

SoCalGas™

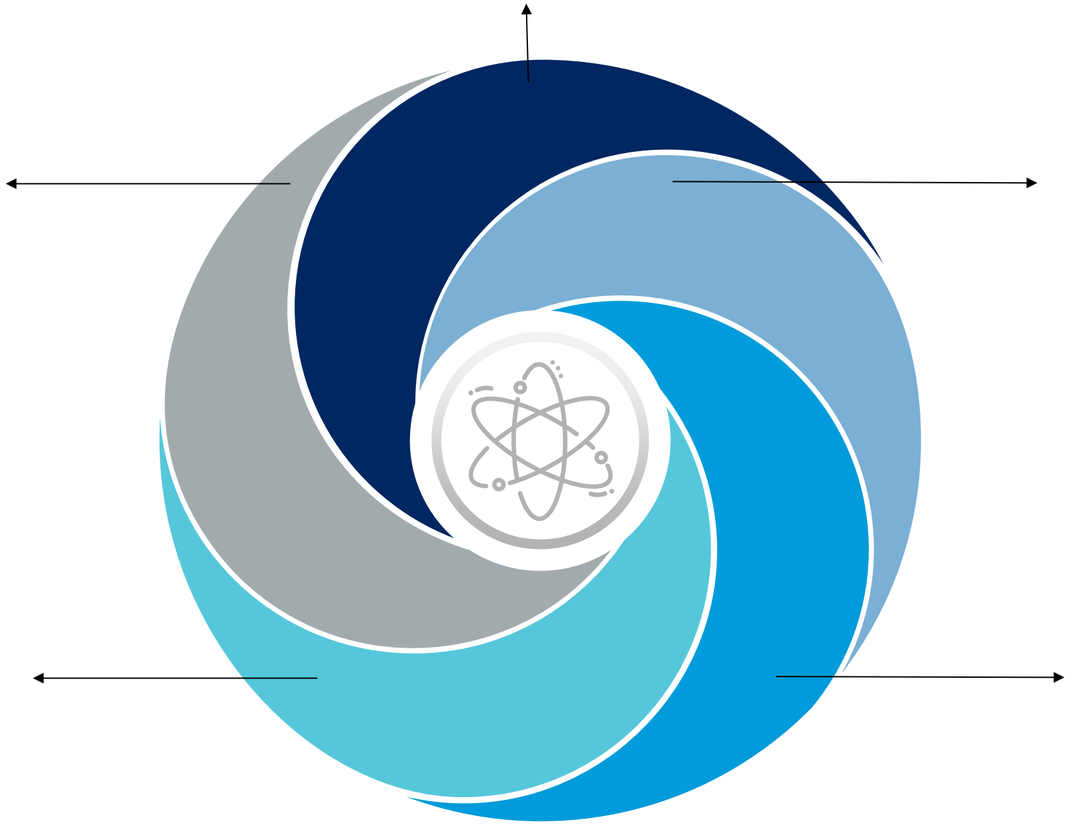
RD&D Program Overview

Ratepayer-Funded Program

Authorized by the California Public Utilities Commission (CPUC)

Public Utilities Code § 740.1

- Improved operational performance and safety
- Energy affordability
- Emissions reductions



Technology Development, Demonstration, and Adoption

- Safety
- Affordability
- Air quality
- Climate action

Collaboration

Coordinate research and avoid duplication with other Gas RD&D Administrators

Diverse Projects

Early-stage lab research to full-scale field demonstrations

2025 in Review

79
Completed Projects

0
Initiated Projects

$5M
Spent on RD&D Projects

5.0x
Leverage Ratio

20+
Publications & Webinars

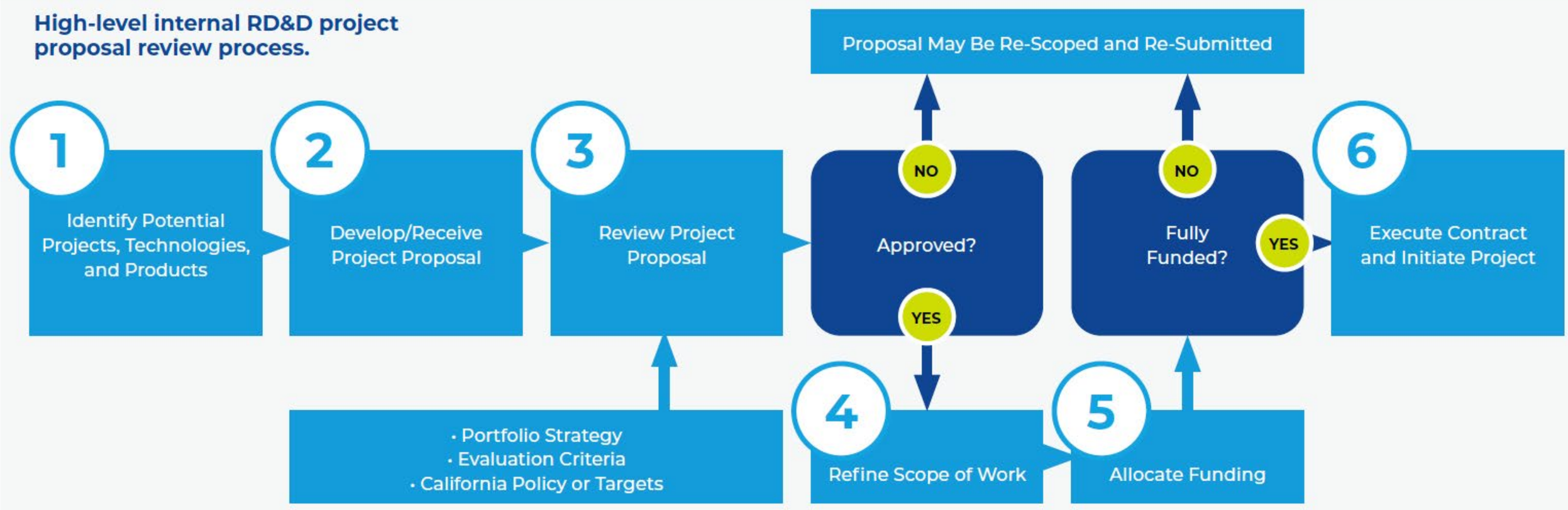
157
Active Projects

Percentage of Projects Active in 2025 Designed to:

IMPROVE AFFORDABILITY	45%
IMPROVE AIR QUALITY	45%
INCREASE OPERATIONAL EFFICIENCY	52%
REDUCE GHG EMISSIONS	64%
IMPROVE RELIABILITY	57%
IMPROVE SAFETY	55%

SoCalGas

Project Selection Process



Proposed Theme Budget Allocations

Theme	Initiatives	Theme Allocations	Budget (2026)	Budget (2027)
Gas System Integrity	Environmental & Safety	15%	$10,227,550	$10,534,377
	System Inspection & Monitoring	15%		
	Community Impact & Energy Conservation	10%		
	System Design & Materials	5%		
	RNG Infrastructure Optimization	15%		
Decarbonization	Low-Carbon Fuel Technologies	15%	$6,818,367	$7,022,918
	Energy Reliability and Resilience	15%		
	Building and Facility Systems	10%		
Program Administration			$1,893,991	$1,950,810
TOTAL 2024 GENERAL RATE CASE AUTHORIZED BUDGET			**$18,939,908**	**$19,508,105**

Break

Theme #1:
Gas System Integrity

2025 Project Highlight - Gas System Integrity

BioVind: Understanding of Microbiologically Influenced in Gas System and Development of Detection Methods (PIR-22-004)

Issue: Certain microbes can accelerate corrosion, resulting in degradation of gas infrastructure that can lead to leaks. Current microbial testing methods are slow and require complex lab processing.

Innovation: Develop a portable system for fast, on-site detection of corrosion inducing microbes.

Highlights:

- Partnered with SoCalGas and successfully demonstrated the microbial detection system at the Aliso Canyon and Playa Del Rey gas storage facilities
- Confirmed the ability to detect the presence of corrosion-inducing microbes in relevant environments
- Delivered test results in approximately 75 minutes (vs. days or weeks required for conventional methods)

Portable Microbial Detecting Tool
Credit: BioVind Inc.

Gas Network Decommissioning Pathways to Scale Infrastructure Retirement

Theme: Gas System Integrity

Presenter: Van Do, Ph.D., Energy Decarbonization Specialist

Gas Network Decommissioning Pathways to Scale Infrastructure Retirement

Theme: Gas System Integrity

Identified Need	Proposed Solution	Anticipated Benefits
Technical and operational complexities in decommissioning at scale: • **Complex gas distribution networks** and interdependencies • **Evolving retrofit needs** and electric equipment market dynamics • Federal incentives and **economic shifts influencing consumer behaviors** • Long-term performance and resilience of alternative energy sources Strategic planning gaps in post-pilot cost and retired pipeline management: • **Uncertain cost-benefit** at scale • **Retired pipeline material management/disposal** • **Evolving permitting and compliance** requirements	**Post-pilot operational studies:** • Develop **strategies to isolate and decommission interconnected zones** based on infrastructure characteristics (e.g., hydraulic pressure) • Assess and forecast operational/household **stranded assets** and analyze new **equipment opportunities** and market trends • Identify infrastructure **repurposing pathways** (e.g., pipeline disposal or material recovery) • Updated and **optimized protocols** for large-scale gas decommissioning	Affordability: **Reduce ratepayers' cost** with streamlined implementation protocols at large scale (e.g., permitting time/cost); retired pipeline management cost-benefit analysis Safety/Reliability: **Improve system integrity, efficiency, and energy resilience** benefits from refined electrification strategies Equity/Community Acceptance: Develop accurate household cost estimates and increase customer satisfaction and consent to decommission

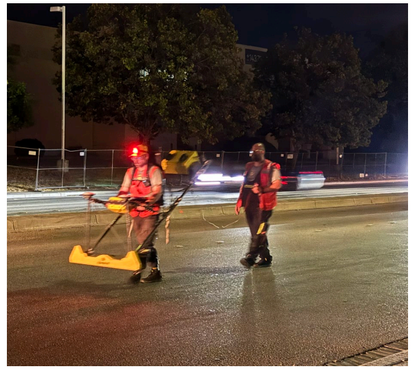
Policy Alignment: Gas Network Decommissioning Pathways to Scale Infrastructure Retirement

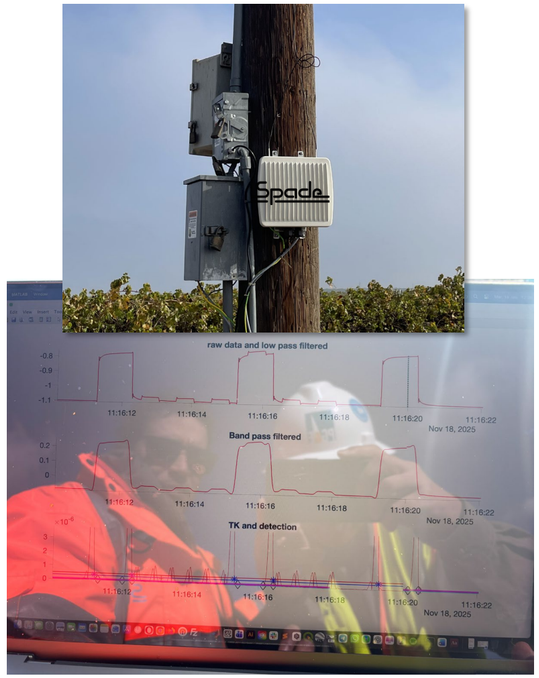
Theme: Gas System Integrity

CPUC Proceedings	Identified Priority
R.20-01-007 & **R.24-09-012** : Long-Term Gas Planning	Advance gas network decarbonization by establishing protocols and pathways with structural, economic, and technical attributes to support decommissioning.
R.19-01-011: Building Decarbonization	Reduce emissions impacts from gas use in buildings.
R.19-10-005: Renewal of the EPIC Program	Complement EPIC electrification investments by accelerating decommissioning pathways and strategies, informing future program design, and quantifying ratepayer benefits.
Policy Drivers	**Identified Priority**
SB 1221: Decommissioning Pilots	Complement SB 1221 with analysis across ongoing decommissioning pilots to enable comparative and iterative learnings for post-pilot phase and statewide scale-up.

Gas System Integrity: 2025 Project Highlight

Priorities





Benefits

Equity	Improve social justice and equity by ensuring reliable and safe gas delivery to all communities, including underserved ones.
Safety	Enhance system safety by developing advanced monitoring and predictive maintenance tools
Reliability	Detect and address issues before they cause service interruptions, helping maintain consistent gas delivery
Improved Air Quality	Reduce the need for emergency repairs and minimizing accidental releases of GHG emissions
Reduced GHG Emissions	Improved maintenance practices support optimal system performance, thereby reducing the overall environmental footprint.

