MANUFACTURING THE ADVANCED ENERGY FUTURE IN KENTUCKY



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Communities in Kentucky have long supplied a significant portion of the natural resources that powered the U.S. economy, namely coal. Since 1790, Kentucky has supplied more than 11 percent of all coal produced in the United States.¹ As global markets shift toward lower-carbon products, communities throughout Kentucky have the opportunity to turn their skills and competencies toward the advanced energy economy. Following a wave of recent investments, Kentucky is now a national leader in economic development, and additional state and federal support can help accelerate this momentum while strengthening the local infrastructure and workforce necessary to sustain it. This brief provides insights from a roundtable hosted in Lexington, Kentucky, in November 2024 that explored the Kentucky-specific market, infrastructure, and workforce considerations that can enable communities in the state to seize the opportunity of an advanced energy manufacturing industry. These insights are reflected in the included policy recommendations developed by participants directly during the event.

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INTRODUCTION

REGIONAL ROUNDTABLES

The United States and the world are transitioning to a low-carbon economy. Communities across the country have an opportunity to leverage their existing advantages to lead the transition while supporting good-paying jobs, attracting investment, and improving the local quality of life. While the low-carbon economy offers new opportunities for many communities, capitalizing on them will require proactively developing new strategies to attract investment.

The private sector is leaning in, and enabling federal and state policies have proven crucial to supporting community efforts to attract investment and grow a secure and resilient domestic advanced energy manufacturing base. Communities are best positioned to identify the opportunities they want to pursue, the challenges they will need to navigate, and which supports are most impactful. Local perspectives can offer unique and invaluable nuance and grounding to federal climate policy conversations.

The Center for Climate and Energy Solutions' (C2ES) regional roundtable program elevates the perspectives of community stakeholders to inform state and federal policy debates and identify concrete next steps to bring home the economic opportunity of investing in the low-carbon transition. Through interactive group discussions, educational programming, and informative sessions—supplemented with research and analysis— C2ES's regional roundtable program brings together leaders of business, government, and communities to explore these opportunities and develop collaborative policy solutions.

Our November 2024 roundtable, held in Lexington, Kentucky, brought together more than 30 participants representing companies, industry groups, state and local government, economic development professionals, nonprofits, academic experts, and others for a discussion focused on how Kentucky's key manufacturing competencies can be leveraged to produce a globally competitive advanced energy industry.

This brief summarizes key takeaways from the discussion and policy recommendations developed during the event in collaboration with and among participants.

KEY TAKEAWAYS FROM THE DISCUSSION

Roundtable participants were optimistic about the opportunity for Kentucky in the emerging advanced energy manufacturing economy. They pointed to recent momentum in attracting investment to the state, driven by more than \$7.6 billion in advanced clean energy industries, as a clear signal of the potential of these industries in the state.² These private sector investments, enabled by federal policies, have benefited the local workforce and communities across the commonwealth. Participants identified additional needs from private- and public-sector investments, including deeper investments in community and workforce development. Several key themes emerged from the discussion.

Companies are driving the transition to more sustainable products and energy sources

Participants across the private and public sector emphasized that markets are driving the transition to lower-carbon energy and more sustainable products globally. They cited low-carbon energy procurement and emissions reduction targets of major multi-national corporations, including companies based in Kentucky, as a significant driving force in decisions to deploy increasing volumes of low-carbon power generation. For example, Yum! Brands, a major food retailer headquartered in Louisville, set a target of reducing the emissions produced by its direct operations and the electricity required to power them—known as scopes 1 and 2 greenhouse gas

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emissions, respectively—46 percent by 2030 compared to 2019.³ In the manufacturing sector, Toyota Motor Company, whose largest global vehicle manufacturing plant is located in Kentucky, has a target of making more than 45 percent of its electricity purchases in North America from renewable sources by 2026, and aims to be carbon neutral at all of its manufacturing facilities by 2035.⁴ Even without a state-level emissions target—and without state support for lower-carbon electricity—utilities, companies, municipalities, and communities are looking to accelerate the build out of clean energy generation in the state to attract and retain companies with these emissions reduction targets.

Federal incentives are catalyzing clean energy investments in Kentucky's communities

While companies' interest in procuring clean energy is driving some new clean generation projects, the current pace of investment is insufficient to meet the scale of projected electricity demand. Roundtable participants highlighted the benefits of recent federal incentives that are tipping the economics in favor of building clean energy in Kentucky, catalyzing a rush of clean energy investments in the state. The clean electricity production and investment tax credits (sections 48E and 45Y), will incentivize the construction and operation of clean-electricity facilities needed to meet that demand.⁵ Additional incentives like the section 48C advanced energy project credit and the section 45X advanced manufacturing production credit support the domestic manufacture of products like batteries and components, solar and wind energy components, inverters, and other advanced energy products.6 With the bonus incentives across each of these tax credits for projects in 'energy communities'-that is, communities that have been hardest hit by coal mine and power plant closures, which encompasses most counties in Kentucky-the incentives are a significant driver of investment in the American advanced energy supply chain, particularly in Kentucky. Roundtable participants also highlighted federal direct investment in projects to develop advanced energy projects and promote research and development through grants and loans. One example of these is the Domestic Manufacturing Conversion Grants program through the U.S. Department of Energy's (DOE), which awarded more than \$6 million to the Kentucky Cabinet for Economic Development to support bolstering local electric vehicle manufacturing capacity and strengthen vehicle supply chains.7

Community and workforce development are central to people's ability to access these new opportunities

Roundtable participants were buoyed by the recent advanced energy investment momentum, and highlighted how important it will be for local workers and communities to share in the benefits these new opportunities bring to the state. This included a discussion of workforce development and training needs, as well as a conversation about expanding community infrastructure, such as investments in roads and bridges, housing affordability, and social infrastructure like childcare, healthcare, and transportation access. Participants identified the need to create a comprehensive, shared understanding among employers and workers in the commonwealth of what jobs in the emerging advanced energy manufacturing sector look like. This could include mapping what kinds of skills and certifications they require against the existing workforce's qualifications to demonstrating to prospective employees the value of a career in the sector. Additionally, participants discussed the physical needs of new facilities, such as electricity, water, access to transportation networks, and environmental remediation. They explored how communities and economic development organizations can proactively promote site readiness—for example, through redeveloping shuttered coal plant sites—to attract manufacturing investment to the areas where the workforce availability is greatest.

