Accelerating energy expansion

Honeywell Technologies

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Overview

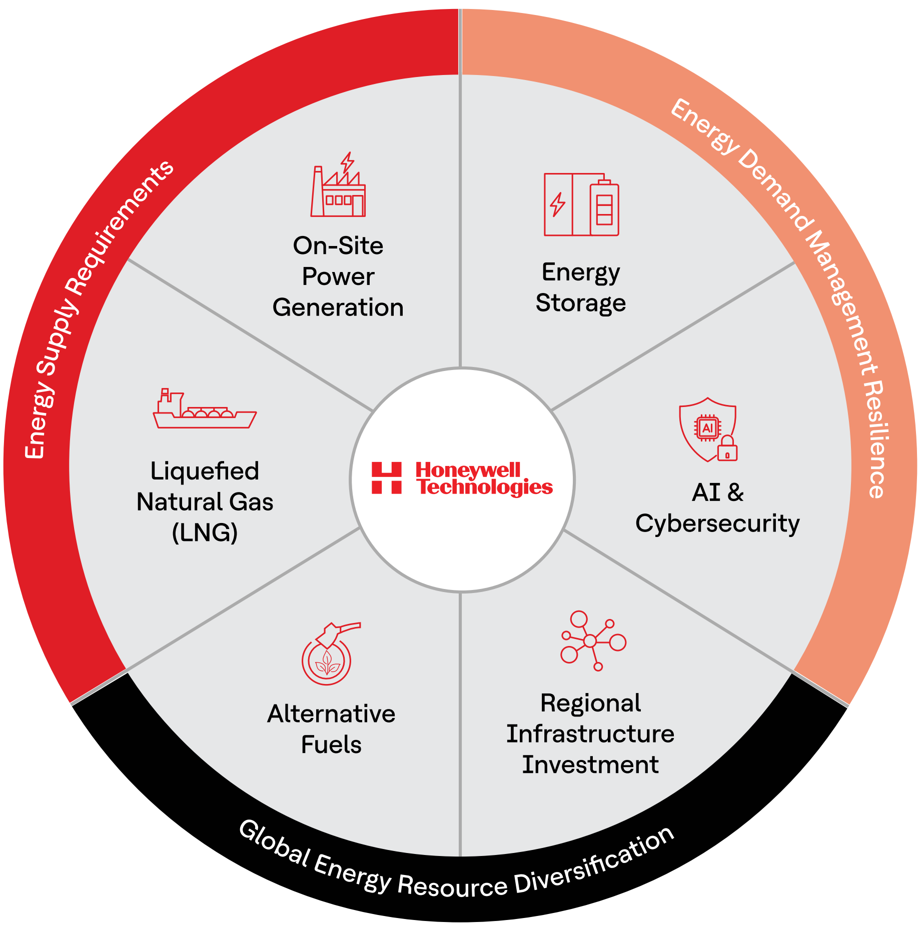
The past year has seen accelerated change in the energy sector, with shifting dynamics impacting U.S. and global focus on energy security, affordability, and overall demand.

Energy security remains a priority, driven in part by recent geopolitical events and changes in energy access, supply, and costs, which have exposed vulnerabilities in the world's energy system and highlighted the impact on global economies. The world is experiencing a unique moment of unprecedented energy demand, compounded by an aging workforce and new global supply pressures. This makes U.S. energy leadership more urgent and more achievable than ever but requires policies that support a broader portfolio of technologies to meet that demand.

Energy demand is expected to grow in the decades ahead, with global population growth projected to expand 17% to 9.6 billion by 2050 and rapidly increasing electricity use expected to more than double as economies electrify and technologies like artificial intelligence (AI) and data centers expand power needs.[1] No single technology will meet this demand, so a mix of strategies and technologies will be required to improve the performance of the current infrastructure, integrate alternative feedstocks, and efficiently add new capacity to strengthen energy supply, affordability and security.