Pipelines and Facilities:

- Non-intrusive pipeline 3D mapping and Dresser couplings locating, bend strain and coating & corrosion survey, AI/ML virtual inspection
- Real-time detection of mechanical impacts via CP system
- Advanced robotic inspection of unpiggable pipelines
- Composite repairs and reinforcement
- Probabilistic crack assessment

Geohazards:

- Non-intrusive survey of exposed pipeline integrity at challenging river crossing with severe erosion
- Strain-based design & assessment and predicative geohazard modeling

Gas System Integrity:
Summary of Feedback from Commission SMEs

Initiative / Topic	CPUC SME (Guest) Feedback	PG&E Clarification
Proactive Geohazard Risk Management	CPUC SMEs found that the PG&E Gas RD&D initiative on Proactive Geohazard Risk Management is likely aligned with the goals of CPUC, provided it clearly demonstrates how the proposed work enhances and builds upon existing research, pilots, and risk management efforts rather than duplicating work already underway. CPUC SMEs emphasized the importance of explicitly incorporating learnings from prior investments and articulating how new research is additive and complementary. CPUC SMEs also encouraged PG&E to pursue approaches that are scalable and shared across utility territories. Clear articulation of how findings will be transferable, coordinated with other Gas RD&D and EPIC efforts, and leveraged to address broader system-level challenges will strengthen alignment with Gas RD&D objectives and ratepayer value.	PG&E understands this feedback to request clearer articulation of how proposed geohazard work builds upon prior Gas RD&D and related investments and produces transferable, system-level learning, while recognizing that validation under PG&E-specific geologic and operational conditions may be appropriate where those conditions materially affect performance.
Innovative and Cost-Effective Integrity Management	CPUC SMEs found that the PG&E Gas RD&D initiative on Innovative and Cost-Effective Integrity Management is likely aligned with the goals of CPUC, provided it is refined and scaled back to focus on proactive, cost-effective risk evaluation that delivers clear ratepayer benefits. CPUC SMEs emphasized that, given the growing cost burden associated with the gas distribution system and the Commission's interest in electrification strategies, proposed work should be carefully targeted to avoid increasing long-term costs for a shrinking group of gas customers. CPUC SMEs also cautioned that any use of artificial intelligence or machine learning to inform investment decisions must retain human decision-making authority, address potential organizational and data bias through transparency in inputs and assumptions, and fully account for associated costs. Clear articulation of how these tools improve outcomes relative to cost will be essential for advancing this initiative under Gas RD&D.	PG&E understands this feedback to emphasize the need to clearly distinguish research- and learning-oriented integrity management activities from routine execution, and to more explicitly explain how proposed work improves proactive risk evaluation, decision-making, or cost-effectiveness beyond business-as-usual practices, while remaining attentive to long-term affordability impacts for gas customers.

GSI: **Proactive Geohazard Risk Management**

RD&D Landscape & Proposal

Identified Need	Proposed Solution	Anticipated Impacts
• Gas transmission and distribution assets face increasing seismic, landslide, and erosion risks from climate related impacts, threatening safety and reliability. • Current geohazard monitoring methods lack real-time visibility and predictive capability for proactive mitigation. • Regulatory requirements demand risk-based decision-making for maintenance, replacement, and cost recovery.	• Deploy advanced sensors and distributed fiber optic sensing (DFOS) for continuous strain and vibration monitoring. • Integrate remote sensing surveys for terrain movement analysis and early warning. • Apply AI/ML models to interpret geospatial and sensor data, enabling predictive risk modeling and faster decision-making.	• Affordability: Lower emergency repair and remediation costs through proactive maintenance strategies. • Safety & Reliability: Reduce pipeline failure risk and service disruptions caused by geohazard events. • Regulatory Compliance: Provide data to support CPUC policy development and risk-based asset management. • Energy Transition Support: Enable safe coordination of gas and electric systems during California's clean energy transition.

GSI: Proactive Geohazard Risk Management
Alignment with CPUC Proceedings

CPUC Proceeding/Policy	Identified Priority and Alignment
R.13-11-006: Develop a Risk-Based Decision-Making Framework to Evaluate Safety and Reliability Improvements and Revise the General Rate Case Plan for Energy Utilities	Prioritized establishment of a new regulatory Risk-Based Decision-Making Framework to determine appropriate rules and expectations for how enhanced utility risk management practices would lead to a safer California at a cost deemed reasonable. Prioritizing safety through the identification and mitigation of geohazard risks to gas infrastructure.
R.24-09-012: Established policies to ensure safe and reliable gas systems by addressing seismic, landslide, and erosion risks	The work in Phase 2 will encompass data, forecasts, metrics, relevant analytical tools and approaches, including but not limited to long-term gas system scenarios. Advances an integrated, resilient energy network.
D.15-06-044/General Order No. 112-F: Rules Governing Design, Construction, Testing, Operation, and Maintenance of Gas Gathering, Transmission, and Distribution Piping Systems	The requirements go beyond 49 CFR §192.903 to be more conservative towards ensuring safety in more densely populated areas. Advances maintaining safety and reliability during California's clean energy transition.

GSI: Proactive Geohazard Risk Management
Alignment with CPUC Proceedings

CPUC Proceeding/Policy	Identified Priority and Alignment
R.13-11-006: Develop a Risk-Based Decision-Making Framework to Evaluate Safety and Reliability Improvements and Revise the General Rate Case Plan for Energy Utilities	Prioritized establishment of a new regulatory Risk-Based Decision-Making Framework to determine appropriate rules and expectations for how enhanced utility risk management practices would lead to a safer California at a cost deemed reasonable. Prioritizing safety through the identification and mitigation of geohazard risks to gas infrastructure.
R.24-09-012: Established policies to ensure safe and reliable gas systems by addressing seismic, landslide, and erosion risks	The work in Phase 2 will encompass data, forecasts, metrics, relevant analytical tools and approaches, including but not limited to long-term gas system scenarios. Advances an integrated, resilient energy network.
D.15-06-044/General Order No. 112-F: Rules Governing Design, Construction, Testing, Operation, and Maintenance of Gas Gathering, Transmission, and Distribution Piping Systems	The requirements go beyond 49 CFR §192.903 to be more conservative towards ensuring safety in more densely populated areas. Advances our role by maintaining safety and reliability during California's clean energy transition.

Innovative and Cost-Effective Integrity Management:
RD&D Landscape & Proposal

Identified Need	Proposed Solution	Anticipated Impacts

• Increasing cost to address stringent PHMSA MEGA Rules, especially in the following areas:
  • Third-party damage
  • Corrosion, crack, dent
  • Underground storage well
	• 3D Mapping and Real-Time Impact Detection for Underground Assets
	
	• Non-intrusive (above-ground) assessment of pipeline coating and corrosion integrity
	
	• AI/ML-Powered Fiber Optic Sensor Monitoring of pipeline and storge well integrity
		• Affordability - Decreased maintenance costs from compliance efforts and proactive management strategies.
		
		• Improved Reliability & Safety - Reduced service interruptions due to pipeline operation incidents and monitored by both frequency and duration
		
		• Maintain Regulatory Compliance

GSI: Innovative and Cost-Effective Integrity Management Alignment with CPUC Proceedings

CPUC Proceeding/Policy	Identified Priority and Alignment
R.13-11-006: Develop a Risk-Based Decision-Making Framework to Evaluate Safety and Reliability Improvements and Revise the General Rate Case Plan for Energy Utilities	This framework supports integrating safety, reliability, and decarbonization priorities across California's energy systems. By mitigating geohazard and pipeline risks with PHMSA and CalGEM, the work strengthens predictive risk management, guides repair and decommissioning, and keeps gas infrastructure safe, reliable, and aligned with the clean energy transition.
R.24-09-012(formerly R.20-01-007): Establish Policies, Processes, and Rules to Ensure Safe and Reliable Gas Systems in California and Perform Long-Term Gas System Planning	This initiative supports advancing safe, reliable, and forward-looking gas system planning. Research under this framework strengthens compliance, enhances seismic and storage well risk management, and informs investment decisions with CalGEM and utilities. By improving gas system resilience and predictability, it aligns long-term planning with EPIC's goals for coordination, safety, and cost efficiency in California's clean energy transition.
D.15-06-044/General Order No. 112-F: Rules Governing Design, Construction, Testing, Operation, and Maintenance of Gas Gathering, Transmission, and Distribution Piping Systems	Compliance-based design and maintenance standards reduce failure risks and strengthen safe gas system operations. This enables data-driven asset management and supports safe, reliable performance as the state transitions toward net-zero emissions. Field testing of new technologies ensures continuous improvement and innovation.
D.20-01-0022: Integrates compliance research into utility rate cases, promoting comprehensive safety and reliability improvements and promoting comprehensive safety and reliability improvements with CalGEM's insights	Integrating compliance research into utility rate cases ensures safety and reliability remain central to investment decisions. This promotes proactive risk reduction, supports CalGEM's safety objectives, and enables cost-effective, data-driven management of the gas system as it evolves within California's clean energy transition.
General Order No. 167: Maintenance and operation standards informed by storage wells research and CalGEM's expertise aim to prevent failures and enhance safety	Maintenance and operation standards for storage wells, guided by research and CalGEM expertise, are vital to preventing failures and ensuring safe, reliable gas storage. This advances risk- and emission-informed asset management that strengthens system flexibility and resilience as California moves toward a net-zero future.

Gas System Integrity:
Summary of Feedback from Commission SMEs

Initiative / Topic	CPUC SME (Guest) Feedback	PG&E Clarification
Advanced Leak Detection and Repair	CPUC SMEs recommended that the Advanced Leak Detection and Repair initiative requires clearer definition before moving forward under Gas RD&D. CPUC SMEs emphasized that the proposal should explicitly build on prior research and investments, particularly given PG&E's progress under the NGLA program and focus any additional work on improving cost effectiveness rather than duplicating existing capabilities. CPUC SMEs also stressed the need for clear coordination among administrators, including alignment across leak detection efforts using AI, LiDAR, and other technologies, and clearer articulation of core research questions, data integration, and roles.	PG&E understands this feedback to encourage clearer definition of remaining research questions and improved articulation of how proposed work builds on prior LDAR investments and progress, rather than to indicate that leak detection research is no longer appropriate where incremental learning and cost-effectiveness improvements can be demonstrated.
Emission Reduction Activities and Refined Reporting	CPUC SMEs indicated a need to provide a clearer description why this is the most efficient use of ratepayer funds. CPUC SMEs stressed the need for coordination among all Administrators in this area to better assign roles. CPUC SMEs noted that PG&E has largely achieved the goals for the NGLA program and that further study should be focused on improving cost effectiveness over marginal emissions reductions.	PG&E understands this feedback to request clearer justification of incremental Gas RD&D value and efficiency gains associated with continued emissions-related research, particularly where prior programs have already delivered substantial progress, rather than to preclude emissions-related research where improved reporting accuracy or cost-effectiveness improvements can be demonstrated.

GSI: Advanced Leak Detection and Repair (LDAR)

RD&D Landscape & Proposal

Identified Need	Proposed Solution	Anticipated Impacts
Traditional LDAR methods can be inefficient and time consuming New technologies are emerging to expedite LDAR	Align the 26 best practices and investigate: • continuous monitoring solutions for gas facilities • aerial leak detection for transmission assets • AMLD for distribution assets	• Affordability - accelerating detection/ improving localization reduces costs • Enhanced Safety – less risk related to leaks • Improved Reliability – timely LDAR enhances reliability • Reduced GHG Emissions – finding/fixing leaks quicker reduces GHG emissions.

GSI: Advanced Leak Detection and Repair
Alignment with CPUC Proceedings

CPUC Proceeding/Policy	Identified Priority and Alignment
R.24-09-012(formerly R.20-01-007): Establish Policies, Processes, and Rules to Ensure Safe and Reliable Gas Systems in California and Perform Long-Term Gas System Planning	By improving gas system resilience and predictability, it aligns long-term planning with EPIC's goals for coordination, safety and cost efficiency in California's clean energy transition. This initiative supports advancing safe, reliable, and forward-looking gas system planning.
D.15-06-044/General Order 112-F**:** Rules Governing Design, Construction, Testing, Operation, and Maintenance of Gas Gathering, Transmission, and Distribution Piping Systems	By defining survey intervals and repair priorities, this order strengthens system reliability, minimizes environmental impact, and advances California's carbon neutrality and coordinated gas-electric transition goals. This initiative supports establishing leak detection and grading standards that reduce methane emissions and improve safety.

