



2024 Federal Policy Blueprint



**Industrial
Innovation
Initiative**

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Participants

The development of the listed policy recommendations by the Industrial Innovation Initiative (I³) was facilitated by the Great Plains Institute and World Resources Institute, with input and involvement from the following participating entities:

American Council for an Energy Efficient Economy	Leilac
ArcelorMittal	Laborers' International Union of North America
Bipartisan Policy Center	Minnesota Power
Breakthrough Energy	National Wildlife Federation
Clean Air Task Force	Nuclear Innovation Alliance
Entergy	Oxy Low Carbon Ventures
Growth Energy	Portland Cement Association
Holcim, US	Syzygy Plasmonics, Inc
International Brotherhood of Boilermakers	Third Way
LanzaTech	United Association

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About I³

The Industrial Innovation Initiative (I³) is an ambitious coalition that aims to advance solutions key to decarbonizing the industrial sector through policy development and implementation, technology demonstration and adoption, and demand-side market development. The Initiative builds on years of stakeholder engagement and extensive work by its co-conveners, [Great Plains Institute](#) and [World Resources Institute](#), to collaborate with government officials and advance decarbonization solutions important to the industrial sector.

I³ values a stable climate, a safe and healthy environment, thriving livelihoods for American workers, and a strong US economy. I³ participants have developed the following Policy Blueprint to recommend to Congress and Federal Agencies a suite of policies that will put American industry on a path to net-zero emissions, retain and create high-wage jobs, and advance technology leadership and economic competitiveness. The Initiative convenes key industry, environmental, labor, and other stakeholders, to advance cross-cutting strategies, policies, and programs for achieving industrial decarbonization by midcentury.

For more information, please visit www.industrialinnovationinitiative.org.

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Introduction

Preface

The Industrial Innovation Initiative (I³) convenes key industry, environmental, labor, and other stakeholders and state officials to advance strategies, policies, and programs for achieving industrial decarbonization by midcentury. I³ focuses on key industrial sectors of Midwestern and Gulf Coast states that make up the Midcontinent region, home to the greatest concentration of industrial production in the United States. I³'s ability to bring together diverse interests has made it a leader in the effort to promote industrial decarbonization and economic competitiveness.

I³ participants have developed this blueprint to recommend to Congress and the administration a suite of policies, regulations, and standards to help put American industry on a path to net-zero emissions, high-wage job retention and creation, technology leadership, and economic competitiveness. This document builds on Decarbonizing Industry by 2050: A Federal and State Policy Blueprint, which I³ released in November 2021.¹ The 2024 Federal Policy Blueprint reflects I³ participants' shared priorities and will be a foundation for I³'s policy advocacy.

The landscape of industrial decarbonization policy has improved significantly since I³ released its first blueprint. The federal government has committed to providing hundreds of billions of dollars in tax credits and investments through the 2021 Bipartisan Infrastructure Law (BIL) and the 2022 Inflation Reduction Act (IRA) to accelerate decarbonization across the American economy. (See Tables 1 and 2 for a breakdown of BIL and IRA funding related to industrial decarbonization.) These investments and policy innovations provide critical support and tools for decarbonizing American industry. The 2024 Federal Policy Blueprint seeks to build on this momentum and bridge remaining policy gaps to accelerate the pace of industrial decarbonization.

The Industrial Sector and Decarbonization

Industry undergirds the country's economy, producing the chemicals, steel, cement, paper, and other essential goods that people and businesses use. The industrial sector is also a critical source of jobs in many small and medium-sized communities. At the same time, to reach national and global climate goals of net zero by midcentury, industrial emissions must decrease significantly in the near and medium term.

The International Energy Agency recently modeled that global industrial emissions would need to decrease by 60 percent between 2022 and 2040 to meet economywide midcentury decarbonization goals.² Looking at the United States, the federal government's long-term strategy for achieving net zero emissions projects that investments in key decarbonization technologies can reduce industrial emissions by 69-95 percent by 2050.³

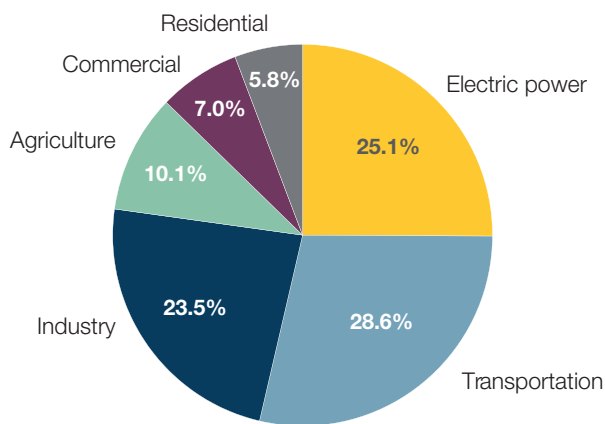
There are several reasons why decarbonizing industry is a daunting task. Some industrial facilities are designed to last decades, making it difficult to incorporate new technologies. Many facilities operate twenty-four hours a day, every day of the year, without interruption. This can create obstacles to drawing on intermittent energy sources. Finally, emissions are an inevitable byproduct of chemical reactions essential to manufacturing specific industrial products. These are only some of the barriers to curbing industrial emissions.

In terms of industry's emissions profile, decarbonization can be challenging because of the variety and complexity of processes and emissions sources across industries. Industry generates both direct and indirect emissions. Direct emissions result from the on-site combustion of fuels and process emissions from chemical reactions required to produce various industrial goods. In 2021, American industry emitted 1,487 million metric tons of carbon dioxide (CO₂) equivalent, approximately 24 percent of total US emissions, as seen in figure 1.⁴ The sector also consumes large amounts of electricity generated off-site, indirectly contributing to emissions from the power sector. Factoring in off-site electricity consumption increases industry's share to 30 percent of total emissions.

The US has already taken steps to reduce the carbon intensity of its manufacturing base. For example, more than 70 percent of American steel is manufactured using electric arc furnaces, significantly reducing emissions from this sector.⁵

There is a unique opportunity for US industry to become a global leader in technology innovation and adoption and for stakeholders to engage in the policy process to ensure that the transition to net zero is equitable and does not endanger the competitiveness of US industries and the communities they support.

Figure 1. Percent of 2021 US emissions by economic sector



Source: US Environmental Protection Agency, Inventory of US Greenhouse Gas Emissions and Sinks, 2023.

Note: Commercial and residential refer to emissions from heat and refrigeration in buildings, plus other emissions.

This is especially important in the industrial sector, where many products are energy-intensive and trade-exposed, making them vulnerable to offshoring in non-regulated jurisdictions unless policies are established to maintain domestic employment and sustainable growth.