BOX 1: Policy Recommendations from the Discussion

ACCELERATE THE DEVELOPMENT OF THE NUCLEAR ENERGY SUPPLY CHAIN IN KENTUCKY

To demonstrate the opportunity for Kentucky to manufacture parts for the existing U.S. nuclear fleet, the Kentucky General Assembly should fund a study to identify what certifications (if any) are required for workers, which parts could be manufactured, and the standards that must be put in place to produce nuclear power plant equipment in Kentucky. Moreover, this would include determining if a new manufacturing line within an existing facility is required (or if they can be produced on existing production lines or if an entirely new facility would be required) to fabricate the equipment.

PROMOTE THE GLOBAL COMPETITIVENESS OF KENTUCKY-MADE PRODUCTS

To support Kentucky's global competitiveness in sustainable product/material manufacturing, the Kentucky General Assembly should dedicate resources to establish an interstate regional coalition across the southeast Ohio River Valley and Appalachia focused on transportation, manufacturing, and energy supply.

BUILD, EXPAND, AND RETOOL INFRASTRUCTURE TO SUPPORT ACCESS TO THE NEW ENERGY ECONOMY

To address the need for greater coordination between state, local, and federal government entities on energy infrastructure buildout, Congress should pass legislation to direct the U.S. Economic Development Administration (EDA) to establish a federal Office of Community Prosperity for Underserved Communities, with coordinating offices in all 50 states, as conduits for state, local, federal, and industry to access federal funds.

The Kentucky General Assembly should pass enabling legislation to support the development of a corresponding office at the state level.

PROMOTE WORKFORCE DEVELOPMENT FOR ADVANCED ENERGY MANUFACTURING IN KENTUCKY

To increase access to and utilization of workforce development opportunities, the Kentucky General Assembly should fund the creation of a comprehensive online database of workforce development resources and opportunities for area development districts, local governments, and local communities across the state.

DEVELOP THE INNOVATION ECOSYSTEM FOR ADVANCED ENERGY IN KENTUCKY

To equitably and transparently strengthen the innovation ecosystem in Kentucky, and across the country, Congress should establish a public/private partnership supporting a national Innovation & Entrepreneurship program that drives a graduated K-12 experiential learning program.

FRAMING THE DISCUSSION IN KENTUCKY

Kentuckians have long supplied the resources and power underpinning the American economy. For more than a century, the state has been one of the top producing coal states in the United States, producing 28.7 million tons in 2023. Kentucky is also the top per capita producer of cars, trucks, and light SUVs in the United States, exporting \$6 billion in automotive-related products in 2023.8 In Kentucky, workers and communities are proud of their legacy of hard work and sacrifice that built the state's energy and automotive industries. As global markets, like those in the European Union, implement policies to accelerate the shift to lower-carbon products, efforts to grow investment in these new industries will need to honor the legacy of Kentucky's workers and communities, and including their traditions, culture, and especially dignity, while also enabling them to remain globally competitive.

Kentucky has a large existing energy workforce, with more than 157,000 workers employed in industries relating to power production; fuels; transmission, distribution, and storage; energy efficiency; and motor vehicles across the state.⁹ According to the Kentucky Cabinet for Economic Development, one out of every 18 workers in the U.S. automotive industry work in Kentucky.¹⁰ Building on this existing industry, new manufacturing facilities for batteries, electric vehicles, and other advanced energy supply chain inputs are bringing tens of thousands of additional jobs to the commonwealth. The electric vehicle industry alone has brought an additional 10,280 expected full-time jobs since 2021.¹¹

Kentucky is largely rural: 93 of the state's 120 counties are defined as predominantly rural by the U.S. Census Bureau, and 54 counties are classified entirely rural (i.e., there is no designated urban area within their boundaries). Additionally, a large portion of the eastern part of the state is part of the Appalachian region.¹² This brings unique challenges to state and local government, economic developers, and companies looking to grow manufacturing facilities in locations accessible to the local workforce. Roundtable participants identified intentional statewide investment in community infrastructure that reaches all counties across the state as foundational to increasing local economic development opportunities. This infrastructure and community development will play a major role in Kentucky's ability to continue to attract private sector investment, build out new facilities, support a local, highly skilled workforce, attract and retain companies and workers, promote resiliency to extreme weather, and ensure that all Kentuckians are able to live in healthy and prosperous communities.

One of these infrastructure challenges is access to affordable and reliable power. As large manufacturing facilities move into the state, surrounding regions are seeing rapid increases in electricity demand. By 2032, utility Louisville Gas and Electric Company (LG&E) and Kentucky Utilities Company (KU) project energy requirements to grow by more than 30 percent from 2024 levels due to anticipated growth in data centers and other economic development projects.¹³ Roundtable participants identified distributed energy resources like solar generation as crucial components in the near-term future of the state's electric grid, while forecasting the need for longer-term investments in transmission, distribution, and storage to help deliver the electricity to facilities across the state.

RECENT MOMENTUM FOR ADVANCED ENERGY MANUFACTURING IN KENTUCKY

Since 2021, there has been a surge in investments announced in Kentucky. For the past 14 quarters, Kentucky has been a top-ten state nationally for economic development.¹⁴ The clean energy industry and its related supply chain has been leading this economic development, particularly the EV industry, which has seen major announcements across final assembly, battery and components manufacturing, and recycling.¹⁵ Other announcements have included low-carbon steel production, heat pump manufacturing, renewable energy development, and investments in the nuclear energy supply chain. Since 2021, \$14.6 billion in new clean energy project and manufacturing investment has been announced in Kentucky.¹⁶

Company	Location	Product	Planned Invest- ment	Reference
Ascend Elements	Hopkinsville	Battery recycling & cathode ac- tive material production	\$1 billion	https://ascendelements.com/ascend- elements-begins-construction-of-apex-1-in- southwestern-kentucky/
Canadian Solar	Shelby	Battery energy storage systems and cells	\$712 million	https://www.energy-storage.news/canadi- an-solar-to-manufacture-bess-and-cells-at- kentucky-plant-after-enervenue-backs-out/
Envision AESC	Bowling Green	EV and stationary storage bat- teries	\$2 billion	https://us.aesc-group.com/aesc-celebrates- structural-completion-milestone-at-state-of- the-art-gigafactory-in-bowling-green/
Ford and SK Innovation	Hardin County	EV batteries	\$6 billion	https://media.ford.com/content/fordmedia/ fna/us/en/news/2021/09/27/ford-to-lead- americas-shift-to-electric-vehicles.html
Hitachi Astemo Americas	Madison County	EV parts	\$153 million	https://www.kentucky.gov/Pages/Activ- ity-stream.aspx?n=GovernorBeshear≺ Id=1860
LioChem	Simpson County	EV batteries	\$104 million	https://ced.ky.gov/Newsroom/News- Page/20220126_LioChem
LOTTE	Elizabethtown	Aluminum cathode foil	\$239 million	https://www.lanereport. com/158178/2022/08/lotte-aluminum-to- build-239-million-facility-in-elizabethtown/
Mitsubishi	Maysville	Heat pumps	\$143.5 million	https://us.mitsubishielectric.com/en/news/ releases/global/2024/1213-a/index.html
Novelis	Guthrie	Automotive/aluminum recycling	\$365 million	https://www.novelis.com/guthrie/
Nucor	Brandenburg	Steel plates	\$1.7 billion	https://www.thomasnet.com/insights/nu- cor-breaks-ground-on-1-7-billion-kentucky- steel-mill/
Rivian	Bullitt County	Remanufacturing	\$10 million	https://ced.ky.gov/Newsroom/News- Page/20230427_Rivian
Toyota Motor North America	Georgetown	EV assembly	\$1.3 billion	https://pressroom.toyota.com/toyota-bring- ing-battery-electric-vehicle-production-to- kentucky/

