

CATF CASE STUDY

Climate and Clean Energy Legislation, 2020-2022

The period from 2020 to 2022 represents a high-water mark for climate and clean energy policymaking in the United States. Combined, the Energy Act of 2020, the Infrastructure Investment and Jobs Act of 2021, the CHIPS and Science Act of 2022, and the Inflation Reduction Act of 2022 collectively unlock hundreds of billions of dollars of investments in clean energy and climate solutions.



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Introduction

These four bills were designed to drive clean energy innovation across the technology development cycle – from research and development in the Energy Act of 2020, to demonstration in the Infrastructure Investment and Jobs Act of 2021, to deployment and commercialization in the Inflation Reduction Act of 2022. With the passage of the CHIPS and Science Act of 2022, Congress restarted the technology development cycle to prompt a new generation of technological innovation while also incentivizing investment in manufacturing and driving technology commercialization. This sequence of policy support for technology from early-stage research and development to mid-stage demonstration to later-stage deployment is critical for the eventual commercialization of cutting-edge clean energy technologies and the decarbonization of the economy. The CHIPS and Science Act and the Inflation Reduction Act represent a pivot for the U.S. federal government toward industrial policy and direct support for manufacturing in particular sectors, marking a historically significant change in the U.S. approach to energy and climate policymaking over the past several decades.

Remarkably, the majority of the provisions included in these large packages of legislation were either passed with bipartisan support, or in the case of the Inflation Reduction Act, have their roots in bipartisan bills even if they were ultimately enacted through party-line votes.ⁱ

This streak of climate policymaking has brought the United States closer to achieving its nationally determined contribution (NDC) under the Paris Agreement: according to an analysis from Princeton University’s ZERO Lab REPEAT project, the passage of the final bill in the set — the Inflation Reduction Act of 2022 — on top of existing policies, would enable the U.S. to reduce greenhouse gas emissions by 42% by 2030 relative to 2005 levels.ⁱⁱ This brings the country much closer to achieving its NDC target of reducing emissions 50-52% by 2030 relative to 2005 levels,ⁱⁱⁱ when existing policies before the Inflation Reduction Act would only have reduced emissions about 27% by 2030.



Supporting clean energy technology development from laboratory to commercialization

Many U.S. government agencies, including the Department of Energy, conduct Technology Readiness Assessments in order to assess the maturity of certain technologies. During this process, technologies are assigned a Technology Readiness Level (TRL), placing them along a scale from 1 to 9.^{iv} At a TRL 1, a technology is at its most nascent stage as scientific research begins to be translated into applied R&D. At a TRL 9, a technology has been operated over a full range of expected use-case conditions, including within a broader system. Beyond TRL 9, new technologies are deployed initially as “first-of-a-kind” (FOAK), which are expected to have higher costs than eventual ubiquitous deployment as “Nth-of-a-kind” (NOAK) after costs have declined as a result of learning-by-doing and economies of scale. Much of this technology development is contingent on earlier investment in basic science research.

Below, we employ the metaphor of a TRL scale to illustrate how ambitious climate and clean energy legislation from 2020 to 2022 is pushing U.S. clean energy technologies from nascent to mature.

DOE Office	Office of Science				Office of Clean Energy Demonstration (OCED)					Loan Programs Office (LPO)	"FOAK"	"NOAK"	Expansion
	ARPA-E		Applied Offices (FECM, NE, EERE)										
TRL	"0"	1	2	3	4	5	6	7	8	9			
	Basic science research	Basic principles observed and reported	Technology concept and/or application formulated	Analytical and experimental critical function and/or characteristic proof of concept	Component and/or system validation in laboratory environment	Laboratory scale, similar system validation in relevant environment	Engineering/pilot-scale, similar (prototypical) system validation in relevant environment	Full-scale, similar (prototypical) system demonstrated in relevant environment	Actual system completed and qualified through test and demonstration	Actual system operated over full range of expected conditions	First-of-a-kind deployment	Nth-of-a-kind deployment	Wide commercialization stage
Legislation	Energy Act of 2020					Infrastructure Investment and Jobs Act of 2021					Inflation Reduction Act of 2022		
	Appropriations												
	CHIPS and Science Act of 2022												

The Energy Act of 2020 focused its support for clean energy technologies in nascent stages, directing relatively small dollar amounts toward research, development, and deployment (RD&D) for technologies critical to decarbonization. The Infrastructure Investment and Jobs Act of 2021 directed much larger dollar amounts to demonstration grants and financing for mid-stage technologies, providing support to move them from the lab bench to market, often through hubs or other models with commercialization in mind. The Inflation Reduction Act of 2022 went further, using tax credits, grants, and other forms of financial assistance to incentivize wide-scale deployment of mature technologies: commercialization was the name of the game. Using the metaphor of the TRL scale, it is clear how these three bills fit together as a set to push critical clean energy technologies from a TRL 1 or 2 to a TRL 8 or 9. Signed into law just before the Inflation Reduction Act and negotiated concurrently with it, the CHIPS and Science Act of 2022 provided support for basic science and RD&D at the DOE, thereby starting the cycle of innovation over again to bring about a future generation of clean energy technologies.

Throughout the 116th and 117th Congresses, support for clean energy in annual appropriations bills has been consistently supportive of RD&D, with increasing attention given to clean energy demonstration and deployment at DOE.