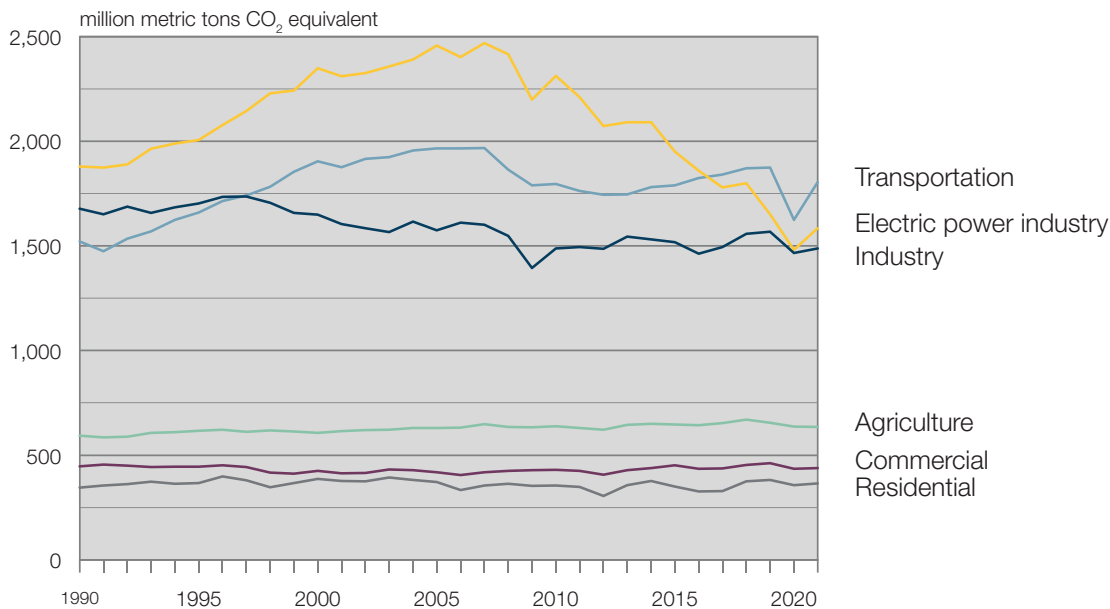
Recent Developments

Decarbonizing industry by midcentury is ambitious but possible—and will be necessary to meet the US target of net zero greenhouse gas emissions by 2050.⁶ According to the Environmental Protection Agency (EPA), industrial emissions have decreased by more than 21 percent over the past three decades.⁷ However, in the past few years, industrial emissions have remained relatively stable, as seen in figure 2. Recent developments within several key decarbonization options can help accelerate industrial decarbonization.

INDUSTRIAL ELECTRIFICATION

The transformation of the electric grid will play an essential role in reducing industrial emissions. Low- and zero-carbon sources represent an increasing share of electricity generation. In the first nine months of 2023, renewable sources generated approximately 21 percent of the electricity produced in the US. This is more than double the share generated by renewable sources in 2010.⁸ Industrial users generally rely on fossil fuels to generate the heat required in their processes. Switching to electricity generated from zero- and low-carbon energy sources—most feasible for low- and medium-temperature heat applications

Figure 2. Historical greenhouse gas emissions in the United States from 1990-2021



Source: US EPA, Inventory of US Greenhouse Gas Emissions and Sinks, 2023.

Note: The industry line shows industrial emissions, excluding industrial electricity use. Emissions and removals from land use, land use change, and forestry are excluded.

in the near term—is a critical avenue for reducing industrial emissions.

As the share of electricity generated from low-carbon sources, such as renewable, advanced nuclear energy, and other sources increases, electrifying industrial processes offers the potential to deliver meaningful emission reductions. Adding transmission capacity and demand response systems to ensure that industry has access to a consistent supply of low-carbon electricity will be critical to electrifying industrial processes.

Thermal storage innovations will also enhance industrial electrification efforts. Industrial users can charge thermal batteries with electricity generated by renewable sources when demand is low and then discharge this energy as heat or electricity when needed. Thermal storage is able to generate high-grade heat, which could mitigate high-heat emissions as the technology grows. In some parts of the country, utility operators must curtail the delivery of electricity generated from renewable sources to avoid overloading the grid. Thermal storage provides an opportunity to use this excess renewable electricity not only to avoid wasting it but also to reduce industrial emissions.

An industrial plant's ability to substitute electricity for coal or natural gas depends on a variety of factors, including the nature of its equipment, relative fuel costs, the temperature and pressure of heat required for its processes, and the availability of low- and zero-carbon electricity. In some regions, industry has access to reliable supplies of low- and zero-carbon electricity. In other regions, switching to electricity will not result in significant short-term emissions reductions because fossil fuels still generate most electricity.

Technology-neutral tax credits in the IRA intended to boost zero-carbon electricity production will enhance industrial electrification efforts. These include the Clean Electricity Production Tax Credit (45Y) and the Clean Hydrogen Production Tax Credit (45V). If the US rapidly increases carbon-free electricity generation, some segments of American industry will be able to significantly reduce their emissions by electrifying aspects of their operations.

CLEAN HYDROGEN

Electrification may not always be a viable option for some industrial subsectors, especially those that rely on high-heat processes. Low-carbon production of steel, chemicals, and cement will require a range of

decarbonization options, and hydrogen is one such flexible option. Hydrogen is already used in American industry, primarily to refine petroleum and produce fertilizer.

Hydrogen's newer, low-carbon uses for industry include reducing iron ore into steel and replacing fossil fuels as a feedstock for chemicals and fuels. Additionally, hydrogen can be combusted as a zero- or low-carbon option to generate the high temperatures (>400°C) required to produce iron and steel, cement, chemicals, and glass.

Almost all the hydrogen used in the US today is produced by steam methane reforming, a process that relies on natural gas fuel as a feedstock.⁹ However, several potential low-carbon production techniques exist, including steam methane reforming with carbon capture and electrolysis. Electrolysis, which uses electricity to split water (H₂O) into hydrogen and oxygen, can be a less emissions-intensive process, particularly if powered by zero- or low-carbon electricity. Today, electrolysis accounts for only a sliver of American hydrogen production, but its growth is considered vital for building clean hydrogen markets.

Developing a robust market for hydrogen is essential to decarbonizing the industrial sector. A critical first step will be to incentivize the production of low-carbon hydrogen—or “clean” hydrogen—which remains costly compared with the incumbent carbon-intensive hydrogen derived via steam methane reforming.

The federal government has signaled its commitment to supporting domestic clean hydrogen production. The 45V production tax credit in the IRA was designed to increase production of clean hydrogen by providing significant tax incentives to hydrogen produced from low- and zero-carbon sources. In October 2023, the Department of Energy (DOE) selected seven hydrogen hubs funded through the BIL, which will further stimulate clean hydrogen production in various regions. In December 2023, the Treasury Department released preliminary guidance related to the 45V tax credits.

In addition, demand-side policies that incentivize the targeting of clean hydrogen to its highest value end uses—including in the industrial sector—will be necessary to bolster the decarbonization of hard-to-electrify applications and minimize harmful competition between clean hydrogen and more efficient solutions, like direct electrification, where available.

CARBON MANAGEMENT

Carbon dioxide emissions are a byproduct of some critical industrial processes. For example, in cement production, the calcination of limestone to create cement generates CO₂ emissions (known as “process emissions”) that must be abated—in addition to emissions from the combustion of fossil fuels to produce the heat that drives this reaction. This process and its emissions are inherent to producing industry-standard cement today, leaving capture and storage of that CO₂ as an important solution to reduce the emissions from cement production.