TABLE 1: New advanced energy products manufacturing announcements since 2021

FEDERAL INCENTIVES

Recent federal investments, including funding and tax credits through the Inflation Reduction Act of 2022 (IRA), have had a significant positive impact on the economics of advanced energy projects in Kentucky. In particular, these investments have prioritized communities most "hard-hit by coal mine and coal power plant closures," which legislation refers to as energy communities. This also includes workers directly employed in coal mining and power generation, as well as workers in related jobs and who are dependent on coal-related tax revenue to fund community infrastructure.¹⁷ Many of the programs and incentives in the IRA include bonuses for projects sited in energy communities and aim to ensure the benefits of these federal investments reach these communities. Most counties in Kentucky fall under this designation (see Figure 1). Although the geography and climate of Kentucky does not make it the most economical to deploy solar and wind generation, federal incentives may be the tipping point for making a project economically feasible in communities across Kentucky. For example, the clean electricity production and investment credits (sections 45Y and 48E) will help to push the cost of wind low enough to make wind energy generation feasible in the state for the first time.¹⁸

Federal Tax Credits

Several key tax credits incentivize the production of advanced energy projects, with emphasis on critical components throughout the supply chain. Many encourage or require the inputs to be sourced domestically, further promoting the build-out of an end-to-end supply chain for advanced energy industries in the United States. Most of the supportive credits were either created or re-established by the IRA (see Table 2).

Federal Grants and Loans

Funded by the Infrastructure Investment and Jobs Act of 2021 (Bipartisan Infrastructure Law), the CHIPS and Science Act, and/or the Inflation Reduction Act, the U.S. Department of Energy and other federal agencies administer billions in funding to support the domestic production of advanced energy products. A few programs of particular interest to Kentucky include:

• The **Battery Manufacturing and Recycling Grants Program** is a \$3 billion program designed to provide grants to support demonstration projects, new commercial-scale facilities, and retrofitting or retooling of existing facilities to support battery component manufacturing, advanced battery manufacturing, and recycling.¹⁹ To date, 16 projects have been selected for these awards, including two projects by Ascend Elements in Hopskinsville, Kentucky.²⁰



FIGURE 1: Kentucky Counties meeting the "energy communities" definition

- The Industrial Training and Assessment Centers Implementation Grant Program is a \$400 million program designed to support facility modernization, including upgrades to reduce waste and pollution, across small- and medium-sized manufacturers.²¹ Three projects in Kentucky have received an award through this program to date, all with a focus on workforce development and deployment (WPT Corp in Beaver Dam, Highland Diversified Services in London, and the University of Louisville).²²
- Grants under the Defense Production Act support electric heat pumps, including \$250 million in funding to accelerate domestic production through workforce development, renovation of existing production facilities, and new facilities.²³ A subsidiary of Mitsubishi Electric, MELCO HVAC, received a \$50 million grant to retool its automotive component factory in Mayville, Kentucky, to produce compressors for electric heat pumps.²⁴
- The Advanced Energy Manufacturing & Recycling Grant Program, established by the Bipartisan Infrastructure Law, will award a total of \$750 million to support manufacturing projects in communities that have experienced closures of coal-related mines or power plants.²⁵ The program focuses on small- to

medium-sized manufacturers, supporting projects to build, expand, or re-equip facilities to produce or recycle advanced energy products and components.²⁶ To date, only \$350 million has been awarded across five projects (none in Kentucky), but the prevalence of communities in Kentucky that have been impacted by coal-related facility closures could creates an opportunity to apply for funds.

• The **Clean Energy Demonstration Program on Current and Former Mine Land** supports projects to deploy clean energy on operating, abandoned, or inactive mine lands, with the goal of creating replicable projects that can maximize local workforce development and community opportunities.²⁷

STATE PROGRAMS

The state's energy strategy, known as KYE3 and led by Governor Andy Beshear, sets out a long-term strategic vision for the state built around the pillars of energy, environment, and economic development.²⁸ Though the state has been very supportive of new advanced energy manufacturing facilities, there is little state funding to support advanced energy deployment, and the state relies largely on federal programs.

TECHNOLOGY-SPECIFIC OPPORTUNITIES

Roundtable participants shared optimism about the opportunity to support a wide variety of advanced energy technologies, including electric vehicle batteries, material inputs for clean energy generation, sustainable aviation fuel (SAF), clean hydrogen, minerals processing, and nuclear power.

ELECTRIC VEHICLE BATTERIES AND SUPPLY CHAIN

Perhaps the most visible advanced energy opportunity in Kentucky is the electric vehicle (EV) and battery supply chain, with forthcoming production facilities bringing billions of dollars in investment to the state. Investments like the BlueOval SK Battery Park in Hardin County and the Envision AESC lithium-ion battery factory in Bowling Green is expected to create thousands of jobs in the local communities while helping to onshore battery production capacity to the United States.²⁹

In addition to battery production, there are growing investments in battery recycling in the state. This represents another crucial component of the domestic battery supply chain that can reduce waste and strengthen domestic critical mineral security by enabling the reuse of the valuable materials within spent batteries. For example, in Hopkinsville, Ascend Elements is building a major facility that will recycle batteries and produce pCAM, the precursor materials to cathode active materials, as well as lithium carbonate, a crucial input to new batteries.³⁰ Roundtable participants were optimistic about the opportunity for Kentucky to become a leader in both the production of battery materials and the batteries themselves.