The following paper has been developed as a collaboration between **Honeywell Technologies** and the **MIT Center for Sustainability Science and Strategy** to address the following focus areas and the supporting policies needed to drive continued U.S. leadership, which is critical to energy security, affordability and competitiveness:

- **Energy Supply requirements:** Liquefied Natural Gas (LNG) expansion and on-site Power Generation
- **Energy Demand Management & Resilience actions:** Energy Storage and AI & Cybersecurity
- **Global Energy Resource Diversification:** Alternative Fuels and Regional Infrastructure Investment



Energy supply

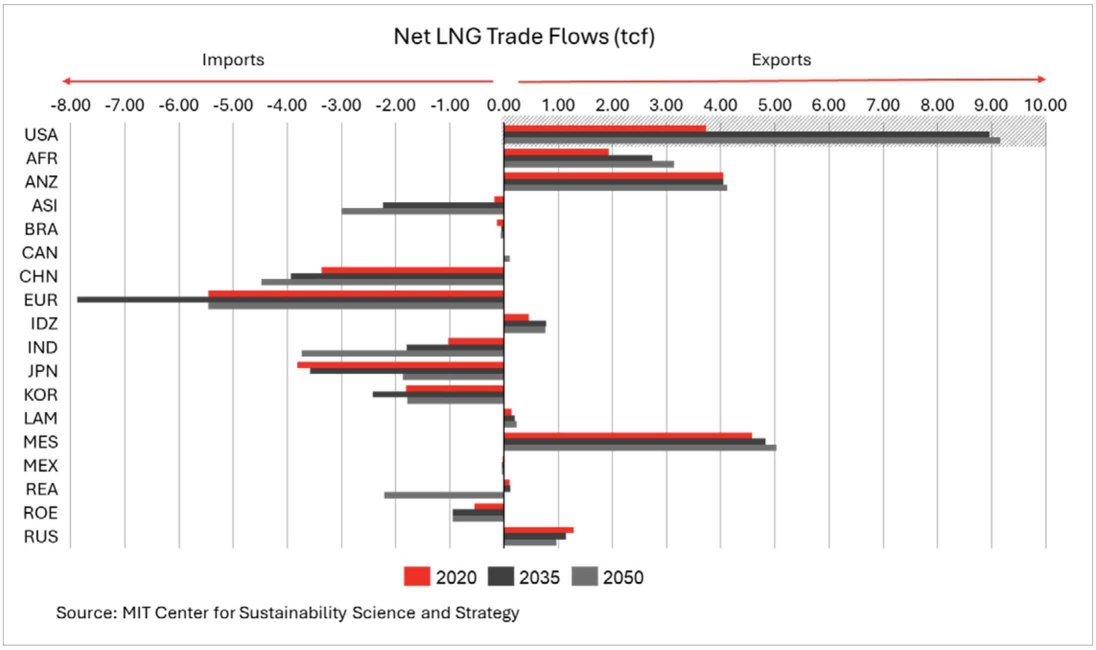
U.S. Leadership in LNG Production and Export

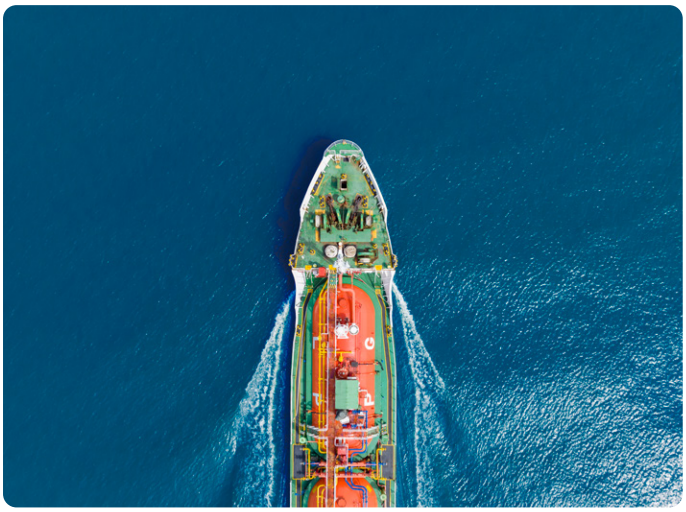
Liquefied Natural Gas (LNG) is critical to global energy security as it can be moved across continents and delivered when and where needed, helping meet rising demand. As a key contributor to energy addition, LNG expansion will require long-term, broad-based policies to sustain production in the U.S. The U.S. is currently the world's largest LNG exporter, shipping 4.2 trillion cubic feet (tcf) to more than 40 countries in 2024[2] and MIT projects that it will reach roughly 9 tcf by 2050.[3] This U.S. expansion of LNG export capacity has enabled regional and domestic economic growth through supporting jobs and infrastructure investments.