Carbon management, which includes capturing emissions at the source (known as carbon capture with utilization or storage, or CCUS), may prove a key option for mitigating process emissions, particularly if

scaled in the short to medium term while other low-carbon technologies emerge. Enhancements to the 45Q tax credit in the IRA support deploying carbon management technologies in the industrial sector through the provision of a tax credit of \$85/tCO₂ for geologically stored CO₂ (and \$60/tCO₂ for beneficial use of CO₂).¹⁰ Provisions in the BIL provide billions in funding for demonstrating and deploying projects focused on capture, transport, and storage of CO₂.

BIL & IRA: Industrial Decarbonization Provisions

A number of provisions in both the BIL of 2021 and the IRA of 2022 are directed toward industrial decarbonization, mainly at the demonstration and deployment stages (see tables 1 and 2).

Table 1. Bipartisan Infrastructure Law investments supporting industrial decarbonization

Bipartisan Infrastructure Law investments	Total funding over five years (million \$)	Section in BIL
Regional Clean Hydrogen Hubs	\$8,000	section 40314
Carbon Capture Demonstration Projects Program	\$2,500	section 41004
Clean Hydrogen Electrolysis Program	\$1,000	section 816
Carbon Capture Large-Scale Pilots	\$937	section 40521
Industrial Research and Assessment Centers	\$550	section 40315
Clean Hydrogen Manufacturing and Recycling Program	\$500	section 41008
Industrial Emissions Demonstration Projects	\$500	section 41008
Front-end Engineering and Design Studies for CCS	\$100	section 40303
Smart Manufacturing Leadership	\$50	section 40534
Total funding for industrial decarbonization	\$14,137	

Source: Infrastructure, Investment and Jobs Act (referred to above as BIL), Public Law 117-58, Nov. 15, 2021, <https://www.congress.gov/117/plaws/publ58/PLAW-117-publ58.pdf>.

Table 2. Inflation Reduction Act investment supporting industrial decarbonization

Tax credits	
Enhancements to 48C tax credit (section 13501)	<ul style="list-style-type: none"> • Direct pay • \$10 billion in additional allocations, of which 40 percent must be spent in communities whose economies were formerly supported by fossil energy • Expanded scope to include industrial applications and installation of equipment that reduces emissions by 20 percent or more
Enhancements to 45Q tax credit (section 13104)	<ul style="list-style-type: none"> • Direct pay • Enhanced credit values (\$60-85 tons of CO₂ for industrial facilities, provided prevailing wage requirements are met) • Lower capture thresholds (12,500 tons of CO₂ per year for industrial facilities)
45V Clean hydrogen production tax credit (section 13204)	<ul style="list-style-type: none"> • Direct pay credit for hydrogen produced with a carbon intensity less than 4 kilograms of CO₂ equivalent (kg CO₂e) per 1kg hydrogen; base credit level up to \$0.60/ kg hydrogen based on carbon intensity. If prevailing wage requirements are met, the credit can be multiplied by 5 for up to \$3/kg hydrogen.
Funding	
\$5.5 billion for Low-Embodied Carbon Materials Investments	<p>Funding to support government procurement of low-embodied carbon materials:</p> <ul style="list-style-type: none"> • \$2 billion to the Federal Highway Administration for incentives or reimbursements for low-embodied emissions construction materials (section 60506) • \$2.15 billion to the Federal Buildings Fund for the use of low-carbon materials by the General Services Administration (section 60503) • \$975 million to the Federal Building Fund for emerging and sustainable technologies (section 60504) • \$250 million to the Environmental Protection Agency for development and standardization of environmental product declarations (section 60112) • \$100 million to the Environmental Protection Agency for low-embodied carbon construction material labeling (section 60116)
\$5.8 billion for the Advanced Industrial Facilities Deployment Program	<p>Financing through the Department of Energy’s Office of Clean Energy Demonstrations for industrial decarbonization retrofits and other upgrades that can reduce emissions at energy-intensive industrial facilities (section 50161)</p>

Source: Inflation Reduction Act of 2022, Public Law 117-69, Aug. 16, 2022, <https://www.congress.gov/bill/117th-congress/house-bill/5376/text>.

I³ Priorities

The recent landmark investments in the BIL and IRA are helping create the supportive policy landscape that the industrial sector needs to reach national climate goals by midcentury. Nearly all recommendations in I³'s 2021 policy blueprint were addressed through the BIL and IRA and, in some cases, through other actions outside those two laws (see appendix 1).

While this blueprint does not specifically address the implementation of current federal policies, I³ has worked to ensure that these policies are thoughtfully carried out. Decision makers must also build on the momentum from the BIL and IRA to ensure the long-term success of current policies and to enhance the competitiveness of the country's manufacturing sector. Congress and the executive branch must focus on effectively implementing all funding and incentives in these laws. The federal government must go even further to ensure we have the policies in place to reach midcentury decarbonization goals.

I³ has identified the following four key areas where policy makers need to focus even greater attention to accelerate industrial decarbonization:

- Supportive infrastructure for carbon management and hydrogen
- Industrial energy demand
- Standards and data for embodied carbon
- Market innovations

This blueprint offers a set of recommendations within each of these policy domains. Additional federal resources will be required to rapidly decarbonize American industry. However, many of this report's recommendations will not require substantial federal outlays. Moreover, they have the potential to create durable markets in new technologies that can stimulate the American economy, resulting in substantial job growth.

We must act now to seize the momentum and adopt new policies to advance industrial decarbonization. I³'s members look forward to working with Congress and the administration to promote the recommendations contained in the 2024 I³ Federal Policy Blueprint.



I³ Blueprint Recommendations

Supportive Infrastructure for Carbon Management and Hydrogen

The Bipartisan Infrastructure Law (BIL) and Inflation Reduction Act (IRA) have both provided significant incentives supporting the scale-up of carbon capture and hydrogen production. These incentives will catalyze investments in these technologies and spur their deployment, helping to reduce industrial emissions. Rapid deployment must also be responsible deployment.

While implementation of these policies is ongoing, this blueprint seeks to identify additional policy gaps that must be bridged to scale up these solutions responsibly to the degree necessary for meeting midcentury climate goals. Enhancing policies that support transportation and storage infrastructure, as well as improving regulatory oversight of these processes, are initial areas that have been identified as priorities for the next phase of policy recommendations.

OVERARCHING PRINCIPLES:

- **Efficiency:** Improve coordination between entities with different jurisdictions to mitigate delays and ease permitting without jeopardizing project or stewardship quality.
- **Stakeholder engagement:** Ensure robust engagement with potentially affected stakeholders, including local communities, before, during, and after the project.
- **Consideration of community and environmental impacts:** Minimize potential adverse impacts in siting decisions, ensure strong risk mitigation measures, and prepare for post-incident remediation actions.
- **Transparency:** Develop projects with transparent and open dialogue with host communities.

RECOMMENDED ACTIONS:

At a glance:

- Identify or establish a federal authority to improve national planning around the siting of CO₂ and hydrogen pipelines.
- Provide technical and capacity-building support to states with or seeking Class VI primacy through the Environmental Protection Agency's Underground Injection Control Program.
- Develop and expand a skilled labor force equipped to construct and maintain carbon management and hydrogen projects.
- Prioritize community and environmental safety and health by requiring transparency and information sharing with communities, increased pipeline inspection capacity, and access to and training for emergency response.

