ESS INC

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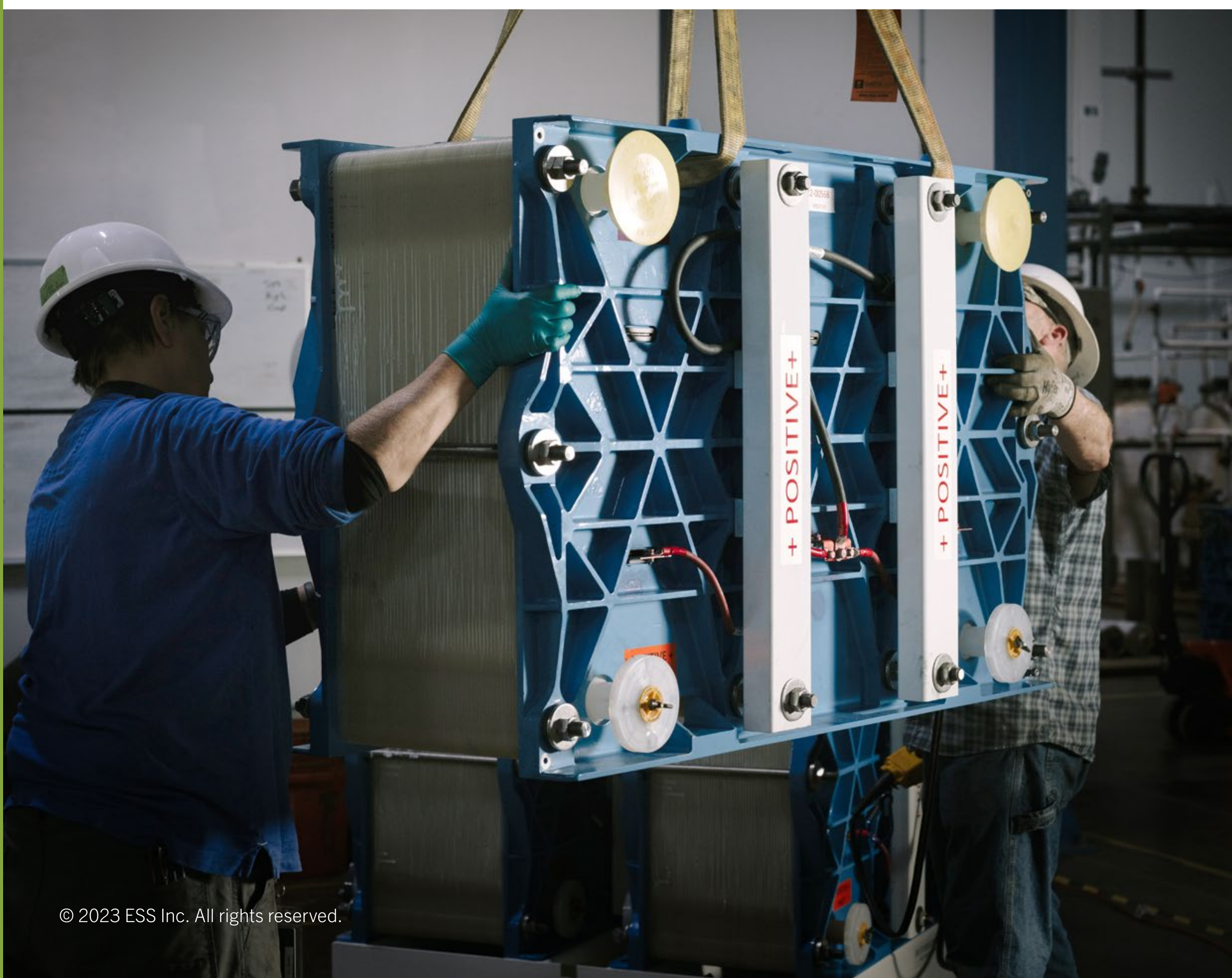
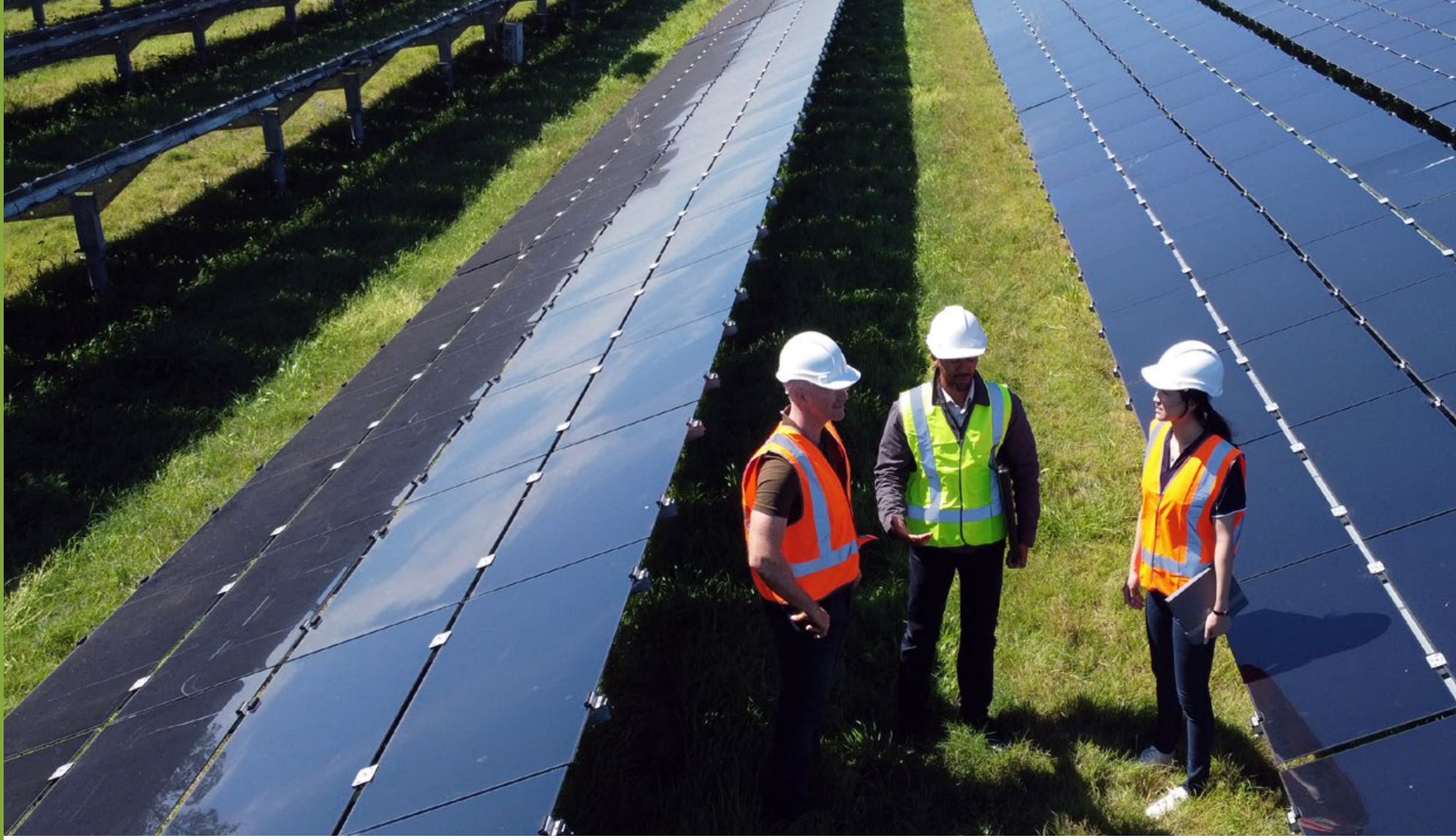
Delivering Opportunity: How the Clean Energy Transition Can Create Millions of Jobs and Drive the 21st Century Economy