INPUTS FOR CLEAN ENERGY GENERATION

The United States lacks a complete domestic supply chain for producing clean energy products, particularly for critical minerals. The U.S. Department of Energy calls these "capabilities of concern." These are critical components needed for clean energy generation that are not yet produced at scale in the United States, and they represent an opportunity for Kentucky's experienced metals and manufacturing industries to grow to fill some of the domestic supply gap. They include: "neodymium magnets manufacturing for wind and electric vehicle motors; large iron and steel castings for wind turbines, hydropower turbines, and nuclear reactor components; specialized steel plate for offshore wind; grain oriented electrical steel for larger transformers; [high-assay lowenriched uranium] (HALEU) and advanced fuels for nuclear energy; and silicon wafers for solar PV."31

Companies in Kentucky are already working to address these "capabilities of concern." For example, steel company Nucor expanded its steel mill in Brandenburg and has dedicated some of its expanded production line to producing steel for offshore wind energy.³² Other companies, like Roberson Machine Company in Louisville, manufacture solar panels and precision parts.³³ With more than 250 metals facilities employing more than 36,000 workers in Kentucky, the state has an opportunity to leverage its expertise and capacity in the metals industry to serve advanced energy components.³⁴

SUSTAINABLE AVIATION FUEL

Sustainable aviation fuel (SAF) is a drop-in replacement for traditional petroleum-based jet fuel, made from more sustainable materials and with significantly lower lifecycle emissions. Although there are many pathways to produce SAF, agricultural resources like vegetable oils, animal fats, corn grains, and waste products are often utilized in its production.³⁵ Kentucky's growing agricultural sector produces \$1.46 billion in corn and more than \$1 billion in cattle, creating an opportunity for it to be a producer of feedstocks for SAF.³⁶

There is growing demand in the state and beyond for SAF. Locally, the Cincinnati/Northern Kentucky International Airport (CVG) has a commitment to reach net zero in their carbon emissions by 2050, and has pledged to enable the use of SAF onsite.³⁷ On the carrier side, Amazon Air launched an air cargo hub at CVG in 2021, and the company has plans to use SAF across its operations.³⁸

Kentucky's agricultural resources, combined with its competencies in chemical engineering, create an opportunity for Kentucky companies and workers to support the development of a SAF industry serving CVG and beyond.

CLEAN HYDROGEN

The Bipartisan Infrastructure Law created a \$7 billion program to establish a set of hydrogen hubs across the United States to accelerate the development and utilization of clean hydrogen.³⁹ The Appalachian Regional Clean Hydrogen Hub (ARCH2), a collaboration across West Virginia, Ohio, and Pennsylvania, was awarded a hub designation to produce hydrogen and build out regional hydrogen fueling stations.⁴⁰ Although Kentucky is not part of the hub, it is close to the planned facilities, providing opportunities to engage. The project will utilize a combination of biomass, clean electricity, and natural gas as inputs to produce clean hydrogen, creating an avenue for Kentucky producers to supply such inputs to the project. Additionally, the development of clean hydrogen fueling infrastructure will support the expansion of hydrogen fuel cell trucking across the entire Appalachian region. The state is already host to portions of the supply chain, as Toyota operates a hydrogen fuel cell module manufacturing facility in Georgetown, Kentucky.41

MINERAL PROCESSING

Across the advanced energy sector, materials like lithium, cobalt, graphite, nickel, copper, and rare earth elements are critical to the supply chain for production of components and products. As the global advanced energy economy grows, demand for these critical materials is projected to rise significantly—demand for lithium rose 30 percent in 2023 alone, and the International Energy Agency (IEA) projects mineral demand for clean energy technologies will double between 2024–30.⁴² By 2040, the IEA projects the combined market value of these "key energy transition materials" will reach \$770 billion by 2040.

Presently, the global minerals economy is dominated by Latin America, Africa, and Asia, and China controls most of the refining and processing capacity globally.⁴³ To accelerate the development of a domestic American supply chain for these minerals—an interest for both American energy and technology companies and national security purposes—the United States must invest significantly in securing sources of mineral extraction and processing. Given Kentucky's long history of expertise in mineral extraction and processing, particularly through its experience in the coal industry, the state is well positioned to support the development of this domestic supply chain. The Eastern and Western Kentucky Coal Fields represent opportunities on both the eastern and western sides of the state to explore the mineral extraction opportunity.

Participants highlighted coal ash as a prospect to source rare earth minerals in Kentucky. When coal is combusted, rare earth metals accumulate in the ash left behind. According to a recent report by the University of Texas, around 70 percent of the coal ash produced from 1985–2021 could be reprocessed for rare earth element extraction.⁴⁴ Additionally, the coal ash derived from the Appalachian Basin, which includes the Eastern Kentucky Coal Field, has the highest concentration of rare earth elements by value of any geographic region in the United States.⁴⁵

Investing in these coal ash processing capabilities to extract rare earth elements could produce significant revenue in the state while capitalizing on the competencies of the communities surrounding coal plants that have operated related infrastructure and processes for decades. The University of Kentucky has already begun innovating a system for separating out the rare earth elements through an integrated physical and chemical separation process based on currently commercially available and environmentally sound processes.⁴⁶

NUCLEAR ENERGY

Although Kentucky does not currently have nuclear energy generation capacity, the state is exploring its options to build nuclear generation through a partnership with the U.S. Department of Energy's Gateway for Accelerated Innovation in Nuclear (GAIN), and at least one utility is considering building an advanced nuclear reactor.47 The Kentucky state legislature directed the state Nuclear Energy Development Working Group to explore opportunities to develop nuclear in Kentucky. According to their 2023 report, there are "no insurmountable barriers to nuclear energy development in Kentucky," although significant regulatory, policy, statutory, financial, social, workforce and education, safety, and environmental challenges remain.48 The report identifies the local benefits of nuclear power to be "reliable, low-carbon electricity and heat," as well as the "potential to create high-paying jobs with concentrated economic benefits for communities most impacted by the energy transition away from conventional fossil resources."49

While roundtable participants were excited about the opportunity to develop nuclear generation in the state, they placed higher emphasis on the nearer-term opportunity for Kentucky to supply fuel and component parts to the U.S. nuclear fleet, which is projected to grow as other states look to grow their energy supply to keep pace with rapidly rising demand while meeting emissions targets.⁵⁰ For instance, the Paducah Gaseous Diffusion Plant-a former uranium enrichment facility that DOE now owns while the plant undergoes environmental remediation and decommissioning-is located in the western part of the state.⁵¹ DOE and the local Paducah community are exploring opportunities to redevelop the site following completion of remediation and cleanup activities. Roundtable participants suggested this facility, and others across the state, could be retooled to supply high-demand inputs for nuclear power generation.