Energy Act of 2020

On December 27, 2020, the Energy Act of 2020 was signed into law by President Donald Trump as part of the omnibus spending bill for the 2021 fiscal year (H.R.133).^v The Energy Act of 2020 authorized over \$35 billion in federal investment, including billions to support research, development, and demonstration dedicated to innovative energy sector technologies with a focus on zero-carbon energy and domestic manufacturing.^{vi}

The enactment of the Energy Act of 2020 marked the culmination of years of efforts in Congress to pass comprehensive bipartisan energy legislation, as the first significant energy policy passed by Congress since the American Recovery and

Reinvestment Act in 2009.^{vii} The bill was compiled from consensus provisions from the American Energy Innovation Act (S. 2657),^{viii} itself a package of over fifty energy bills developed by the Senate Energy & Natural Resources Committee, and the Clean Economy Jobs and Innovation Act (H.R. 4447)^{ix} developed by the House Science, Space & Technology and Energy & Commerce Committees.

The FY2021 omnibus bill also included several other important bipartisan climate provisions originating with the Senate Environment and Public Works Committee, namely: requiring a phase-down of the production and use of hydrofluorocarbons (S. 2754, AIM Act);^x funding to replace dirty diesel engines with domestically-produced clean technologies (S. 747, Diesel Emissions Reduction Act);^{xi} and directing DOE to conduct R&D on carbon utilization and direct air capture technologies (S. 383, USE IT Act).^{xii}

Negotiations across both parties and chambers of Congress ultimately resulted in a pre-conferenced bipartisan and bicameral agreement on the above provisions announced on December 21, 2020. By passing the Energy Act of 2020, Congress realized the ambitions of the previous half-decade of bipartisan energy policy development on Capitol Hill, set down markers on policy priorities for the next generation of clean energy technologies and made a critical “down payment” on early-stage R&D, setting the stage for larger investments in the future. CATF supported the above-named provisions, which were ultimately included in this historic piece of bipartisan policymaking, among others, including provisions that increased federal support for carbon management technologies and industrial decarbonization (see Table 1 for additional details).

Infrastructure Investment and Jobs Act of 2021

On March 31, 2021, President Joe Biden unveiled the American Jobs Plan, a framework which called for a roughly \$2 trillion investment in the nation’s physical infrastructure as well as clean energy and the care economy. Later that spring, Congressional Democratic leadership divided President Biden’s policy priorities into two separate vehicles: a Democrat-only budget reconciliation bill, which included climate and care economy investments, and a bipartisan “regular order” bill focused primarily on physical infrastructure and energy. After months of negotiations on a regular order bill led by a bipartisan group of Senators, a package including many of President Biden’s infrastructure priorities was signed into law on November 15, 2021 as the Infrastructure Investment and Jobs Act of 2021 (H.R. 3684).^{xiii}

The Infrastructure Investment and Jobs Act of 2021 (IIJA), also known as the Bipartisan Infrastructure Law, represents an investment of \$1.2 trillion in the nation’s infrastructure — an increase of \$550 billion over baseline federal spending levels.^{xiv} In terms of dollar amounts, IIJA prioritized spending on strengthening the nation’s highway, rail, broadband, and water infrastructure. Significantly, IIJA also provided \$62 billion in clean energy investment, primarily for large-scale technology demonstration and deployment.^{xv} IIJA also appropriated funds for many programs that had been authorized the previous year in the Energy Act of 2020.



\$62 billion

provided for clean energy investment through the Infrastructure Investment and Jobs Act



INFRASTRUCTURE INVESTMENT AND JOBS ACT PROVIDED:

\$12.1 billion

for carbon management, including demonstration projects and loans

\$9.5 billion

for zero-carbon fuels, including \$8 billion for regional, clean hydrogen hubs

\$4.71 billion

to plug abandoned oil and gas wells on federal and Tribal lands to curb methane emissions

\$8+ billion

to support nuclear energy and foster nuclear energy innovation

\$12.5 billion

increase in loan authority for DOE and Power Marketing Administrations for electric transmission upgrades and expansion

Many of the clean energy and climate provisions in the Infrastructure Investment and Jobs Act were derived from other bills from the 117th Congress, such as the Senate Energy and Natural Resources Committee's Energy Infrastructure Act (S. 2377)^{xvi}, which itself included provisions from bills such as the SCALE Act (H.R. 1992/S. 799)^{xvii} and the Senate Environment and Public Works Committee's Surface Transportation Reauthorization Act (S.1931),^{xviii} among others. Several provisions in the Infrastructure Investment and Jobs Act were derived from bills from earlier Congresses, such as the sweeping Moving Forward Act (H.R. 2)^{xix} package from the 116th Congress, which itself included provisions from the House Transportation and Infrastructure Committee's INVEST in America Act (H.R. 7095).^{xx}

The Infrastructure Investment and Jobs Act provided \$12.1 billion for carbon management, including demonstration projects and loans; \$9.5 billion for zero-carbon fuels demonstrations, including \$8 billion for clean hydrogen hubs; \$4.71 billion to plug abandoned oil and gas wells on federal and Tribal lands to curb methane emissions; and over \$8 billion to support the nuclear energy industry and foster nuclear energy innovation. The Infrastructure Investment and Jobs Act also established a new Office of Clean Energy Demonstrations at DOE, which is tasked with implementing \$21.5 billion in clean energy programs and bridging the R&D work of DOE's applied energy offices with the commercialization objectives of the Loan Programs Office.^{xxi}

The passage of the Infrastructure Investment and Jobs Act accomplished **two policy goals**:

1. **fund many of the programs** authorized the previous year in the Energy Act of 2020
2. provide support for a new set of bipartisan **clean energy and climate policy priorities**, such as clean hydrogen hubs.