Introduction

The global energy economy is undergoing a radical transformation. Energy systems, technologies, and economic models that developed over the course of the past 150 years are now rapidly evolving from year to year. Meanwhile, advancements in clean energy technology and the urgent need to address climate change are combining to drive deep decarbonization of the global economy.

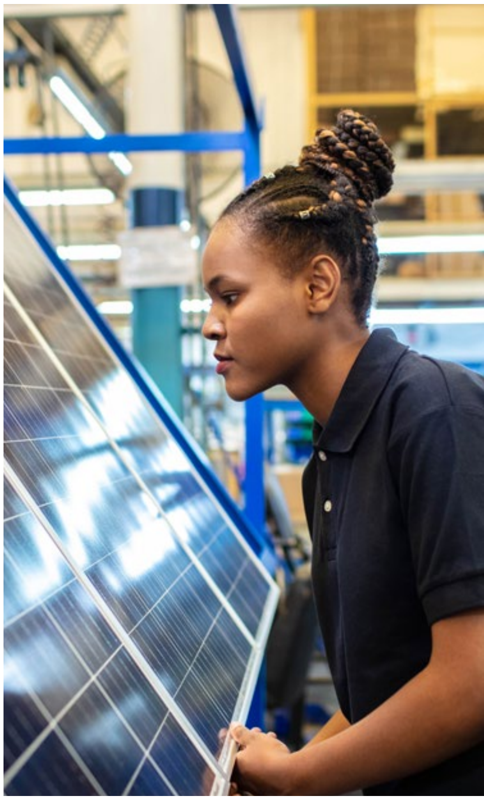
This transition has the potential to deliver real economic benefits and opportunities to people and communities across the United States. Recent domestic policies provide substantial funding for new clean energy technologies and contain critical provisions that ensure the economic benefits are broadly realized. Public funding is expected to ignite private investment with new infrastructure and manufacturing projects creating enduring, quality employment opportunities. These new policies are expected to create **over nine million jobs[1] and spur as much as $1.7 trillion in investment over the next decade alone.[2]**

Additionally, reducing reliance on polluting fossil fuels will result in improved air quality and quality of life for under-resourced and disadvantaged communities that have long borne the brunt of fossil fuel infrastructure.