Policy Recommendation: Accelerate the development of the nuclear energy supply chain in Kentucky

To demonstrate Kentucky's opportunity to manufacture parts for the existing U.S. nuclear fleet, the Kentucky General Assembly should fund a study to identify: (1) what certifications (if any) are required for workers, (2) which parts could be manufactured, and (3) the necessary to produce nuclear power plant equipment. Moreover, the study should determine the investment needed to fabricate the equipment (i.e., if parts can be produced on existing production lines, if a new manufacturing line within an existing facility is required, or if an entirely new facility would be required).

Kentucky already possesses the facilities and skilled labor force to manufacture new parts for industrial facilities, including pumps, pipes, valves, and other components. As the U.S. nuclear power plant fleet ages, Kentucky can produce new parts that routine maintenance requires. However, these parts must be produced according to specific standards.

To date, the Nuclear Energy Development Working Group has explored in-depth the opportunity to develop nuclear energy in the state, but a comprehensive analysis of the opportunity for the state to develop nuclear energy generation inputs and component parts is needed. This must include both a review of the existing capacity as well as a consideration of what is needed to expand this capacity. Additionally, it must also consider and clarify the necessary safety, regulatory, and statutory qualifications for inputs in the nuclear energy supply chain.

PROMOTING THE GLOBAL COMPETITIVENESS OF KENTUCKY-MADE PRODUCTS

The global market for clean energy technologies is projected to reach more than \$2 trillion by 2035, almost tripling from its 2023 value of around \$700 billion.⁵² In the United States, an emerging "battery belt" of electric vehicle and battery production and recycling is emerging across the Southeast and Midwest, and states from Oklahoma and Wyoming to Virginia and New York are deploying onshore and offshore wind and solar generation at a rapid pace. Kentucky is located no more than a day's drive from 34 states and 65 percent of the country's population.⁵³ This central location, combined with a strong rail and maritime transportation network, as well as Kentucky's existing energy and manufacturing capacity, make it a compelling state for new investment to produce advanced energy products.

At the same time, Kentucky will be in competition with other states and countries to serve this domestic and global demand. Lower emissions production processes and access to low-carbon electricity could be the deciding factors in the ability of Kentucky's industries to compete in the global market.

CARBON BORDER ADJUSTMENT MECHANISM ENCOURAGES EMBODIED CARBON EMISSIONS REDUCTIONS

Alongside the rising global demand for advanced energy products, foreign countries are starting to put a carbon price on covered imported goods to ensure their ambitious climate action does not disadvantage companies against cheaper carbon-intensive imports. The European Union, for example, will begin applying its Carbon Border Adjustment Mechanism (CBAM) beginning in 2026.54 Under the EU CBAM, importers will be required to purchase certificates equal to the total embedded emissions of the covered good each year. The price of the CBAM certificate will be based on the weekly average auction price of EU ETS allowances. If a non-EU producer can show that they already paid a price for carbon emitted during production of the imported good, then that price can be deducted from the CBAM fee paid by the importer. The first phase of this program has already begun, requiring importers of certain goods to report on the direct and indirect greenhouse gas emissions from their production.

Under a CBAM, goods with lower embodied emissions will face lower import duties, which could grant them a

competitive advantage over high-emission counterparts. This has significant implications for the competitiveness of manufactured goods in markets that export a large percentage of their products to the EU. Of the \$40 billion of manufactured goods produced in Kentucky annually, \$9.6 billion—nearly 25 percent—is exported to the European Union.⁵⁵ Although not all sectors are currently covered by the EU CBAM, the EU is planning to assess and expand coverage by 2030. To remain competitive as an exporter, Kentucky must enable access to energy and production processes that support the competitiveness of its companies in European markets.

Moreover, other countries are getting serious about CBAMs. The United Kingdom is planning to implement their CBAM starting in 2027, and other countries are considering implementing their own respective CBAMs. There is antidotal evidence that other countries that rely significantly on the European market are creating their own carbon pricing program to maintain market access and to capture the carbon pricing revenue that would otherwise go to the EU.⁵⁶ For example, China is considering adding CBAM-exposed sectors to its emissions trading scheme.⁵⁷ Manufacturers in Kentucky can prepare for this possibility by accelerating their emissions reductions through the utilization of low-carbon power and industrial processes.

CORPORATE CARBON-NEUTRALITY TARGETS CRE-ATE PRESSURE TO MAKE LOW-CARBON POWER ACCESSIBLE

In addition to national and regional emissions policies, corporations are setting increasingly ambitious emissions and renewable energy procurement targets that influence their siting and operations decisions. Of the largest 2,000 publicly traded companies globally by revenue, almost 1,200 have some form of a net-zero target, whether pledged, integrated into their corporate strategy, or already achieved.58 Automakers including General Motors, Ford, Toyota, Volkswagen, Volvo, BMW, Mercedez-Benz, Land Rover, and Ferrari have made commitments to reach net-zero emissions or carbon neutrality across their entire value chains by 2050.59 In the metals industry, the Global Steel Climate Council represents 21 major steel producers committed to reaching net-zero emissions by 2050, and major aluminum companies including Alcoa (which operates an aluminum smelter on the Kentucky

border) have endorsed a strategy to achieve net-zero emissions by 2050.⁶⁰ Companies across Kentucky's key industries, including the distilling industry, are also setting similar targets. Brown-Forman, headquartered in Louisville, has a target of cutting emissions in half by 2030 and reaching net-zero by 2040.⁶¹ This includes a target of sourcing 100 percent of its electricity from renewable sources by 2030.

Taken together, this private-sector shift toward prioritizing emissions reductions heightens the need to offer access to low-carbon electricity. Although Kentucky's overall energy consumption has been generally declining since the early 2000s, its share of renewables has slowly increased, reaching 8 percent in 2022 (see Figure 2).⁶² This is still significantly below the national average of 20 percent.⁶³ For Kentucky to be able to compete with other states offering access to low-carbon electricity, it must advocate for streamlining the federal permitting and interconnection processes for renewable and low-carbon electricity sources. And, for a state long regarded for its inexpensive industrial electricity rates, it must maintain cost-effectiveness.

Recommendation: Promote the global competitiveness of Kentucky-made products

To support Kentucky's global competitiveness in manufacturing, the Kentucky General Assembly should dedicate resources to establish an interstate regional coalition across the southeast Ohio River Valley and Appalachia focused on transportation, manufacturing, and energy supply.