Identify or establish a federal authority to improve national planning around the siting of CO₂ and hydrogen pipelines.

States have the primary siting authority for CO₂ pipelines, while the federal government, through the Pipeline and Hazardous Materials Safety Administration (PHMSA), sets safety requirements and monitors compliance. To facilitate more centralized and coordinated planning, the federal government's role in interstate pipeline planning should be more clearly defined by Congress. Creating parity in federal siting authorities for similar types of linear energy infrastructure could help reduce negotiation delays and facilitate planning decisions in a consistency-minded venue while adopting and adhering to consistently high standards to reduce impacts on the environment and people.

The federal government can improve coordination and planning first and foremost by proposing and periodically updating a national CO₂ infrastructure network to guide project proposals. This could

connect emission sources to geologic storage sites via transport routes. Additionally, identifying or establishing a federal option for siting CO₂ pipelines would enable similar planning and permitting as other interstate infrastructure like natural gas pipelines

Developing CO₂ pipelines through piecemeal permitting processes between states rather than a uniform, federally coordinated option might not yield the most efficient or responsible national-scale network of carbon management infrastructure. A federal option, such as backstop authority, could improve communication and management between federal agencies involved in overseeing pipelines and their development. Pipelines currently well-served by the current state-by-state regulatory authority should be allowed to continue that process, with a federal option available for future projects.

Similarly, hydrogen pipelines lack federal authority and thus hold a similar rationale around the need for coordination and efficiency. Given hydrogen's properties and unique transport needs, options for regulation could include creating an entirely new regulatory system to account for its distinct needs and uses or regulating it with proper distinctions under the existing Natural Gas Act or Interstate Commerce Act (both existing acts place rate setting and siting jurisdiction under the Federal Energy Regulatory Commission with different siting requirements and implications). Although hydrogen pipelines have been used for decades, with the Department of Transportation (which houses PHMSA) overseeing safety since 1970, the expected growth in production and expanded end uses will necessitate an increase in oversight capacity and planning.

Provide technical and capacity-building support to states with or seeking Class VI primacy through the Environmental Protection Agency's Underground Injection Control Program.

The BIL provided \$50 million in grant funding for states that were granted or are seeking primacy to develop and implement Class VI well injection programs, along with \$25 million to the EPA to advance permitting. Class VI wells are used to inject carbon dioxide into deep rock formations. Although states that have been granted primacy have been determined to meet, at minimum, federal standards for Class VI well injections, additional federal funding should be made available to ensure that states can maintain and expand their capacity. Federal funding can support state capacity to implement their Class VI programs or have the option of federal consultation to address any knowledge or

experience gaps that might arise as interest in carbon management grows.

Develop and expand a skilled labor force equipped to construct and maintain carbon management and hydrogen projects.

Expanding federal investment in apprenticeship opportunities to grow a pool of skilled workers in carbon management and hydrogen industries should support pipeline construction, carbon management, and hydrogen sectors, aligning with industry-specific skills. Project developers can leverage existing registered apprenticeship programs to develop workforce training opportunities tailored to specific local and regional projects. Adopting project labor agreements can also maintain high-quality labor standards, regardless of the project's location or scale. Additionally, it can ensure that labor standards, such as prevailing wages and apprenticeship utilization, are upheld in clean energy projects.

Prioritize community and environmental safety and health by requiring transparency and information sharing with communities, increased pipeline inspection capacity, and access to and training for emergency response.

CO₂ and hydrogen pipelines and sites for geologic storage of captured CO₂ should be sited, constructed, and maintained efficiently while prioritizing transparency and avoiding harm to surrounding people and ecosystems. Project developers should provide communities near potential carbon management and hydrogen projects with information on expected environmental and social impacts as early as possible and engage with community members to understand their perspectives on the project. Particular attention should be paid to communities with industrial histories and high cumulative pollution burdens. Project developers should endeavor to learn this history to understand the basis for community perspectives.

While CO₂ pipelines have strong operational safety records, PHMSA's oversight authority occurs after pipelines are sited and constructed. I³ supports revising CO₂ pipeline rules to ensure they are built and operated to a high standard that mitigates risks to host communities. I³ will respond to PHMSA's anticipated release of new CO₂ pipeline regulations in 2024 to ensure they provide meaningful safeguards to host communities.

Hydrogen is the smallest and lightest molecule and can escape through valves or cracks more easily than other energy carriers and gaseous

molecules. Therefore, the federal government should allocate funding for more pipeline safety inspectors proportional to pipeline mileage, particularly in rural areas where mileage per inspector might be larger and more difficult to access. As an emerging and growing field, hydrogen infrastructure has not received investment at scales similar to other interstate infrastructure networks.

While federal agencies continue to invest in new and improved technology that can detect and prevent trace volumes of hydrogen, safety requirements should reflect the highest known standards for developing projects. This would allow the hydrogen market to scale up and reduce risks from hydrogen leaks, such as flammability and indirect global warming effects—the latter of which risks offsetting the climate benefits of using clean hydrogen.

Finally, PHMSA should have sufficient resources to enforce current pre- and post-incident safety measures for all pipelines in the likelihood that infrastructure will grow substantially in the coming decades. Today, some of these required pre-incident measures include, but are not limited to, sensors to detect leaks and automatic shut-off valves following detection. Further research into and use of odorizing agents in CO₂ pipelines to identify escaped plumes can further reduce impacts from potential leaks. Post-incident measures should require operators and municipalities to train local authorities on emergency response measures in case of an incident, such as a leak or rupture. While operators are currently required to coordinate and cooperate with communities, expanding those requirements to response training can mitigate potential damage or harm from an incident.



Industrial Energy Demand

Recommendations that support access to affordable, clean electricity for industrial electrification will build upon I³'s previous work in the space by going beyond the fence line and looking at industrial needs across the energy system. Industries that rely on low- and medium-temperature heat are anticipated to electrify, increasing the demand for low-carbon electricity. Accelerating construction of the transmission and distribution system will be required to deliver clean electricity to industrial facilities. Additionally, process heat is another important emissions source to consider when decarbonizing this sector.

A range of approaches exist or are in development, from industrial electrification to clean hydrogen use to more nascent approaches still in early development. Bridging policy gaps that will make low-carbon process heat accessible to our highest-emitting industries is critical to meeting midcentury climate goals.

OVERARCHING PRINCIPLES:

- **Clean, reliable, and affordable electricity:** Develop plans and policies that provide a clear pathway for transitioning to cleaner and more affordable electricity generation while ensuring a reliable energy supply.
- **Energy efficiency:** Prioritize near-term energy efficiency improvements that can decrease energy use in parallel with longer-term decarbonization pathways for electrification and process heating.
- **Grid planning:** Invest in the infrastructure needed to generate and deliver 24/7 clean firm electricity to industrial end users and meet anticipated demand from electrification.

RECOMMENDED ACTIONS:

At a glance:

Industrial Electrification:

- Support grid balancing with dispatchable load.
- Enhance affordability with robust planning.
- Develop industrial rates for subsectors that are fully electrified to pilot affordable power purchase agreements as the rest of the industrial sector electrifies.