GSI: Emission Reduction Activities and Refined Reporting

RD&D Landscape & Proposal

Identified Need	Proposed Solution	Anticipated Impacts
PG&E is still on the road to net-zero	Continuing to identify new technologies to help reduce methane emissions by: • ensuring the solution is effective for PG&Es specific needs • confirming it performs as marketed within PG&Es territory • collecting necessary data to facilitate adjustments in the reporting framework to improve reporting accuracy	• Enhanced Safety – less risk/ climate impacts related to GHG emissions • Improved Reliability – Better emissions data enhances reliability through better planning • Reduced GHG Emissions

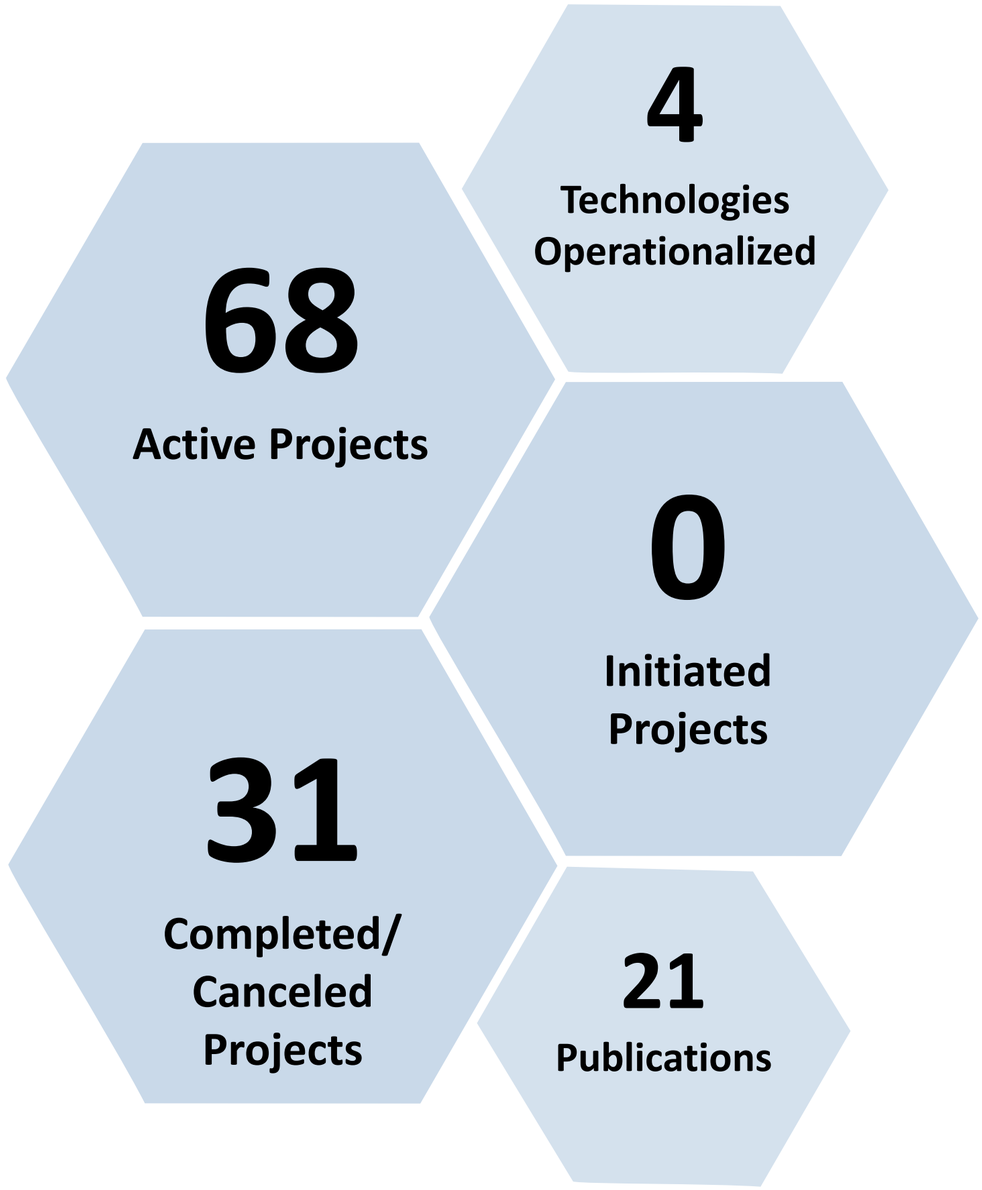
GSI: **Emission Reduction Activities and Refined Reporting**

Alignment with CPUC Proceedings

CPUC Proceeding/Policy	**Identified Priority and Alignment**
R.15-01-008 Methane leak proceeding that established the gas Leak Abatement OIR to carry out the intent of Senate Bill 1371	These efforts reduce GHG emissions, enhance operational safety, and align with California's carbon neutrality goals through integrated gas system management and data-driven decision-making. Supports advancing emission reduction and refined reporting activities that decrease methane leakage and improve accountability.
D.17-06-015 Decision requiring annual reporting for methane emissions; 26 mandatory best practices for minimizing emissions, and a biennial compliance plan incorporated into the utilities' annual Gas Safety Plans	These requirements strengthen data transparency, drive continuous improvement in leak detection and repair, and directly support California's carbon neutrality and integrated energy system goals. Advances annual methane reporting and implementation of 26 best practices that reduce emissions and enhance safety.

Gas System Integrity

2025 Gas Operations Portfolio Milestones



Significant Project Milestones

Environmental & Safety

NOx and NH3 Sensor Evaluation

Operations Technology

Screening Remote Flow Monitoring and Control

Data Logger Evaluation (85% complete)

System Design & Materials

RNG Blending Skid Study

Action Limits for RNG Specifications (95% complete)

Study on Impact of Trace Constituents in RNG on Natural Gas Grids and Consumer Appliances (95% Complete)

System Inspection & Monitoring

Microbial Influenced Corrosion (75% complete, prototype dev.)

Sensing Liquid Accumulation in Mains

Skipper NDT Demonstration (90% complete, 1 successful field demonstration)

The 2025 RD&D Annual Report will be available after March 31, 2026, at: https://www.socalgas.com/sustainability/research-development-demonstration

Project Spotlight

Advanced Through-Tubing (TT) Casing Inspection for Underground Gas Storage Wells

Project Background:

- State rules require downhole inspections every 24 months.
- Maintaining casing integrity in underground gas storage (UGS) wells remains a significant industry priority.

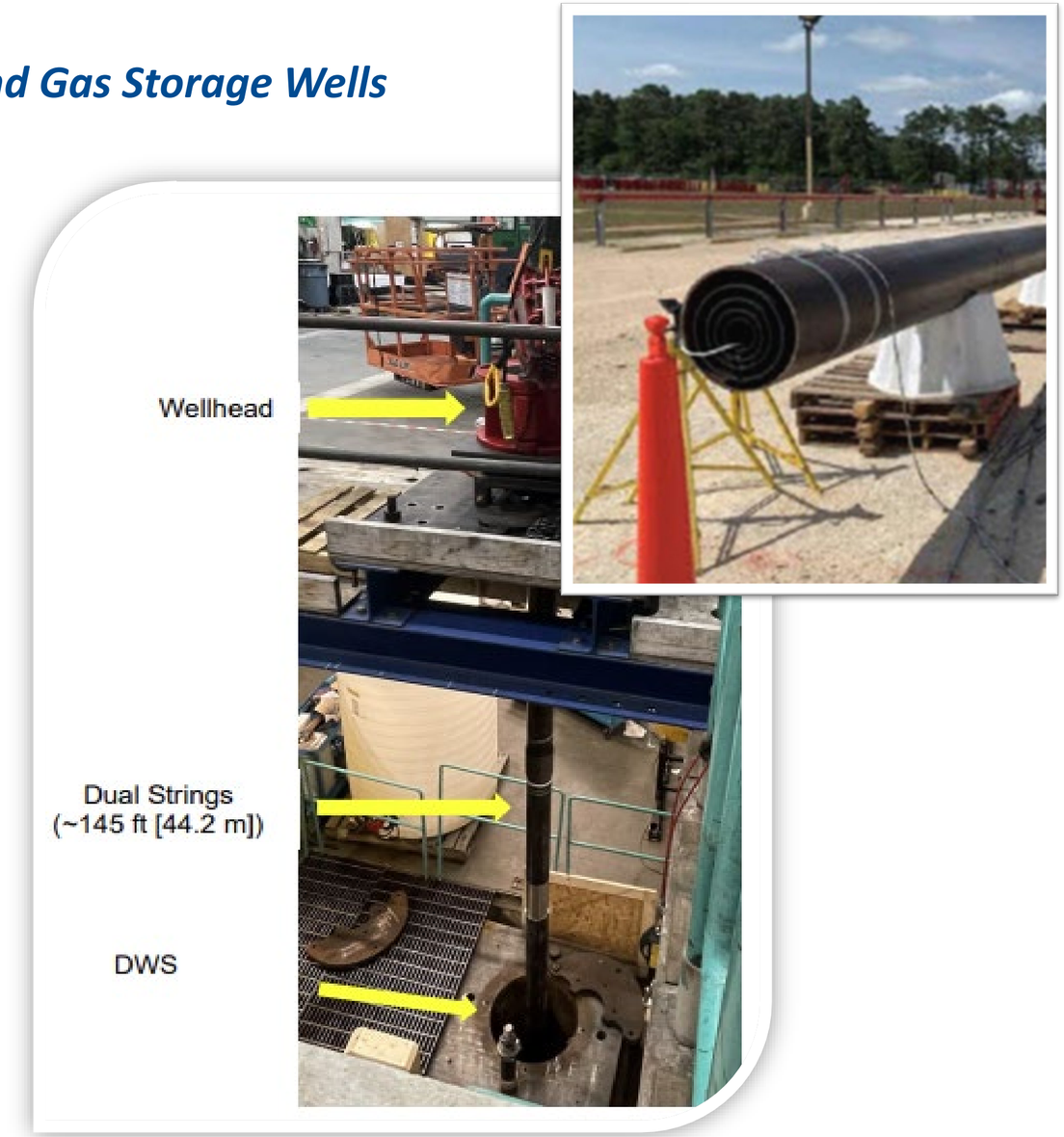
Project Objectives:

- Evaluate through-tubing inspection technologies to maintain integrity of UGS wells.
- Inspect the well casing without removing inner tubing, making the process faster, safer, and more efficient.

Why It Matters:

- Improves system safety, reliability, and efficiency.
- Keeps ratepayer costs down.

PHMSA Project Site:
https://primis.phmsa.dot.gov/matrix/PrjHome.rdm?prj=943



Courtesy: Pipeline Research Council International

SoCalGas

Glad to be of service.®

Gas System Integrity: Environmental & Safety Initiative

RD&D Landscape & Proposal

Funding Amount: 15%

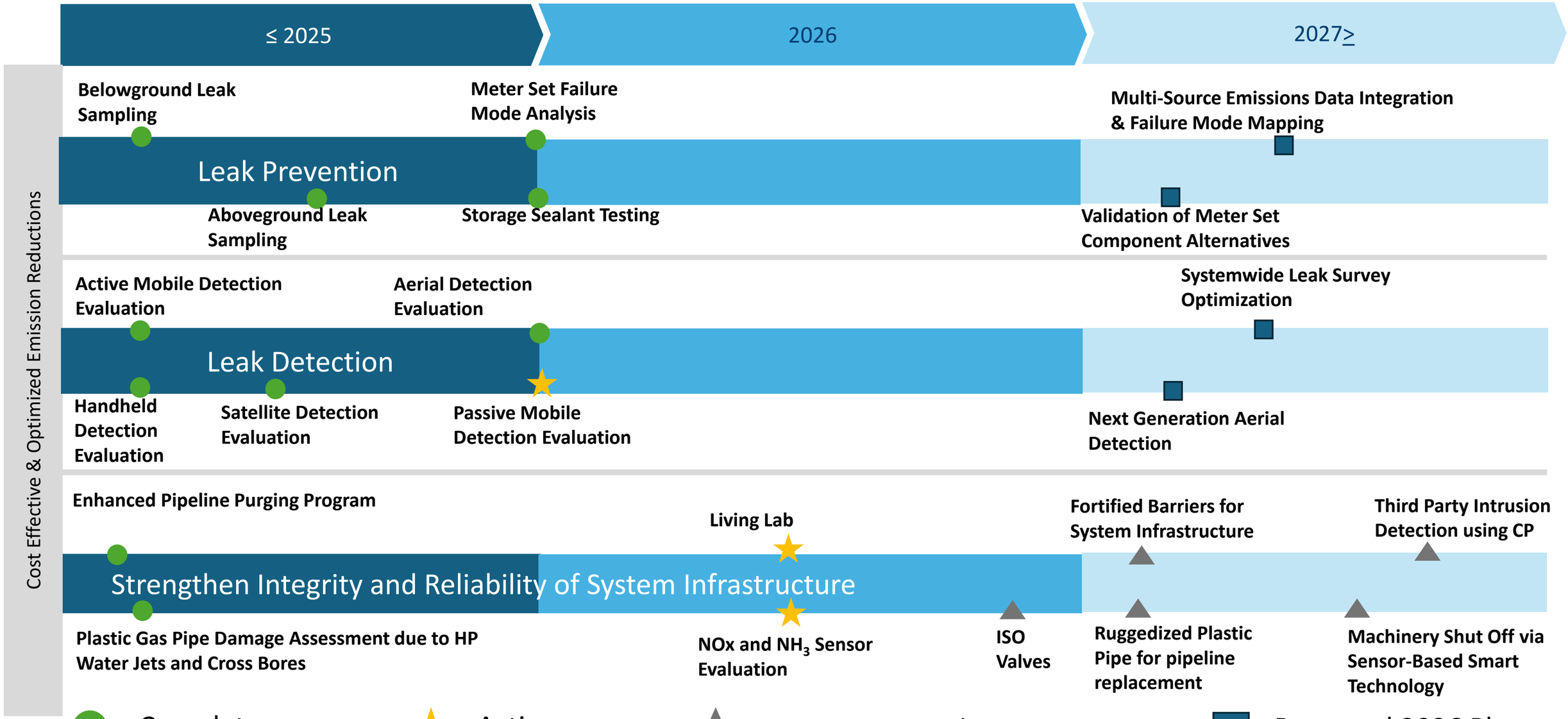
Identified Need	Proposed Solution	Anticipated Impacts
• The success of the NGLAP research program enabled SoCalGas to achieve the ~40% reduction target ahead of schedule, but more work is needed to achieve NZE. • Distribution Main & Services and Customer Meters represent 80% of the remaining emissions. These emissions come from tens of thousands of leaks spread over 6 million meters and 100,000 miles of pipeline. • Cost-effective system survey and leak prevention methods are needed to achieve safety and environmental goals while reducing ratepayer costs.	1. Evaluate advanced leak detection technologies capable of rapidly and frequently covering the vast territory at lower overall cost. 2. Integrate and analyze existing data from siloed systems to uncover prominent failure modes. 3. Leverage failure mode data and lessons learned from prior research to identify and validate cost-effective leak prevention solutions.	Carbon Emissions Reduction: Decrease in greenhouse gas emissions, measured in metric tons of CO2e. Safety: Reduction in probability of incident occurrence. Cost Efficiency: Reduction in inspection, maintenance and repair costs.