The law placed a strong emphasis on clean energy technology demonstration, pushing many of the innovative technologies included as subjects of research in the Energy Act of 2020 towards large-scale demonstration and eventual commercialization. CATF supported many of the provisions, which went on to be included in the Infrastructure Investment and Jobs Act, including the clean hydrogen hubs program and the provisions supporting carbon capture and storage infrastructure deployment that originated in the SCALE Act.

Inflation Reduction Act of 2022

The Inflation Reduction Act of 2022 represents a \$369 billion investment in clean energy innovation and climate solutions, primarily through tax credits and deployment incentives for zero-carbon technologies.^{xxii} The Senate passed the Inflation Reduction Act on Sunday, August 7, 2022 through a party-line Democratic vote; the bill was passed by the House of Representatives three days later and signed into law by President Biden on August 16, 2022. The bill was passed under budget reconciliation, which limited the types of provisions eligible for inclusion to those with primarily budgetary impacts. The bill, which eventually became the Inflation Reduction Act, earlier known as the Build Back Better Act, was originally envisioned as part of a much larger social and climate spending package. Ultimately, many of the social spending provisions in the bill were stripped out while the climate and clean energy provisions remained at the bill's core through its passage, indicating the importance of those provisions to securing all the necessary votes — particularly in an evenly divided Senate.

The Inflation Reduction Act is comprised of a mosaic of provisions and ideas from a wide array of both bipartisan and partisan bills including the CLEAN Future Act (H.R. 1512),^{xxiii} the GREEN Act (H.R. 848),^{xxiv} the Clean Energy for America Act (S. 1298),^{xxv} the CATCH Act (H.R. 3538),^{xxvi} and more. Many of the tax credit proposals in the Inflation Reduction Act were previously included in the U.S. Treasury's Made in America Tax Plan, which was released in April 2021 as a companion to President Biden's American Jobs Plan,^{xxvii} and in the Build Back Better Act as passed by the House of Representatives in November 2021.

The law overhauled and expanded federal clean energy tax credits, which the U.S. Treasury expects will deliver an estimated \$270 billion in clean energy and climate benefits.^{xxviii} These include new and expanded tax credits for: clean electricity generation; clean vehicles; clean fuels and fueling infrastructure, including clean hydrogen; carbon capture, utilization, and storage (CCUS) and direct air capture; and clean manufacturing (see Table 1). Full funding for many of these credits is conditional on meeting labor requirements, and in some cases bonus funding is provided for meeting domestic content thresholds or locating in energy communities. Some incentives also target benefits specifically to low-income communities (e.g. Inflation Reduction Act Sec. 13103).

The Inflation Reduction Act also expanded DOE's capacity to partner with the private sector in deploying clean energy. The bill expanded the DOE Loan Programs Office loan authority by nearly \$350 billion. This included a \$250 billion in loan authority for projects under a new Energy Infrastructure Reinvestment that convert or repurpose existing energy infrastructure to reduce greenhouse gas emissions and \$40 billion in additional loan authority for the existing Innovative Clean Energy program, which targets clean energy, clean fuels, clean vehicles, and pollution control projects.^{xxix} The Inflation Reduction Act also provided \$1.55 billion for a new program at the Environmental Protection Agency (EPA) to curb methane emissions from the oil and gas sector in addition to investing billions of dollars to deploy low- and zero-emission technologies in communities throughout the United States.

By heavily investing in tax credits and other deployment incentives for businesses and consumers, the Inflation Reduction Act boosted clean energy and low-carbon technologies at the final stages of development: deployment and commercialization. The level of clean energy deployment driven by the bill is projected to be truly historic: analysis from Princeton University's REPEAT project predicts that the Inflation Reduction Act, combined with earlier policies including those in Infrastructure Investment and Jobs Act, will drive nearly \$3.5 trillion in cumulative capital investment in energy infrastructure by 2032.^{xxx} Furthermore, by creating tax incentives that will persist for a minimum of ten years, the U.S. has established a critical level of policy certainty, which will allow for both businesses and other governments (including sub-national U.S. state and local governments and international governments) to plan accordingly. Along with a wide range of coalition partners, CATF supported many of the tax and non-tax provisions in the Inflation Reduction Act, including the clean energy production and investment tax credits, the clean hydrogen production tax credit, the expansion of the 45Q tax credit for carbon capture, utilization, and storage, and the clean vehicles tax credit for commercial vehicles, as well as the Methane Emissions Reduction Program.



