Toward Best Practices for Industrial Innovation: Lessons from the Department of Energy's Industrial Demonstrations Program

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About ACEEE

The **American Council for an Energy-Efficient Economy** (ACEEE), a nonprofit research organization, develops policies to reduce energy waste and combat climate change. Its independent analysis advances investments, programs, and behaviors that use energy more effectively and help build an equitable clean energy future.

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Acronyms

- **ARL** = Adoption Readiness Levels
- **CBP** = Community Benefits Plan
- **DOE** = U.S. Department of Energy
- **EOP** = Executive Office of the President
- **FOA** = Funding Opportunity Announcement
- **IDP** = Industrial Demonstrations Program
- **IIJA/BIL** = Infrastructure Investment and Jobs Act, also known as the Bipartisan Infrastructure Law
- **IRA** = Inflation Reduction Act
- **NOFO** = Notice of Funding Opportunity
- **NOI** = Notice of Intent
- **OCED** = Office of Clean Energy Demonstrations
- **OTA =** Other Transaction Authority
- **TRL** = Technology Readiness Levels

Executive summary

From 2022 to 2025, the federal government made a significant investment in industrial innovation. The U.S. Department of Energy's (DOE) Industrial Demonstrations Program (IDP) was a centerpiece of the effort to reduce emissions from energy-intensive industrial subsectors that require high heat or have process-based greenhouse gas emissions while maintaining the competitiveness of American industry. Based on interviews with a dozen senior staff from DOE, the White House, and other technical experts who designed and implemented the program based on Congressional direction, **this paper highlights a central lesson from IDP: Industrial innovation requires alignment across government programs (grants, procurement), financing mechanisms (tax credits, loans), and institutional capacity**. When these three elements are in place and backed by sustained commitment from the public sector, private industry, and external stakeholders, the transition from demonstration to deployment becomes viable.

The lessons from those involved in IDP suggest that future federal industrial innovation programs should seek to maximize flexibility, align government and industry objectives as much as possible, and ensure accountability. This will build confidence with project teams in both industry and government and sustain momentum across not only individual project life cycles but also for future programs. The recommendations in this paper reflect those broader themes, and many of the lessons learned can also apply to regional- and state-level efforts to modernize the industrial sector.

The key findings and opportunities for future programs include the following:

- **Stakeholder engagement, both internal and external to the federal government, generated insights that would have been difficult to obtain through general outreach.** In addition to working with Congressional offices, White House staff, and federal agency partners, IDP staff conducted one-on-one conversations with more than 400 companies, investors, labor organizations, and nongovernmental organizations (NGOs). These led to improved program design that helped attract applicants with limited prior experience working with the federal government. They also informed post-award engagement efforts to maximize project benefits and minimize risk.
- **Applicants needed help navigating the federal landscape.** Industrial innovation projects often relied on multiple federal tools, including demonstration grants, tax credits, loans, and technical assistance. Applicants often lacked a clear understanding of how IDP, the Advanced Energy Project Credit (Section 48C of the Internal Revenue Service code), and other programs best fit their needs. It was the internal stakeholder engagement mentioned above that helped here: Coordination among DOE offices and others including the U.S. Department of the Treasury and U.S. Department of Transportation helped applicants better understand available federal incentives, including grants and tax credits, and helped match projects to available resources.
- **Long timelines created uncertainty.** Time between project selection and execution often extended beyond applicant expectations. For capital-intensive industrial projects operating on commercial timelines, prolonged negotiations affected planning, financing, and investment decisions. Streamlined negotiations and publishing templates for standard agreements could reduce risk for applicants. Additionally, adopting milestone frameworks that (a) more appropriately align with the natural progression of industrial projects and (b) weigh performance against compliance may help speed program execution.

- **The right people and tools should be in place early.** Enhanced DOE technical vetting of projects provided a clear lesson for the future. Combining Technology Readiness Levels (TRLs) and Adoption Readiness Levels (ARLs) allowed the IDP team to evaluate both technical feasibility and deployment risk during project selection. Likewise, up-front access to financial expertise helped the program team more accurately assess commercial viability.
- **The chemicals subsector likely requires a tailored approach.** Chemicals and refining had the highest application volume of any subsector in IDP but did not always score highly in the final portfolio. This was largely due to strict facility operational timelines that did not align with the federal timeline. Other challenges include funding needs and the lack of a clear market for low-carbon chemicals. Recommendations include aligning federal milestones with industrial operations and maintenance schedules and developing demand-side programs to help new products access low-carbon markets domestically and internationally.

Based on an analysis of data from USAspending.gov in summer 2026, around two-thirds of the IDP awards (19 of 29) have been or are expected to be terminated. That is a loss to U.S. industrial innovation and to the communities that would have hosted the projects. Moreover, other nations are continuing to invest in industrial innovation and decarbonization. This work helps preserve what was learned so that it can be applied in the future, ideally alongside lessons from the IDP projects that are still active. When aligned appropriately and supported by the public, these efforts can ensure further progress on industrial innovation. It is important to preserve what was learned and apply it to what comes next, and that is the purpose of this work.

Introduction

Between 2022 and 2025, the U.S. federal government deployed billions of dollars through a modern industrial strategy enabled by the Infrastructure Investment and Jobs Act of 2021 (IIJA), the CHIPS and Science Act of 2022, and the Inflation Reduction Act of 2022 (IRA).[1] Much of this strategy was implemented through the U.S. Department of Energy (DOE) as part of a whole-of-government approach to industrial competitiveness, energy innovation, and decarbonization. The experience of DOE's Industrial Demonstrations Program (IDP) illustrates the opportunities and challenges that come with building a commercial-scale industrial decarbonization program.

Through partnerships with major industrial firms across subsectors, IDP was perhaps the first program to test approaches to advancing first-of-their-kind demonstration technologies with the goal of scaling success. While developed to reduce industrial greenhouse gas (GHG) emissions, many of the program's lessons extend beyond decarbonization and are relevant to future efforts supporting industrial innovation, technology commercialization, and manufacturing modernization.[2] The IDP provides important lessons for future policy and program staff, and the learnings apply to aluminum and metals, cement and concrete, chemicals and refining, glass, iron and steel, food and beverage, and pulp and paper.

As this paper details, the IDP was not a standalone effort. It was accompanied by multiple initiatives that together represented an emerging federal investment strategy for industrial decarbonization, including:

- Complementary investments in domestic manufacturing and workforce development through DOE's Office of Manufacturing and Energy Supply Chains
- Section 48C Advanced Energy Project tax credits for advanced energy projects
- Efforts coordinated by the White House to build demand through programs such as Federal Buy Clean, which leveraged the government's purchasing power to grow the low-carbon buildings sector

Even though the IDP made progress in advancing industrial demonstrations to scale deployment, much of the institutional knowledge across the federal government is now at risk of being lost. In 2025, 19% of DOE employees departed from federal service, and offices focused on industrial programs were particularly affected.[3] Alongside industrial staff, IDP projects were significantly impacted: nearly two-thirds were terminated by DOE—an estimated 62% or close to $3 billion as of June 2026.[4] Of these, cement and chemicals had the largest dollar losses; this included two cement awards (Heidelberg and National Cement) and Eastman Chemical. All three glass manufacturing projects awards were canceled, and iron and steel fared better as four projects are moving forward in terms of federal financial outlays. However, even awards still in place have experienced low outlays.

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[1] The White House, *Building a Clean Energy Economy: A Guidebook to the Inflation Reduction Act's Investments in Clean Energy and Climate Action* (Washington, DC, 2022). https://gfoa-craftcms.files.svdcdn.com/production/prismic/ZBC2TxQAAIrrFBpi_Inflation-Reduction-Act-Guidebook.pdf?dm=1758139269.

[2] The U.S. Department of Energy's Office of Clean Energy Demonstrations developed a set of Project Fact Sheets and Community Benefits Commitments for 29 IDP awardees (alphabetically). See www.aceee.org/idp.

[3] Government Accountability Office, *Federal Workforce: Executive Actions Reshaped Probationary Employment Rules and Reduced Staff Levels at Selected Agencies* (Report GAO-26-108557, 2026), https://www.gao.gov/products/gao-26-108557.

[4] U.S. Department of the Treasury, *Advanced Award Search: Assistance Listing 81.255, Awards DECD0000079 - DECD0000111*, retrieved July 2026 from USAspending.gov.

The reduction in projects and staff departures are, in part, why decarbonization efforts are still needed. To help inform future efforts, this paper synthesizes lessons learned from the design, launch, and execution of the IDP.