Process Heat:

- Support research, development, and deployment (RD&D) for innovative technologies and alternative fuels for industrial heat applications.
- Provide deployment incentives for decarbonizing process heat.

Industrial Electrification:

Support grid balancing with dispatchable load.

Electrifying industry will require supportive measures such as grid balancing with dispatchable load and load curtailment. This will help maintain a clean, affordable, and reliable grid, which is particularly crucial for industrial subsectors requiring consistent 24/7 energy demand. This can be achieved in several ways, such as providing analogous access for thermal energy storage to wholesale energy markets as traditional electric battery storage. Potential grid strain could also be reduced by incentivizing on-site or captive energy generation at industrial facilities to address waste heat and ensuring excess industrial energy can be competitively dispatched to the grid. Additionally, load curtailment programs that incentivize some facilities to reduce their electricity demand at peak periods can make less costly and cleaner power available for 24/7 consumers. Independent system operator/regional transmission organization market rules and regulated utility rates should be created to accurately reflect the systemic value of load shifting and dispatchable load.

Enhance affordability with robust planning.

Grid planning is a long-term investment across decades, so thoughtful and robust planning of the

transmission and distribution systems is crucial to ensure prudent investments. The increased load from industrial electrification efforts could be considerable and should be incorporated into the planning process to enhance affordability. Thoughtful planning will allow operators to take full advantage of market design and maximize federal investments in electrotechnologies. Increased cooperation and communication between utilities and industrial end users will be central to achieving this. This will provide end users more opportunities to offer input on utility plans and the potential increased load from their electrification efforts.

Develop industrial rates for subsectors that are fully electrified to pilot affordable power purchase agreements as the rest of the industrial sector electrifies.

Developing specialized electricity rates for industrial customers can create a supportive environment for industrial electrification, as seen in the aluminum sector—a fully electrified sector that requires 24/7 energy. Industrial electricity rates can vary significantly based on factors such as the volume of electricity used, time-of-day energy consumed, and the specific requirements of the industrial processes. Developing tailored rates ensures that industrial customers have access to cost-effective electricity pricing structures that align with their electrification goals. Power purchase agreements can allow industrial customers to purchase electricity from sources at agreed-upon prices. Agreements can be structured to create a supportive environment for industrial electrification by offering competitive, low-cost electricity rates to drive more durable adoption.

Process Heat:

Support research, development, and deployment (RD&D) for innovative technologies and alternative fuels for industrial heat applications.

Recent federal funding through the BIL and IRA has increased support for ways to produce clean industrial energy and heat. However, some approaches and technologies will require additional RD&D, particularly for industrial heat applications. This includes technologies such as, but not limited to, thermal heat batteries, renewable heat, industrial heat pumps, hydrogen, and other low-carbon fuels and carriers. Incentives to support the scalability of these innovative process heat solutions will be necessary to lower the economic hurdles for their deployment and, in turn, to meet climate goals.

Provide deployment incentives for decarbonizing process heat.

While recent federal investments provided demand-side incentives for low-carbon products, additional support is still needed to deploy technologies that can provide less carbon-intensive industrial heat, such as carbon capture retrofits, clean hydrogen, advanced nuclear, and solar thermal. These incentives could take a variety of forms, such as, but not limited to, contracts for differences, direct procurement, guaranteed offtake agreements, and tax credits to accelerate commercial-ready technologies. It is essential that these incentives complement and fill the gaps in existing federal programs, such as the funding available from the Office of Clean Energy Demonstrations' Industrial Demonstration Program.



Standards and Data for Embodied Carbon

The demand for low-embodied carbon products, such as low-carbon cement and steel, is growing. Policies and initiatives supporting green procurement for construction materials are rapidly gaining momentum in the US and overseas.

For green procurement and related policies to be successful and lead to significant emissions reductions, robust data measurement, reporting and verification, and greenhouse gas (GHG) benchmarking standards must be foundational. The way low-embodied carbon products are evaluated for their carbon intensity must be consistent and harmonized with domestic and international frameworks to ensure these products are accurately assessed and qualified for use.

Harmonized standards with consistent and interoperable methodologies are critical to ensuring that policies and initiatives are complementary. Notably, “harmonized” does not mean identical, but rather that initiatives’ standards use the same basic definitions, data frameworks, and methodologies. Lack of harmonization could risk sending contradictory signals to the market, resulting in an uneven playing field and undercutting decarbonization efforts.

OVERARCHING PRINCIPLES:

- **Robust data methodologies:** Adopt standards for green procurement that are rigorous in accounting for the scope of GHG emissions, i.e., the boundary of emissions accounting (e.g., Scope 1, 2, 3), type of GHG emissions (e.g., only CO₂ or other GHGs as well), and source of GHG emission (e.g., biogenic or non-biogenic) consistently and coherently.
- **Standardized reporting:** Align measurement methodologies, data collection, and reporting standards through harmonized product category rules (PCRs) and common methodologies for Type III environmental product declarations (EPDs) and product lifecycle assessment (LCAs) for embodied carbon in construction materials.
- **Data transparency:** Advocate for transparent data and preferably open-source background datasets that increase the reliability, credibility, and comparability of EPDs and product LCAs.
- **Consistent benchmarking:** Promote consistent definitions for terms such as “low emission,” “near-zero emission,” and “net-zero emission” to avoid confusion and misalignment in GHG emissions benchmarking standards and targets.

RECOMMENDED ACTIONS:

At a glance:

- Work toward standardized reporting frameworks.
- Harmonize domestic and international standards for reporting and benchmarking.
- Build capacity to provide technical support and incentives to manufacturers on standards.
- Support development of EPA’s EPD assistance program.
- Support development of EPA’s carbon labeling program.

Work toward standardized reporting frameworks.

Adopt data reporting methodologies across US product valuations, particularly harmonized PCRs, open-source LCA tools, and standardized Type III EPDs and product LCAs. Harmonized standards and tools are also vital for non-construction materials such as hydrogen and electricity. Encourage product-specific, facility-specific, project-specific, and supply chain-specific (such as cement in concrete EPDs) data reporting over industry averages. Promote EPDs to cover cradle-to-grave stages of product lifecycles. Ensure data are reported in a standard digital format, preferably in open-source repositories.

Harmonize domestic and international standards for reporting and benchmarking.

Promote the harmonization between local, state,

national, and international reporting standards, benchmarks, and trade frameworks in the US for interoperability across borders and international cooperation. Make targets flexible by setting ranges and categories for GHG emissions intensity benchmarks instead of absolute values. Update North American Product and Industry Classification Systems (NACPS and NAICS) to include the latest low-carbon construction materials ready for consumer use.

Build capacity to provide technical support and incentives to manufacturers on standards.

Encourage government agencies to build up in-house capacity, improve interagency coordination, and liaise with external partners to provide technical assistance to manufacturers for complying with standards. Ramp up funding for the interagency LCA commons and encourage staff engagement in the development of PCR guidelines. Provide targeted training on standards, education, and access to background datasets for manufacturers in regions with low availability of data and/or high industrial activity. Support the uptake of EPDs and product LCAs in both government and private sector contracts, particularly through accreditation programs for reliable verification. Make funding and reimbursements readily accessible to incentivize manufacturers to accurately report data with EPDs.

Support development of EPA's EPD assistance program.