\$369 billion

investment in clean
energy innovation and
climate solutions made
through the Inflation
Reduction Act

CHIPS and Science Act of 2022

On August 9, 2022, President Biden signed the bipartisan CHIPS and Science Act of 2022 (CHIPS+) into law. The law is expected to drive an investment of tens of billions of dollars into both basic science and applied technology research, with significant implications for clean energy research, development, deployment, and commercialization. CHIPS+ is mainly comprised of provisions that were part of either the Senate’s United States Innovation and Competition Act (USICA) or the House’s America COMPETES Act.^{xxxix}

On top of investing \$54.2 billion in boosting domestic semiconductor production in the U.S, the CHIPS and Science Act also authorized the largest five-year investment in public R&D in U.S. history – \$169.9 billion for scientific research and development across the federal government, representing an \$82.5 billion increase over the preexisting baseline.^{xxxix} This included a \$67.9 billion five-year authorization for programs at the DOE, a \$30.5 billion increase over the department’s baseline. CHIPS+ authorized an additional \$12.9 billion in funding over five years for the DOE Office of Science, bringing the office’s total budget authorization over that period to \$50.3 billion. The law replenished existing funding streams for research, including in basic energy sciences, environmental and climate research, and research into key energy applications like fusion. CHIPS+ also dedicated \$14.7 billion for infrastructure, equipment, and instrumentation across DOE’s 17 National Laboratories.

Notably, the CHIPS and Science Act created new science and technology innovation programs at the DOE and authorized \$17.6 billion for these programs. These include: a new Foundation for Energy Security and Innovation to foster collaboration between the public and private sectors and accelerate technology commercialization; authorizations for a range of new clean energy technology transfer programs; new programs to support the deployment of advanced nuclear reactors in communities affected by coal facility retirement; authorization for a new low-emissions steel manufacturing technology research and development program, focused on key technologies including carbon capture and hydrogen (originally part of the SUPER Act); and authorized funding for new research and development activities in DOE applied energy offices. CHIPS+ also created additional authority for the newly created DOE Office of Clean Energy Demonstrations (OCED) to coordinate with the Office of Technology Transitions, the Loan Program Office, and all other applied energy program offices within DOE — coordination that will be critical for the success of many of the programs described in this case study.



CHIPS AND SCIENCE ACT PROVIDED:

\$14.7 billion

for DOE National Laboratories

\$800 million

for Fission for the Future
advanced nuclear deployment

\$11.2 billion

for research and development in
DOE applied energy offices

\$100 million

for the DOE Office of
Technology Transitions

Conclusion

The passage of the Energy Act of 2020, the Infrastructure Investment and Jobs Act of 2021, the CHIPS and Science Act of 2022, and the Inflation Reduction Act of 2022 in a span of just two years represents an unprecedented era of accomplishment for climate and clean energy policymaking. By supporting clean energy innovation at all stages of development across a variety of sectors, this set of laws maximizes the range of low- and zero-carbon technology options that will be available in the future.

In the coming years, decision-makers and advocates must turn their attention to ensuring the optimal implementation of the policies and programs created by this set of laws. The scale of zero-carbon technology deployment that will be needed for the U.S. to reach net-zero emissions by midcentury is daunting, but the enactment of this set of policies is a critically important first step toward meeting that goal. The enactment of these laws also demonstrates the viability and value of bipartisan policymaking on clean energy, particularly on the topic of support for zero-carbon technology innovation.

Table 1: Selected clean energy and climate innovation legislation, 2020-2022

Sector	Provision
Energy Act of 2020 (Consolidated Appropriations Act, 2021)	
Advanced nuclear energy	Authorizes RD&D programs for advanced nuclear reactor development and HALEU fuel development. Based on provisions in Nuclear Energy Leadership Act (S. 903) ^{xxxiii} and Nuclear Energy Research and Development Act (H.R. 6097). ^{xxxiv}
Grid modernization	Establishes programs to modernize electric power grid. Based on Grid Modernization Act (S.2332). ^{xxxv}
Carbon management	Establishes R&D and demonstration/ pilot programs for fossil fuel carbon capture, utilization, storage, and removal. Based on EFFECT Act (S. 1201), ^{xxxvi} Fossil Energy Research and Development Act (H.R. 3607), ^{xxxvii} and LEADING Act (S.1685). ^{xxxviii}
Industrial decarbonization	Creates a technology R&D program at DOE aimed at reducing emissions from the industrial sector. Based on Clean Industrial Technology Act of 2019 (S. 2300). ^{xxxix}
Technology commercialization and deployment	Establishes programs and incentives to facilitate commercialization of clean energy technologies developed in federal labs. Based on Energizing Technology Transfer Act (S.4725) ^{xl} and Energy Technology Maturation Act (S. 1286). ^{xli}
	Reforms DOE Loan Program Office Title XVII loan guarantee authority; expands eligibility for program to new technologies and otherwise makes loans more affordable to borrowers. ^{xlii}
DOE research and innovation	Reauthorizes ARPA-E, DOE's cutting-edge science and technology research institution. Based on ARPA-E Reauthorization Act (S. 2714), ^{xliii} (H.R. 4091). ^{xliv}
Reducing greenhouse gas emissions	Phases down manufacturing and use of hydrofluorocarbons (HFCs). Based on the American Innovation and Manufacturing Act of 2020 (S. 2754). ^{xlv}
	Financing to replace diesel engines. Based on the Diesel Emissions Reduction Act of 2019 (S. 747). ^{xlvi}