1 Pollin, Robert, Chirag Lala, & Shouvik Chakraborty. "Job Creation Estimates Through Proposed Inflation Reduction Act." Retrieved from: https://peri.umass.edu/publication/item/1633-job-creation-estimates-through-proposed-inflation-reduction-act#:~:text=They%20find%20that%2C%20over%20a,private%20investments%20at%20%2498%20billion

2 Credit Suisse. "U.S. Inflation Reduction Act: A catalyst for climate action." Retrieved from: https://www.credit-suisse.com/about-us-news/en/articles/news-and-expertise/us-inflation-reduction-act-a-catalyst-for-climate-action-202211.html

The Coming Renaissance of American Industry



The United States has a long history of leadership in industrial manufacturing. The passage of recent legislation, including the Inflation Reduction Act (IRA) and Infrastructure Investment and Jobs Act (IIJA), lays the groundwork to build and expand this leadership position through the 21st century by supporting the manufacture of clean energy technologies with unprecedented funding in the form of grants, subsidies, and tax credits. This funding will be available both for companies who manufacture and who purchase the technologies that underpin a decarbonized energy system.

These bills effectively set new, green industrial policy which will drive manufacturing employment and economic opportunity nationwide for years to come. Funding contained in the IRA alone is projected to create millions of jobs within the next decade[3] while reinvigorating communities most affected by the shift away from fossil fuels. If renewable energy infrastructure is located near the fossil infrastructure it replaces, as is incentivized by provisions of the IRA, researchers at the University of Michigan predict that **the fossil fuel workforce can successfully transition to clean energy jobs without having to relocate.**[4]

The Central Role of Long-Duration Energy Storage

Solar and wind are the most well-known renewable energy technologies, but it is long-duration energy storage (LDES) that will make full adoption of these clean energy sources possible. Wind and solar are intermittent by nature, with generation exceeding or falling short of grid demand as day turns to night and weather conditions vary. As renewable penetrations increase, intermittency poses challenges to grid stability and the critical need for LDES becomes clear.

When the wind is not blowing and the sun is not shining, LDES can enable excess energy generated and stored during windy or sunny periods to meet demand. Today, absent storage capacity, this excess energy is curtailed, essentially wasting potential clean energy when it is most abundant. If renewable deployments continue without adequate storage capacity, the mismatch between supply and demand can be expected to increase as well, resulting in more wasted clean energy during periods of abundance and greater shortfalls when renewables are not available. By storing 8+ hours of energy, LDES systems can use clean energy to keep the lights on 24/7.

To achieve a cost optimal, net-zero energy system, up to 8 TW of installed LDES capacity will be required globally by 2040, representing an investment of up to $2.5 trillion USD.[5] When compared to the 17 GW installed worldwide at the end of 2020,[6] the need for rapid growth in LDES deployment is clear.

3 Ibid 1

4 Vanatta, Max, Michael T. Craig, Bhavesh Rathod, et al. "The costs of replacing coal plant jobs with local instead of distant wind and solar jobs across the United States." iScience (25)8. Aug 19, 2022. Retrieved from: https://www.cell.com/iscience/fulltext/S2589-0042(22)01089-6

5 LDES Council & McKinsey & Company. Net-zero heat: Long-duration energy storage to accelerate the clean energy transition. Retrieved from: https://www.ldescouncil.com/assets/pdf/221108_NZH_LDES%20brochure.pdf

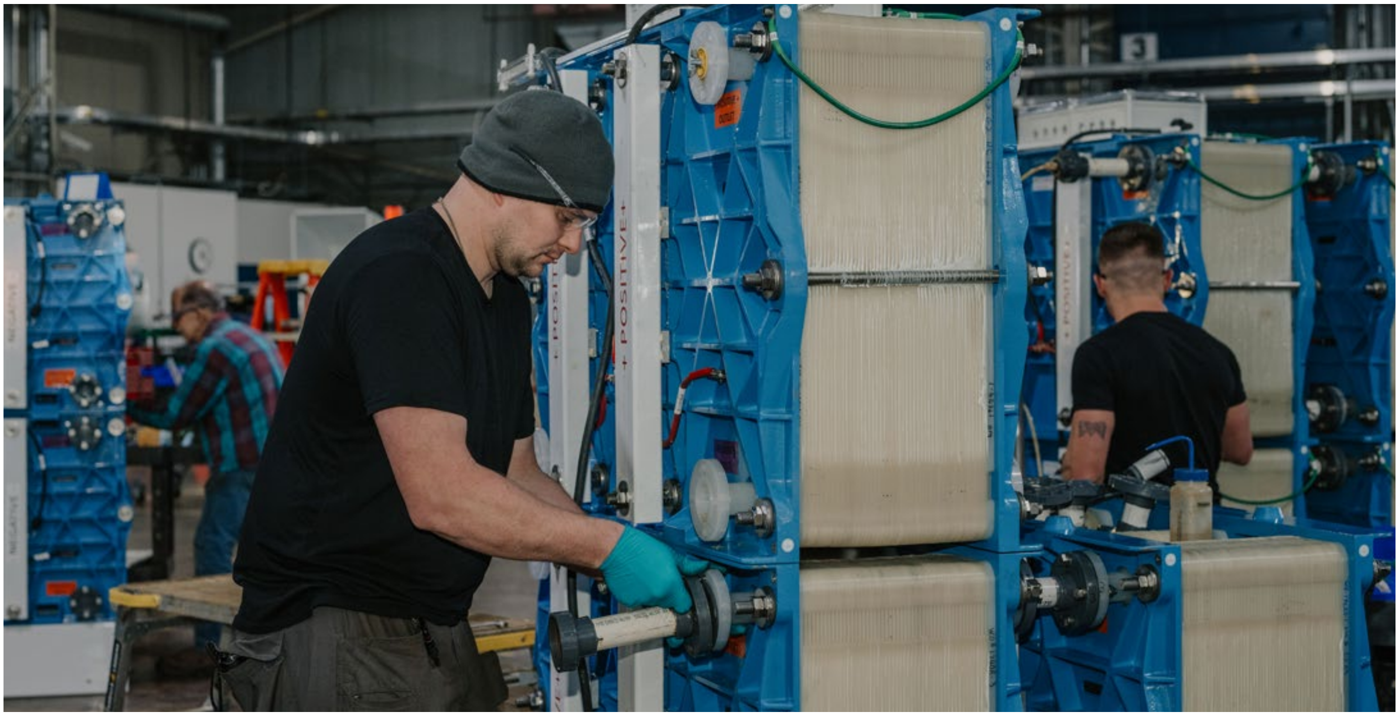
6 Bloomberg NEF. "Global Energy Storage Market Set to Hit One Terawatt-Hour by 2030." Nov 15, 2021. Retrieved from: https://about.bnef.com/blog/global-energy-storage-market-set-to-hit-one-terawatt-hour-by-2030/