Sources and intended audience

This paper provides insights from interviews with over a dozen experts who led or engaged with IDP. These individuals include senior Agency (DOE) and other executive branch staff and technical experts who helped design and implement the program and/or industrial decarbonization efforts. It documents how Congressional intent was translated into program design and highlights lessons from the initial deployment of projects. Despite the relatively modest sample size, which is a clear limitation of this work, the information gathered touches on a wide range of elements, including program design, the application and review processes, project execution, and interagency coordination. Additionally, we interviewed a majority of the team who designed and led IDP, including project managers, senior advisors, fellows, and others with expertise in industrial and manufacturing programs—in short, many of the individuals who operationalized IDP.

In distilling the IDP experience, this paper offers lessons that can benefit policymakers, future DOE leadership, and program staff in designing and implementing programs based on Congressional direction. The recommendations are designed to inform a future private-sector-led, government-enabled effort to decarbonize the industrial sector, meaning federal and state policymakers alongside industry leaders. All can benefit from these learnings when developing the next industrial innovation effort. Finally, this paper contributes to better public understanding of the value and impact of industrial decarbonization.

Learnings from industry-wide activities

Policy context

Industry was responsible for around 20% of U.S. carbon dioxide (CO_2) emissions in 2025.[5] Industrial sector CO_2 emissions rose by 5 million metric tons between 2024 and 2025 and reached approximately 960 million metric tons.[6]

According to the International Energy Agency (IEA), approximately half of industrial emissions reductions may need to come from technologies that are not yet commercially available.[7] Moreover, as facilities are capital-intensive, operate on long investment cycles, and face significant competitive pressures, adoption of lower-emissions technologies is difficult even when the technologies are available.[8] Many

[5] "U.S. Energy-Related Carbon Dioxide Emissions, 2025," U.S. Energy Information Administration, July 21, 2026, https://www.eia.gov/environment/emissions/carbon/. EIA's "industrial sector" encompasses manufacturing and mining, agriculture, and construction, and limits data to energy-related CO_2. This differs from IDP-eligible subsectors, which focus on energy-intensive manufacturing and accounting for process emissions and non-CO_2 greenhouse gases.

[6] U.S. Energy Information Administration, "U.S. Energy-Related Carbon Dioxide," for sector totals and for the 2024–25 change breakdown, see appendix Table A-1 at https://www.eia.gov/environment/emissions/carbon/pdf/emissions_report_appendix.pdf.

[7] International Energy Agency, *Energy Technology Perspectives* 2020 (Paris, 2020), https://www.iea.org/reports/energy-technology-perspectives-2020.

[8] Christopher Russell and Rachel Young, *Understanding Industrial Investment Decision Making Report IE124* (Washington, DC: ACEEE, 2012), https://www.aceee.org/wp-content/uploads/2026/05/ie124.pdf.

decarbonization efforts remain stuck in earlier stages of commercial readiness and face financing, market, and regulatory barriers.[9]

The federal government has a longstanding role in bridging research, development, demonstration, and deployment (RDD&D) gaps. It does this by supporting the full innovation continuum: basic science, applied research, demonstration, commercialization, and, in some cases, procurement. Federal agencies including the National Science Foundation and the Department of Defense have long supported research across this continuum. Efforts comprise industrial decarbonization, advanced manufacturing, grid modernization, and emerging energy technologies; all benefit from collaboration to bridge gaps the market alone cannot overcome. For example, the Environmental Security Technology Certification Program funds projects that validate energy resilience technologies at military installations; it provides the performance data needed to overcome institutional aversion to use of these technologies in mission-ready conditions.[10] Comparable efforts abroad include the European Union's Innovation Fund, which supports complex industrial emissions abatement projects.[11]

As described in DOE's Industrial Decarbonization Roadmap, emission reductions in industry can come from four major decarbonization pillars: energy efficiency; electrification; low-carbon fuels, feedstocks, and energy sources; and carbon capture, utilization, and storage.[12] The Liftoff Reports published by DOE provide industry-specific analyses of technology readiness.[13]

Congressional direction and the role of demonstrations

Industrial programs at DOE were largely driven by sustained congressional direction beginning in the 116th (2019–2021) and 117th (2021–2023) Congresses.[14] Both the need for and scope of federal industrial efforts were defined by the House Select Committee on the Climate Crisis and FY2020 appropriation language that directed DOE to develop an industrial decarbonization roadmap. Those efforts articulated a federal strategy to decarbonize energy-intensive industries centered on expanded RDD&D, large-scale demonstration projects, market creation through procurement, and standards such as Federal Buy Clean, and stronger cross-agency coordination. The Energy Act of 2020 built on earlier groundwork and codified key authorities that informed later large-scale investments under IIJA, the CHIPS and Science Act, and the IRA. Many of the core elements later reflected in DOE programs—particularly the emphasis on demonstrations, market creation, and whole-of-government coordination—closely track these Congressional recommendations. This Congressional vision provided the foundation for IDP and was key to the coordination of federal agencies. That coordination was, in

[9] Edward Rightor, Pavitra Srinivasan, and Neal Elliott, *Reimagining Program Design at DOE to Accelerate Transformative Industrial Technology Deployment at Scale* (Washington, DC: ACEEE, 2022), https://www.aceee.org/resource/reimagining-program-design-doe/.

[10] "About ESTCP," Environmental Security Technology Certification Program, U.S. Department of Defense, accessed August 25, 2026, https://serdp-estcp.mil/about/programs?Id=cf88fbc0-872d-4b9b-9673-d08833e7bb9a.

[11] "Innovation Fund," European Commission, accessed August 25, 2026, https://climate.ec.europa.eu/eu-action/eu-funding-climate-action/innovation-fund_en.

[12] Joe Cresko, *Industrial Decarbonization Roadmap and Context*, presentation at the Industrial Technology Innovation Advisory Committee (ITIAC) Meeting, March 21, Washington, DC, Office of Energy Efficiency & Renewable Energy, U.S. Department of Defense/Department of Energy, https://www.energy.gov/sites/default/files/2024-12/itiac-march-2024-cresko-industrial-decarb-roadmap.pdf.

[13] U.S. Department of Energy, *Pathways to Commercial Liftoff* (Washington, DC, 2023), https://yardsale.energy/liftoff-reports/.

[14] *Infrastructure Investment and Jobs Act*, H.R. 3684, 117th Congress, 2021, www.congress.gov/bill/117th-congress/house-bill/3684/text and *Inflation Reduction Act of 2022*, H.R. 5376, 117th Congress, 2022, https://www.congress.gov/bill/117th-congress/house-bill/5376/text.

turn, critical to the broader orientation of the public sector and private industry, which is a central lesson of the IDP.

Demonstration projects test low-emission technologies and integrated systems under real-world operating conditions; this reduces uncertainty about cost and performance while generating learnings to support broader market adoption. These demonstrations occur at different scales. Programs like the General Services Administration's Green Proving Ground and DOE's Federal Energy Management Program validate cleaner products and technologies within federal facilities and provide technical and operational insights that complement large-scale industrial demonstrations.

Industrial demonstrations deploy technologies in active manufacturing environments where production requirements, process integration needs, and supply chain changes can create technical and operational challenges. Beyond technology validation, demonstration projects can produce broader benefits by supporting near-term employment, strengthening domestic supply chains, developing operational workforce capabilities, and building confidence among investors, customers, and facility operators. In this way, demonstrations serve as a bridge between research and development and commercial deployment and support the diffusion of decarbonization strategies across the economy.

Objectives of the Industrial Demonstrations Program (IDP)

In its final iteration, IDP was housed in DOE's newly established Office of Clean Energy Demonstrations (OCED). It was authorized under two statutory provisions:

Commercial Demonstration Projects (Infrastructure Investment and Jobs Act (IIJA) Section 41008 / Energy Independence and Security Act (EISA) 42 U.S.C. 17113): This was designed to support the development and demonstration of innovative industrial emissions reduction technologies. The program funded demonstration projects that tested and validated emerging technologies in real-world operating conditions and supported pathways toward commercial-scale deployment.

Advanced Facility Deployment (Inflation Reduction Act (IRA) Section 50161 / Energy Independence and Security Act (EISA) 42 U.S.C. 17113b): This was designed to accelerate deployment of advanced industrial technologies by providing financial assistance to eligible facility owners and operators. The program supported the purchase and installation of advanced equipment, facility retrofits, upgrades, operational improvements, and related engineering activities to achieve near-term industrial emissions reductions.[15]

Congressional guidance required a focus on subsectors where technologies could have the greatest impact, including aluminum and metals, cement and concrete, chemicals and refining, glass, food and beverage, iron and steel, and pulp and paper. The statute directed DOE to prioritize projects based on expected GHG reductions and community benefits and set a deadline to obligate by September 30,

[15] "IRA Section 50161: Clean Industrial Facilities," Inflation Reduction Act Tracker, accessed May 10, 2026, https://iratracker.org/programs/ira-section-50161-clean-industrial-facilities/.