Collaborating across states can help each state leverage its comparative advantages across industries and natural resources, while enabling the region as a whole to have greater buying power and share best practices across workforce development and infrastructure investments. One example of such an interstate coalition is the Heartland Advanced Medical Manufacturing Regional Cluster (HAMMRC).⁶⁴ The collaboration aims to "attract, develop, and retain a professional healthcare manufacturing presence in the Northwest Arkansas and Northeast Oklahoma region with the primary objective of developing the region into one of the top 20 healthcare destinations in the world."65 Through the coalition, partners pool resources on workforce development and best practices for site readiness, while creating political support for passing enabling legislation in both states.



FIGURE 2: Kentucky Energy Consumption by Fuel, 1960-2022

BUILDING, EXPANDING, AND/OR RETOOLING INFRASTRUCTURE TO SUPPORT ACCESS TO THE NEW ENERGY ECONOMY

Kentucky's existing infrastructure and legacy of leadership in the energy and manufacturing industries make it an attractive location to build, expand, and retool existing infrastructure to support access to the new energy economy. Kentucky's central location creates an advantage in supplying inputs and finished products to major markets across most of the United States, with 34 states just a day's drive away.⁶⁶ In addition to highway access, the state has access to multi-modal transportation corridors including rail and maritime that can help products reach demand centers elsewhere (see Figure 3). Roundtable participants highlighted the value of these resources, as well as the significant investments in infrastructure improvements necessary to secure their future safety and functionality.⁶⁷ The American Society of Civil Engineers, for example, rated Kentucky's infrastructure a C- in 2019, identifying a need for a "big-picture approach to infrastructure investment," additional investments in Kentucky's multimodal freight network to eliminate bottlenecks and prepare for the future, and significant funding for rural communities to address "dilapidated infrastructure systems."68

Sites surrounding current and retired coal plants are rich in the capital that can make them attractive to

advanced energy industries, such as a skilled workforce, electric sector infrastructure (i.e., transmission lines and substations), and rail and maritime transport access. Many of these sites, as well as other kinds of brownfields, can be remediated and revitalized to host new industrial projects through the Kentucky Brownfield Program, which offers resources for technical assistance and access to federal and state funding, among other offerings.⁶⁹

Kentucky is also a hub for the manufacturing of vehicles and parts throughout the automotive supply chain, as well as other heavy industries. In 2023, the state's exports of motor vehicles and parts totaled \$5.4 billion, and the Kentucky Automotive Industry Association estimates that around two-thirds of Kentucky counties have at least one employer within the automotive manufacturing, service, and/or technology sector.⁷⁰ These assets are directly applicable to new industries such as the electric vehicle and battery industries, as well as other kinds of advanced energy development. Kentucky's communities and workers have the expertise, infrastructure, supply chain networks, and other core competencies to help them lead in the manufacture of advanced energy products.



FIGURE 3: Kentucky's Maritime, Rail, and Highway Infrastructure

PROMOTING COMMUNITY INFRASTRUCTURE AND ECONOMIC DEVELOPMENT

Appalachian states, including Kentucky, have a regional identity rooted in a deep history of production for the coal and automotive industries. Roundtable participants emphasized the importance of this proud, deep-rooted regional identity. They agreed that efforts to promote community development in this region must respectfully acknowledge and build upon this regional identity rather than trying to reinvent it.

Local economic development participants raised that access to infrastructure—whether physical infrastructure like roads and bridges or community infrastructure like access to housing and social services—is a major challenge. They highlighted that, particularly in the rural areas of the state, transportation infrastructure may be inadequate, and access to healthcare, housing, childcare, and other services may be limited. This can exacerbate barriers to communities' ability to reap the benefits of new facilities in the state and prevent workers from making the most of job opportunities.

Participants called for greater investment in coordinated community economic development among the public and private sectors, led by the Kentucky Cabinet for Economic Development and, at the local level, the Kentucky Area Development Districts.⁷¹ They recommended that community economic development research and planning utilize participatory action and bring in communities and workers from the very beginning. This can build buy-in among communities and ensure research and planning efforts are reflective of conditions on the ground.

Transportation is a particular challenge. Due to the geographic distribution of Kentucky's population, and the rural nature of many counties, new facilities may create a significant need for jobs in regions geographically removed from where there are greater concentrations of job seekers. Additional transportation infrastructure, particularly highway and rail infrastructure, is crucial to enabling these job seekers to reach sites with employment opportunities.

Recommendation: Build, expand, and/or retool infrastructure to support access to the new energy economy

To address the need for greater coordination between state, local, and federal government entities on energy infrastructure buildout, Congress should pass legislation to require the U.S. Economic Development Administration (EDA) to establish a federal Office of Community Prosperity for Underserved Communities, with offices in all 50 states, as conduits for state, local, and federal government, as well as industry. The Kentucky General Assembly should pass enabling legislation to support the development of a corresponding coordinating office at the state level that can help distribute federal funding while helping to identify the communities most in need of investment.

In 2019, the U.S. Department of Agriculture launched the Centers of Community Prosperity initiative, a \$4 million funding program to support socially disadvantaged farmer and rancher communities across the United States.⁷² The program facilitated partnerships among community organizations and offered capacity building support for rural and underserved areas of the United States.⁷³

Roundtable participants recommended a similar initiative focused more broadly on energy infrastructure buildout in underserved communities across the nation. They suggested such an initiative would be most impactful with corresponding state leadership to promote coordination with federal efforts and ensure federal investment is fully utilized to support Kentucky's communities. State legislators could look to Michigan's Office of Rural Prosperity, for example, as a model for a state-level initiative.⁷⁴

PROMOTING WORKFORCE DEVELOPMENT FOR ADVANCED ENERGY MANUFACTURING IN KENTUCKY

As new facilities produce thousands of jobs in construction and operations, Kentucky has seen a steady rise in employment, recovering to pre-pandemic levels by 2022 and surpassing them in 2023 (see Figure 4).75 Although overall unemployment in Kentucky remains above the national average (5.2 percent in Kentucky vs. 4.2 percent nationwide in April 2025), roundtable participants shared concerns that growing advanced energy manufacturing developments in the state might outpace the availability of a trained and skilled workforce to meet their labor needs.⁷⁶ Representatives of companies, economic development, and workforce organizations highlighted a need for investment to grow the local advanced energy manufacturing and installation workforce, particularly through skills training and certification for young workers. They also suggested much of the anticipated gap can be filled by recruiting workers from other states, as well as recruiting from groups that may experience higher barriers to entry to the workforce, such as veterans, formerly incarcerated workers, and workers with disabilities.

