

Cost-Effective Industrial Decarbonization

INITIATIVE DESCRIPTION

Pages 148-152

- Demonstrate and support deployment of emerging industrial decarbonization technologies that reduce criteria air pollutants that disproportionately affect Disadvantaged and Vulnerable Communities.
- Combine electrification, clean flexible generation, thermal storage, advanced processes, and integrated energy management to lower energy needs, shift electricity consumption to cheaper and less congested periods, and maintain production reliability.
- Accelerate innovative approaches, strategies, and business models toward lifecycle cost-parity for difficult-to-decarbonize commercial and industrial buildings and processes.
- Maximize effectiveness by addressing both technology performance and adoption risk.

PROPOSED INITIATIVE BUDGET	\$105M
% OF TOTAL BUDGET (excl. admin & overhead)	14%
# OF RESEARCH TOPIC AREAS	4

ALIGNMENT SUMMARY

STRATEGIC OBJECTIVE ALIGNMENT

Pages 149-150

Accelerate innovative approaches, strategies, and business models to achieve lifecycle cost-parity for difficult-to-decarbonize commercial and industrial buildings and processes, with a specific focus on strategies that lead to the reduction of NOx, PM, and other surface-level pollutants impacting Disadvantaged and Vulnerable Communities

By demonstrating reliable, cost-competitive alternatives to fossil-fuel-based industrial processes while limiting additional strain on the electric grid, the initiative reduces local air pollution affecting Disadvantaged and Vulnerable Communities and supports lifecycle cost-parity, grid reliability, and increased technology adoption beyond EPIC-funded projects.

CPUC ALIGNMENT

Pages 150-151

- The industrial sector's substantial fossil gas use, pollution impacts on DVCs, often costly electrification, and potential electricity demand growth make demonstrations of multi-benefit, cost-effective, grid-supportive decarbonization timely.
- Demonstrations would generate California-specific operational, emissions, cost, and grid-impact data to inform CPUC planning, policy, and program design.
- Ratepayer investment would support broader affordability and reliability benefits through efficient infrastructure use, avoided grid upgrades, reduced renewable curtailment, and lower pollution near DVCs.

Grid-Integrated Industrial Electrification for Affordability and Reliability

INNOVATIVE APPROACHES FOR
DIFFICULT-TO-DECARBONIZE
SECTORS

WHAT PROBLEM ARE WE SOLVING? Pages 155-156

High capital and operating costs slow achievement of lifecycle cost-parity and adoption of cleaner industrial technologies and processes that can reduce pollutants impacting DVCs. Zero emission industrial technologies also face technical challenges and limited performance data which increase deployment risk and scaling. Additionally, careful grid integration will be needed to electrify industry while limiting peak demand and grid infrastructure costs.

COST-EFFECTIVE INDUSTRIAL
DECARBONIZATION

START	2027
OUTPUTS	2030
MARKET READY	2031 – 2032

ALIGNMENT SUMMARY

WHAT IS THE DISTINCT RESEARCH APPROACH?	HOW WILL YOU KNOW YOU ARE SUCCESSFUL?	HOW WILL YOU COORDINATE?
• Advance industrial electrification through technology development, technoeconomic analysis, and pilot support. (pp. 156 – 158) • Validate performance and economics under California-specific conditions to reduce risk and attract private investment. (pp. 155 – 156) • Develop advanced electrification and complementary clean energy strategies where direct electrification may be insufficient. (p. 156) • Integrate flexible loads, thermal storage, demand response, and process scheduling to reduce peak demand and grid costs while maintaining reliability. (pp. 155 – 157)	• Verified performance, reliability, cost, and grid-integration data for technology solutions in difficult-to-decarbonize industrial applications under California conditions. (pp. 156 – 158) • Quantified cost, grid, and criteria-pollutant reduction benefits to disseminate for broader adoption. (pp. 158 – 159) • Reduced industrial emissions and peak demand. (p. 158)	• Coordinate with IOU EPIC and Gas R&D Administrators, CPUC and CEC staff on demand flexibility, resource planning, and long-term gas planning. (p. 158) • Build on thermal storage, heat pumps, and process innovations demonstrated through EPC-23-012, EPC-24-015, EPC-20-001, EPC-18-009, and others. (pp. 157 – 158). • Extend clean generation, storage, load shifting, and energy-management research from GFO-23-315, EPC-24-034, EPC-24-040, EPC-25-027 and others to industrial electric load use-cases. (pp. 157 – 158)

Decarbonizing Construction Materials for Cost-Effective Infrastructure

INNOVATIVE APPROACHES FOR
DIFFICULT-TO-DECARBONIZE
SECTORS

WHAT PROBLEM ARE WE SOLVING? Pages 160-161

Construction materials are responsible for a significant share of GHG and air pollution emissions due to energy intensive and process related emissions. These emissions disproportionately affect DVCs near industrial facilities. Low-carbon material technologies remain immature and have not yet been validated at commercial scale. Limited validation of potential solutions' performance, durability, constructability, and cost prevents lifecycle cost-parity and adoption.