For the U.S. to maintain competitive LNG expansion going forward, it will require continued streamlined permitting and approval processes, as well as investments in programs focused on developing talent. Skilled labor shortages in specialized trades like welding, pipe fitting, plant operations, and process controls risk constraining rapid U.S. LNG expansion. Government investment in apprenticeship and employer-led training programs will help make workforce development a priority and will be essential to building the talent needed to maintain U.S. leadership in LNG production and export.

Modular LNG technologies can further mitigate skilled labor risks while optimizing existing assets to retain cost competitiveness by constructing modular plants in centralized locations, creating concentrated labor pools. Modular solutions can also support producers by mitigating schedule and budget risk, reducing construction risk and complexity, and bringing capacity online faster.

In addition, AI-enabled solutions can improve efficiency and reduce production cost, making U.S.-based supply and technologies more competitive. MIT research shows that U.S. LNG producers adopting AI-based technologies alone could reduce global LNG price by 0.3% in 2035 and by 1.1% in 2050. If adopted by LNG producers globally, the price reduction increases to 1.3% by 2035 and 4.5% by 2050, ultimately resulting in annual global LNG production costs savings in 2050 of up to $80 billion per year.[4]





On-Site Power Generation

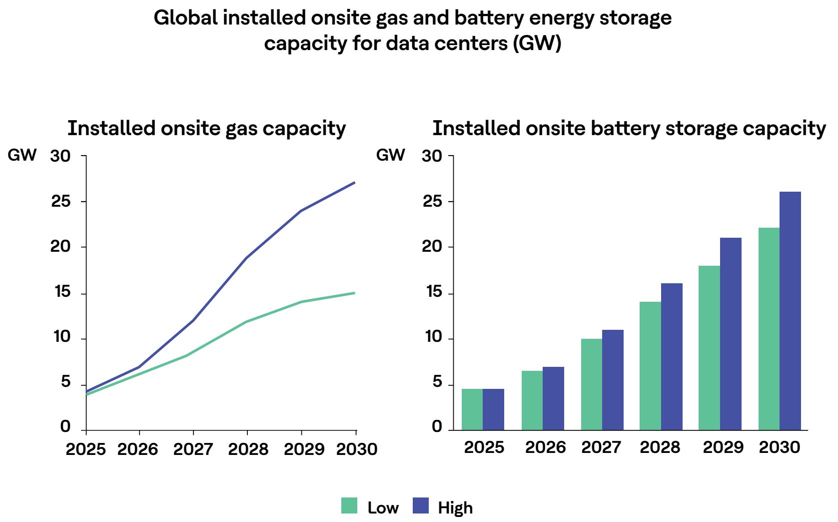
The rapid expansion of data centers is driving power demand beyond what existing infrastructure can deliver at scale. Global data center electricity use is projected to more than double, from roughly 415 terawatt-hours in 2024 to 945 by 2030, with the U.S. accounting for the largest single share.[5] A single data center campus can draw as much electricity as five million households,[6] more than the capacity of the largest existing U.S. nuclear or gas plants. The U.S. has technologies available today to help meet this demand without increasing costs for consumers, reinforcing its leadership in AI, which is central to security and economic competitiveness.

On-site, behind-the-meter generation will play a critical role in meeting this demand. Producing energy on-site reduces reliance on the grid and allows data center operators to more quickly scale and deploy energy supply with fewer permitting hurdles. The IEA projects that on-site gas fired generation for data centers will grow more than 200% between 2025 and 2030, from roughly 5 GW to 15-27 GW, primarily in the U.S.; and on-site battery storage will increase 300-400% to 20-25 GW, during the same time period.[7]

However, conventional gas-turbine solutions face challenges, including multi-year equipment delays, rising costs, and lengthy permitting processes. Increasing regulatory hurdles and public resistance to new data center development in some regions may further slow deployment and put U.S. competitiveness at risk.