2026. In response to Congressional direction and informed by the Executive Office of the President (EOP), DOE translated the statute into four program objectives:[16]

- **Deep decarbonization:** Demonstrate how significantly less carbon-intensive industrial production processes can reduce emissions by 50-75%, including the development of materials that can be labeled as having substantially lower levels of embodied carbon emissions.
- **Timeliness:** Achieve results quickly through rapid technology demonstrations that can address emissions in the near term, meet funding horizons, and be replicated by fast followers.
- **Market viability:** Create viability with technological approaches designed to spur follow-on investments for widespread decarbonization and partnerships between buyers and sellers of the materials produced. Here special consideration was given to industries that can shift entire ecosystems and contribute to new market structures for low-carbon products.
- **Community benefits:** Optimize benefits and reduce risks through substantial engagement with local and regional stakeholders, labor unions, and Tribal Nations across the project life cycle. This supports environmental justice and economic opportunity for local communities.

Stakeholder engagement

The IDP was designed to engage external stakeholders early and meaningfully, including industry trade associations, companies and their executives, investors, nongovernmental organizations (NGOs), and state and local governments. Engagement was also inside the federal government, as it extended to policymakers across Congress, the White House, Executive Branch agencies, and at DOE, legal counsel, procurement staff, and contracting experts. While engagement took time and certain engagements were challenging, the efforts were beneficial. Table A1 in the Appendix provides the broader list of IDP stakeholders, their role, and key impacts.

Outside the federal government

A key lesson from the IDP is that applicants interested in industrial innovation support generally come from an existing project pipeline, and new projects are not frequently created in response to a Funding Opportunity Announcement (FOA). By the time an FOA (now referred to as Notice of Funding Opportunity or NOFO) is released, most viable demonstration projects have already invested years in research, development, pilot testing, permitting, and internal planning. One-on-one engagement helped the IDP team understand the market it was entering, identify projects already in development, and better align program requirements with industry realities.

Box 1. Why one-on-one engagement succeeded

The DOE staff developing IDP conducted structured, one-on-one engagements with more than 400 companies, trade associations, labor organizations, and NGOs. To ensure consistency, the team asked a standardized set of intake questions, including:

- What is your definition of a “demonstration” in terms of scale and cost?

[16] “Industrial Demonstrations Program Mid-Atlantic and Appalachian Regional Community Briefing,” Office of Clean Energy Demonstrations, April 16, 2024, https://www.energy.gov/sites/default/files/2024-04/IDP%20Mid-Atl%20App%20Region%20Community%20Briefing%20FINAL.pdf.

- What are your technology readiness timelines, for both near-term and longer-term deployment?
- What are your internal decision timelines and financing constraints?

These engagements helped ensure companies were more open regarding project economics, internal decision-making dynamics, and financing challenges than in public forums or written submissions. These bilateral engagements with IDP staff helped companies either create a more robust proposal or decide not to apply, thereby saving time and money.

Industry stakeholders

The IDP staff connected with a wide range of decision-makers at industrial firms, including chief executive officers, chief technology officers, chief financial officers, sustainability officers, government affairs staff, plant managers, and other industry technical experts. Rather than treating industrial stakeholders as a monolith, the team conducted extensive outreach across energy-intensive subsectors and learned about specific barriers and opportunities.

This engagement aligned with DOE's broader Industrial Decarbonization Liftoff Report, which drew on stakeholder input and modeling to establish subsector-specific cost benchmarks, supply chain structures, and emissions reduction pathways. The Industrial Decarbonization Liftoff Report synthesized the one-on-one conversations with companies, financial backers, and buyers and served as commercial diligence for the program. For future IDP efforts, a key lesson is that sector-specific analyses such as Liftoff Reports can help both DOE and applicants assess fit before solicitation.

The engagement also helped generate a substantial applicant pool: The IDP concept paper stage drew 411 submissions requesting over $60 billion. This was about 10 times the amount of funding and attracted $100 billion in private capital, with proposals from all 50 states and Puerto Rico. OCED encouraged 130 of those applicants to submit full applications. This was comparable to oversubscription rates for other major DOE initiatives such as the Hydrogen Hubs program, which benefited from a Presidential announcement. Despite a significant number of concept papers, there was a substantial variation in decarbonization readiness across subsectors. In certain industries, particularly chemicals, concept papers likely did not meet one or more of IDP's commercial viability thresholds for technology readiness, financial viability, or market demand.

Lesson: The IDP team's engagement was well received by industry and seems to have helped attract a broad and diverse applicant pool. Future industrial decarbonization programs should invest in early, sustained engagement to understand subsector-specific barriers and match program designs to applicant needs (e.g., one-size-fits-all funding structures may not be as effective at attracting a broad applicant pool).

State and local governments

State engagement was largely driven by the individual states' interests and the geographic scope of industrial activity. There was limited regional or state-specific association engagement. The effort included two areas:

- **State leadership.** Governors' offices, state energy offices, economic development agencies, and state legislators regularly engaged with DOE. These discussions often focused on specific projects, economic development opportunities, and funding coordination. States were particularly valuable in making connections between DOE and prospective applicants; they identified complementary state policies and, in some cases, helped projects identify sources of matching funds. A future program could benefit from more engagement with state associations

to bolster knowledge of complementary state efforts and support advanced manufacturing and workforce development; state funding is also a potential source of federal cost share.

- **Regional and local efforts.** Engagement with trade associations, regional organizations, and local stakeholders helped expand awareness of funding opportunities, and those interviewed cited the need for more connections with local elected officials and community stakeholders. However, given the compressed implementation timeline and the subsequent political transition, IDP relationship-building efforts at the local level did not reach fruition. (OCED similarly sought to engage host communities and identify and address local concerns, but building trust at the local level requires sustained engagement over time and would have required continued efforts and flexibility across leadership and political transitions.)

Lesson: States are often highly effective connectors. Their ability to convene stakeholders, align complementary policies, provide matching funds, and support project development can materially improve project viability and long-term success. When developing local and community engagement efforts, building trust is essential and it takes time to accomplish. The IDP team ran out of time to fully engage communities because projects were abruptly canceled and program staff departed.

Non-governmental organizations (NGOs)

The interviewees consistently indicated that the national nonprofits, think tanks, and industry-aligned associations were key partners. Because of their role in shaping Congressional legislation, they were able to activate their networks to help boost awareness and credibility among potential applicants. Those interviewed noted this as one reason why there was strong demand for IDP funding.

These organizations were also trusted partners once awards were announced. Just prior to the public launch, and after Congress was notified, a small set of NGOs with industrial sector expertise were briefed by DOE and the White House under embargo. From there, they drafted blogs, recorded episodes for podcasts, and activated networks to explain selection decisions. All of this helped amplify the DOE announcement and generated stakeholder excitement around the project selections.

From interviews it was clear that environmental justice (EJ) engagement proved more constructive at the local level than through national organizations, although both added value. Local EJ organizations and community partners had on-the-ground insight that would have benefited projects had more discussions occurred prior to grant applications being submitted.

Lesson: Building EJ engagement into application requirements and timelines—rather than addressing it retroactively after selection—did not occur due in part to a lack of institutional support and coordination across government. Future programs should require applicants to identify local EJ partners as part of project proposals and clarify in the grant application that EJ goals will be disclosed upon award. While this takes time, it has the likelihood of avoiding more significant disruptions later in the project life cycle.

Workforce, labor, and community benefits

Across DOE, Community Benefits Plan (CBP) requirements expanded engagement beyond traditional industrial stakeholders to include labor unions, workforce development organizations, and community-based organizations. Though time-intensive and challenging at the staff level, these discussions helped teams better understand projects.

Lesson: CBPs served as a forcing mechanism for identifying and categorizing workforce, community, and implementation risks across the project development life cycle. Future programs should engage labor and community stakeholders early, especially in projects and places where such efforts were historically

less common, and ensure that staffing, training, and contracting approaches are aligned appropriately during project negotiations and execution.[17]

Investors and developers

Direct outreach to project developers and private investors focused on how federal funding interacts with investment decisions. The IDP team defined and clarified award milestones and cost-share requirements, as both were key to companies in terms of securing final investment decisions (FID) from corporate leadership. Reaching FID typically requires completion of engineering, financing, permitting, commercial agreements, and internal corporate approvals. Investors, in turn, wanted to be sure projects met core business objectives, plans, operational needs, and market opportunities.