Sector	Provision
Carbon management	Establishes technology research, development, and deployment programs for carbon capture and utilization and direct air capture. Based on the USE IT Act (S. 383). ^{xlvii}
Infrastructure Investment and Jobs Act of 2021	
Carbon management	\$2.54 billion for carbon capture demonstration projects; \$937 million for large-scale carbon capture pilot projects; \$2.1 billion in low-interest loans for carbon dioxide transport infrastructure (CIFIA Program); \$2.5 billion in grants for carbon storage commercialization; \$3.5 billion for four regional direct air capture hubs. Based on provisions in SCALE Act (H.R. 1992/S. 799). ^{xlviii}
Zero-carbon fuels	\$8 billion for clean hydrogen hubs; \$1 billion for clean hydrogen electrolysis RD&D; \$500 million in grants for RD&D for recycling clean hydrogen system components.
Methane emissions reduction	\$4.71 billion to plug abandoned oil and gas wells on federal and Tribal lands.
Nuclear energy	\$6 billion for civil nuclear credit program, to maintain the U.S.'s existing nuclear reactor fleet — similar to provisions in ANIA (116 th : S.4897; ^{xlix} 117 th : S. 2373). ⁱ \$2.48 billion for advanced reactor demonstration program (authorized in Energy Act of 2020).
Grid modernization	Increases loan authority for DOE and Power Marketing Administrations by \$12.5 billion for electric transmission upgrades and expansion.
Low-carbon transportation	\$2.5 billion for “clean corridors” alternative fuel infrastructure (including BEV charging and FCEV refueling – hydrogen infrastructure) along major highways in the U.S. Based on a provision from the Surface Transportation Reauthorization Act of 2021 (S.1931).
	\$2.3 billion for port infrastructure, including hydrogen refueling infrastructure for trucks and trains that service the port. Based on a provision from the Surface Transportation Reauthorization Act of 2021 (S.1931).
Inflation Reduction Act of 2022	
Carbon management	Extends and enhances 45Q tax credit for point-source carbon capture, direct air capture, sequestration through secure geologic storage, and carbon dioxide utilization through 2033 (Sec. 13104). Similar to provisions in the Carbon Capture, Utilization, and Storage Tax Credit Amendments Act of 2021 (S. 986) ⁱⁱ Increases 45Q credit for point-source carbon capture, storage, and utilization to \$85/tonne, based on CATCH Act (H.R. 3538). ⁱⁱⁱ Increases 45Q credit for direct air capture to \$180/tonne. Direct pay available for all recipients for first 5 years of credit (for nonprofits and co-ops, 12 years).
Zero-carbon energy generation	Establishes new fuel-neutral clean electricity production (Sec. 13701) and investment tax credits (Sec. 13702) aimed at facilities placed in service starting in 2025. Similar to provisions in Clean Energy for America Act (S.1298); ⁱⁱⁱⁱ GREEN Act (H.R. 848). ^{lv} Includes direct pay and transferability.
	Extends existing renewable energy production tax credit (Sec. 13101) and investment tax credit (Sec. 13012) through 2024. Similar to provisions in CLEAN Future Act (H.R. 1512). ^{lv} Includes direct pay and transferability.

Sector	Provision
	<p>Creates a new tax incentive to maintain electricity production from existing nuclear power plants through 2032 (Sec. 13105).</p> <p>Similar to provisions in Zero-Emission Nuclear Power Production Credit Act of 2021 (H.R. 4024).^{lvi}</p> <p>Includes direct pay and transferability.</p>
	<p>\$700 million to ensure availability of high-assay, low-enriched uranium (HALEU) for advanced nuclear energy (Sec. 50173).</p>
Zero-carbon transportation	<p>Extends and modifies tax credits for individuals buying new (Sec. 13401) or used (Sec. 13402) clean light-duty passenger vehicles. Electric and fuel cell vehicles are eligible.</p>
	<p>Creates new tax credit for purchase of clean medium- and heavy-duty commercial vehicles (Sec. 13403). Electric and fuel cell vehicles are eligible.</p>
	<p>Extends tax credit for developing clean refueling properties, including hydrogen fueling (Sec. 13404). Similar to provisions in Securing America's Clean Fuel Infrastructure Act (S.975).^{lvii}</p> <p>Includes direct pay and transferability.</p>
	<p>Provides \$5 billion to DOE Office of Clean Energy Demonstrations in loans and grants to establish advanced clean vehicle manufacturing and convert existing facilities (Sec. 50142, 50143).</p>
Zero-carbon fuels	<p>Creates a new tax credit for production of clean hydrogen (Sec. 13201). Credit amount is based on GHG intensity of hydrogen. Lifecycle GHG emissions are "well-to-gate" through point of production.</p> <p>Includes direct pay and transferability.</p> <p>Credit <i>cannot</i> be combined with 45Q carbon capture tax credit but <i>can</i> be combined with renewables or nuclear tax credits.</p>
Clean energy manufacturing	<p>Expands existing 48C 30% investment tax credit for manufacturers and industrial facilities to produce a range of advanced energy technology and systems, as well as reduce their own emissions by at least 20% (Sec. 13501).</p> <p>Similar to provisions in Clean Energy for America Act; American Jobs in Energy Manufacturing Act (S. 622).^{lviii}</p> <p>Includes direct pay and transferability.</p>
	<p>Establishes new advanced manufacturing production tax credit for manufacture of solar and wind energy equipment, including offshore service equipment, as well as battery components and certain critical minerals (Sec. 13502).</p> <p>Includes direct pay and transferability.</p>
Clean energy demonstration and deployment	<p>Appropriates \$5.8 billion for DOE Office of Clean Energy Demonstrations for Advanced Industrial Facilities Deployment Program (Sec. 50161).</p> <p>Authorizes up to \$40 billion in loan guarantee authority to the DOE Loan Programs Office for clean energy, clean fuels, clean vehicles, and pollution control projects; appropriates \$3.6 billion to cover costs of loans (Sec. 50141).</p> <p>Authorizes up to \$250 billion in loan authority to the DOE Loan Programs Office for an Energy Infrastructure Reinvestment Program for projects that retool, repurpose, or replace energy infrastructure that is no longer in operation; appropriates \$5 billion to cover costs of loans (Sec. 50144).</p> <p>Appropriates \$9.7 billion to USDA for grants and loans for rural electric cooperatives; available to construct or purchase new clean energy systems (Sec. 22004).</p>