Gas System Integrity: Environmental & Safety Initiative

Alignment with CPUC Proceedings and Policy

CPUC Proceeding/Policy	Identified Priority and Alignment
R.15-01-008 - OIR to Adopt Rules and Procedures Governing Commission-Regulated Natural Gas Pipelines and Facilities to Reduce Natural Gas Leakage /Senate Bill 1371 Natural Gas: Leakage Abatement	Establishes rules and best practices for leak detection, prevention, and repair to reduce emissions of natural gas from CPUC-regulated gas facilities to the maximum extent feasible.
Resolution G-3605 - SoCalGas 2024 Compliance Plan	SoCalGas may move its NGLA Research, Demonstration & Development projects as appropriate to its broader Research and Development program.
R.24-09-012 - OIR to Establish Policies, Processes, and Rules to Ensure Safe and Reliable Gas Systems in California and Perform Long-Term Gas System Planning / AB 32 GHG Emissions Reductions	Operationalizes AB 32's climate mandates within the gas sector by creating a regulatory framework for safe, reliable, and equitable gas transition planning. Manage infrastructure, cost, and reliability challenges.

Gas System Integrity: Environmental & Safety Initiative



Gas System Integrity: System Inspection & Monitoring

RD&D Landscape & Proposal

Funding Amount: 15%

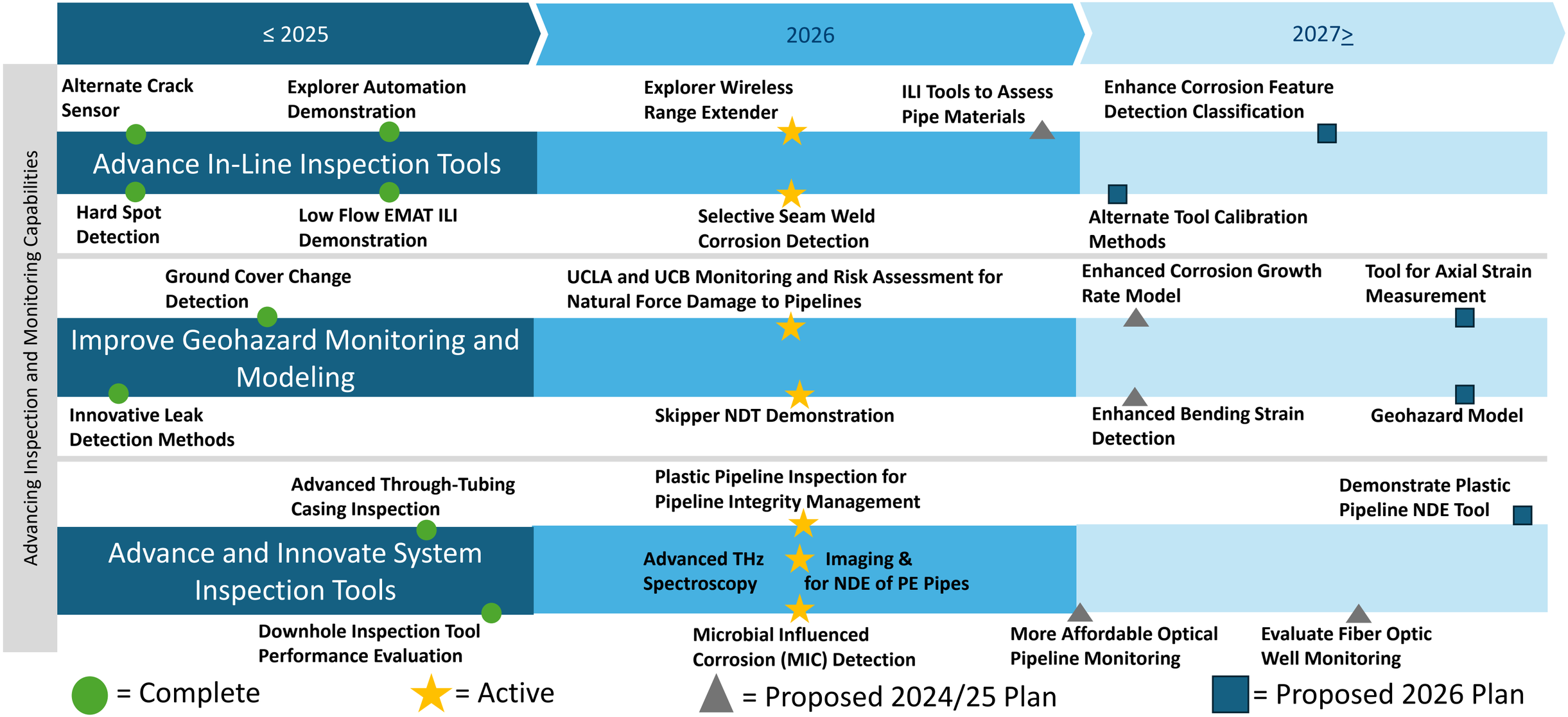
Identified Need	Proposed Solution	Anticipated Impacts
Advance inspection and monitoring capabilities while reducing inspection costs and increasing infrastructure availability. **Current Research State** 1. Robotic ILI tools can be pre-calibrated; free-swimming tools are not. 2. IMU, satellite, and strain/fiber inspection data are disparate. 3. Current Research under SB 1371 Tablet Based Electronic Survey.	Adopt techniques from adjacent technologies to increase operational efficiencies, leverage AI to connect disparate data sources, improve access and usability of real time information for field employees. 1. Develop Alternate In-Line Inspection Tool Calibration Methods. 2. Develop tool to analyze and model geohazard impacts, machine learning (ML) or artificial intelligence (AI) assisted 3. Develop tools to streamline system inspections, including augmented reality tools.	Operational Efficiency: Improvement in operational efficiency metrics such as maintenance costs. Cost Efficiency: Reduction in inspection, maintenance and repair costs. Reliability: Reduce out of service time for infrastructure and increase energy availability.

Gas System Integrity: System Inspection & Monitoring

Alignment with CPUC Proceedings and Policy

CPUC Proceeding/Policy	**Identified Priority and Alignment**
R.18-04-019 - OIR to Consider Strategies and Guidance for Climate Change Adaptation.	Directs utilities to develop Climate Adaptation and Vulnerability Assessments (CAVA), which identify specific climate-related infrastructure, operations, and service vulnerabilities. Develop novel technologies to support CAVA goals.
D.15-06-044 / CPUC General Order 112-F / Federal pipeline safety regulations (49 C.F.R. Part 192)	Rules governing operation and maintenance of gas transmission and distribution systems (49 CFR Part 192, Subpart O). Ongoing research and technology advancement in safety, design, and inspection for pipeline infrastructure to support affordability and safety.

Gas System Integrity: System Inspection & Monitoring Initiative



Gas System Integrity: Community Impact & Energy Conservation Initiative

RD&D Landscape & Proposal

Funding Amount: 10%

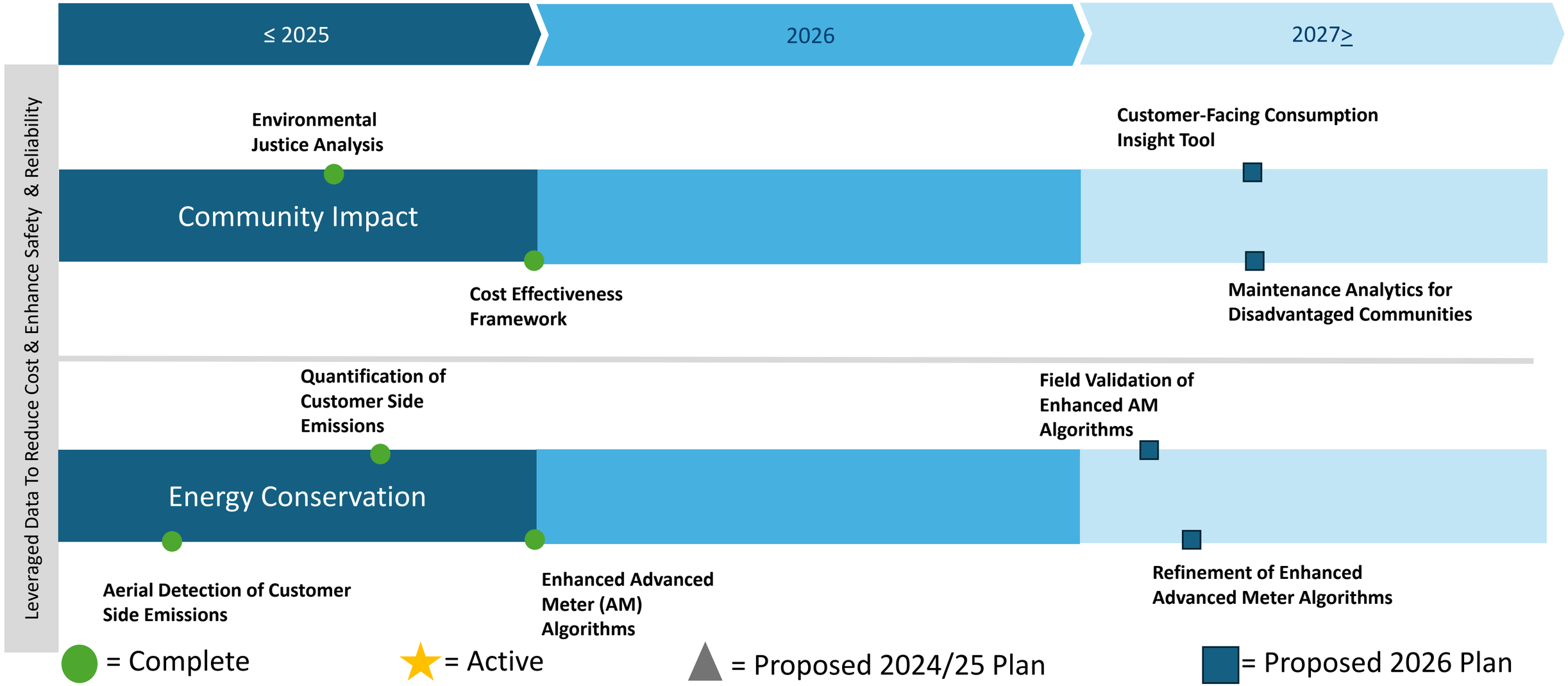
Identified Need	Proposed Solution	Anticipated Impacts
• Ratepayers have very few ways to notice unintended gas usage. The only warning signs are indirect indicators such as the smell of gas or a sudden and unexplained increase in their monthly bill. • Monetary impact of excess usage disproportionately effects disadvantaged communities. • Algorithms utilizing Advanced Meter (AM) data detect some, but not all usage anomalies. • False positive indications from AM algorithms increase operational costs.	• Prior research showed aerial leak survey data could be used to enhance AM algorithms, improving gas leak and hot water leak detection. • Further refinement of this approach is needed to reduce false positive rate. • Accurate identification of these anomalies can reduce ratepayer costs while enhancing safety. • Data insights into areas of frequent or unresolved gas and hot water leaks could support efforts to address systemic maintenance challenges in disadvantaged communities.	Cost Savings: Reduction in energy usage for ratepayers. Cost Efficiency: Reduction in maintenance and repair costs. Carbon Emissions Reduction: Decrease in greenhouse gas emissions, measured in metric tons of CO_2e.

Gas System Integrity: Community Impact & Energy Conservation Initiative

Alignment with CPUC Proceedings and Policy

CPUC Proceeding/Policy	**Identified Priority and Alignment**
R.24-09-012 - OIR to Establish Policies, Processes, and Rules to Ensure Safe and Reliable Gas Systems in California and Perform Long-Term Gas System Planning / AB 32 GHG Emissions Reductions	Operationalizes AB 32's climate mandates within the gas sector by creating a regulatory framework for safe, reliable, and equitable gas transition planning. Manage infrastructure, cost, and reliability challenges.
SB 350 Disadvantaged Community Advisory Group	Guiding Principles: Maintain or enhance the affordability of energy service in disadvantaged communities, by considering potential rate impacts of any proposed program.