Energy Storage Incentives Jump Start Battery Storage Projects

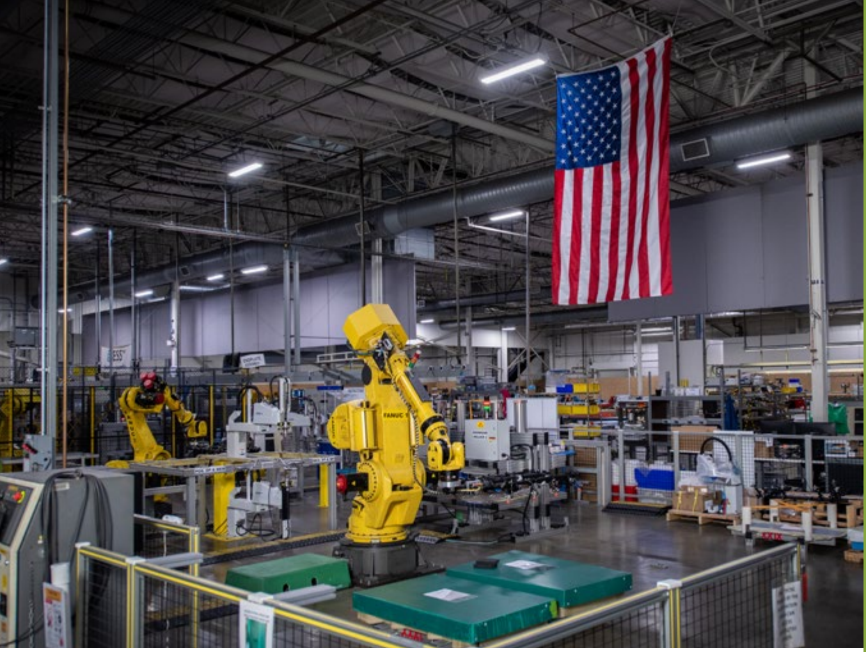
With new legislation in place, the U.S. is poised to take the lead on energy storage technology development and deployment, seizing the tremendous opportunities that will come from building the clean energy grid of the future.

The IRA represents the largest investment in clean energy in the country's history. The IRA provides $369 billion in funding,[7] including the Advanced Manufacturing Production Tax Credit (AMPTC) for the manufacturing of clean technology in the United States, and Investment Tax Credits (ITC) for the deployment of clean energy solutions. ITCs have been available to wind and solar developers and investors for some time, but for the first time, these tax incentives are now available for standalone energy storage projects as well.

The tax credits are structured to drive not only the deployment of clean energy, but growth in American manufacturing, employment and economic opportunity. The AMPTC provides manufacturers a tax credit of $10/kWh for energy storage technology produced in the United States. And, the ITC not only incentivizes the deployment of energy storage, but includes provisions to drive American manufacturing and deliver broad economic benefits.



7 U.S. Dept. Of the Treasury. "Fact Sheet: Four Ways the Inflation Reduction Act's Tax Incentives Will Support Building an Equitable Clean Energy Economy." Retrieved from: https://home.treasury.gov/system/files/136/Fact-Sheet-IRA-Equitable-Clean-Energy-Economy.pdf



For further detail, the base ITC rate of 6%-10% is available for energy storage projects regardless of equipment country of origin. However, through 2024, a 30% bonus credit is available for projects where 40% of overall project component costs are derived from domestically produced components. The domestic content requirement increases each subsequent year until it reaches 55% in 2027.

> Through 2024, a 30% bonus credit is available for projects where 40% of overall project component costs are derived from domestically produced components.