Advocate for the EPD assistance program being developed by EPA to provide technical assistance, including access to open-source databases for background datasets; access to PCR requirements, open-source LCA tools, EPD templates; access to a list of available technical experts for LCAs and EPDs; and training to allow manufacturers to understand PCR requirement and EPD methodologies and report data accurately.¹¹ Encourage EPA to set aside a separate portion of the \$250 million appropriated under the IRA EPDs assistance program for small and medium-sized enterprises to develop EPDs.

Support development of EPA's carbon labeling program.

Encourage EPA to develop a robust carbon labeling program for construction materials in line with independent system operator standards using its \$100 million IRA funding for a carbon labeling program. Develop embodied carbon labels that are user-friendly and transparent and play the role of translating EPDs into simple information that purchasers can interface with easily.



Market Innovation

There are many opportunities to decarbonize the industrial sector that make innovative use of low-carbon resources, technology, and industrial processes. Approaches to transform the sector, including those mentioned in this blueprint, would benefit from greater support. Historically, industrial decarbonization has not received a level of federal investment commensurate with its portion of domestic emissions compared to other emitting sectors, such as electric power.

The federal government is committing new levels of funding to industrial decarbonization technologies and strategies through the BIL and clean energy tax credits in the IRA, with most of this funding directed at supporting demonstration and commercial-scale solutions. However, additional and consistent support for research, development, demonstration, and deployment (RDD&D) and support for existing markets or tax credits are needed to enable rapid scale-up of cost-competitive, low-emissions technologies for the industrial sector.

The needs are as varied as the solutions, and enabling a supportive and competitive marketplace throughout all stages of innovation will be critical. The following recommendations build off previous sections by addressing policies that support transforming the market across the spectrum of technology readiness. These recommendations expand beyond what has been mentioned in the blueprint and broadly include industrial decarbonization approaches and emerging technologies.

RECOMMENDED ACTIONS:

At a glance:

Research and development:

- Drive market innovation with the potential for transformational, not marginal, change through R&D funding, incentives, and competition and prizes.

Demonstration:

- Continue funding for innovative solutions with a higher technology readiness level to enable scaling from first-of-a-kind demonstrations to 2nd-, 3rd-, and Nth-of-a-kind project deployment.

Deployment:

- Advance demand-side market incentives for low-carbon products.
- Accelerate testing and validation for low-carbon products for use in construction and infrastructure projects at the federal and state levels.

Research and Development:

Drive market innovation with the potential for transformational, not marginal, change through R&D funding, incentives, and competition and prizes.

Priority technologies that may achieve transformational change through R&D funding and incentives could include innovative applications of processes that have seen change more recently and solutions that could be applied across multiple industrial sectors.

One set of priority technologies for competitions and challenges are those with the potential to transform processes or products that have been more stagnant to technological advancement. For example, in the building sector, rooftop unit air conditioners had slow improvements in energy efficiency over many years until DOE's 2011 rooftop unit challenge. Within two years of its launch, two manufacturers created rooftop units that were 25–30 percent more efficient than the best products on the market.¹²

Similarly, the Industrial Efficiency and Decarbonization Office (IEDO) can develop competitions and prizes with ambitious performance criteria that require a transformational change to achieve emissions reductions. The prizes could consist of commitments from purchasers (particularly the private sector) for products that meet the criteria, a financial award and recognition, or connect prize winners to opportunities for demonstration projects and support as the

winning technology continues down the pathway to commercialization.

Demonstration:

Continue funding for innovative solutions with a higher technology readiness level to enable scaling from first-of-a-kind demonstrations to 2nd-, 3rd-, and Nth-of-a-kind project deployment.

The deployments after the first-of-a-kind are pivotal in demonstrating a technology's feasibility on a commercial scale. Consistent funding will create the path for additional commercial deployments, therefore achieving the emissions reduction needed in the required timeline. Funding to prioritize deploying beyond the first, especially with a varied application and for industrial retrofits, will create an example for additional potential uses and begin to create opportunities for commercial deployment within the industrial sector.

Deployment:

Advance demand-side market incentives for low-carbon products.

Closing the cost gap between incumbent and decarbonized technologies will be important for deep decarbonization of the industrial sector. Securing bankable demand for low-carbon products and accelerating market transformation by implementing incentives or requirements to create public and private demand will increase the deployment of newer low-carbon technologies that are market-ready.

The public sector should establish procurement standards to create a required carbon intensity benchmark for public purchasing at the federal or state level or create longer-term advanced market commitments.

Given the global market for many industrial products, it may be helpful to draw upon international examples, such as the First Movers Coalition, when applicable. Non-financial incentives to advance the private-market demand include priority processing of permitting in exchange for using low-carbon materials in buildings and construction or other incentives valuable to developers.

Accelerate testing and validation for low-carbon products for use in construction and infrastructure projects at the federal and state levels.

As demand-side market incentives are set in place for low-carbon products, support will be needed to ensure the testing and approval to use these products in planned infrastructure projects can be done efficiently and without delay. This process is especially critical ahead of infrastructure projects that will arise from funding in the BIL. Funding support will be needed at the federal and state levels to ensure departments can provide this accelerated process. In addition to validation for use, it will require collaboration across technical standards organizations, state and local governments, private construction companies, and other stakeholders for new low-carbon products to gain acceptance in the marketplace.



Forward-Looking Areas

In addition to the main recommendation areas outlined above, several topics may warrant additional consideration as areas of “forward-looking interest” beyond the I³ Federal Policy Blueprint.

Policies that support material efficiency, such as recovering waste products for use as feedstocks and increased use of scrap inputs, can provide multiple benefits, including spurring the development and deployment of lower-carbon construction and building products. From reduced emissions and waste to keeping more of the supply chain domestic and lowering input costs, exploring the opportunities and incentives necessary to support a more circular industrial economy may be of interest in the future.

Recognizing the importance of moving toward performance-based specifications may also be another opportunity to encourage adopting new and innovative technologies for building materials.

The intersection between climate and trade policy may also present an opportunity for harmonization with international measures, such as Carbon Border Adjustment Mechanisms and hydrogen standards.

In early December 2023, the Clean Competition Act was reintroduced by Senator Sheldon Whitehouse (D-RI) and two Democratic co-sponsors, with an identical companion bill in the House by Representative Suzan DelBene (D-WA) and three Democratic co-

sponsors. This bill would apply carbon intensity charges on domestic and imported goods above a certain emissions intensity benchmark. This follows the Foreign Pollution Fee Act introduced by Senators Bill Cassidy (R-LA) and Lindsey Graham (R-SC) in November 2023, which would apply fees on imported products that generate more pollution or emissions than American-made products. Both bills would cover a variety of products, including aluminum, cement, glass, iron and steel, petrochemicals, and pulp/paper. Earlier in 2023, the bipartisan PROVE IT (Providing Reliable, Objective, Verifiable Emissions Intensity and Transparency) Act was introduced by Senators Chris Coons (D-DE) and Kevin Cramer (R-ND) along with four Republican, three Democratic, and one Independent co-sponsors. The PROVE IT Act seeks to study the emissions intensity of both domestic and imported carbon-intensive goods.