Sector	Provision
Methane emissions reduction	Creates a two-part Methane Emissions Reduction Program (Sec. 61103): 1) Provides \$1.55 billion to EPA to issue loans, rebates, contracts, and grants to support the oil and gas sector in reducing methane emissions; 2) Beginning with emissions in 2024, directs EPA to place a charge on methane emissions which exceed waste thresholds.
CHIPS and Science Act of 2022	
Scientific research	Authorized \$14.7 billion for infrastructure, equipment, and instrumentation across 17 DOE National Laboratories.
	Adds additional authorizations for the DOE Office of Science related to basic energy sciences. Increased funding authorizations for DOE Office of Science to \$50.3 billion, an increase of \$12.9 billion over the preexisting baseline.
Technology commercialization and deployment	Established a new Foundation for Energy Security and Innovation to engage with the private sector and accelerate technology commercialization. Authorizes \$40.5 million over 5 years.
	Authorizes \$75 million over 5 years for a new national clean energy incubator program.
	Authorizes \$5 million over 5 years for a new university prize competition for the commercial application of an innovative clean energy technology.
	Authorizes \$15 million over 5 years to coordinate technology transfer programs within DOE.
	Authorizes \$125 million over 5 years for a new program to provide clean energy commercialization entrepreneur fellowships at DOE National Laboratories.
	Authorizes \$125 million over 5 years to provide small businesses with vouchers RD&D, technology transfer, or commercialization activities at DOE National Laboratories.
	Authorizes \$100 million over 5 years for the DOE Office of Technology Transitions.
Nuclear energy	Authorized \$800 million over 5 years for a new program to support the deployment of advanced nuclear reactors in communities affected by coal facility retirement. Based on Fission for the Future Act (S. 3428). ^{lix}
Clean energy manufacturing	Authorized a new low-emissions steel manufacturing technology research and development program, focused on key technologies including carbon capture. Based on the SUPER Act (H.R. 4599). ^{lx}
Technology research and development	Authorized \$11.2 billion over 5 years for research and development activities in DOE applied energy offices.