The bonus rate of 30% can be increased to 40% or 50% if other conditions are met. Altogether, projects meeting prevailing wage and domestic content requirements, and also sited in energy communities or historically disadvantaged regions, can potentially receive tax credits of up to 70% of project cost. This provides a strong incentive for U.S. developers and utilities to build new renewable energy projects that not only benefit the climate, but that deliver maximum benefits to the American economy.

8 https://www.eia.gov/dnav/pet/hist/rwtcD.htm

9 https://www.lazard.com/media/451419/lazards-levelized-cost-of-energy-version-140.pdf

Renewables + Storage: A Hedge Against Inflation and Energy Price Shocks

In 2022, inflation in western economies hit levels not seen in decades driven primarily by unstable fossil energy markets. Europe's reliance upon Russia for energy made it vulnerable to disruptions caused by associated instability and economic sanctions. Meanwhile, OPEC+ seized the opportunity to cut production and drive prices even higher. Fluctuations in energy prices as a product of geopolitics have been a fact of life for decades. But, this does not need to continue: The clean energy transition can end the cycle.

In contrast to oil's volatility,[8] wind and solar energy have declined in cost steadily and substantially[9] since 2009 and are now the lowest cost alternatives for new generation capacity. Low costs are a positive, but an often-overlooked additional benefit is the relative price stability that renewable projects deliver.

The reason is simple: Renewable project cost structures are fundamentally different than their fossil fuel counterparts. Wind, solar and storage projects require significant initial capital expenditures, but then cost very little to operate given that the fuel is free and maintenance requirements are minimal. Once a renewable project achieves commercial operation, the cost of energy generated by that project is stable, regardless of broader economic trends and global price volatility.

On a macro level, this means that as the proportion of renewables increases, primary energy costs can be expected to stabilize. In a predominantly renewable energy economy, energy will shift from a driver of inflationary cycles to a bulwark against them.

Energy Communities: The IRA Drives Economic Development Where it is Most Needed

Bonus credits provide significant incentives for creating an inclusive energy transition that does not leave any community behind. Provisions in the bill provide significant incentives for clean energy projects located in "energy communities," defined as:

A brownfield site (as defined in… of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980).

An area which has (or, at any time during the period beginning after December 31, 1999, had) significant employment related to the extraction, processing, transport, or storage of coal, oil, or natural gas (as determined by the Energy Secretary).

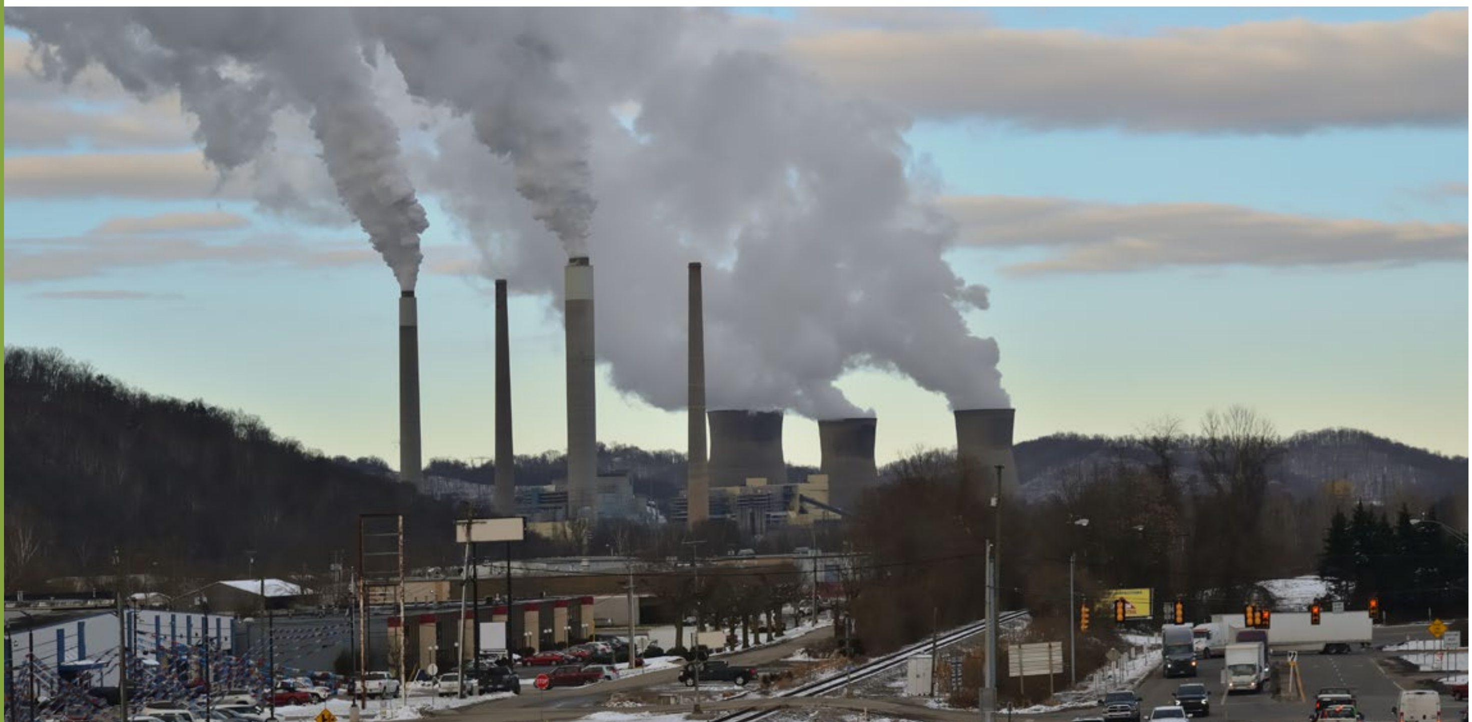
A census tract in which, after December 31, 1999, a coal mine has closed, or after December 31, 2009, a coal-fired electric generating unit has been retired, or which is directly adjoining to any census tract described in subclause.[10]