Financial and legal experts

Engagement with financial experts helped the IDP team better understand how federal grants interacted with broader project finance considerations and the IRA incentive landscape. Some applicants lacked project finance expertise and that made it difficult to navigate opportunities. To supplement internal agency capabilities, the OCED IDP team convened biweekly discussions with a group of experts with decades of project finance experience. These advisors supported negotiation teams by helping DOE understand project financing risks and the challenges associated with reaching FID. Those interviewed felt having these experts available earlier would have improved applicant interviews and negotiations.

Lesson: Understanding how projects will be financed and executed is as important as technical merit in achieving successful outcomes. Future IDP teams need commercial and project finance experts at the table from the start. Waiting until negotiations start is not sufficient.

Inside the federal government

The IDP team had a range of internal partners, including Congressional offices, White House staff, and federal agency partners. These relationships shaped what the program could do and how quickly it could move to program implementation. The lessons from these relationships are among the most transferable in this paper.

Congress

After Congress drafted and enacted the legislation that established the program's statutory authority, Congressional offices engaged DOE via briefings with offices and experts. These helped DOE clarify legislative intent and gave Congressional champions sufficient visibility into major program choices.

Executive Office of the President (White House)

Because industrial policy touched climate, manufacturing, procurement, competitiveness, trade, supply chain needs, and data collection and recordkeeping, the White House elevated industrial decarbonization as a "whole-of-government" priority and connected DOE staff with expertise across government. At the start of the new administration in 2021, DOE faced significant ambiguity in interpreting its authority and initially operated with relative autonomy from the EOP, as the EOP team was rebuilding and reorganizing across government.

[17] Betony Jones and Joe Peck, *The Receipts: The Untold and Underappreciated Outcomes of Biden's Clean Energy Strategy* (New York: The Roosevelt Institute, 2026), https://rooseveltinstitute.org/publications/the-receipts-the-untold-and-underappreciated-outcomes-of-bidens-clean-energy-strategy/.

By 2022, however, EOP engagement increased, particularly around CBP program requirements. While helpful in terms of adding expertise, those interviewed described a lack of decisive, top-down prioritization. Competing goals across agencies seemed, to those interviewed, unsettled, and the variable EOP input appeared to reflect unclear priorities. At the same time, Congress continued to pressure DOE to move faster on IDP program execution. Here, the lack of alignment between federal agency efforts or limited senior leadership focus on industry may have contributed to the lack of clear and consistent guidance to which IDP staff attributed delays in program implementation timelines.

Lesson: A key lesson is that any significant policy initiative needs clarity with administration leadership. Creating a hierarchy of priorities and a path to settle competing priorities is essential. Because the EOP typically operates with a small number of staff who have broad and dispersed responsibilities, future industrial decarbonization programs should push EOP for both leadership direction and dedicated staffing support. The latter could come through the Council on Environmental Quality and the Office of Science and Technology Policy via agency details and streamlined hiring to support needed prioritization.

Interagency coordination

Like most cooperative agreement-based funding programs at the time, IDP moved through four stages: (1) internal review within the cognizant program office, including General Counsel; (2) inter-office review on cross-program policy matters, including Justice40 (EJ) staff, the Office of Energy Jobs, and relevant policy offices; (3) presentation to a cross-section of program leaders and DOE leadership for feedback; and (4) a White House review involving the National Economic Council, the Climate Policy Office, and Counsel. These stages were often repeated to accommodate multi-stage feedback and/or to resolve major design decisions, and the process was generally viewed as substantive and appropriate.

The IDP team also engaged with other agencies: the Department of Labor on workforce issues, the Department of Defense on procurement, the Department of Commerce on CHIPS-related alignment, and the Department of Transportation's Federal Highway Administration on Buy Clean. The Office of Management and Budget intervened periodically, but there was no centralized EOP-level visibility across the full set of interrelated activities, and that limited coherence across agencies.

Coordination with the Environmental Protection Agency (EPA) was helpful, as 20 EPA staff participated in reviewing IDP concept papers. While this cross-agency technical support worked well, IDP team members felt this was the exception that proved the rule: Interagency coordination requires considerable time and effort.

Lesson: A future administration should define parameters for interagency collaboration and participation requirements such as time commitment and staffing levels. Future program staff should also assess and communicate the value versus the effort involved.

Emissions data leadership

Organizations that steward product-level emissions data were not engaged in IDP, but interviewees stated that, in retrospect, engagement would have been beneficial. These organizations include standards developers, Environmental Product Declaration (EPD) program operators, data aggregators, and others. These groups certify product-level embodied carbon data, establish guidelines through Product Category Rules, and provide the data and credentialing infrastructure that makes Buy Clean procurement, Scope 3 reporting, and emerging carbon programs such as carbon border adjustment requirements function effectively.

Lesson: Future programs should first seek to evaluate the data needs and assess the capacity of federal programs to collect and manage data. EPD program operators and data aggregators are needed as active partners in program design, but collection has likely been negatively impacted by staff departures and other program changes. Engaging these organizations early is essential, because they help shape how emissions are measured, verified, and reported. This can ensure a credible federal decarbonization demonstration program.

Program design

Like many federal programs, IDP relied on a Notice of Intent (NOI) and FOA to solicit applications and execute awards under cooperative agreements authority (2 CFR 200.204).

Box 2. The Funding Opportunity Announcement (FOA) process

The **Notice of Intent (NOI)** signals program intent and builds awareness.

The **FOA** defines eligibility, evaluation criteria, cost-share, and topic areas. Now referred to as a Notice of Funding Opportunity or NOFO, the IDP FOA was designed with three topic areas:

- *Topic Area 1* supported world-leading, first- or early-of-a-kind full-facility builds capable of achieving near-net-zero operations; federal shares ranged from $100 million to $250 million over a time horizon of 8–12 years.
- *Topic Area 2* focused on large, facility-level installations and overhaul retrofits; it provided between $75 million and $500 million for infrastructure upgrades or accelerated new builds.
- *Topic Area 3* targeted specific unit operations or single process lines within existing facilities and offered federal shares between $35 million and $75 million for localized decarbonization upgrades and operational improvements.[18]

In the **concept paper phase**

- Applicants submitted concept papers and DOE conducted reviews of eligibility and compliance.
- External technical reviewers scored and internal teams evaluated and then briefed selection officials.
- Encourage/discourage feedback was provided.

In the **full application phase**

- Full applications were submitted and reviewed for compliance.
- The federal merit panel reviewed, discussed, and scored, and applicants were interviewed as needed.
- Selection officials then made final determinations, and Congress was notified before the awards were announced.

The IDP was one of three federal tools supporting industrial decarbonization, and each addressed a different part of the industrial investment pipeline. In addition to Section 40209, IDP supported large-scale demonstration projects to reduce technical and commercial risk at commercial scale. The **Section 48C Advanced Energy Project Tax Credit**, meanwhile, provided competitive investment tax credits to support deployment of advanced manufacturing, industrial decarbonization retrofits, and critical materials projects to enable broad participation across firms and subsectors. Finally, **enabling activities (supply chain and workforce support, technical assistance, and industrial analysis)** related to DOE's Office of Manufacturing and Energy Supply Chains supported manufacturing capacity, supply chain

[18] U.S. Department of Energy, Office of Clean Energy Demonstrations, *Industrial Demonstrations Program: Funding Opportunity Announcement DE-FOA-0002936* (Washington, DC, 2023), https://www.energy.gov/sites/default/files/2023-03/FINAL_OCED%20IDP%20FOA-webinar%20deck.pdf.

development, workforce development, and analytical inputs that informed project development and scaling without directly funding large capital demonstration projects.

These programs operated alongside a broader set of enabling efforts across DOE and other agencies, including early-stage research, development, and demonstration programs such as the Advanced Research Projects Agency–Energy (ARPA-E), the Industrial Efficiency and Decarbonization Office (IEDO), financing tools like the Loan Programs Office (LPO), and related supply chain and workforce analyses and technical-assistance activities.[19] While this represented the most significant federal commitment to decarbonization in recent years, these programs were largely implemented as parallel instruments rather than as a coordinated strategy. For instance, although IDP and 48C often drew from overlapping applicant pools and had similar timelines, the programs did not integrate into a shared program design. Applicants therefore had limited visibility into how grants, tax credits, financing, and enabling support (e.g., workforce) could function as a coherent investment pathway.

It was also common for debates on tax credits to go to cabinet-level discussions. Often, DOE, Treasury, the Internal Revenue Service, and White House officials would debate what a given design question would mean for various priorities. These were both substantive (e.g., supply chain benefits vs. deployment benefits vs. local benefits) and administrative (e.g., legal risk or administrative burden).