ENDNOTES

- i Bipartisan Policy Center. (2022). *Inflation Reduction Act (IRA) summary: Energy and climate provisions*. <https://bipartisanpolicy.org/blog/inflation-reduction-act-summary-energy-climate-provisions/>
- ii ZERO Lab, Princeton University. (2022). *Preliminary report: The climate and energy impacts of the Inflation Reduction Act of 2022*. https://repeatproject.org/docs/REPEAT_IRA_Preliminary_Report_2022-08-04.pdf
- iii Fact Sheet: President Biden sets 2030 greenhouse gas pollution reduction target aimed at creating good-paying union jobs and securing U.S. leadership on clean energy technologies. (2021, April 22). The White House Briefing Room. Retrieved October 26, 2022, from <https://www.whitehouse.gov/briefing-room/statements-releases/2021/04/22/fact-sheet-president-biden-sets-2030-greenhouse-gas-pollution-reduction-target-aimed-at-creating-good-paying-union-jobs-and-securing-u-s-leadership-on-clean-energy-technologies/>
- iv United States Department of Energy. (2011). *Technology readiness assessment guide*. <https://www.directives.doe.gov/directives-documents/400-series/0413.3-EGuide-04-admchg1/@images/file>
- v Consolidated Appropriations Act, 2021, H.R. 133, 116th Cong. (2021). <https://www.congress.gov/bill/116th-congress/house-bill/133/text>
- vi ICYMI: What they're saying about the Energy Act of 2020. (2020, December 29). Senate Committee on Energy & Natural Resources, Republican News. Retrieved October 14, 2020, from <https://www.energy.senate.gov/2020/12/icymi-what-they-re-saying-about-the-energy-act-of-2020>
- vii Powell, R., Kersey, M., & Nelson, S. (2021, April 1). The Energy Act of 2020: A monumental climate and clean energy bill. Clearpath. <https://clearpath.org/our-take/the-energy-act-of-2020-a-monumental-climate-and-clean-energy-bill/>
- viii United States Senate Committee on Energy & Natural Resources. (2020). *American Energy Innovation Act: Modern policy for modern energy*. <https://www.energy.senate.gov/services/files/4BC53A6A-C275-44DE-9BB5-D973702F8F93>
- ix Clean Economy Jobs and Innovation Act, H.R. 4447, 116th Cong. (2019). <https://www.congress.gov/bill/116th-congress/house-bill/4447/text>
- x AIM Act of 2020, S. 2754, 116th Cong. (2020). <https://www.congress.gov/bill/116th-congress/senate-bill/2754>
- xi Diesel Emissions Reduction Act of 2019, S. 747, 116th Cong. (2019). <https://www.congress.gov/bill/116th-congress/senate-bill/747/text>
- xii USE IT Act, S. 383, 116th Cong. (2019). <https://www.congress.gov/bill/116th-congress/senate-bill/383/text>
- xiii Infrastructure Investment and Jobs Act of 2021, H.R. 3684, 117th Cong. (2021). <https://www.congress.gov/bill/117th-congress/house-bill/3684/text>
- xiv Biden Administration releases Bipartisan Infrastructure Law guidebook for state, local, tribal, and territorial governments. (2022, January 31). The White House Briefing Room. Retrieved October 14, 2022, from <https://www.whitehouse.gov/briefing-room/statements-releases/2022/01/31/biden-administration-releases-bipartisan-infrastructure-law-guidebook-for-state-local-tribal-and-territorial-governments/>
- xv United States Department of Energy. (2022, February 9). DOE optimizes structure to implement \$62 billion in clean energy investments from Bipartisan Infrastructure Law. <https://www.energy.gov/articles/doe-optimizes-structure-implement-62-billion-clean-energy-investments-bipartisan>
- xvi Energy Infrastructure Act, S. 2377, 117th Cong. (2021). <https://www.congress.gov/bill/117th-congress/senate-bill/2377/text>
- xvii The SCALE Act, H.R. 1992, 117th Cong. (2021). <https://www.congress.gov/bill/117th-congress/house-bill/1992/text>
- xviii Surface Transportation Reauthorization Act of 2021, S. 1931, 117th Cong. (2021). <https://www.congress.gov/bill/117th-congress/senate-bill/1931/text>
- xix Moving Forward Act, H.R. 2, 116th Cong. (2020). <https://www.congress.gov/bill/116th-congress/house-bill/2/text>
- xx INVEST in America Act, H.R. 7095, 116th Cong. (2020). <https://www.congress.gov/bill/116th-congress/house-bill/7095/text>
- xxi United States Department of Energy. (2022, April 29). Office of Clean Energy Demonstrations. https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&ved=2ahUKEwi4joqzjtf6AhXKkYkEHdgmBbIQFnoECGgQAQ&url=https%3A%2F%2Fwww.nationalacademies.org%2Fevent%2F04-29-2022%2Fdocs%2FDF0943A73A243E39FA824389617833B37C1FD5DF374A&usq=AOvVaw3y_N2ER0oKWHLiOv2dF3E
- xxii The Inflation Reduction Act of 2022, H.R. 5376, 117th Cong. (2022). <https://www.congress.gov/bill/117th-congress/house-bill/5376/text>
- xxiii The CLEAN Future Act, H.R. 1512, 117th Cong. (2021). <https://www.congress.gov/bill/117th-congress/house-bill/1512/text>
- xxiv The GREEN Act, H.R. 848, 117th Cong. (2021). <https://www.congress.gov/bill/117th-congress/house-bill/848/text>
- xxv The Clean Energy for America Act, S. 1298, 117th Cong. 2021, <https://www.congress.gov/bill/117th-congress/senate-bill/1298/text>
- xxvi The CATCH Act, H.R. 3538, 117th Cong. (2021). <https://www.congress.gov/bill/117th-congress/house-bill/3538/text>
- xxvii United States Department of the Treasury. (2021). The Made in America Tax Plan. Retrieved October 19, 2022 from https://home.treasury.gov/system/files/136/MadeInAmericaTaxPlan_Report.pdf
- xxviii Fact sheet: Treasury, IRS open public comment on implementing the Inflation Reduction Act's clean energy tax incentives. (2022). United States Department of Treasury. Retrieved October 14, 2022, from <https://home.treasury.gov/system/files/136/FactSheet-Implementing-IRA-Climate-CleanEnergy-TaxIncentives.pdf>