In addition to incentives tailored to energy and disadvantaged communities, the bill contains provisions that accelerate the modernization and decarbonization of municipal and cooperative utility infrastructure. For non-profit and publicly-owned utilities, many of which serve rural areas and smaller communities, these incentives are "direct pay," which means that the tax credits can be received as direct payments from the IRS. These direct payments are an investment in local economies, enabling communities nationwide to quickly build renewable energy projects, creating jobs and economic opportunity.

Included in the bonus credits discussed above are incentives for projects that provide apprenticeship opportunities which encourage long-term workforce development and build a foundation for local economies for years to come. According to the UN, **only 7% of the current clean energy workforce is located in the United States, despite representing 17% of the world's energy demand.**[11] The IRA marks a significant effort to encourage the growth not only of U.S. clean energy generation capacity, but of the human capital necessary to build and operate the clean energy system of the future.

10 H.R.5376 - Inflation Reduction Act of 2022 Retrieved from: https://www.congress.gov/bill/117th-congress/house-bill/5376/text

11 IRENA and ILO. "Renewable Energy and Jobs 2022." Retrieved from: https://www.irena.org/-/media/Files/IRENA/Agency/Publication/2022/Sep/IRENA_Renewable_energy_and_jobs_2022.pdf?rev=7c0be3e04bfa4cddaedb4277861b1b61



Addressing Environmental Justice in the Clean Energy Transition

The fossil energy industry leaves behind a legacy of environmental degradation and inequality. Historically, fossil infrastructure has been disproportionately located in lower-income communities and communities of color, resulting in disproportionate impacts.

Currently, fossil fuel generators, typically either natural gas or diesel, are used to provide "peaking" capacity during periods of high demand and/or low renewable generation. Fossil generators are also used to provide backup power during grid outages. Often, these generators, which can be heavy polluters, are sited adjacent to disadvantaged communities, affecting the health of residents and contributing to disproportionate levels of asthma, cancer, lung disease, and related deaths.

Research has shown that minority communities experience 28% more nitrogen dioxide pollution,[12] **which is just one of ~40 types of hazardous emissions from fossil generators.** One recent study conducted in the San Francisco Bay Area found that ~2,500 deaths result from nitrogen dioxide each year just in that area. The researchers also found that minority communities experienced childhood asthma at double the rate of predominantly white neighborhoods.[13]

A recent study conducted in the San Francisco Bay Area found that ~2,500 deaths result from nitrogen dioxide each year in the Bay area alone.

12 Demetillo, Mary Angelique G., Colin Harkins, Brian C. McDonald, et al. "Space-Based Observational Constraints on NO2 Air Pollution Inequality From Diesel Traffic in Major US Cities." Geophysical Research Letters (48)17. Sep 8, 2021. Retrieved from: https://agupubs.onlinelibrary.wiley.com/doi/10.1029/2021GL094333

13 Southerland, Veronica A., Susan C. Anenberg, Maria Harris, et al. "Assessing the Distribution of Air Pollution Health Risks within Cities: A Neighborhood-Scale Analysis Leveraging High-Resolution Data Sets in the Bay Area, California." Environmental Health perspectives (129)3. Mar 31, 2021. Retrieved from: https://ehp.niehs.nih.gov/doi/10.1289/EHP7679

Energy storage provides an ideal, emission-free replacement for fossil peaker and backup generation. Batteries can be charged during periods of high renewable generation and low demand then tapped when needed to meet peaks or provide resilience. However, if these batteries are placed within the same disadvantaged communities, technology selection becomes critical. Lithium-ion batteries pose hazards to surrounding communities (See sidebar: "New Technologies Are Needed to Deliver Safe, Secure and Sustainable Clean energy Infrastructure"), most notably fires with toxic smoke.

In contrast, new technologies, such as the iron flow batteries manufactured by ESS, are made of non-toxic materials and pose no safety risks to the community around them. And among various flow battery chemistries, iron flow batteries were found to have the lowest environmental impact by the California Department of Energy[14] making them a safe and sustainable choice for resilient, reliable energy.