As this paper highlights throughout, demonstration-to-deployment viability depends on alignment across programs, financing, and institutional capacity. A future IDP program has an opportunity for those in charge to address these challenges in the design and rollout of tax credit guidance.

Structural FOA challenges

When designing the FOA, the IDP team sought to address three interconnected structural challenges:

- **Cross-office coordination complexity.** FOA development required extensive coordination across DOE offices to solicit input, and it generated more than 1,100 comments from approximately 60 internal reviewers. Reviewers noted that this feedback varied and responding to such extensive input placed substantial demands on staff and reviewer bandwidth and contributed to multiple review cycles with diminishing returns. Except for 48C, tax credits have no application or selection process; this limits officials' ability to explicitly weigh and evaluate competing goals the way they can during FOA's merit review.
- **Statutory eligibility constraints.** Section 50161 defined eligibility as "owner or operator of an eligible facility," and this effectively required the applicant to own a plant. While intended to ensure accountability, this structure did not fully reflect how industrial projects often involve subsidiaries or joint ventures prior to final project delivery and thus narrowed the effective applicant pool relative to the underlying market.
- **Innovation versus impact.** All federal programs must balance technical and market risk, and the IDP was no exception. The FOA embedded explicit trade-offs that shaped both who applied and what was ultimately selected for financial support. The program's emphasis on technologies "ready now" delivered real value, but some felt this came at a cost to portfolio diversity and long-term decarbonization impact. The IDP sought to address this flexibility through innovation across the FOA "pillars" or emissions reduction options.

[19] DOE has since renamed programs offices: IEDO is now called the Industrial Technologies Office, and the Loan Programs Office is now the Office of Energy Dominance Financing.

Box 3. FOA flexible "pillars" allow innovation

IDP demonstrated that meaningful flexibility is possible within existing statutory and administrative structures. Unlike many DOE funding opportunities that prescribe specific technologies or pathways, IDP was intentionally designed around emissions-reduction outcomes. Its "subsector- and solution-agnostic" approach allowed applicants to combine multiple decarbonization strategies, including efficiency improvements, electrification, fuel switching, feedstock substitution, and carbon management, within a single project.

Interviewees from IDP largely described this flexibility as a strength. Industry stakeholders noted that it better reflected how industrial firms evaluate capital investments and allowed projects to be designed around facility-specific operational and economic realities rather than predefined technology categories. Similarly, the Federation of American Scientists' 2026 report, *DOE 4.0: Rethinking Program Design for a Clean Energy Future*, identified IDP as an example of flexible program design that aligned federal funding with real-world industrial decision-making.[20]

While difficult to quantify, this outcome-oriented approach also appears to have broadened the range of viable applications by accommodating diverse technology combinations and project structures.

Suggestions for a future program

The solutions that emerged regarding FOA design and review range from streamlining contracting language to improving coordination across the federal government. They include

- **Broaden the definition of prime eligibility:** A future program team could advocate for changes in the legislation to allow technology developers to serve as prime applicants. This would help expand the options beyond facility owner/operators.
- **Balance near-term impact and innovation:** While IDP was flexible in how applicants could meet emissions-reduction objectives, the program's focus on commercially relevant demonstrations meant limited participation by earlier-stage technologies that might have greater impact over time.
- **Differentiate funding tracks:** Building on the idea above, consider distinct solicitations for small firms, large incumbents, and emerging technology providers. The IDP team's approach to have a single FOA was one solution, but separate procurements could be explored, especially to help support highly disruptive technologies that may need $100 million per award, according to those interviewed, and are challenged in meeting funding needs to move to scale. These gaps are sometimes referred to as the "missing middle."

[20] Alice Wu, Addy Smith, and Megan Husted, *DOE 4.0: Rethinking Program Design for a Clean Energy Future* (Washington, DC: Federation of American Scientists, 2026), https://fas.org/publication/program-design-for-a-clean-energy-future/; see specifically the section on "Industrial Decarbonization and Efficiency," which identifies the $6 billion IDP as "sector and solution agnostic" and "extremely flexible."

Box 4. Financing the "missing middle"

In April 2026, the Council on Foreign Relations published a report, *Financing the Missing Middle: Mobilizing Investment to Scale Emerging Energy Technologies*. It stated that the lack of investment in the "missing middle" slows or blocks technologies that could help the energy system become more secure, affordable, reliable, and sustainable from advancing through the demonstration and scale-up stages.[21] **This aligns with the IDP experience, which found that mid-stage TRL projects (TRL 6-8) need more funding and policy support, including demand-side mechanisms, to be successful.**

The report recommends establishing a federal commercial "industrial readiness" fund within DOE with authority to invest up to $5 million per project. Such a fund would complement larger DOE demonstration investments by providing seed funding, supporting state and field validation projects, connecting projects to regional innovation ecosystems, and improving access to shared performance and cost data. The report argues that this approach would help bridge the gap between successful pilot projects and commercial-scale deployment.

Program implementation

Once projects were selected, the challenge was in moving them toward award. This stemmed less from project-specific issues than from the institutional environment in which IDP was launched and the subsequent gaps from the transition to a new administration. For a future program, the institutional gaps covered three areas: contracting and procurement delays, workforce expertise, and project finance expertise.

Contracting and procurement

The contracts included standard cooperative agreement termination clauses that allowed for broad cancellation authority and the 2 CFR 200.340(a) "no longer effectuates program goals" language; these were used to cancel awards, regardless of project performance. A future industrial program likely needs to be structured differently to rebuild trust in government commitments. Below are two changes that may be able to be implemented under existing Agency authority:

- **Publish draft commercial contracts**: Help applicants and their counsel to engage on key contractual terms before the selection process, as this will reduce post-award negotiation delays. Often the time between selection and award can take 6–12 months and this is in part due to back-and-forth on final contract language. Addressing terms up-front is thus beneficial for both sides.
- **Use Other Transaction Authority (OTA)** to deploy projects more in line with company needs around timing and budgets. Recent writing expands on this idea.[22]

[21] David M. Hart, *Financing the Missing Middle: Mobilizing Investment to Scale Emerging Energy Technologies* (New York: Council on Foreign Relations, 2026), https://www.cfr.org/reports/financing-the-missing-middle.
[22] Ramsey Fahs, Alan Propp, and Louise White, *Clean Energy Implementation Report* (Washington, DC: Energy Implementation Group, 2025), https://energyimplementation.github.io/implementation-report.pdf.

Box 5. Other Transaction Authority

Where new contractual approaches are feasible, DOE should explore them. For example, several reports have highlighted how Other Transaction Authority (OTA) offers greater flexibility than traditional grants and cooperative agreements. OTA is often used by agencies when the government wants more flexibility, faster timelines, and terms that are easier for commercial firms but still established by the government.[23]

While shifting from a FOA to an OTA may not always be possible or practical, especially for individual contracting structures like sole-source agreements, DOE should explore an OTA model for any future industrial program. There are several thoughtful efforts on OTA that could be used to draft a Secretarial Decision Memo on Day 1 of a new administration or otherwise help ensure that OTA is an option DOE staff are allowed to evaluate alongside traditional procurement.[24]

Workforce expertise, tools and systems

To help ensure that a future program has the staff expertise and resources for an industrial program, a future IDP should **invest in shared systems to manage demand-side programs.** Shared data systems for awardees can (a) support future industry groups in navigating Buy Clean or similar initiatives and (b) avoid current fragmentation of emissions data and life cycle assessments by consistently funding existing tools so the United States can maintain an existing public database that helps domestic industry navigate evolving global carbon trade policies. Adding staff to help support a standardized carbon-intensity reporting system would further benefit U.S. competitiveness.

As described earlier, such coordination on programs like IDP may at times require investment that cuts across programs and agencies. Still, by benefitting programs and bolstering institutional capacity, this investment decision would likely save resources in the long term.

Additionally, explore the use of artificial intelligence (AI). DOE is already exploring the use of AI to reduce staff burden and accelerate environmental reviews. Industrial programs and demonstration efforts can explore its use to support administrative aspects of merit reviews and thus free up time for other workstreams.

[23] Katelyn O'Dell Dean et al., *The Untapped Benefits of DOE's Other Transaction Authority* (Washington, DC: EFI Foundation, 2025), https://efifoundation.org/reports/the-untapped-benefits-of-does-other-transaction-authority/.
[24] "Getting the Bureaucracy Out of Its Own Way," *Keith Boyea* (Substack), April 16, 2026, https://boyea18.substack.com/p/getting-the-bureaucracy-out-of-its.