Gas System Integrity: Community Impact & Energy Conservation Initiative



Gas System Integrity: System Design & Materials Initiative

RD&D Landscape & Proposal

Funding Amount: 5%

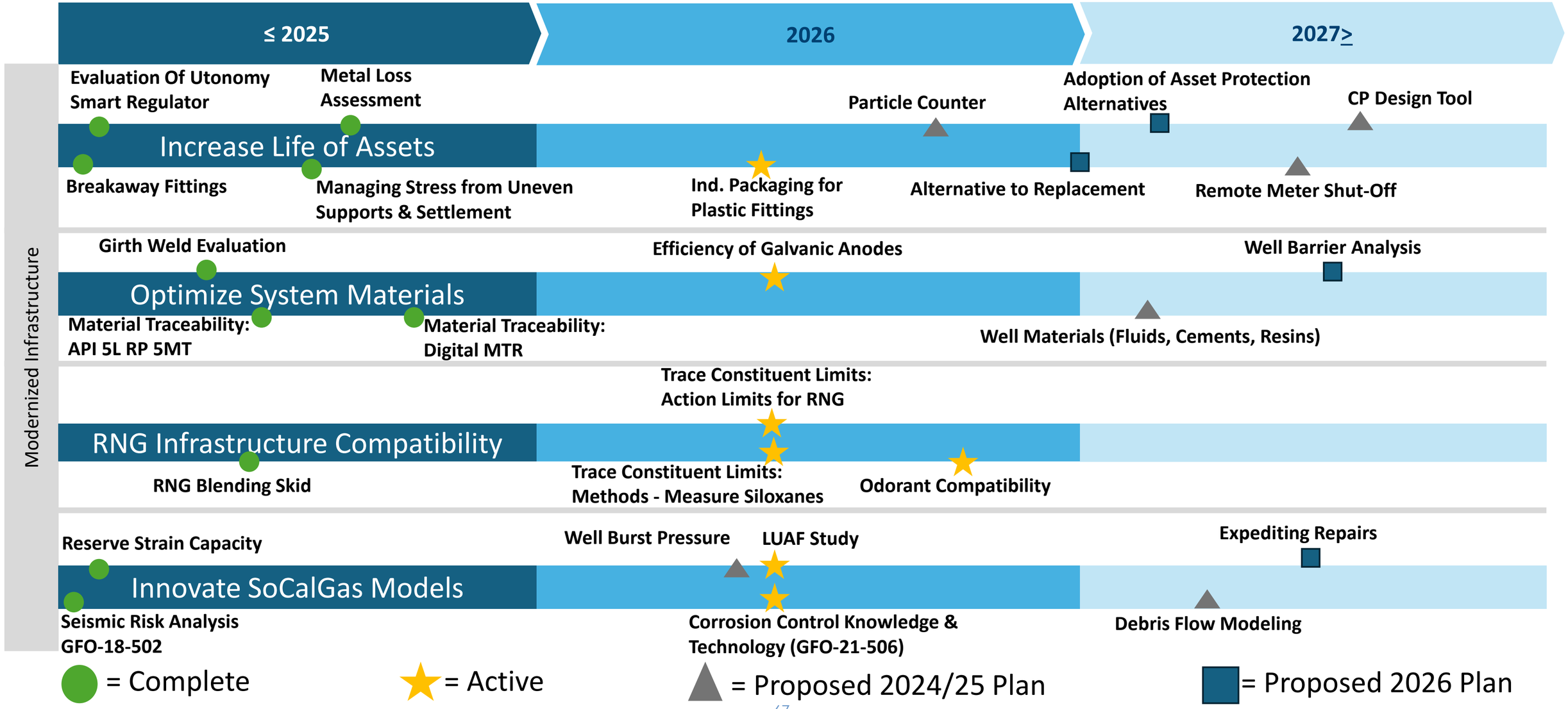
Identified Need	Proposed Solution	Anticipated Impacts
1. A probabilistic fracture mechanics model for metal pipelines is in progress, but polyethylene (PE) pipe lifetime-prediction models need to be enhanced. 2. Risk Model to identify Well Barrier Flow Path issues for potential failure modes. 3. Replacement alternatives to increase longevity of existing infrastructure. 4. Alternative technologies for infrastructure protection.	1. Develop robust PE pipe lifetime prediction models supported by field sampling and material aging data. 2. Establish integrity values and thresholds with barrier evaluation and analysis of flow paths. 3. Evaluate non-traditional repair methods for safety and reliability. 4. Enhance breakaway fitting capabilities to facilitate technology adoption.	**Safety**: Increase safety during well operations through failure mode analysis. **Reliability**: Increase lifetime of existing assets and end of life predictions. **Affordability**: Reduction in capital replacement costs.

Gas System Integrity: System Design & Materials Initiative

Alignment with CPUC Proceedings and Policy

CPUC Proceeding/Policy	Identified Priority and Alignment
R.20-01- 007- Long-term Gas System Planning OIR	Calls for more RNG research, especially on customer and infrastructure impacts.
D.15-06-044 / CPUC General Order 112-F / Department of Transportation 49 Code of Federal Regulations Part 192: Federal pipeline safety regulations /	Rules governing operation and maintenance of gas transmission and distribution systems (49 CFR Part 192, Subpart O). Ongoing research and technology advancement in safety, design, and inspection for pipeline infrastructure is needed to support affordability and safety.
R-13-02-008 - OIR to Adopt Biomethane Standards and Requirements, Pipeline Open Access Rules, and Related Enforcement Provisions	Research on system design, environmental impacts and safety are necessary to support this rulemaking. Research to increase affordable pipeline access is required to support CPUC goals. These efforts contribute to the development of procurement targets for RNG with safe and reliable integration into the gas pipeline system

Gas System Integrity: System Design & Materials Initiative



Gas System Integrity: RNG Infrastructure Opt. Initiative

RD&D Landscape & Proposal

Funding Amount: 15%

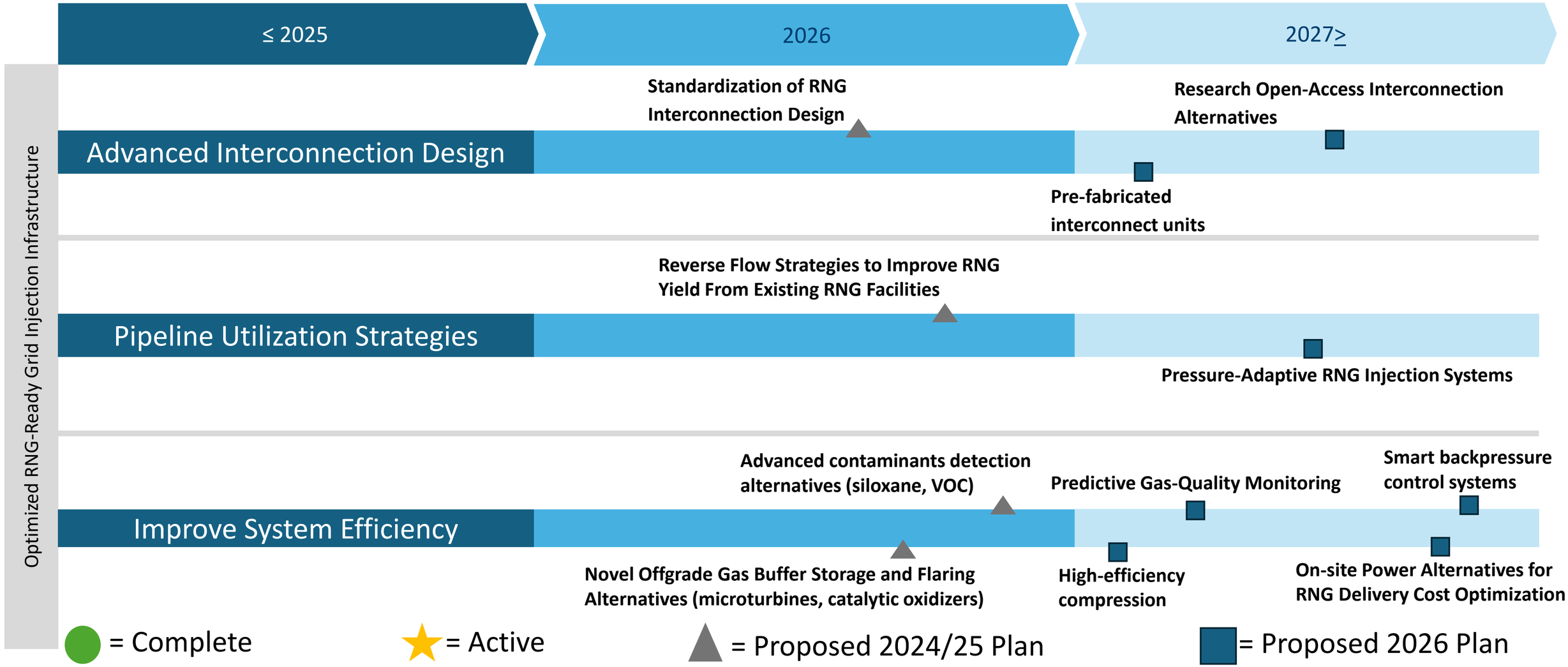
Identified Need	Proposed Solution	Anticipated Impacts
1) Lower the cost and timeline of RNG interconnections by standardizing engineering design and reducing construction complexity **2)** Increase the supply of affordable, safe, and reliable RNG by unlocking more feasible injection points for small and medium-sized projects. **3)** Address cost drivers for RNG to reach the pipeline, such as post-processing, compressing, measurement, and other system related elements.	Optimizing technology integration and interconnection costs by: **1)** Developing advanced interconnection designs with standard and modular interconnect skids, commissioning packages and SCADA/cybersecurity profiles. **2)** Developing reverse flow/bidirectional pipeline demonstrations with operational controls and localized pressure management to open space in constrained or lower-pressure segments while validating safety and reliability. **3)** Improve systemic efficiency: wide-turndown efficient compression; continuous gas-quality monitoring; buffering storage solutions; autonomous operational frameworks.	**Improved Affordability:** Lower fabrication, interconnection and O&M costs, brought by fewer change orders, shorter schedules and standardization, reduce delivered RNG cost, especially for small/medium projects. **Safety:** Studies that evaluate and test compatibility of new RNG technologies with the gas system enhance safety for end-users and utility employees **Improved Air Quality:** Eliminate/reduce flaring from biogas production facilities such as wastewater treatment plants, and emissions of criteria pollutants.

Gas System Integrity: RNG Infrastructure Optimization Initiative

Alignment with CPUC Proceedings and Policy

CPUC Proceeding/Policy	Identified Priority and Alignment
R.13-02-008 - OIR to Adopt Biomethane Standards and Requirements, Pipeline Open Access Rules, and Related Enforcement Provisions	Research on system design, environmental impacts and safety are necessary to support this rulemaking. Research to increase affordable pipeline access is required to support CPUC goals. These efforts contribute to the development of procurement targets for RNG with safe and reliable integration into the gas pipeline system.
R.20-01- 007- Long-Term Gas System Planning OIR	Joint Agency staff white paper noted a need for more research and innovation on RNG.

Gas System Integrity: RNG Infrastructure Optimization Initiative



Environmental and Social Justice (ESJ) Panel

ESJ Discussion on Gas System Integrity

1. What are your initial thoughts on the presented draft initiatives? Are there any you would like to see prioritized, and do you see any potential concerns?
2. Do you have any specific suggestions on how we strengthen or adjust the draft initiatives to better reflect ESJ community needs and support increased benefits to these communities?
3. Are there any additional research initiatives you would recommend?
4. Do you have any specific suggestions on how we can enhance our community engagement efforts?

General Audience Feedback

Break

Questions for the Audience

1. What are your initial reactions to the presented Gas System Integrity initiatives? Are there any areas you would prioritize?
2. Do you have any specific suggestions to strengthen or refine the draft initiatives?
3. What changes or additions would help ensure the research portfolio delivers meaningful and inclusive benefits?
4. Are there specific concerns or priorities related to gas infrastructure or the broader energy transition you think gas research should address?