As new advanced energy industries continue to offer opportunities for Kentucky's communities and workers, workforce development programs must address gaps among the existing workforce and prepare recent entrants to the workforce for the new skills and competencies needed to succeed in the evolving industry.

Jobs in the advanced energy manufacturing and deployment industries often require new, specialized skill sets. Battery manufacturing and testing, for instance, necessitates specific safety training and competencies, in addition to engineering and manufacturing competencies. For example, the Institute of the Motor Industry (IMI), a UK-based independent organization, offers several levels of internationally accepted EV battery safety certifications, which it recommends for all workers who may come into contact with a high-voltage battery, whether in manufacturing, service, or dismantling.⁷⁷ There is a network of similar training programs that exists to help potential workers gain the skills necessary to participate in new industries, but the programs are often not easily visible to individuals or economic development professionals.

Intentional efforts are necessary to raise awareness among regional economic development agencies of the opportunities available to communities to access state and federal funding and workforce training programs. Policymakers and trusted community partners like academic institutions should familiarize themselves with and lead these awareness and information-sharing efforts about opportunities well-suited to their communities.

Recruiting new workers into programs is only one facet of the issue. Retention of workers—particularly skilled workers educated at Kentucky universities—is another key challenge to ensuring a skilled workforce in the state. Participants emphasized that community leaders, state government, academic institutions, and employers must promote worker retention by ensuring a Kentucky-educated workforce feels they can continue to live in their home state.



FIGURE 4: Kentucky employment numbers in the Manufacturing and Construction Sectors

One aspect of worker recruitment and retention is the support ecosystem that enables workers to access jobs and be fully present at work. This includes expanded access to wraparound services like childcare, broadband, transportation, opioid abuse prevention and treatment, and housing to develop communities that workers want to move to and stay in.

Policy Recommendation: Promote workforce development for advanced energy manufacturing in Kentucky

To increase access to and utilization of workforce development opportunities, the Kentucky General Assembly should fund the creation of a comprehensive online database of workforce development resources and opportunities for area development districts, local governments, and local communities across the state.

Efforts are beginning in Kentucky to convene manufacturers across the industries with the goal of mapping common skills, job duties, certification needs, and workforce training programs. For example, Kentucky is one of the first states in the country to pilot a talent pipeline management program through the U.S. Chamber of Commerce Foundation.⁷⁸ Led by the Kentucky Chamber of Commerce Foundation, the program is facilitating employer-led collaboration to align education and workforce needs with offerings in the state. However, especially for the emerging advanced energy industry, there is not yet a comprehensive, publicly accessible database that employers and workers across the state can use to explore and connect to these opportunities.

The Michigan Electric Vehicle Jobs Academy (EVJA) can serve as a model for an online portal centralizing information about job opportunities, necessary qualifications, possible career paths, and supportive funding like tuition assistance.⁷⁹ A similar state-wide and industry-specific database in Kentucky could help serve local needs and promote coordination among the many employers and economic development areas.

DEVELOPING THE INNOVATION ECOSYSTEM FOR ADVANCED ENERGY IN KENTUCKY

Investing in an entrepreneurship- and startup-friendly innovation ecosystem across Kentucky could create jobs while helping the state become a key player in the advanced energy economy. One organization working to support advanced energy innovation in the state is the Regional Energy Business, Education, and Commercialization Convergence Accelerator (REBECCA) Tech Hub, one of 31 tech hubs across the nation supported by the U.S. Economic Development Administration (EDA).⁸⁰ Through collaborative partnership across companies, academic institutions, local government, and nongovernment organizations, the consortium aims to promote local workforce development and innovation to advance the energy sector.⁸¹

Roundtable participants highlighted the benefits of collaboration among economic or political regions that can promote joint success. They emphasized that regional investment must transcend county boundaries in Kentucky to promote collaboration by leveraging the unique strengths of nearby communities, rather than forcing competition between counties that stretches resources and stifles innovation.

Policy Recommendation: Develop the innovation ecosystem for advanced energy in Kentucky

To equitably and transparently strengthen the innovation ecosystem in Kentucky, and across the country, Congress should establish a public-private partnership supporting a national innovation & entrepreneurship program that leads a graduated K–12 experiential learning program.

Building on the EDA tech hubs model, participants recommended a nationwide commitment to facilitate innovation and entrepreneurship. Public-private partnerships (PPPs) have been demonstrated to promote improved outcomes by helping to de-risk public spending and promote innovation.⁸² Coupled with experiential learning (i.e., educational programming designed to utilize applied learning oriented toward career-related learning opportunities), such an investment could accelerate American innovation and entrepreneurship from K–12 classrooms through the workforce.⁸³

CONCLUSION

As recent momentum has demonstrated significant opportunities for Kentucky to leverage its infrastructure and human capital in the emerging advanced energy economy, further state and federal investment is necessary to continue to attract investment and preserve or even expand the global competitiveness of Kentuckymade products. Roundtable participants were optimistic about the opportunity for the state, but noted that significant investment in workforce and community development are necessary to ensure communities are able to support these emerging industries and enjoy the benefits they bring to the Commonwealth.

Additional C2ES Resources

C2ES Regional Roundtables https://www.c2es.org/accelerating-the-us-net-zero-transition/regional-roundtables/

Scaling Sustainable Aviation Fuel in Washington State https://www.c2es.org/washington-roundtable-sustainable-aviation-fuel

Firing Up Clean Hydrogen in Texas https://www.c2es.org/document/firing-up-clean-hydrogen-in-texas/

Creating a Circular Economy for Critical Materials in Ohio https://www.c2es.org/document/creating-a-circular-economy-for-critical-materials-in-ohio/

Deploying Long-Duration Energy Storage in Virginia https://www.c2es.org/document/deploying-long-duration-energy-storage-in-virginia/

Energizing the Future Mobility Workforce in Michigan *https://www.c2es.org/document/energizing-the-future-mobility-workforce-in-michigan*