Box 6. AI-driven NEPA modernization

DOE is deploying the PermitAI system to transition the National Environmental Policy Act (NEPA) process from manual document review to a data-driven ecosystem. The initiative focuses on three pillars:

- Search and synthesis: Using AI to extract precedents and technical insights from decades of prior environmental reviews.
- Public engagement: Automating the sentiment analysis of thousands of public comments to significantly reduce the time required to understand and explore how to address community concerns.
- Drafting efficiency: Synthesizing field data into regulatory prose and pilot programs thus far show a 15% reduction in total drafting time.

Per DOE Policy 203.1, each of these and other AI tools require a "Human-in-the-Loop" review, meaning that a designated NEPA Accountable Official is required to ensure the legal and technical integrity of the findings for the administrative record.

Project finance, cost share, and investment readiness

Technical merit alone is insufficient for successful project deployment and the IDP experience demonstrated how to align finance to benefit commercial readiness. Key lessons include

- **A higher industry cost share does not equate to a stronger project**. A high industry cost share demonstrates commitment but can also expose the project to greater dependence on uncertain future capital and future corporate decision-making. Several interviewees noted that some projects with high industry cost shares faced greater challenges reaching FID than projects requesting larger federal participation.
- **Engage financial experts early.** To supplement internal capabilities, the IDP team convened project finance experts who helped negotiation teams evaluate financing assumptions, capital structures, and commercial risks. However, interviewees felt that embedding this expertise earlier in the review process would have strengthened project evaluation and negotiations.
- **Timing is key for bankability.** Projects must secure financing after selection and before construction. Understanding financing requirements and potential barriers earlier can improve DOE's assessment of project viability and execution risk. Demonstration projects should be evaluated not only on technical performance but also on whether they can attract future investment and serve as replicable models for broader deployment.

Strengthen project funding

Industrial demonstration projects often require 5–10 years to progress from selection to operation. As a result, project success depends not only on technology and financing, but also on the ability to sustain momentum across changing political, market, and institutional conditions.

Project funding and execution

- **Use milestone-based funding.** Align federal funding with the natural progression of industrial projects—in other words, engineering, permitting, procurement, construction, commissioning, and then operations. Phased funding tied to these milestones can reduce project risk, improve accountability, and help projects maintain momentum across multi-year investment timelines.

For large demonstration projects, milestone-based structures used by OCED may need adjustments to focus on outcomes rather than being time bound.

- **Accelerate execution where projects benefit.** IDP used accelerated negotiation tracks ("sprint negotiations") for specific projects identified through up-front readiness assessment. The lesson is that acceleration is feasible but depends on applicant readiness; a future program could provide fast-track project progressions if project teams are in place.
- **Ensure project financing is well vetted.** As noted earlier, having DOE staff with finance and investment-banking experience can help project teams assess financial viability and pathways to bankability, which are core to replicability. Future programs should also explore ways to better align federal award structures with commercial investment timelines and decision-making processes.

Market durability

Use Buy Clean to create demand. A critical challenge for industrial decarbonization is demand for low-carbon goods. Demonstration grants can help commercialize technologies, but long-term deployment depends on customers being willing to purchase these goods. Administration experts emphasized the importance of performance-based procurement specifications that reward lower-carbon materials while providing on-ramps for producers in legacy industrial regions as they decarbonize. Key tools include EPDs, federal procurement standards, and flow-down requirements that ensure Buy Clean signals reach state and local projects receiving federal funding. Programs such as the General Services Administration's Green Proving Ground demonstrate how public procurement can help create early markets for emerging industrial technologies and materials.

Invest in emissions data measures. Buy Clean policies depend on credible, comparable emissions data. Future industrial policy should treat carbon measurement and reporting infrastructure as a strategic investment rather than a compliance requirement. Beyond supporting procurement, emissions data can strengthen the durability of industrial policy itself. Verified product-level emissions data create stakeholders far beyond industrial sector recipients, including state procurement officials, corporate sustainability teams, investors, architects, engineers, and Scope 3 reporting organizations. These stakeholders help sustain demand for transparent carbon accounting after individual grant programs end and they also benefit future programs.

The EU's Carbon Border Adjustment Mechanism (CBAM), Construction Products Regulation, and other requirements and frameworks are all establishing a global carbon measurement architecture for industry. Future industrial demonstration programs could align with international carbon accounting standards (e.g., ISO 14067, 14025, and 21930), incorporate product rules for development for priority industrial subsectors, particularly chemicals and other hard-to-abate industries, and expand EPD capacity via verified product-level emissions data and investing in transparent missions-data repositories.

Consider place-based approaches. Future programs targeting strategically aligned states such as Colorado and California and regions such as Appalachia or the industrial Midwest, or that focus on hard-to-abate subsectors such as chemicals, may build more durable political constituencies by clustering economic benefits, strengthening regional supply chains, and increasing support from local stakeholders. It also makes strategic and financial sense to site projects in existing regions with grid capacity and a trained workforce.

Use Advanced Industrial Zones. Future place-based funding could also incorporate leading ideas for industrial development such as Advanced Industrial Zones (AIZs) or similar integrated ecosystems. AIZs align the right ingredients for industrial development to accelerate project timelines, drive economic development, and create high-quality jobs in the clean industries of the future. By treating industrial clusters as unified platforms rather than a collection of discrete projects, DOE can align federal investment with the physical and procedural realities of industrial development.

Build capacity for community benefits. Several interviewees suggested that the challenges associated with CBP implementation reflected the learning curve of a new program and likely would have diminished in future funding rounds as both DOE and industry gained experience. A recent report provides detailed lessons and data on CBPs and labor that may be useful for future industrial demonstration programs.[25]

Box 7. Community benefits and place-based innovation: Baytown, TX

Though the IDP's statutory goal of supporting high-emitting incumbents yields the greatest environmental benefit for overburdened communities, it was not always aligned with all stakeholder needs. The ExxonMobil project in Baytown, Texas illustrates this. Despite proactive engagement and a projected 200 ton/year nitrogen oxides (NO_x) reduction alongside GHG reductions, national EJ stakeholders were opposed and advocated for facility closure, which was outside DOE's authority.

Future programs should seek to anticipate and resolve these differences in strategic priorities at the design stage rather than leaving them to emerge during review. Guidance should treat transparency as a project deliverable; for example, using project funds for local air quality monitors provides a tangible way to provide transparent, site-specific data needed to address community concerns. However, these monitors may not be approved as an allowable cost under federal requirements (2 CFR 200), and such information should be made more transparent to applicants, awardees, and stakeholders.

Highlight local success. Public-facing events in communities tied to milestones can increase visibility and community support. Future industrial programs could align more closely with nontraditional stakeholders and downstream market actors such as housing developers using low-carbon cement; this could be particularly impactful for emerging technologies such as cement and advanced nuclear reactors. Broader stakeholder engagement can expand political support and strengthen market demand.

Institutional durability and capacity

IDP required capabilities that extend beyond traditional financial assistance, award management, and project oversight. DOE staff, NGOs, universities, and others highlighted the importance of retaining technical, commercial, financial, and institutional expertise across agencies and administrations. The experience of IDP suggests that future success will depend not just on funding and management, but also on building and preserving the institutional capacity needed to design, implement, and sustain complex industrial investments.

The IDP experience demonstrates that industrial decarbonization requires institutional capacity alongside financial resources. Many implementation challenges stemmed not from technology risk, but

[25] Jones and Peck, *The Receipts: The Untold and Underappreciated Outcomes of Biden's Clean Energy Strategy*.

from the need to simultaneously build staffing, expertise, governance structures, and interagency coordination mechanisms while executing a first-of-a-kind federal program.

Staff and expertise. IDP required expertise well beyond traditional grant administration, including industrial operations, project finance, commercialization, workforce development, community engagement, and technology adoption. The program also benefited from outside expertise. During negotiations, OCED engaged a small group of experienced project finance advisors to support some of the most complex projects. While it took time to identify and engage with these experts, interviewees consistently described their input as invaluable. Future programs should ensure access to specialized commercial and financial expertise early in program implementation.

Agency, interagency, and White House capacity. Implementation required coordination across DOE offices, Treasury, and White House policy staff. These reviews generally improved program design and alignment across federal programs, but they also required substantial staff time and repeated review cycles. A broader lesson is that large industrial investment programs require coordination capacity that often exceeds existing staffing levels. Several interviewees noted that EOP offices are bandwidth constrained. Accelerating future industrial decarbonization efforts will likely require dedicated staff capacity both within DOE and across the White House policy apparatus.