Theme #2:
Decarbonization

2025 Project Highlight - Decarbonization

Lawrence Berkeley National Laboratory - SUMMATION (PIR-17-015)

Issue: Methane emissions in the San Joaquin Valley are significantly under-detected and under-reported, limiting the ability to conduct targeted mitigation

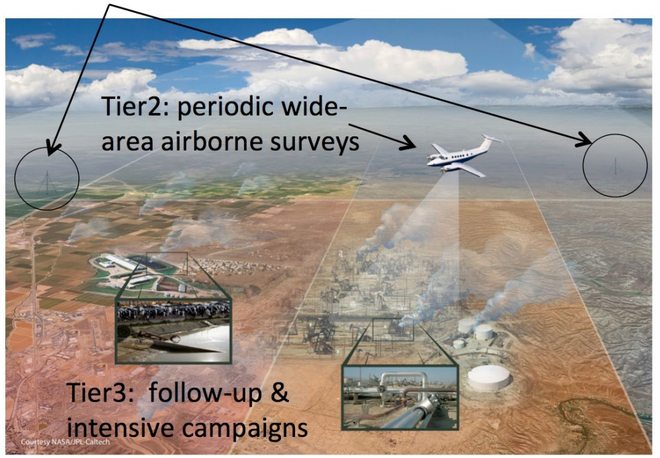
Innovation: Develop and demonstrate a cost-effective, sustained methane monitoring framework that integrates mobile platforms, towers, aircraft, and in-home measurements to identify super-emitters and improve methane accounting

Highlights:

- Successfully demonstrated a multi-scale monitoring approach to identify and quantify super-emitters across San Joaquin Valley
- Supports targeted methane and co-pollutant reductions, improved air quality, public health protection, and community education in the SJV
- Strong interest from the U.S. DOE, fostering collaboration with CARB and Sonoma Technology
- Results shared widely through international conferences, industry meetings, and tribal nation events, highlighting project's broad impact and cross-sector benefits

Website: https://summation.lbl.gov/

Oil and gas fields in Poso Creek, California are part of SUMMATION project (Credit: Andrew Moyes/Berkeley Lab)



The tiered methane observation. (Credit: NASA/JPL-Caltech, Berkeley Lab)

Advancing Health and Equity in California's Gas Transition

Theme: Decarbonization

Presenter: Maninder Thind, Ph.D., Air Resources Engineer

Advancing Health and Equity in California's Gas Transition

Theme: Decarbonization

Identified Need	Proposed Solution	Anticipated Benefits
2023 Integrated Energy Policy Report (IEPR) • Decarbonizing California's gas system will require "ongoing, long-term, coordinated planning… to manage challenges to energy affordability, reliability, health, and safety" **Build on prior Gas RD&D plans (e.g., FY 2023/24, FY 2021/22, FY 2017/18, FY 2016/17), leverage earlier efforts to support:** • Public-facing decision support tools • Health co-benefit quantification to inform equity-driven gas transition planning • Methane monitoring expansion • Integrating climate + equity scoring into gas transition planning	Interactive Tool: Develop public facing tool to **quantify non-energy impacts** of residential gas transitions Climate & EJ Scores: Combine satellite and field data to **identify gas production areas with the greatest** combined climate **emissions** and health/**environmental justice risks** Methane Monitoring: Build on ongoing field study, SUMMATION,* to develop low-cost sensors and deploy/improve tower-based **monitoring at local scale**	Affordability: **Inform strategies that reduce decarbonization cost** for low-income households (e.g., projected energy bill impacts, avoided fuel costs) Improved Public Health: **Inform actions that reduce exposure to pollutants** (e.g., NO_2 and $PM_{2.5}$) from gas use Equity: Identify and **address burdens** in disproportionately impacted communities (e.g., reductions in population-weighted pollutant exposure, prioritization of high-vulnerability census tracts) Emissions Reduction: Track methane leaks and **support cleaner infrastructure decisions** (e.g., increased leak detection frequency, CO_2e avoided/year)

*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"

Policy Alignment: Advancing Health and Equity in California's Gas Transition

Theme: Decarbonization

CPUC Proceedings	Identified Priority
R.24-09-012: Long-Term Gas Planning	Support system transition planning and public health.
R.19-01-011: Building Decarbonization	Inform health and affordability in building electrification.
R.13-02-008: Renewable Gas	Support decisions on clean gas alternatives.
R.19-10-005: Renewal of EPIC Program	Complement EPIC's health and air quality research by focusing on gas infrastructure and ratepayer impacts—quantifying non-energy co-benefits to inform an equitable gas transition.

Policy Drivers	Identified Priority
AB 32 / SB 32: GHG Reduction Targets	Improve measurement and mitigation of methane emissions to support statewide climate targets and reduce short-lived climate pollutants.
AB 1279: California Climate Crisis Act	Support cost-effective pathways to address hard-to-decarbonize gas system emissions and inform strategies for achieving the "last 10%" of GHG reductions.
SB 1221: Gas Planning & Transition	Provide data and tools to support coordinated gas system transition planning that protects public health, equity, and ratepayer affordability.
SB 350: Clean Energy and Electrification	Inform building electrification decisions through quantification of health, non-energy, and affordability impacts.

Strategic Assessment of Cost-Effective Seasonal Energy Storage Pathways

Theme: Decarbonization

Presenter: Maryam Haddad, Ph.D., Air Pollution Specialist

Strategic Assessment of Cost-Effective Seasonal Energy Storage Pathways

Theme: Decarbonization

Identified Need	Proposed Solution	Anticipated Benefits
As electrification grows, gas demand declines, and **infrastructure costs disproportionately fall on fewer customers**, including low-income households and renters in hard-to-retrofit buildings and industrial users with limited electrification options **No cost-effective seasonal storage pathway tailored to California's grid and policy context exists today**, and most available studies focus on short-term balancing, leaving uncertainty around viable technologies and investment needs for the state's seasonal reliability Limited coordination between electric and gas planning increases risks of overbuilding and reliability gaps **Equity impacts have historically been under-represented in storage planning.** To address this, systematic studies must incorporate California-specific rates and community outcomes	**Conduct** a comprehensive system-level analysis of seasonal storage technologies as **alternatives to fossil gas** for seasonal reliability, exploring potential to repurpose existing gas infrastructure **Evaluate** a broad **range of energy storage technologies** and pathways to support coordinated, long-term electric and gas planning in California **Develop** an **integrated electric–gas planning framework** aligned with IRP (e.g., IRP-ready outputs) **Make** cost, emissions, infrastructure, and equity core evaluation criteria, **consistent with IRP and IEPR** contexts, including rate impacts and stranded-cost risks	Affordability: Reduces stranded gas assets and **stabilizes rates** and reduces disproportionate impacts on remaining gas customers Reliability: Reduces reliance on gas peakers by **shifting surplus renewables across seasons**, enhancing system reliability during prolonged stress events System Efficiency: Reduces unnecessary investments/overbuilding and **supports orderly gas system transition** Equity & Decarbonization: **Lowers pollution and rate burdens** in disadvantaged and vulnerable communities and tribes, and supports geotargeted electrification and deep decarbonization

Policy Alignment: Strategic Assessment of Cost-Effective Seasonal Energy Storage Pathways

Theme: Decarbonization

CPUC Proceedings	Identified Priority
R.24-09-012: Long-Term Gas Planning	Identify seasonal storage pathways that strengthen electric–gas coordination, reduce reliance on gas for seasonal reliability, and minimize stranded costs.
R.20-05-003 & **R.25-06-019**: Reliability & Integration	Integrate seasonal storage into planning to sustain reliability while reducing peak gas use.
R.19-10-005: Renewal of EPIC Program	Complement EPIC's electrification and distributed energy resource investments by addressing seasonal supply–demand gaps and improving system cost-effectiveness.
Policy Drivers	**Identified Priority**
ESJ Action Plan & DACAG Priorities	Reduce rate impacts for remaining gas customers (e.g., in rental or low-income housing) and advance equitable access to clean seasonal storage solutions.
SB 100: 100% Clean Energy by 2045	Support SB 100 by identifying seasonal storage solutions needed to balance renewable variability and maintain reliability during electrification.

Optimizing Thermal Energy Networks for Decarbonization

Theme: Decarbonization

Presenter: Pooya Khodaparast, Ph.D., P.E., Utilities Engineer

Optimizing Thermal Energy Networks for Decarbonization

Theme: Decarbonization

Identified Need	Proposed Solution	Anticipated Benefits
Over 50% of building energy use in CA is from air conditioning and hot water demand **Large facilities:** • **Produce waste heat** that can be used to **decarbonize** heating and cooling for nearby communities • Require decarbonization pathways • **Increasingly demand electricity**, posing scarcity issues, higher rates, and elevated grid stress, which can negatively impact nearby communities and beyond	**Evaluate feasibility and technoeconomics of modular TENs** for thermal storage and waste heat recovery from large facilities for surrounding communities, expanding on FY 25-26 initiative Compare dual vs. single loop TENs with other alternative technologies to **evaluate cost-effectiveness and benefits to ratepayers** Quantify environmental impacts and benefits of heat recovery and reuse for TENs. Evaluate benefits of reduced electric demand from large facilities and other end users	Affordability: Enable **beneficial re-use of waste heat** for heating, cooling, and hot water; avoid additional procurement and generation costs; improve overall demand side efficiency, stabilize utility bill costs Safety and Reliability: **Alleviate grid stress** via alternative clean heating and cooling resources serving large facilities and communities; reduce combustion and health risks and climate impacts Environmental Sustainability: Support simultaneous **community-scale and commercial building decarbonization** through efficient cooling, heating, and hot water for residential and commercial use Equity: **Alleviate disproportionately adverse impacts** of large facilities on disadvantaged and vulnerable communities

Policy Alignment: Optimizing Thermal Energy Networks for Decarbonization

Theme: Decarbonization

CPUC Proceedings	Identified Priority
R.24-09-012: Long-Term Gas Planning **R.19-01-011**: Building Decarbonization	Develop alternative decarbonization solutions for community-scale heating, cooling, and hot water demands. Remedy challenges of partial or phased decommissioning (e.g., holdouts).
R.18-07-006: Affordability of Utility Services	Assess how data center loads drive utility cost shifts to other customers and identify strategies to prevent or mitigate them, safeguarding affordability.
R.19-10-005: Renewal of EPIC Program	Complement EPIC's building and community-scale decarbonization work by supporting large-scale decarbonization of heating, cooling, and hot water while reducing the increase in electricity demand.
Policy Drivers	**Identified Priority**
SB 1221: Decommissioning Pilots	Support evaluation of costs, benefits, and implementation barriers of Thermal Energy Networks (TENs) by assessing and advancing deployment and retrofit opportunities for TENs connected to large-scale facilities with high-yield waste heat output.

Cleaner Industry, Healthier Communities

Theme: Decarbonization

Presenter: Neeva Benipal, Ph.D., Electric Generation System Specialist

Cleaner Industry, Healthier Communities

Theme: Decarbonization

Identified Need	Proposed Solution	Anticipated Benefits
Persistent Industrial Emissions: • Ongoing emissions of in **criteria air pollutants** (e.g., NOx, SOx, PM) from industrial facilities continue to impact local air quality • **High-temperature industrial processes** are projected to remain dependent on fossil gas through 2045 under current transition pathways **Near-Term Transition Gaps:** • Technical and economic barriers **limit rapid electrification** of many industrial processes • Disproportionate exposure to industrial pollution persists in disadvantaged vulnerable communities • **Limited deployable options** exist to reduce localized emissions in the near term	Deploy **add-on co-pollutant removal technologies** at existing industrial facilities Advance **retrofit-ready emissions** reduction technologies Evaluate **deployment-relevant performance metrics** (e.g., emissions reductions, cost-effectiveness, retrofit feasibility) **Generate data** to inform industrial gas system transition and **regulatory decisions**	Localized Emissions Reductions: Demonstrate up to **90% reductions in criteria air pollutants**, delivering near-term improvements in local air quality and public health Affordability: Enable **cost-effective, near-term emission reductions for the hardest-to-electrify industries** through co-pollutant removal technologies, measured by metrics such as cost per ton of pollutants reduced Equity/Environmental Justice: **Prioritize reductions in criteria air pollutants** in disadvantaged vulnerable communities facing the highest cumulative exposure risks Near-term Ratepayer Value: Deliver **immediate benefits** through low-risk, cost-effective, deployable emissions controls that avoid long-lived infrastructure investments

Policy Alignment: Cleaner Industry, Healthier Communities

Theme: Decarbonization

CPUC Proceedings	Identified Priority
R.20-05-003: Integrated Resource Planning and Related Procurement	Explore non-electrification technologies for industrial emission reductions to mitigate projected electricity demand growth.
R.24-09-012: Long-Term Gas System Planning	Support system transition planning and public health.
R.19-10-005: Renewal of EPIC Program	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.

Policy Drivers	Identified Priority
SB 643: Carbon Dioxide Removal (CDR) Purchase Program	Demonstrate CDR pathways and provide verified CO2 removal data.
SB 905: CARB Carbon Capture Utilization & Storage program **AB 209**: CEC Clean Energy Programs	Advance readiness for integrated co-pollutant and carbon capture systems and enable validated CDR pathways.