The U.S. needs to deploy technologies quickly and securely without negatively impacting the grid or raising the cost of energy for consumers. For example, emerging fuel-cell-based systems can be deployed faster and produce high-concentration CO_2 streams that reduce the cost, complexity and energy consumption of carbon capture. While nuclear power options through utility scale plants and small modular reactors (SMRs) have been gaining attention, long lead times to technology readiness and permitting limit their ability to meet near-term demand.

Looking ahead, the integration of on-site power generation, along with supportive policy frameworks, will be critical to sustaining data center growth and supporting U.S. leadership in the AI space. Given constraints in the build-out of conventional technologies, new alternative technologies such as fuel cells will need support to help the industry meet rising demand while maintaining competitiveness and advancing long-term carbon reduction goals.



Source: IEA

Policy Priorities – Energy Supply:

Regulatory certainty for LNG and incentives for power development: establish stable, long-term frameworks that give producers and developers the confidence to commit capital, including durable export-approval processes for LNG through pending legislative proposals (e.g., LNG Export Security Act, S. 4520; Unlocking Our Domestic LNG Potential Act, H.R. 1949) and incentives for on-site generation for large energy users (DATA Act, S. 3585), while leveraging existing incentives like the Section 45Q tax credit to pair generation with carbon-capture infrastructure.

Comprehensive permitting reform: enact bipartisan reform to accelerate energy infrastructure deployment by streamlining environmental reviews, establishing enforceable permitting timelines, and improving interagency coordination across the supply chain, from carbon capture and sequestration (CCS) wells to power interconnection and LNG terminal authorizations (e.g., SPEED Act, H.R. 4776; CERTAIN Act, H.R. 8308).

Build and upskill the American energy workforce: expand registered apprenticeships and employer-led training to fill skilled-trades gaps in LNG and power generation, leveraging the Administration's initiatives (e.g., EO 14278, Department of Labor's (DOL) $86M Skills Training Fund) in key energy states. Bipartisan efforts in Congress are aligned, including proposals like the LEAP Act (H.R. 1662), a $1,500 tax credit per registered apprentice in energy industries, and the VET Act (H.R. 4105), a DOL grant program connecting transitioning service members to energy careers.

Energy demand management & resilience

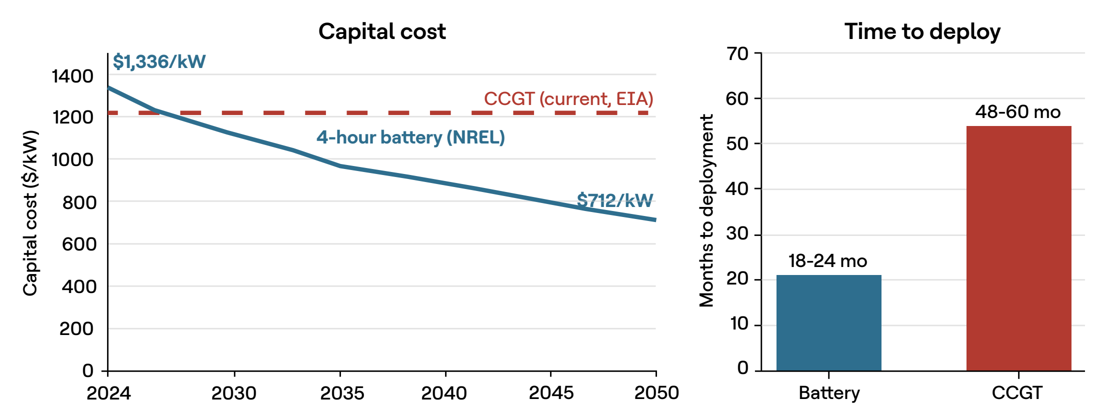
Energy Storage

As energy demand continues to outpace supply from existing infrastructure, meeting that demand will require a broad mix of technologies and strategies. Intelligent energy storage is a practical and ready-now technology that can help improve grid flexibility, reliability and efficiency, which has never been more critical given load growth and variability from data centers. By shifting intermittent power to align with intra-day demand, energy storage decreases the need for costly incremental grid and generation capacity investment by reducing peak demand. Its value was demonstrated recently during a Texas winter storm when battery systems delivered roughly $750 million in market savings and freed up 3 gigawatts of gas generation to meet demand.[8]