With bipartisan support building, these bills indicate that Congress may consider trade legislation intended to benefit domestic manufacture of low-carbon products. In 2025, Congress may consider a new energy bill and taxation-related legislation. These bills may be appropriate vehicles for some of the priorities identified in this blueprint. I³ looks forward to sharing lessons learned from the BIL and IRA with Congress and the administration as they consider new legislation intended to further accelerate decarbonization.



Conclusion

The United States is the world's largest and most dynamic economy. Its strong industrial base is a critical pillar of American prosperity, providing well-paying jobs and the metals, chemicals, fiber, and fuels that businesses and households require. The industrial sector faces a massive challenge: to maintain and, in some cases, increase production levels while sharply reducing emissions.

The industrial sector is committed to overcoming these challenges. The federal government must provide incentives for broader adoption of available decarbonization techniques to reduce emissions in the near term. It must also support industry as it pursues new technologies and production methods that will enable it to significantly decrease emissions in the medium and long term.

The prospects for industrial decarbonization are much brighter than they were a few years ago. The passage of the Bipartisan Infrastructure Law, the Inflation Reduction Act, and other legislative and regulatory measures has created a firm foundation for greater future action.

Nonetheless, accelerating industrial decarbonization will require additional policy and regulatory measures. The I³ 2024 Federal Policy Blueprint highlights many of the key next steps needed to make the vision of a more efficient and cleaner industrial sector a reality. Additional federal policy support will be required to realize the promise of the technologies and approaches highlighted in this blueprint and many other earlier-stage innovations.

Additional federal support will benefit households and communities across the country. It will also ensure the continued production of the goods and materials that are the building blocks of the modern economy. Retooling industrial facilities to curb emissions can create new jobs. Policy and regulatory steps that accelerate decarbonization will ensure that American industry can compete internationally. The European Union's Carbon Adjustment Mechanism is scheduled to take effect in 2026, creating additional incentives for American industry to reduce the intensity of its products' emissions.

Decarbonizing industry also has the potential to improve Americans' health. Curtailing greenhouse emissions can reduce other types of industrial emissions, especially particulate matter, delivering substantial health benefits to communities.

Achieving net-zero industrial emissions by midcentury is an ambitious but achievable goal. The support for the recommendations outlined in this I³ Federal Policy Blueprint among leading industrial companies, labor unions, and environmental organizations demonstrates the commitment of key private sector actors to reducing industrial emissions. However, the private sector needs additional assistance from the federal government to build the infrastructure, workforce, and business climate required to rapidly advance industrial decarbonization.



Appendix 1

Comparison of 2021 I³'s [federal and state policy blueprint](#) priorities with investments included in Bipartisan Infrastructure Law¹³, Inflation Reduction Act¹⁴, and elsewhere.

Carbon management

2021 I ³ blueprint recommendations	Bipartisan Infrastructure Law	Inflation Reduction Act	Other
Enhance the federal 45Q tax credit, including through direct pay, extension for 10 years, increased credit value, and elimination of capture thresholds.		<ul style="list-style-type: none"> 10-year 45Q extension (until January 2033) Direct pay Increased industrial credit (\$85 per ton of CO₂ sequestered and \$60 per ton of CO₂ used for facilities that meet labor-related requirements) Lower capture threshold: 12,500 tons of CO₂ per year (tCO₂/yr). for industrial facilities 	
Reform and expand other federal incentives, including 48C and eligibility for private activity bonds and master limited partnerships.	Adds qualified CO ₂ capture facilities (including industrial facilities with CO ₂ capture technologies) as recipients of exempt facility bonds (should become eligible to use private activity bonds while financing their facilities).	<ul style="list-style-type: none"> Extends the Advanced Energy Project Credit (48C) An additional \$10 billion in allocations The definition of qualifying advanced energy projects would be amended to include (among others) projects that reequip, expand, or establish a manufacturing or industrial facility for a range of needs, including reducing greenhouse gas emissions by at least 20% 	
Responsibly accelerate the build-out of CO ₂ transport and storage infrastructure, including enacting the bipartisan SCALE (Storing CO ₂ and Lowering Emissions) Act.	<ul style="list-style-type: none"> \$310 million: CO₂ utilization program \$100 million: Carbon Capture Technology Program (FEED studies) \$2.1 billion: CO₂ transport infrastructure \$2.5 billion: Development of geologic storage sites 		

<p>Increase investment in RDD&D through fully funding carbon management authorizations in the 2020 Energy Act and funding commercial-scale technology demonstration projects in the American Jobs Plan.</p>	<ul style="list-style-type: none"> • \$937 million: Carbon capture large-scale pilot projects • \$2.54 billion: Carbon capture demonstration programs • \$3.5 billion for direct air capture (DAC) hubs 	<p>\$5.8 billion: Advanced industrial facilities deployment program at the Office of Clean Energy Demonstrations.</p>	<p>FY23 appropriations of \$685 million for industrial decarbonization in a cross-cutting initiative, \$140 million on a cross-cutting DOE carbon removal priority, and more.¹⁵</p>
<p>Target jobs and environmental benefits by leveraging federal apprenticeship and workforce training programs in affected communities and assessing the impact of industrial carbon capture retrofits on local criteria air and other pollutants.</p>	<p>DAC hubs prioritization criteria include the following: “The Secretary shall give priority to eligible projects that are likely to create opportunities for skilled training and long-term employment to the greatest number of residents of the region.” (See section 40308)</p>	<ul style="list-style-type: none"> • IRA tax credits include registered apprenticeship requirements associated with enhanced credit rates for 45Q, 48C, and the new clean hydrogen tax credit • Significant worker training funding for dislocated workers, including \$4.6 billion for industry or sector partnership grants related to employment and training activities for high-skill, high-wage, or in-demand industry sectors or occupations 	

Hydrogen

2021 1 st blueprint recommendations	Bipartisan Infrastructure Law	Inflation Reduction Act
Provide hydrogen tax credits		New credit for the qualified production of clean hydrogen, with direct pay. The credit would be \$3.00 per kg, times the applicable percentage for facilities that meet labor-related requirements.
Develop hydrogen hubs	\$8 billion for hydrogen hubs with diversity requirements for feedstock (fossil fuel, nuclear, renewable energy), end use (power, industrial, residential, and commercial), and geography (two in natural gas-producing areas).	
Scale hydrogen transport and storage infrastructure	Covered by the hydrogen hub program, which includes connective infrastructure between producers and consumers.	
Ensure additional financing mechanisms for hydrogen		
Fund RDD&D for hydrogen	<p>\$1.5 billion in funding, including:</p> <ul style="list-style-type: none"> • Clean Hydrogen Electrolysis program: \$1 billion to reduce the cost of hydrogen production with electrolyzers • Clean Hydrogen Manufacturing Initiative: \$500 million for RD&D projects to advance new clean hydrogen production and to create innovative approaches to increase reuse and recycling of clean hydrogen technologies 	
Strengthen and modernize electricity grids	<ul style="list-style-type: none"> • \$5 billion: grant program for grid hardening and weatherization • \$6 billion: grid reliability and resilience research, development, and demonstration, including \$1 billion specifically for rural areas • \$3 billion: grid flexibility • \$2.5 billion: Transmission Facilitation Fund and a Transmission Facilitation Program 	<ul style="list-style-type: none"> • \$2 billion: transmission line and intertie incentives • \$800 million: grants to facilitate the siting of interstate electricity transmission lines • Investment credit for electric transmission property