Studying Industrial Process Heat Decarbonization Pathways

Theme: Decarbonization

Presenter: Neeva Benipal, Ph.D., Electric Generation System Specialist

Studying Industrial Process Heat Decarbonization Pathways

Theme: Decarbonization

Identified Need	Proposed Solution	Anticipated Benefits
System Planning and Infrastructure Need: • The industrial sector uses one-third of CA's fossil gas and relies on fossil fuels for 90% of its heat • Statewide **gas transition** and **grid expansion** require clear analysis of viable industrial clean heat pathways and transition costs • Comparative evaluation of high-temperature **(> 300°C)** industrial heat options remains limited **Policy and Resource Evaluation Gap:** • The Long-Term Gas Planning OIR requires **clearer analysis** of industrial heat demand and transition pathways to operationalize coordinated gas system transition planning	Conduct a **comparative study** of high-temperature **industrial heat pathways** including electrification, clean fuels, advanced nuclear reactors, and CCUS etc. Develop a statewide industrial **heat load dataset** to inform targeted planning and gas transition decisions Evaluate **cost, infrastructure, scalability, and community impacts** across pathways to inform gas transition scenarios and gas-electric coordination **Model grid** impacts on reliability, resilience, renewable integration, and public health outcomes	Emission Reduction: **Quantify potential reductions** in fossil gas use, CO2 emissions, and air pollutants Reliability and Grid Impacts: Assess impacts on **grid stress, peak demand**, and overall system reliability Public Health and Ratepayer Impacts: Evaluate **health benefits from reduced emissions** and **long-term ratepayer** cost implications Infrastructure and Investment Needs: Assess long-term **gas and electric infrastructure requirements** and how industrial **heat load mapping** can inform target gas system decommissioning under alternative pathways

Policy Alignment: Studying Industrial Process Heat Decarbonization Pathways

Theme: Decarbonization

CPUC Proceedings	Identified Priority
R.24-09-012: Long-Term Gas Planning	Support evaluation of non-pipeline industrial heating alternatives and provide foundational analysis to inform gas transition planning, gas-electric coordination, and SB 1221 decarbonization zone implementation.
R.25-06-019: Integrated Resource Planning (IRP)	Support IRP by evaluating reliable and cost-effective industrial heat pathways, including electrification and clean firm resources to inform long-term resource planning

Policy Drivers	Identified Priority
AB 1172 (2023-24): Fusion Energy Assessment **SB 80** (2025-26) Fusion Research and Development Innovation Initiative	Support state exploration of advanced clean energy technologies by evaluating nuclear and other firm, non-combustion heat pathways
AB 32/SB 32: GHG Reduction Targets **SB 100**: 100 Percent Clean Energy Act	Advance CA's GHG reduction and 100% clean electricity goals by identifying viable pathways to reduce industrial gas use and decarbonize high-temperature process heat
AB 1207 (Irwin) & **SB 840** (Limón) Cap-and-Invest Extension	Support economy-wide emissions reductions, including industrial sources, by providing analysis of cost-effective industrial heat decarbonization pathways

Thank You!

Decarbonization:
Summary of Feedback from Commission SMEs

Initiative / Topic	CPUC SME (Guest) Feedback	PG&E Clarification
Clean Fuels Integration	CPUC SMEs recommended that the Clean Fuels Integration initiative should be reframed to align with Commission priorities by removing hydrogen related elements and refocusing on clearly defined problem statements associated with renewable natural gas. CPUC SMEs emphasized that RNG presents more immediate and well articulated challenges relevant to gas system planning, ratepayer impacts, and decarbonization objectives. To move forward, the initiative should clearly redefine its scope around RNG integration, articulate the specific technical, operational, and cost challenges being addressed, and demonstrate how proposed work delivers measurable ratepayer benefits. Clear alignment with Commission direction and coordination with other Gas RD&D and EPIC efforts focused on RNG will be essential.	PG&E understands this feedback to prioritize RNG-focused challenges under current Commission direction and to guide near-term scope accordingly, rather than to make a broader determination regarding all potential clean fuel pathways beyond the EPIC 5 framing.
Sustainable Energy Solutions	CPUC SMEs emphasized the need for a clearly defined role for this initiative within the broader portfolio, including explicit articulation of how it complements existing work and avoids duplication. CPUC SMEs also stressed that any proposed activities must demonstrate clear and measurable ratepayer benefits, particularly in light of concerns that a significant share of future ratepayer costs is concentrated in the gas distribution system. Initiatives should prioritize strategies that support electrification and system transition goals in order to avoid placing increasing cost burdens on a shrinking base of gas customers.	PG&E understands this feedback to condition advancement of sustainable energy solutions on clearer role definition, coordination, and demonstrated ratepayer benefits, particularly where initiatives interact with long-term gas system transition and electrification strategies.

Decarbonization: Clean Fuels Integration

Alignment with CPUC Proceedings

CPUC Proceeding/Policy	Identified Priority and Alignment
D.22-12-057: Decision Directing Biomethane Reporting and Directing Pilot Projects to Further Evaluate and Establish Pipeline Injection Standards for Clean Renewable Hydrogen	Prioritizes evaluation and establishment of pipeline injection standards, providing safe lower and upper hydrogen blend limits, for clean renewable hydrogen supporting SB 1075. Supports research that ensures the safe, affordable integration of clean renewable hydrogen and biomethane into California's gas network.
R.13-02-008: Order Instituting Rulemaking to Adopt Biomethane Standards and Requirements, Pipeline Open Access Rules, and Related Enforcement Provisions	Prioritizes advancing biomethane procurement and integration with other clean fuels to lower GHG emissions. Additionally, supports requirement for joint IOU research into upper and lower action level specifications for mercury. Promotes cost-effective decarbonization, leverages existing infrastructure for cleaner energy delivery, and contributes directly to California's carbon neutrality.
D.24-03-007: Decision Adopting EPIC Strategic Goals	Prioritizes cost-effective opportunities for reaching the 'last 10%' of the state's goal to be carbon neutral by 2045 economywide including evaluation of hydrogen's potential and clean fuels use for long-duration storage, backup power and grid support. Supports investment in California-specific strategies for hard-to-decarbonize energy-consuming sectors that could be decarbonized through electrification and coordination with other California RD&D programs to align investments and activities for emerging strategies.

Decarbonization: Clean Fuels Integration

RD&D Landscape & Proposal

Identified Need	Proposed Solution	Anticipated Impacts

• Increase RNG throughput volume
• Cost and time reduction of RNG interconnection
• Develop a standard practice for gas quality analysis with clean fuels in use
	• Supporting the integration of traditional energy resources with emerging fuels can help to achieve net-zero carbon goals and enhance affordability by:
	  • Investigate expansion of biogas feedstock options
	  • Flexible skids that enable faster, more cost-effective interconnection with varied biogas feedstocks
	  • Implement measurement and analysis technologies that monitor trace constituents across gas assets
		• Safety – safe delivery of clean fuels that enhance air quality
		• Energy Supply & Resilience – reduced power outage impact by leveraging clean fuels for load balancing
		• Energy Storage Capacity – enhanced energy storage by leveraging clean fuels
		• GHG Reduction – reduced use of GHG-intensive traditional energy sources

Thank you

Gas Research & Development

Innovation@pge.com

https://www.pge.com/en/about/pge-systems/research-and-development.html

Decarbonization

2025 Decarbonization Portfolio Milestones

Low Carbon Resources

- 19 Active Projects
- 5 Completed Projects
- 0 Initiated Projects
- 5 Publications

Customer End Use

- 44 Active Projects
- 26 Completed Projects
- 0 Initiated Projects

Clean Generation

- 19 Active Projects
- 10 Completed Projects
- 0 Initiated Projects

Significant Projects Completed

Low Carbon Resources

*LLNL Composite Sorbents – Enabling Economical Biomethane Product

Clean Generation

*GTI Marathon/EC Power mCHP Testing and Demonstration

*UCI Fuel Cell Supported Nanogrid Controls Evaluation

Customer End-Use Applications

*GTI SCAQMD HE/Low-Nox EcoZone Burner Kroger Demonstration

*Mitigating Methane Emissions from ResCom End Use Equipment

Note: The Clean Transportation subprogram (retired) had seven projects that were completed in 2025.

The 2025 RD&D Annual Report will be available after March 31, 2026, at: https://www.socalgas.com/sustainability/research-development-demonstration

Project Spotlight

NREL P2G Biomethanation Systems Integration & Optimization

Project Challenge: Need to collect extensive amounts of on-site data to assess feasibility of RNG production from mixed sources.

Proposed Approach:

Develop a scale-down, state-of-the-art biomethanation mobile RD&D platform that can:

- Increase RNG production using renewable power
- Enable faster biogas testing in the field
- Accelerate RNG production validation
- Support conceptual design development
- Reduce cost of RNG via biomethanation

Next Steps:

- Complete the trailer system commissioning.
- Plan follow-on project for onsite demonstration/data collection in California to assess RNG production and feasibility via biomethanation.

Courtesy: National Laboratory of the Rockies

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Decarbonization: Low-Carbon Fuel Technologies

RD&D Landscape & Proposal

Funding Amount: 15%

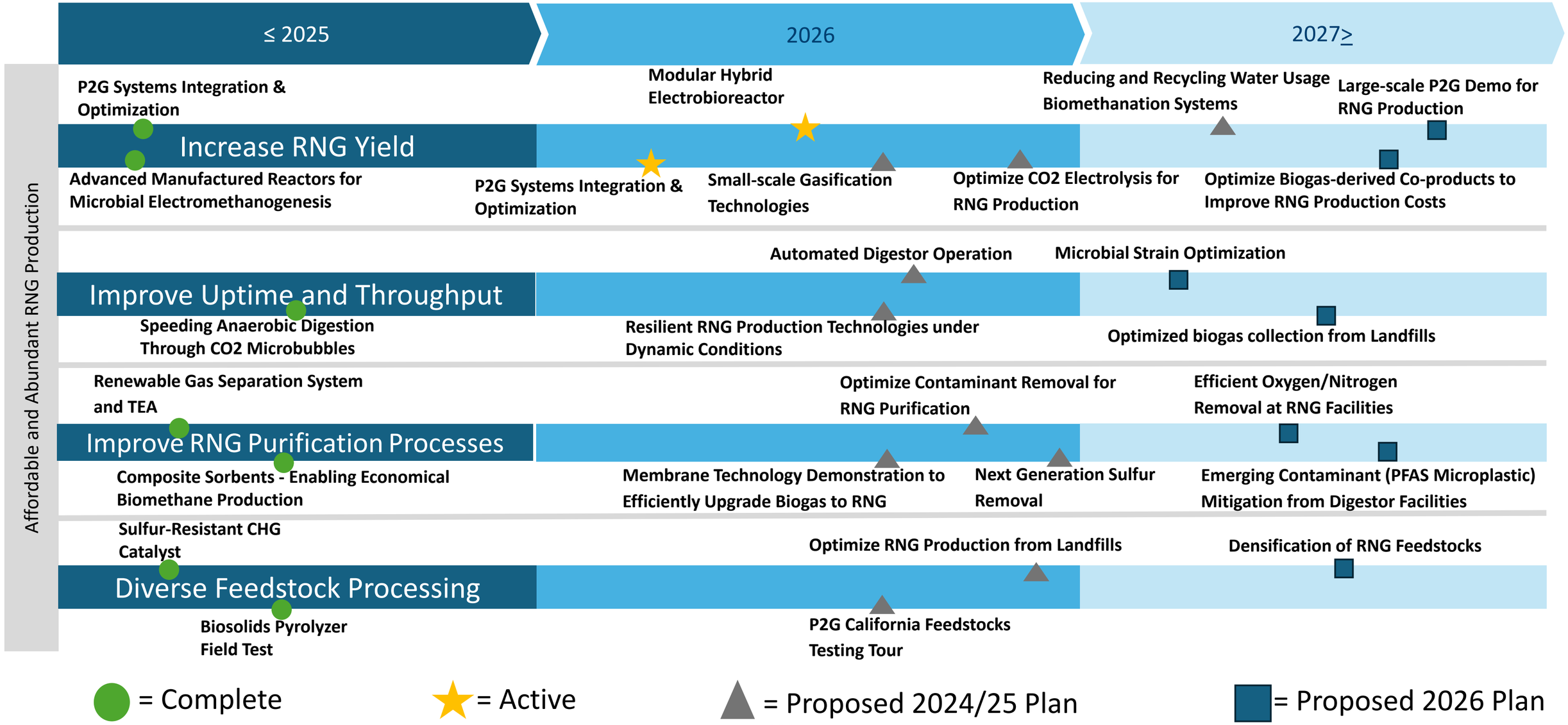
Identified Need	Proposed Solution	Anticipated Impacts
Improve affordability and emissions performance by addressing RNG production and upgrading bottlenecks: • Improved capability to process diverse feedstocks (manure, food waste, biosolids, organics, woody biomass) while maintaining stable operations. • Lower cost of upgrading raw biogas to pipeline quality, contaminant removal and upgrading efficiency. • Increase RNG production reliability with improved uptime and yields. Expand supply of low-carbon fuels by improving the cost and efficiency of production pathways, including RNG and other low-carbon options.	Develop technologies that increase RNG yield and reduce upgrading cost through biologic and/or synthetic methanation of CO_2 in biogas. Improve biogas gathering and RNG throughput by developing advanced monitoring and predictive controls to reduce flaring and enable higher loading rates. Develop alternative separation/purification processes to reduce parasitic load; and simplified, modular, high-efficiency upgrading systems for small and mid-scale projects. Research emerging RNG production technologies and cost optimization opportunities through added-value coproduction strategies, including water reutilization, digestate and fiber applications, siloxane recovery, high-fat residues valorization, CO2 off-gas conversion, among others.	**Improved Affordability:** Reduce capital, O&M, and fuel costs by improving yield, uptime, and upgrading efficiency. Expanded feedstock flexibility and reduced downtime increase total RNG supply available, which can lower the costs to reach SB 1440 biomethane procurement goals. **Reduced Emissions:** Reduce GHG emissions by increasing capture and productive use of methane, reusing process effluents, and improving efficiency of fuel production. **Reliability:** Enable fuel production technologies that can support intermittent operations and integrate with variable renewable energy resources.