COST-EFFECTIVE INDUSTRIAL
DECARBONIZATION

START	2027
OUTPUTS	2030
MARKET READY	2031 – 2032

ALIGNMENT SUMMARY

WHAT IS THE DISTINCT RESEARCH APPROACH?	HOW WILL YOU KNOW YOU ARE SUCCESSFUL?	HOW WILL YOU COORDINATE?
• Advance development of low-carbon materials through applied research, certification, and higher-TRL demonstrations. (pp. 161 – 162). • Validate performance, durability, constructability, and cost under California-specific conditions. (pp. 161 – 162) • Develop promising chemistries, manufacturing pathways, carbon utilization, recycling, and complementary clean energy systems. (pp. 160 – 162) • Support material qualification, procurement, and broader adoption. (p. 162, p. 165)	• Validated manufacturing and deployment pathways supporting broader production and adoption of low-carbon materials. (pp. 164–165) • Quantified cost, embodied-carbon, GHG, and criteria-pollutant reductions. (p. 164) • Validated cost-effective low-carbon construction materials, cost relative to conventional materials. (p. 164)	• Coordinate with IOU EPIC and Gas RD&D Administrators, and CEC demand flexibility programs to align research, leverage opportunities, and avoid duplication. (pp. 163–164) • Build on industrial process and low-carbon cement research in PIR-20-007, GFO-22-301, EPC-23-015, and EPC-24-020. (pp. 162–163) • Extend carbon utilization and clean-energy research from GFO-23-502, PIR-25-001, GFO-23-315, and other efforts to additional construction materials. (p. 163)

Affordable Clean Chemical Production

INNOVATIVE APPROACHES FOR
DIFFICULT-TO-DECARBONIZE
SECTORS

WHAT PROBLEM ARE WE SOLVING? Pages 166-167

COST-EFFECTIVE INDUSTRIAL
DECARBONIZATION

START	2027
OUTPUTS	2030
MARKET READY	2031 – 2032

Chemical production underpins agriculture, materials, and industrial supply chains, yet it remains heavily dependent on fossil-based feedstocks and energy-intensive processes. They also contribute to criteria air pollutant emissions that disproportionately affect DVCs located near industrial operations. Electrification may be insufficient to meaningfully reduce emissions from this sector. Additionally, growing electricity demand requires grid-integrated approaches that bolster reliability and limit or avoid infrastructure and upgrade costs.

ALIGNMENT SUMMARY

WHAT IS THE DISTINCT RESEARCH APPROACH?	HOW WILL YOU KNOW YOU ARE SUCCESSFUL?	HOW WILL YOU COORDINATE?
• Advance low-carbon chemical production through technology development, technoeconomic analysis, pilot support, and higher-TRL demonstrations. (pp. 166 – 167) • Develop electrochemical processes, advanced separations, carbon utilization, and sustainable feedstocks for high-volume chemicals. (p. 166) • Validate performance, cost, and operational reliability under California conditions. (p. 167) • Demonstrate integration with existing facilities, flexible loads, storage, and on-site generation. (pp. 166 – 167)	• Demonstrated production pathways for chemicals such as fertilizers, industrial gases, and those from waste and sustainable feedstocks. (p. 169) • Validated beneficial integration with industrial facilities and the electric grid. (pp. 168 – 169) • Cost-effective low-carbon chemical production, production cost relative to conventional pathways. (p. 168) • Reduction in criteria air pollutants. (p. 168)	• Coordinate with IOU EPIC and Gas RD&D Administrators, and CEC demand flexibility programs to align research and avoid duplication. (pp. 168 – 169) • Build on industrial efficiency and waste heat research in PIR-17-004, PIR-17-017, PIR-19-005, PIR-20-007, and other efforts. (pp. 167 – 168). • Extend carbon utilization and clean generation research from PIR-24-004, GFO-23-315, and other efforts to decarbonize chemical production. (p. 168)

First-of-a-Kind Deployment for Difficult-to-Decarbonize Industrial Sectors

INNOVATIVE APPROACHES FOR
DIFFICULT-TO-DECARBONIZE
SECTORS

WHAT PROBLEM ARE WE SOLVING?

Pages 170-171

Industry remains difficult to decarbonize due in part to the high cost and lack of commercially available electrification solutions for this sector. While a number of emerging technologies have been technically validated or demonstrated at some scale, widespread commercial deployment is stalled, delaying the delivery of ratepayer and climate benefits these technologies could provide. The challenges faced by these "first-of-a-kind" (FOAK) deployments are due in part to a lack of project development skills on technology innovators' teams, as well as a funding gap – called the “missing middle” – where FOAK project investments are considered too large for venture capital and too risky for traditional finance.

COST-EFFECTIVE INDUSTRIAL
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START	2027
OUTPUTS	2029
MARKET READY	2030 - 2031

ALIGNMENT SUMMARY

WHAT IS THE DISTINCT RESEARCH APPROACH?

- Develop guidance for California industrial decarbonization deployment for technology developers, project developers, and the finance sector. (p. 170)
- Fund the provision of hands-on project development support including design, engineering, site selection, permitting, offtake agreements, and supply chain management to competitively selected firms seeking to deploy emerging industrial decarbonization technologies. (p.170)
- Gather and analyze project performance, cost data, and lessons learned through these deployment efforts to inform CPUC proceedings and other policy efforts. (p.171)

HOW WILL YOU KNOW YOU ARE SUCCESSFUL?

- California-specific FOAK tools, resources, and networks available to technology and project developers. (p. 174)
- Data gathered and lessons learned to support and help inform regulatory proceedings that could facilitate and accelerate industrial decarbonization at scale. (p. 174)
- Accelerated deployment pathways for commercial-scale, grid-supportive industrial decarbonization projects in California. (p. 174)
- Number of FOAK industrial decarbonization deployments, number of rules, regulations, or utility tariffs established to facilitate deployments. (p. 174)

HOW WILL YOU COORDINATE?

- Share operational, cost, emissions, and grid-impact data with other EPIC administrators, technology developers, and Gas R&D programs; directly engage and connect private sector and non-profit organizations in project support and development. (pp. 173 – 174)
- Build on technology demonstrations that are proving technical viability (GFO-22-301, Commercializing Industrial Decarbonization) and manufacturing support that is scaling production (GFO-21-304, Realizing Accelerated Manufacturing Production); adapt lessons learned from early deployments (INDIGO). (p. 173)