Procurement

2021 1 st blueprint recommendations	Bipartisan Infrastructure Law	Inflation Reduction Act	Other
Support information and disclosure policies		<ul style="list-style-type: none"> \$250 million: environmental product declaration assistance \$5 million: greenhouse gas corporate reporting \$100 million: low-embodied carbon labeling for construction materials 	Executive Order (EO) 14057: Buy Clean Task Force will provide recommendations ¹⁶ , including: <ul style="list-style-type: none"> “...to increase transparency of embodied emissions, including supplier reporting; procedures for auditing environmental product declarations and verifying accuracy of reported emissions data; and recommendations for grants, loans, technical assistance, or alternative mechanisms to support domestic manufacturers in enhancing capabilities to report and reduce embodied emissions in priority materials they produce.”
Establish procurement bonus policies		<ul style="list-style-type: none"> \$2 billion: low-carbon transportation materials grants/incentives \$2.15 billion: low-embodied carbon materials and products for use in the construction or alteration of buildings 	EO 14057: Buy Clean Task Force will provide recommendations on the following: <ul style="list-style-type: none"> materials covered increasing transparency (detail above) pilot programs to incentivize federal procurement
Develop public sector procurement standards			EO 14057: Buy Clean Task Force will provide recommendations on the following: <ul style="list-style-type: none"> materials covered increasing transparency (detail above) pilot programs to incentivize federal procurement

Electrification

2021 1 st blueprint recommendations	Bipartisan Infrastructure Law	Inflation Reduction Act
Provide incentives for RDD&D		<ul style="list-style-type: none"> \$186 million: basic energy sciences clean energy research \$176 million: zero-emissions testing and demonstration
Provide financial incentives such as tax credits or grants for deployment		<ul style="list-style-type: none"> \$2.88 billion: electric loans for renewable energy Enhanced and extended investment tax credit/production tax credit
Offer workforce training programs		<ul style="list-style-type: none"> Tax credits include registered apprenticeship requirements associated with enhanced credit rates for the investment tax credit and production tax credit. Significant worker training funding for dislocated workers, including \$4.6 billion for industry or sector partnership grants related to employment and training activities for high-skill, high-wage, or in-demand industry sectors or occupations.
Improve federal permitting procedures		

Energy Efficiency

2021 I ³ blueprint recommendations	Bipartisan Infrastructure Law	Inflation Reduction Act
Expand strategic energy management programs		<ul style="list-style-type: none"> \$300 million: assistance for the latest and zero building energy code adoption
Assist facilities in conducting energy assessments	<ul style="list-style-type: none"> \$600 million: energy efficiency research, assessment, and smart manufacturing 	
Support RDD&D for emerging technologies	<ul style="list-style-type: none"> \$50 million: energy efficiency materials pilot program 	
Expand state block grants to support industrial efficiency	<ul style="list-style-type: none"> Expanded efficiency coverage (not specific to industry) and \$550 million energy efficiency and conservation block grant program 	
Provide tax credits		<ul style="list-style-type: none"> Modify/enhance energy-efficient commercial buildings deduction New tax credit for labor costs of installing mechanical insulation property

Innovative Approaches

2021 I ³ blueprint recommendations	Bipartisan Infrastructure Law	Inflation Reduction Act
Employ competitive grantmaking for clean industrial hubs		
Spur market innovation with competition and challenges	<ul style="list-style-type: none"> \$100 million: DAC commercial prize \$15 million: DAC pre-commercial prize 	
Fund and support RDD&D for innovative technologies		<ul style="list-style-type: none"> \$230 million: clean industrial technology research

Endnotes

- 1 See <https://industrialinnovation.org/wp-content/uploads/2021/11/i3-Federal-and-State-Policy-Blueprint.pdf>.
- 2 International Energy Agency (IEA), *Net Zero Roadmap: A Global Pathway to Keep the 1.5 °C Goal in Reach: 2023 Update* (Paris: IEA, September 2023), 63.
- 3 United States Department of State (DOS) and United States Executive Office of the President (EOP), *The Long-Term Strategy of the United States: Pathways to Net-Zero Greenhouse Gas Emissions by 2050* (Washington, DC: DOS and EOP, November 2021).
- 4 US EPA, *Inventory of US Greenhouse Gas Emissions and Sinks: 1990-2021*, 430-R-23-002 (EPA, 2023), ES-22, <https://www.epa.gov/system/files/documents/2023-04/US-GHG-Inventory-2023-Main-Text.pdf>.
- 5 American Iron and Steel Institute, *Facts about American Steel Sustainability* (Washington: 2021), https://www.steel.org/wp-content/uploads/2021/11/AISI_FactSheet_SteelSustainability-11-3-21.pdf.
- 6 United States Department of State and United States Office of the President, *The Long-Term Strategy of the United States: Pathways to Net-Zero Greenhouse Gas Emissions by 2050* (Washington DC: US Department of State, November 2021), 33-34.
- 7 US EPA, *Inventory of US Greenhouse Gas Emissions and Sinks*, 4-4.
- 8 US Energy Information Administration, Office of Energy Statistics, *Monthly Energy Review*, DOE/EIA-0035 (2023-12), December 2023, 133, <https://www.eia.gov/totalenergy/data/monthly/pdf/mer.pdf>.
- 9 US Energy Information Agency, *Hydrogen Explained: Production of Hydrogen* (June 2023), <https://www.eia.gov/energyexplained/hydrogen/production-of-hydrogen.php>
- 10 See Section 1304 of the Inflation Reduction Act, available at <https://www.congress.gov/117/plaws/publ169/PLAW-117publ169.pdf>.
- 11 For more information on this funding, see <https://www.epa.gov/inflation-reduction-act/inflation-reduction-act-programs-fight-climate-change-reducing-embodied>
- 12 Michael Deru, Miles Hayes, Katie Vrabel, Carly Burke, Amy Jiron, and Cedar Blazek, *The Long and Winding Road to Higher Efficiency – the RTU Story* (National Renewable Energy Laboratory, 2020). <https://www.nrel.gov/docs/fy21osti/77092.pdf>.
- 13 Infrastructure, Investment and Jobs Act (referred to above as BILL), Public Law 117-58, Nov. 15, 2021, <https://www.congress.gov/117/plaws/publ58/PLAW-117publ58.pdf>.
- 14 Inflation Reduction Act of 2022, Public Law 117-69, Aug. 16, 2022, <https://www.congress.gov/bill/117th-congress/house-bill/5376/text>.
- 15 US Congress, Energy and Water Development and Related Agencies Appropriations Act, 2023, <https://www.appropriations.senate.gov/imo/media/doc/Division%20D%20-%20Energy%20&%20Water%20Statement%20FY23.pdf>.
- 16 President Biden, Executive Order 14057, “*Catalyzing Clean Energy Industries and Jobs Through Federal Sustainability*,” Dec. 8, 2021, <https://www.whitehouse.gov/briefing-room/presidential-actions/2021/12/08/executive-order-on-catalyzing-clean-energy-industries-and-jobs-through-federal-sustainability/>.