Decarbonization: Low-Carbon Fuel Technologies

Alignment with CPUC Proceedings and Policy

CPUC Proceeding/Policy	Identified Priority and Alignment of Gas
R.24-09-012 - Long-term Gas System Planning OIR	Highlights need for research and innovation on H2 and carbon capture, storage, and sequestration. Supports H2 and RNG use in power generation, industry, transportation, and “hard-to-electrify” applications.
R-13-02-008 - OIR to Adopt Biomethane Standards and Requirements, Pipeline Open Access Rules, and Related Enforcement Provisions	D.22-02-025: Iimplements SB 1440, requires IOUs to procure 17.6 BCF of RNG annually by 2025 (SoCalGas share is 49.26%), and 12.2% of its own share of 2020 annual bundled core customer natural gas demand by 2030. D.22-12-057 (Phase 4): Orders gas IOUs to file applications proposing demonstration projects to help inform a systemwide renewable hydrogen injection standard.
D. 24-12-074 - SoCalGas General Rate Case TY 2024	Supports funding RD&D activities that benefit ratepayers through improved reliability, safety, environmental benefits, or operational efficiencies, and activities to evaluate microgrids, fuel cells, renewable natural gas, and hydrogen.

Decarbonization: Low-Carbon Fuel Technologies Initiative



Decarbonization: Energy Reliability and Resilience

RD&D Landscape & Proposal

Funding Amount: 15%

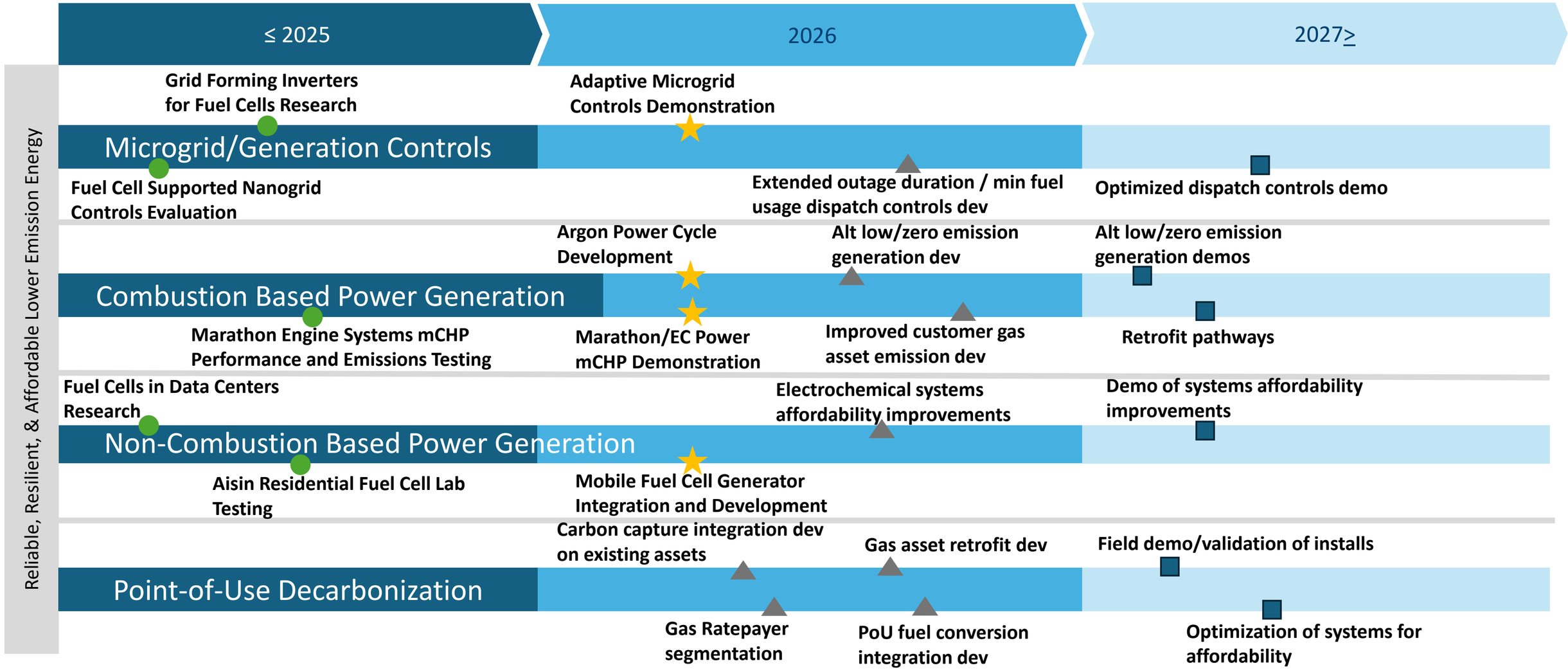
Identified Need	Proposed Solution	Anticipated Impacts
Diverse, affordable and decarbonized energy resources to support customer reliability and resiliency. Lower emission backup generation options that rely less on diesel usage. Enable a gradual to full transition to decarbonized systems while keeping ratepayer investments reliably powered. **Current Research State (examples)** 1. No CARB certified generation systems under 50kW are commercially available. 2. Current control systems lack the ability to adapt and achieve interoperability to changing real world conditions. 3. Limited integration of affordable onsite fuel conversion, fuel flexible retrofits, and CO2 mitigation technologies for existing customer assets.	Research, development and demonstrations of advanced energy management system controls and integration, optimization of Combined Heat and Power (CHP) systems, and scalable microgrid control systems. Additional examples include: 1. Demonstrate broader generation technologies, efficiency optimization, and integration. 2. Use AI to improve controls system and optimize power generation systems. 3. Develop and integrate point-of-use decarbonization technologies (e.g., onsite fuel conversion, fuel flexible retrofits, CO2 mitigation technologies).	Reliability: Support electric grid reliability with diverse energy resources to prevent grid strain and disruptions. Improved Air Quality: Reduce criteria pollutant emissions. Improved Affordability: Lower energy cost low carbon technologies.

Decarbonization: Energy Reliability and Resilience

Alignment with CPUC Proceedings and Policy

CPUC Proceeding/Policy	Identified Priority and Alignment
R. 24-09-012 - Long-term Gas System Planning OIR	Joint Staff Whitepaper supports the development of microgrids and distributed energy resources to enhance resiliency as an alternative to diesel generators. Promotes clean backup generation and microgrids as part of long-term planning to achieve greenhouse gas reduction goals and improve reliability during outages.
AB 205	Emphasizes the importance of energy reliability, while ensuring a clean energy transition and achieving climate targets and air quality requirements.
D. 24-12-074 - SoCalGas General Rate Case TY 2024	Authorizes funding RD&D activities that benefit ratepayers through improved reliability, safety, environmental benefits, or operational efficiencies, and activities to evaluate microgrids, fuel cells, renewable natural gas, and hydrogen.

Decarbonization: Energy Reliability and Resilience Initiative



Decarbonization: Building and Facility Systems

RD&D Landscape & Proposal

Funding Amount: 10%

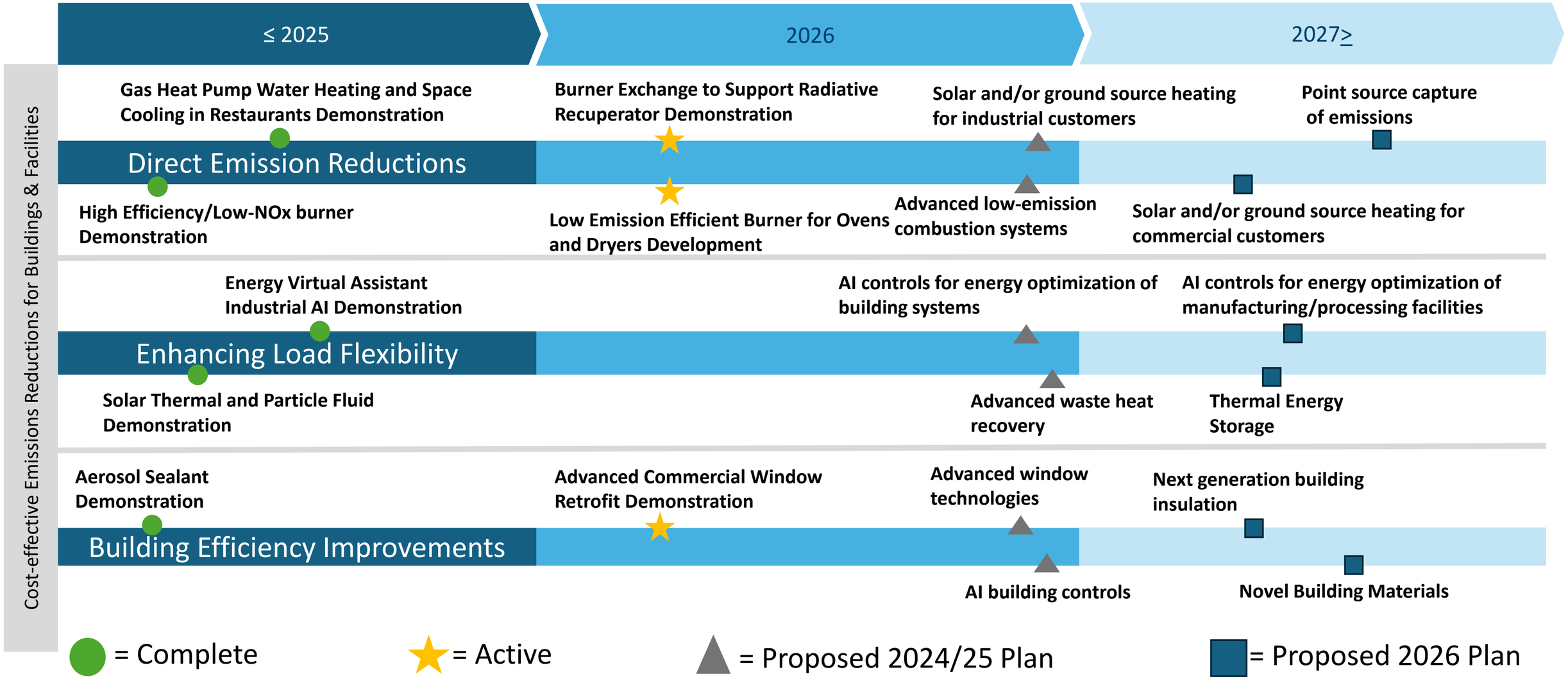
Identified Need	Proposed Solution	Anticipated Impacts
Lower-cost and reduced emission commercial and industrial heating technologies, advanced energy management systems, waste heat recovery, and smart building controls for buildings and facilities. **Current Research State (examples)** 1. Advanced window retrofits and other novel building materials need additional development and demonstration. 2. The use of AI for energy management within commercial and industrial facilities and equipment is relatively new. 3. Industrial processes are complex, diverse, and often unique, requiring tailored solutions reduce energy utilization and emissions.	Research, development, and demonstration of a wide range of heating equipment, energy management, thermal energy recovery and storage, and novel building technologies. 1. Developing advanced building envelope materials. 2. Demonstrations of advanced energy management and smart building controls that reduce gas use and optimize the operation of electric and gas equipment. 3. Cutting direct emissions from boilers, water heaters, commercial cooking appliances, and industrial process equipment.	Improved Affordability: Customer bill savings, avoided customer energy used (kWh saved), maintained or reduced capital, operations and maintenance costs. Improved Air Quality: Reduce criteria pollutant emissions. GHG reductions: Reduce GHG emissions.

Decarbonization: Building and Facility Systems

Alignment with CPUC Proceedings and Policy

CPUC Proceeding/Policy	Identified Priority and Alignment
R. 24-09-012 - Long-term Gas System Planning OIR	Staff white paper supports RNG to be used selectively in non-residential buildings and hard-to-electrify facilities and supports research and demonstration programs to develop technologies that can reduce fossil gas demand and emissions.
D. 24-12-074 - SoCalGas General Rate Case TY 2024	Supports funding RD&D activities that benefit ratepayers through improved reliability, safety, environmental benefits, or operational efficiencies.

Decarbonization: Building and Facility Systems Initiative



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Environmental and Social Justice (ESJ) Panel

ESJ Discussion on Decarbonization

1. What are your initial thoughts on the presented draft initiatives? Are there any you would like to see prioritized, and do you see any potential concerns?
2. Do you have any specific suggestions on how we strengthen or adjust the draft initiatives to better reflect ESJ community needs and support increased benefits to these communities?
3. Are there any additional research initiatives you would recommend?
4. Do you have any specific suggestions on how we can enhance our community engagement efforts?

General Audience Feedback

Next Steps

Written comments may be submitted via email to:

admin@buildmomentum.io by 5:00pm on March 11, 2026

Technical or General Subject Inquiries:

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Documents and presentations for this workshop will be available at:

https://efiling.energy.ca.gov/Lists/DocketLog.aspx?docketnumber=23-ERDD-02