14 California Energy Commission. "Life Cycle Assessment of Environmental and Human Health Impacts of Flow Battery Energy Storage Production Use." Retrieved from: https://www.energy.ca.gov/sites/default/files/2021-12/CEC-500-2021-051.pdf

15 U.S. Department of Energy. Grid Energy Storage: Supply Chain Deep Dive Assessment. Retrieved from: https://www.energy.gov/sites/default/files/2022-02/Energy%20Storage%20Supply%20Chain%20Report%20-%20final.pdf

16 Foreign Mineral Supply Chain Dependence Threatens U.S. Security. CRES Forum. Retrieved from: https://cresforum.org/wp-content/uploads/2022/03/CRES_WhitePager_CriticalMinerals_03212022_v1.pdf

17 Power Spike: How battery makers can respond to surging demand from EVs. McKinsey & Co. Retrieved from: https://www.mckinsey.com/capabilities/operations/our-insights/power-spike-how-battery-makers-can-respond-to-surging-demand-from-evs

18 Tesla Moss Landing power storage facility fire shuts Highway 1; Residents told to shelter in place. Retrieved from: https://www.cbsnews.com/sanfrancisco/news/tesla-moss-landing-power-storage-facility-fire-shuts-down-highway-1-residents-told-shelter-in-place/

New Technologies Are Needed to Deliver Safe, Secure and Sustainable Clean Energy Infrastructure

Today, most grid-scale battery installations use lithium-ion (Li-ion) technology. However, Li-ion technology has well-documented drawbacks that limit its ability to provide the scale of energy storage, and especially long-duration energy storage, that will be needed to achieve deep decarbonization. The U.S. Department of Energy recently issued a report on the vulnerability of U.S. interests resulting from the Li-ion supply chain,[15] finding that "the United States is currently at a significant disadvantage" in the mineral extraction and manufacturing required for Li-ion batteries. In fact, U.S. resource extraction currently accounts for less than 2% of global Li-ion raw materials production. For some required resources, namely cobalt, nickel, manganese, and graphite, almost none is mined in the U.S.

After the initial extraction of these materials, their refining is also largely done offshore; in fact over 80% of the world's lithium refining capacity is controlled by China.[16] The lack of domestically-sourced lithium introduces significant risk into the clean energy supply chain and reduces opportunities for developers and utilities using Li-ion batteries to qualify for domestic content requirements under the IRA.

In addition, the Li-ion supply chain is dominated by electric vehicles, not grid-scale storage. By 2030, approximately 90% of Li-ion battery supply is expected to serve EV demand.[17] This competition for resources could make the expansion of energy storage difficult if reliant upon Li-ion technology alone.

Technology Drawbacks

In addition to supply constraints, Li-ion technology has a number of safety and operational drawbacks that make it ill-suited to meeting the large-scale grid storage needs of the future. Li-ion batteries experience capacity fade over time and are limited in the number and frequency of charge/discharge cycles they are able to deliver. This imposes long-term costs on operators and reduces operational flexibility, which also reduces revenue opportunities.

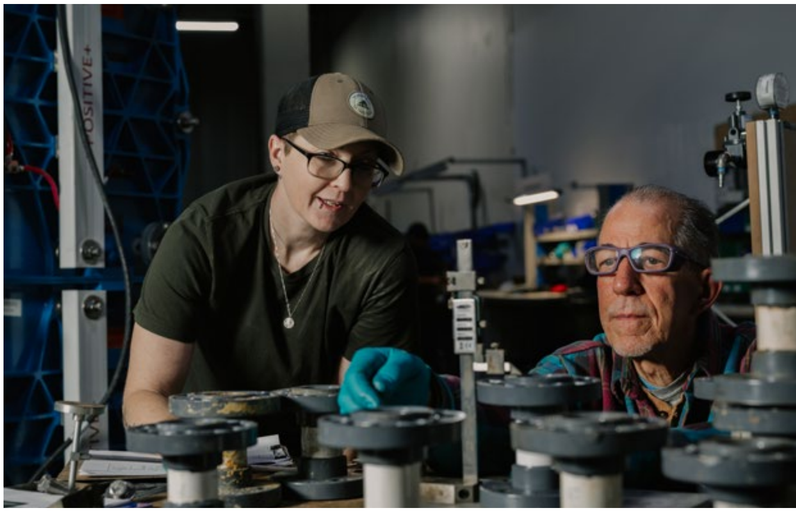
Li-ion also poses well-documented flammability and toxicity issues, which have led to prominent facility fires. In one recent example, a fire at a PG&E Li-ion storage facility in Moss Landing, Calif. resulted in a "shelter in place" warning to area residents out of concern for toxic smoke.[18]

Realizing the Opportunity

If done well, the economic benefits of the clean energy transition will reverberate in communities nationwide, delivering a cleaner, healthier and more secure energy economy. However, rulemaking and regulatory processes will shape the implementation of recent legislation and new technologies have the potential to either limit or amplify those benefits.

Though the IRA has been signed into law, the U.S. Department of Treasury has significant leeway to define details of specific provisions. Provisions such as domestic content bonuses are subject to rulemaking, currently underway, which will define the conditions under which bonus credits can be awarded. **The Treasury Department must ensure that robust domestic content requirements are included in the final rulemaking to maximize domestic economic benefits.** The domestic content bonus ITC was intended to incentivize American-made products. Many batteries, including virtually all Li-ion batteries and their subcomponents, are made, mined and produced outside of the U.S. Rulemaking must preserve the intent of the legislation and ensure that clean energy projects qualifying for bonus credits deliver meaningful manufacturing, supply chain and community benefits.