TABLE A: Tax credits supporting clean energy generation

Tax Credit Name	IRS Section	Function	Base Value	Bonuses & Limitations	Domestic Content Requirements	Time Scale	Reference
Clean Electric- ity Investment Credit	48E	Incentivizes the develop- ment of zero-emissions electricity generation and energy storage tech- nologies.	6 percent of qualified investment	Prevailing Wage and Apprenticeship: x5 or +30% Energy Community Bonus: +10 percentage points Cannot be claimed with 45Y	+10 percentage points	For facilities placed into service after Dec. 31, 2024. Phases out begin- ning in 2032 or when U.S. greenhouse gas emissions from electric- ity are 25 percenter or fewer of 22 emissions.	https://www.irs.gov/ credits-deductions/ clean-electricity-invest- ment-credit
Clean Electric- ity Production Credit	45Y	Incentivizes the opera- tions of zero-emissions electricity generation and energy storage tech- nologies.	0.3 cents/kWh of elec- tricity producted (base credit of 1.5 cents/kWh for small facilities with an output of < 1MW)	Prevailing Wage and Ap- prenticeship: Required for small facilities Energy Community Bonus: +10 percentage points Eligible for direct pay- ment or transfer. Cannot be claimed with 48E.	+10 percentage points	For facilities placed into service after Dec. 31, 2024. Phases out begin- ning in 2032 or when U.S. greenhouse gas emissions from electric- ity are 25 percenter or fewer of 22 emissions.	https://www.irs.gov/ credits-deductions/ clean-electricity-produc- tion-credit
Clean Fuel Pro- duction Credit	45Z	Incentivizes the domes- tic production of clean transportation fuels, including sustainable aviation fuel (SAF) and non-SAF transportation fuel.	product of the amount per gallon of transporta- tion fuel produced/sold and the emissions factor of the fuel	Prevailing Wage and Apprenticeship: N/A Energy Community Bonus: N/A Must register as fuel producer to claim credit. SAF must produce at least 50 percent fewer lifecycle emissions than conventional jet fuel.	required	Available beginning January 1, 2025.	https://www.irs.gov/ credits-deductions/ clean-fuel-production- credit
Credit for Carbon Oxide Sequestration	45Q	Incentivizes the capture and geologic storage or utilization of carbon oxide at a qualified in- dustrial facility or direct air capture facility.	\$17/metric ton for geologic sequestered carbon; \$12/metric ton for injected carbon for enhanced oil or natural gas recovery; or \$36/ metric ton for direct air capture facilities	Prevailing Wage and Ap- prenticeship: x5 Energy Community Bonus: N/A Eligible for direct pay- ment or transfer.		Construction of qualified facility must beghin before Jan. 1, 2033.	https://www.irs.gov/ credits-deductions/ credit-for-carbon-oxide- sequestration

Tax Credit Name	IRS Section	Function	Base Value	Bonuses	Domestic Content Requirements	Timescale	Reference
Advanced Energy Project Credit	48C	Incentivizes the invest- ment in advanced en- ergy projects, including: re-equipping, expand- ing, or establishing an industrial or manufactur- ing facility to produce or recycle advanced energy; installing tech- nology at an industrial or manufacturing facility to reduce greenhouse gas emissions at least 20 percent; or requipping, expanding, or establish- ing an industrial facility to process, refine, or recycle critical materials.	6 percent of qualified investment	Prevailing Wage and Apprenticeship: 30 % of qualified investment Energy Community Bonus: N/A Allocated by the U.S. Department of Energy Office of Manufactur- ing and Energy Supply Chains (MESC). A total of \$10 billion has been al- located for credits under the Inflation Reduction Act, with \$4 billion set aside for projects in energy communities.			https://www.energy.gov/ infrastructure/qualifying- advanced-energy-proj- ect-credit-48c-program; https://www.irs.gov/ credits-deductions/busi- nesses/advanced-energy- project-credit
Advanced Manufactur- ing Production Credit	45X	Incentivizes the produc- tion of solar energy com- ponents, wind energy components, battery components, inverters, and critical minerals produced in the United States or its territories.	energy production, transmission, or storage technologies receive credits proportional to their capacities; subcomponent goods receive either flat credits or credits proportional to the subcomponents' size or weight; critical minerals and electrode active materials receive credits of 10 percent of the production costs. Offshore wind vessels receive a credit equal to 10 percent of the vessel's sales price.	Prevailing Wage and Apprenticeship: N/A Energy Community Bonus: N/A		With the exception of credits for critical miner- als, full credits for goods sold from 2023-2029, 75 percent of normal credit amounts for goods sold in 2030, 50 percent for goods sold in 2031, and 25 percent for goods sold in 2032.	https://crsreports.con- gress.gov/product/pdf/IF/ IF12809

TABLE A: Tax credits supporting clean energy generation (cont.)

Tax Credit Name	IRS Section	Function	Base Value	Bonuses	Domestic Content Requirements	Timescale	Reference
Zero-emission Nuclear Power Production Credit	45U	Incentivizes the produc- tion of electricity at a qualified nuclear power facility.	0.3 cents/kWh, inflation adjusted after 2024	Prevailing Wage and Ap- prenticeship: x5 or +30% Energy Community Bonus: N/A Eligible for direct pay- ment or transfer.		For electricity produced and sold beginning after Dec. 31, 2023, and before Jan. 1, 2033.	https://www.irs.gov/ credits-deductions/zero- emission-nuclear-power- production-credit
Clean Hydro- gen Production Credit	45V	Incentivizess the produc- tion of clean hydrogen.	\$0.60/kg, based on the lifecycle greenhouse gas emissions of the process used to produce the clean hydrogen: 100 percent for hydrogen produced with <0.45 kg CO2e/kg H2; 33.4 per- cent for hydrogen pro- duced with 0.45-1.5 kg CO2e/kg H2; 25 percent for hydrogen produced with 1.5-2.5 kg CO2e/ kg H2; 20 percent for hydrogen produced with 2.5-4 kg CO2e/kg H2.	Prevailing Wage and Apprenticeship: x5 Energy Community Bonus: does not apply Eligible for direct payment or transfer.	does not apply	Qualified property must be placed in service after Dec. 31, 2022.	https://www.feder- alregister.gov/docu- ments/2025/01/10/2024 -31513/credit-for-produc- tion-of-clean-hydrogen- and-energy-credit
Clean Vehicle Purchase In- dividual Tax Credit	30D	Incentivizes the purchase of an electric or hydro- gen fuel cell vehicle for individual use.	\$2,500, plus \$417 for a vehicle with at least 7kWh of battery capac- ity; plus \$417 for each kWh of battery capacity beyond 5kWh	Prevailing Wage and Ap- prenticeship: N/A Energy Community Bonus: N/A Vehicle must be as- sembled in North America; must meet critical mineral and bat- tery component require- ments (a portion of these materials and compo- nents must be produced in the United States or a country with which the United States has a free trade agreement)		For vehicles purchased from 2023-2032.	https://www.irs.gov/ credits-deductions/ credits-for-new-clean- vehicles-purchased-in- 2023-or-after

TABLE A: Tax credits supporting clean energy generation (cont.)

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