- xxix United States Department of Energy, Loan Programs Office. (2022). Inflation Reduction Act of 2022. Retrieved October 14th, 2022, from <https://www.energy.gov/lpo/inflation-reduction-act-2022>
- xxx ZERO Lab, Princeton University. (2022). *Preliminary report: The climate and energy impacts of the Inflation Reduction Act of 2022*. https://repeatproject.org/docs/REPEAT_IRA_Preliminary_Report_2022-08-04.pdf
- xxxi Information Technology and Innovation Foundation. (2022, July 29). Three cheers for the CHIPS and Science Act of 2022! Now, let's get back to work. <https://itif.org/publications/2022/07/29/three-cheers-for-the-chips-and-science-act-of-2022-now-lets-get-back-to-work/>
- xxxii United States House of Representatives Committee on Science, Space, & Technology. (2022). CHIPS and Science Act of 2022. Retrieved October 14, 2022, from https://science.house.gov/imo/media/doc/chips_and_science_act_leadership_fact_sheet.pdf
- xxxiii Nuclear Energy Leadership Act, S. 903, 116th Cong. (2019). <https://www.congress.gov/bill/116th-congress/senate-bill/903/text>
- xxxiv Nuclear Energy Research and Development Act, H.R. 6097, 116th Cong. (2020). <https://www.congress.gov/bill/116th-congress/house-bill/6097/text>
- xxxv Grid Modernization Act of 2019, S. 903, 116th Cong. (2019). <https://www.congress.gov/bill/116th-congress/senate-bill/903/text>
- xxxvi EFFECT Act of 2019, S. 1201, 116th Cong. (2019). <https://www.congress.gov/bill/116th-congress/senate-bill/1201/text>
- xxxvii Fossil Energy Research and Development Act of 2019, H.R. 3607, 116th Cong. (2019). <https://www.congress.gov/bill/116th-congress/house-bill/3607/text>
- xxxviii Launching Energy Advancement and Development through Innovations for Natural Gas Act of 2019, S. 1685, 116th Cong. (2019). <https://www.congress.gov/bill/116th-congress/senate-bill/1685/text>
- xxxix Clean Industrial Technology Act of 2019, S. 2300, 116th Cong. (2019). <https://www.congress.gov/bill/116th-congress/senate-bill/2300/text>
- xl Energizing Technology Transfer Act of 2020, S. 4725, 116th Cong. (2020). <https://www.congress.gov/bill/116th-congress/senate-bill/4725/text>
- xli Energy Technology Maturation Act of 2019, S. 1286, 116th Cong. (2019). <https://www.congress.gov/bill/116th-congress/senate-bill/1286>
- lxii Sullivan, M.A., Wickett, J., Chappell, B., & Webster, E. (2021, January 13). The Energy Act of 2020 revitalizes and reforms the DOE Loan Guarantee Program. Hogan Lovells. https://www.hoganlovells.com/~/_media/hogan-lovells/pdf/2021-pdfs/2021_01_13_the_energy_act_of_2020_revitalizes_and_reforms_the_doe_loan_guarantee_program.pdf
- lxiii ARPA-E Reauthorization Act of 2019, S. 2714, 116th Cong. (2019). <https://www.congress.gov/bill/116th-congress/senate-bill/2714/text>
- lxiv ARPA-E Reauthorization Act of 2019, H.R. 4091, 116th Cong. (2019). <https://www.congress.gov/bill/116th-congress/house-bill/4091/text>
- lxv AIM Act of 2020, S. 2754, 116th Cong. (2020). <https://www.congress.gov/bill/116th-congress/senate-bill/2754>
- lxvi Diesel Emissions Reduction Act of 2019, S. 747, 116th Cong. (2019). <https://www.congress.gov/bill/116th-congress/senate-bill/747/text>
- lxvii USE IT Act, S. 383, 116th Cong. (2019). <https://www.congress.gov/bill/116th-congress/senate-bill/383/text>
- lxviii The SCALE Act, H.R. 1992, 117th Cong. (2021). <https://www.congress.gov/bill/117th-congress/house-bill/1992/text>
- lxix The American Nuclear Infrastructure Act of 2020, S. 4897, 116th Cong. (2020). <https://www.congress.gov/bill/116th-congress/senate-bill/4897/text>
- l American Nuclear Infrastructure Act of 2021, S. 2373, 117th Cong. (2021). <https://www.congress.gov/bill/117th-congress/senate-bill/2373/text>
- li Carbon Capture, Utilization, and Storage Tax Credit Amendments Act of 2021, S. 986, 117th Cong. (2021). <https://www.congress.gov/bill/117th-congress/senate-bill/986/text>
- lii The CATCH Act, H.R. 3538, 117th Cong. (2021). <https://www.congress.gov/bill/117th-congress/house-bill/3538/text>
- liiii The Clean Energy for America Act, S. 1298, 117th Cong. 2021, <https://www.congress.gov/bill/117th-congress/senate-bill/1298/text>
- liiv The GREEN Act, H.R. 848, 117th Cong. (2021). <https://www.congress.gov/bill/117th-congress/house-bill/848/text>
- liv The CLEAN Future Act, H.R. 1512, 117th Cong. (2021). <https://www.congress.gov/bill/117th-congress/house-bill/1512/text>
- lvi The Zero-Emission Nuclear Power Production Credit Act of 2021, H.R. 4024, 117th Cong. (2021). <https://www.congress.gov/bill/117th-congress/house-bill/4024/text>
- lvii The Securing America's Clean Fuel Infrastructure Act, S. 975, 117th Cong. (2021). <https://www.congress.gov/bill/117th-congress/senate-bill/975/text>
- lviii The American Jobs in Energy Manufacturing Act, S. 622, 117th Cong. (2021). <https://www.congress.gov/bill/117th-congress/senate-bill/622/text>
- lix The Fission for the Future Act, S. 3428, 117th Cong. (2021). <https://www.congress.gov/bill/117th-congress/senate-bill/3428/text>
- lx The SUPER Act of 2021, H.R. 4599, 117th Cong. (2021). <https://www.congress.gov/bill/117th-congress/house-bill/4599/text>