Knowledge retention and learning. Future programs should build on lessons learned from IDP rather than recreating new processes from scratch. Additionally, relevant international examples include the Department of Defense's Environmental Security Technology Certification Program and the European Union's Innovation Fund, both of which support demonstration and commercialization of industrial decarbonization technologies. Interviewees also highlighted the value of documenting and sharing lessons learned. Resources such as OCED's First-of-a-Kind case studies help future applicants, policymakers, and program managers better understand demonstration project risks and commercialization pathways.[26]

IDP's experience shows that when staff are engaged early, when coordination is advanced to meet the scale of the programs, and when agencies use institutional knowledge and capacity broadly, durable industrial decarbonization policy is achievable.

Four key recommendations for future industrial programs

Based on insights from many involved in IDP, the following recommendations emerged. The table below is a high-level summary across key areas including program development, design, and execution.

[26] U.S. Department of Energy, Office of Clean Energy Demonstrations, *Learning from Case Studies: Financing and Development Approaches from Recent First-of-a-Kind Projects* (Washington, DC, 2024), https://www.energy.gov/sites/default/files/2024-11/FOAK%20Financing%20and%20Development%20Approaches_112024_vf.pdf.

Table 1. Key themes and recommendations from the interviews

	Theme	Challenge	Recommendations
1	Stakeholder engagement	Stakeholder engagement required time and effort, and applicants struggled to navigate multiple federal tools (grants, tax credits, loans, and technical assistance).	Use early-stage engagement during program design and solicitation development to prioritize subsectors with limited prior federal participation and formalize interagency coordination to match projects to federal programs and resources.
2	Timelines in project awards	Time between project selection and execution did not meet applicant needs, and this affected planning and financing cycles for capital-intensive projects.	Streamline negotiations, publish standard agreement templates in advance, and adopt milestone-based funding tied to engineering, construction, and commissioning gates that align with industrial project timelines.
3	People and tools in place early	Programs need to evaluate both technical feasibility and deployment/commercial risk; teams lacked support to assess viability accurately.	Make use of Agency expertise, including evaluation frameworks; ensure up-front access to financial and commercial expertise; and pair DOE technical vetting with additional support where needed.
4	Chemicals require specific attention	Chemicals had high application rates but did not always score into the final portfolio, due to facility operational timelines misaligned with federal timelines and no viable low-carbon market.	Align federal milestones with industrial operations and maintenance schedules; develop demand-side programs or advance existing demand-side programs to help new products access low-carbon markets, both domestic and international.

Learnings from the chemicals subsector

For simplicity, this section refers to the chemicals and refining applications of the IDP collectively as "chemicals." Due to their complexity and carbon intensity—chemicals are embedded in our economy and largely fossil-fuel based—the subsector was one of the harder areas to serve under the IDP funding. Below are details on how a future program could support modernization and decarbonization.

Background

The U.S. chemicals subsector is dominated in production volume and emissions by just a handful of chemicals—primarily ammonia, ethylene, methanol, propylene, and aromatics (benzene, toluene, and xylene). The petrochemicals subsector alone now accounts for nearly 5% of U.S. GHG emissions.[27] However, its complexity rapidly increases as one moves downstream. Ethylene gas is the feedstock for polyethylene, which gets turned into thousands of plastic products across the economy; this diversity of end uses makes it challenging to track and credit emissions as the products move from the factory to the consumer to disposal.

[27] Rhodium Group, *Preliminary US Greenhouse Gas Emissions Estimates for 2025* (New York: Rhodium Group, 2026), https://rhg.com/research/us-greenhouse-gas-emissions-2025/.

The chemicals industry converts raw materials into over 70,000 different products, and any changes in feedstocks and upstream chemicals trigger a complicating effect down the value chain. A recent study found that the production life cycle emits at least 306 million metric tons of CO_2e nationwide.[28]

Decarbonizing the chemicals subsector requires addressing both process energy (e.g., electrifying steam crackers) and carbon feedstocks (e.g., shifting from hydrocarbons to bio-based or captured CO_2). Despite the challenges and complexity involved, the IDP portfolio made efforts to engage the subsector, and these did not go unnoticed by industry. The subsector produced the highest submission volume of any in both the concept and full application phases, and projects spanned fuel switching, onsite thermal energy, and biofuels. Still, chemicals did not always score highly in the final portfolio.

Unique attributes

Highly diverse facilities

There were notable gaps in terms of FOA applicants in both inorganics such as sulfuric acid, chlorine, and ammonia used in making paper, detergent, disinfectants, and fertilizers, and bio-based products and chemicals. Future programs would benefit from exploring approaches that address such unique needs in terms of technical and commercial readiness.

Uptime expectations and aligning retrofits with turnaround times

Chemical plants often operate at low margins. Because downtime is costly, scheduled maintenance outages are planned years in advance, and any changes result in significant negative financial consequences. Demonstration project timelines must therefore align with scheduled maintenance and retooling times (often called turnaround times). Additionally, missing a corporate capital planning window can mean a two-to-three-year delay until the next opportunity arises. Any future industrial program that ignores these windows will be challenging to execute, regardless of the size of the financial award.

Geographic concentration and community benefits

Reflective of where the industry operates, IDP applications were heavily concentrated in Gulf Coast corridors (Louisiana, Texas), and there were secondary clusters in Appalachia (Kentucky, Tennessee), and the industrial Midwest. Program staff described operating histories in chemical corridors as often fraught. Accumulated community concerns from emissions and safety incidents created skepticism, and projects therefore needed to receive a community's endorsement, known as the social license to operate.

Economics and investment behavior

Scale mismatch with available funding

Major chemical facility investments often require billions of dollars in capital expenditure. While IRA Section 50161 required a minimum 50% industry cost share, the larger challenge for some projects was the program's $500 million federal award limit. For multi-billion-dollar chemical facilities, even such a

[28] "Chemicals Value Chain Decarbonization: Integrated Solutions for a Complex Challenge," U.S. Department of Energy, Industrial Technologies Office, March 21, 2024, https://www.energy.gov/cmei/ito/articles/chemicals-value-chain-decarbonization-integrated-solutions-complex-challenge.

large maximum award was often too small to substantially alter project economics or investment decisions. Conversely, projects with industry contributions that were more aligned with core operations and existing investment plans requested smaller amounts, which is an important lesson for any future IDP program.

Competitive sensitivity

Intellectual property is a foundation of competitive advantage in the chemical industry, and that reality shaped how firms engaged with IDP. Process economics, yield data, and margin information are closely held. Protecting proprietary data while meeting federal transparency and validation requirements was a recurring friction point, and some firms hired consultants specifically to manage submissions without exposing internal data directly. A future program should address this through clearer protection provisions for intellectual property and tiered disclosure requirements calibrated to competitive sensitivity.

Measurement and market structure

While facility-level emission reductions can be measured directly, attributing those reductions to individual chemical products is often difficult. Chemical facilities frequently produce multiple products and co-products from integrated processes, and those products move through complex downstream value chains. These factors should be considered in future programs, and care should be taken to account for how product-level carbon accounting and market differentiation are more challenging for this subsector.

Lack of Buy Clean market integration

Market demand remains less developed for low-carbon chemicals. Unlike steel, cement, glass, and aluminum, where federal, state, or local procurement has the potential to create demand signals, many chemical products are rarely purchased directly by government agencies. As a result, traditional Buy Clean approaches have more limited applicability.

Future industrial policy should instead focus on strengthening demand signals where they naturally occur. Potential approaches include supporting product-level carbon accounting, leveraging corporate Scope 3 reporting requirements, or expanding recycled-content through state or international policies. More broadly, future programs should identify market mechanisms capable of rewarding lower-carbon production and incorporate those demand signals into program design at the start.

Stakeholder engagement with producers

The IDP program provided an opportunity for strong alignment between government and industry around energy security and regulatory risk management. Non-petroleum options help insulate chemical producers from global oil and gas markets and the economy from international energy shocks. The IDP also offered a pathway for technology and operations innovation that could support a first-mover advantage, such as onsite thermal storage, hydrogen, and electrification.

However, future programs should focus on investment-ready intent and seek to avoid organizations that may be hedging to avoid regulation or are simply not ready for viable demonstrations. This can be addressed in part by prioritizing “FID-readiness” in the Federal Merit Review Program interviews. Teams should ask questions about outage schedules, integration plans, commissioning timelines, and contingencies. One interviewee suggested that the most useful questions to ask upfront are, “What would it take to get this to FID?” and “What evidence do you need that you do not have?’