In addition to implementation of the IRA, state-level regulations must evolve to encourage the adoption of new technologies. **To accelerate the deployment of LDES, state and regional energy markets need to evolve to adequately compensate LDES assets for the value they deliver.** LDES is capable of providing grid services including energy, reliability and capacity among others, however, in most markets, only a subset of these services is compensated. Reforming market structures to provide resource compensation mechanisms would improve the potential return of LDES projects for customers and investors and more properly value their benefits.



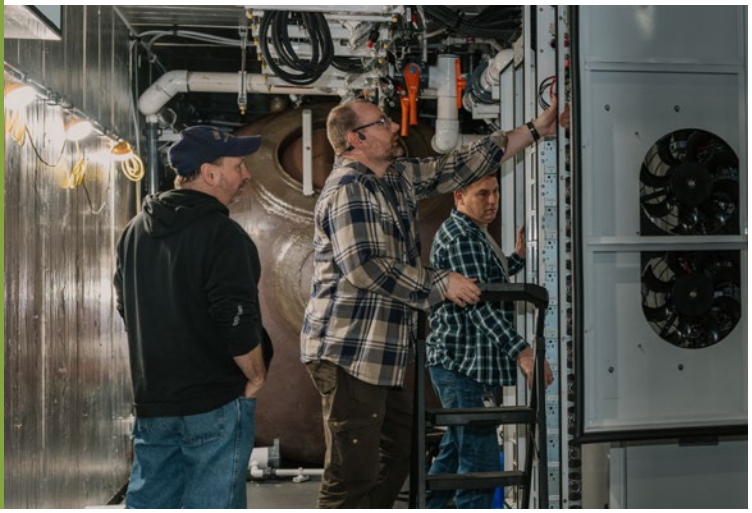
If we get the implementation right, the U.S. is now positioned to lead a transition that will transform the global economy. The International Energy Agency estimates that **22.7 million jobs will be created globally by achieving net zero carbon emissions.**[19] This includes millions of jobs in clean electricity generation, increasing energy efficiency, and electrification of existing technologies and is in addition to the 12.7 million people worldwide who already work in clean energy.[20]

Through public investment and the ever-increasing urgency of climate change, the speed of change is accelerating. As illustrated by the ESS case study below, the growth of emerging clean energy industries will drive opportunity for decades to come as American-made clean technology fills a crucial role in the clean energy transition. By providing secure, sustainable technologies to deliver a resilient, decarbonized energy grid, the clean energy economy will deliver job growth, economic activity, and energy security while supporting environmental justice.

19 International Energy Agency. World Energy Outlook 2021: People centered transitions. Retrieved from: https://www.iea.org/reports/world-energy-outlook-2021/people-centred-transitions

20 IRENA and ILO. "Renewable Energy and Jobs 2022." Retrieved from: https://www.irena.org/-/media/Files/IRENA/Agency/Publication/2022/Sep/IRENA_Renewable_energy_and_jobs_2022.pdf?rev=7c0be3e04bfa4cddaedb4277861b1b61

Case Study: How an American Clean Energy Manufacturer is Building the Clean Energy Economy



ESS is a leading manufacturer of long-duration energy storage (LDES) solutions. The company's corporate headquarters and manufacturing operations are located in Wilsonville, Oregon, outside of Portland. To meet growing domestic and global demand for LDES, the company is scaling rapidly, growing its workforce and capacity to manufacture iron flow battery systems and components for domestic and international sale.

> The company's activity in 2022 drove $173.4 million in economic activity, and directly and indirectly supported over 530 full time jobs.

ESS is currently shipping commercial products to customers worldwide. At 2022 production levels, the company delivered real economic benefits in Oregon and nationwide through its direct and indirect employment and expenditures on supplies and equipment. It is estimated that the **company's activity in 2022 drove $173.4 million in economic activity**, and **directly and indirectly supported over 530 full time jobs.**[21]

Demand for LDES is growing rapidly. Global installed LDES capacity is expected to reach up to 140 TWh by 2040. In 2022 alone, ESS announced major partnerships with the Sacramento Municipal Utility District (SMUD) for up to 2 GWh of energy storage over the next five years, and an agreement with Energy Storage Industries Asia Pacific, an Australian energy service provider, for up to 12 GWh of iron flow batteries.

To meet the needs of these and additional customers, the company will need to expand manufacturing capacity. In one scenario modeled, if the company makes the necessary investments **to increase production capacity at the Wilsonville facility 10x over 2022 levels, the total economic impact would be over $200 million** from investments in components and construction for that expansion alone, **creating or supporting thousands of jobs** over the course of the project. Once the facility achieved full expanded production capacity, it is estimated that ESS would directly employ nearly 2,000 people in Wilsonville, Oregon building and supplying iron flow battery components to communities worldwide. ■

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21 Analysis conducted by Chmura Economics and Analytics based upon ESS public financial disclosures.