IDP projects and outcomes

Seven projects were selected by the IDP for award negotiations in chemicals and refining. They spanned a range of decarbonization pathways from hydrogen fuel switching to chemical recycling to CO_2 utilization (48C tax credit projects also had a smaller share of chemical facilities, with an estimated 12% of tax credits going to chemicals).[29] However, several project types were not selected. For example, ammonia and nitrogen fertilizers appeared in H2Hubs as offtake partners but not as IDP primary projects, and although there were a large number of applications for biobased chemicals, few of them were ultimately selected. Inorganic chemicals, which are chlor-alkali, phosphates, sulfuric acid, and chlorine, and specialty chemical products such as sustainable aviation fuels, polyolefins, and major resins were also not represented in the final portfolio.

Future programs should map program requirements and evaluation criteria against the target subsector landscape to better understand potential tradeoffs and unintended consequences. The four interrelated factors below help explain the lack of final chemical projects in the IDP portfolio. They relate both to the attributes of the projects themselves and to how the FOA evaluation criteria challenged the chemical subsector:

- **Technical readiness exceeded financial viability.** Applications often failed not because the technology was immature, but because they were not investment ready. The emphasis on near-term emission reductions and pathways to FID favored projects with stronger financing and deployment plans and placed earlier-stage concepts at a disadvantage.
- **Facility and operational complexity did not support replicability.** Chemical facilities are difficult environments in which to develop replicable demonstrations. Changes to one production line often cascade across an entire facility, and this makes standardized or "plug-and-play" solutions rare. Because replicability was an evaluation criterion, chemical applications may have been disadvantaged.
- **Evaluation criteria favored scale.** The FOA placed significant weight on total GHG emissions reductions. While consistent with statutory objectives, this approach inherently favored large commodity production facilities. Because individual specialty chemicals represent only a small share of subsector-wide emissions, it was difficult for projects to compete on emissions reductions.
- **Market and stakeholder engagement were lacking.** Markets for low-carbon chemicals remain less developed than those for materials such as steel, cement, glass, and aluminum. Unlike these subsectors, chemicals generally lack a market premium for lower-carbon products and that makes replication challenging.

It is important to note that ammonia and inorganic chemicals are already investment-ready decarbonization solutions as they are high-volume, standardized commodities. For example, while innovation is needed in producing "green" ammonia from hydrogen, the need may be to develop a decentralized production program to support various markets such as California and the Midwest. These industries are likely seeking funding for near-term commercialization and may not fit clearly in a future IDP program.

[29] "U.S. Department of the Treasury and IRS Announce $6 Billion in Tax Credit Allocations for the Second Round of the § 48C Qualifying Advanced Energy Project Tax Credit," January 10, 2025, https://home.treasury.gov/news/press-releases/jy2779.

Program design ideas

Consider eligibility and teaming

Several solutions exist to address challenges around project and teams. IDP Topic Areas 1 and 2 (see Box 2, above) were required by Congressional direction to have the owner/operator of a facility as the prime applicant. This impacted teaming structures and limited collaboration opportunities. Solutions for future programs are twofold. First, allowing technology developers to partner with operators would better reflect how chemical projects are typically developed and financed. Second, including flexibility for alternative processes and technologies, such as extending the first budget period (pre-construction), would help emerging chemicals better compete with incumbents. More broadly, grants may not be the right tool for all chemical-scale projects. For large facilities where the federal share is a fraction of total capital, loan financing may be a more appropriate tool and could also reduce compliance burden.

Distinguish biobased pathways from fossil-based pathways

Perhaps because the biofuels industry is a well-connected, collaborative network, biobased applications generated the highest volume in chemicals. Unfortunately, the applications consistently failed in multiple areas—early-stage TRL, weak market pull (e.g., no offtake agreements), and inability to compete on decarbonization metrics. Regarding metrics, it would take dozens of biorefineries to have the same emissions reduction potential as one ethylene plant.

A future industrial program should therefore either create a dedicated evaluation track with criteria matched to biobased development realities or publish explicit pre-application guidance on what a meritorious biobased application requires. It would also help if a future IDP program was well-aligned with the U.S. Department of Agriculture's efforts to advance biofuels and biobased products, which are Congressionally mandated.

Seven recommendations for the chemicals subsector

The following recommendations complement the cross-subsector lessons documented elsewhere in this paper.

	Recommendation	Actions required
1	Explore financial mechanisms	Grants may not be the appropriate tool for all projects. For large facilities where the federal share is a fraction of total capital needed, discuss loan or other financing options that could help reduce compliance risk.
2	Build FID-readiness into merit criteria	Financial viability failures were the primary cause of chemical project attrition in merit review. Explicit FID-readiness assessment would focus evaluation on investment-readiness rather than projected emissions-reduction potential.
3	Align program milestones with turnaround schedules	"Start of construction" milestones that ignore planned outage windows will fail in chemicals regardless of award size. Require applicants to identify their next turnaround window at the application stage and build federal milestone schedules around it.
4	Create a biobased track or publish explicit eligibility guidance	Either create a dedicated evaluation track for bio-based projects (e.g., biofuels) or publish explicit pre-application guidance on what a meritorious application requires.

5	Address the Buy Clean gap in parallel	Buy Clean mechanisms exist for steel, cement, glass, and aluminum, but not chemicals. Procurement standards and certification frameworks for low-carbon chemicals and supply-side funding are likely both needed due to the nascent market.
6	Resolve the innovation goal early	Prior to developing funding, determine if the program prioritizes deep reductions at existing facilities or supports new projects, and be clear on the choice in the evaluation criteria.
7	Define community benefits and EJ criteria before applications close	Clear, subsector-appropriate benchmarks are needed to improve applicant quality, reduce negotiation friction, and ensure that projects reflect genuine community benefit analysis.

Conclusion

The challenges IDP encountered reflected the institutional realities of launching a program on an unprecedented scale and timeline. It is clear from those interviewed that future government decarbonization programs will benefit from transparency on program priorities. Industrial decarbonization is not solely a technology innovation challenge: It is a coordination challenge that requires alignment among industry, finance, procurement, workforce development, and government institutions, and timelines are measured in decades rather than public-funding cycles.

Even though future government programs will have different people and goals, and operate under different constraints, those involved will face familiar obstacles. They will need to build industry trust, navigate interagency coordination, deploy capital quickly, and sustain support across investment cycles. New programs that understand how IDP handled those challenges will be better positioned to succeed.

The interviews showed that the chemicals subsector needs particular attention. Its complexity, capital intensity, and limited market demand for low-carbon products made it arguably the hardest subsector for IDP to decarbonize, and those conditions are not likely to change soon. A future program will likely need to address chemicals differently, perhaps through a dedicated effort rather than fitting it under a broader funding vehicle.

Finally, it is important to acknowledge that nearly two-thirds of the IDP awards had been canceled as of July 2026, according to analysis of data from USASpending.gov. This is a loss to industrial innovation and to the communities that would have hosted these projects. It is also a loss to the federal workers, including those interviewed for this paper, who spent countless hours to help bolster U.S. competitiveness. We offer this work to help preserve what was learned and apply it to what comes next.

Appendix

Table A1 summarizes stakeholders with which DOE worked to support specific outcomes. This is provided as a starting point for future industrial programs.

Table A1. IDP stakeholders and engagement outcomes

Stakeholder	Role	Outcomes
External parties to inform programs		
Industry	Main applicants and project sponsors	1:1 outreach raised awareness of operational and investment needs; improved proposal quality
Trade associations	Provide sector-wide input around industry and subsector priorities	Helped compare common barriers across subsectors
Developers	Help determine financial viability	Feedback helped show which projects were commercially viable via industry days
NGOs, EJ and environmental groups	Support design and public understanding; EJ engagement	Helped shape statute and explain award decisions via public-facing materials; EJ NGOs engaged DOE staff on projects located in disadvantaged communities
State and local governments	Influence permitting and project operating conditions	Engagement was mostly project-specific, not central to program design; some association and state-specific engagement
Communities	Affect local acceptance and accountability (social license to operate)	Engagement was challenging at times as it takes time to build connections and trust especially in historically marginalized communities
Labor	Support project construction and operations in labor-friendly communities	Workforce engagement was strategic but at times limited to projects or locations more accepting of organized labor
Standards and data	Stewards of product-level emissions data	Support alignment with broader markets
Internal to federal government		
White House	Help inform and review program funding documents and align to administration policies / strategies	Briefings conducted as requested, ramped up over time
Executive agencies	Develop and provide input to program and review funding documents and procurement / demand drivers	Briefings and application reviews and support for merit reviews
Congress	Originate funding/program design/legal framework	Provide program guidance and ongoing oversight as program is rolled out via staff briefings (members, appropriators)
Legal, and contracting and financial experts (DOE internal)	Help DOE address compliance and avoid fraud, waste, and abuse	Essential to contract FOA development and contract negotiations; contracting expertise at DOE OCED benefited to IDP