Battery project development has improved recently and the time to deploy energy storage solutions in the market continues to reduce. Because of these dynamics, the time-to-value to deploy battery-based energy storage solutions has reduced materially relative to conventional gas power generation projects. In addition, the cost of energy storage continues to fall driven by technological advances and scale, increasing its competitiveness relative to conventional power generation sources. The costs for utility-scale, four-hour lithium-iron-phosphate batteries are projected to decline more than 25% over the next decade and more than 40% by 2050.[9]

Broader deployment will benefit from ongoing permitting reform and grid modernization. For grid-connected energy storage projects (front of the meter), interconnection studies are required in many regions which can add costs and delay deployment. For on-site energy storage projects (behind the meter), the time to deploy is typically quicker; however, consistent and coordinated jurisdictional requirements across regional market will be critical to enabling deployment of storage solutions at scale.

Also, as lithium-iron-phosphate chemistry takes an active role in stationary storage over the next decade, the U.S. has an opportunity to rebuild domestic battery production, supporting national energy security interests and strengthening its position in the global market as an alternative to foreign supply chains.



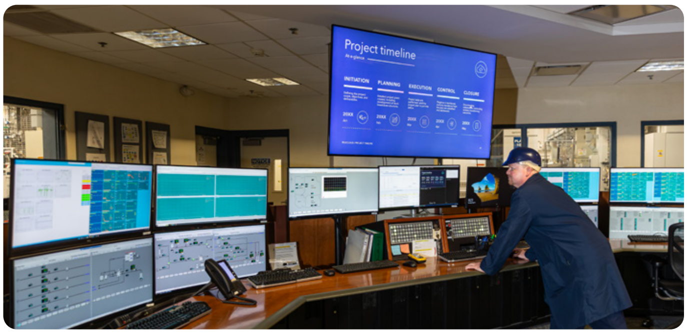
Sources: battery capital — NREL 2025 (4-hr Li-ion, $/kWh × 4); CCGT capital — EIA AEO 2025; deployment times — Wood Mackenzie.

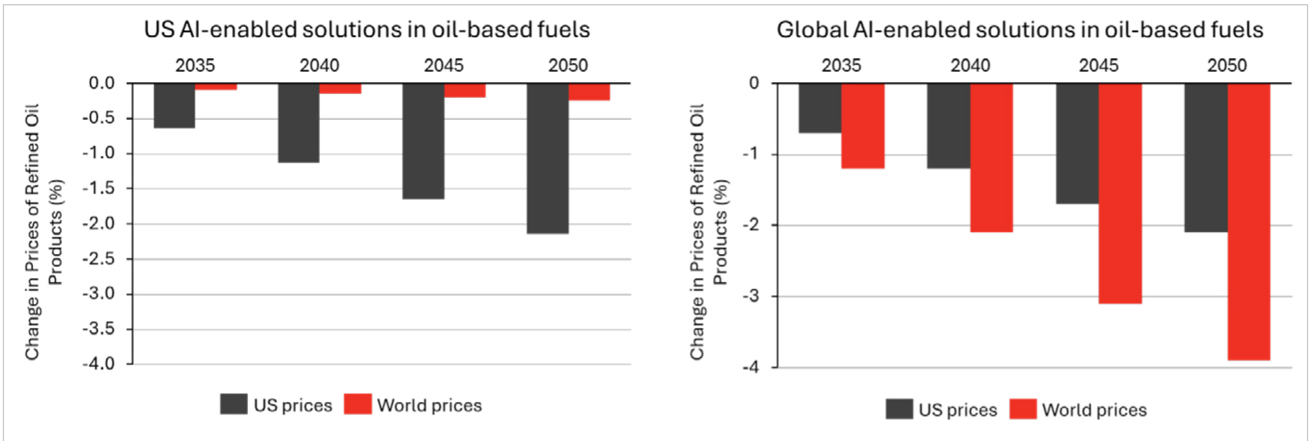
AI & Cybersecurity

Newly deployed automation and AI-enabled solutions can drive increased efficiencies in energy production without the need for costly, time-consuming investments. AI and digital technologies can support energy production facilities across fuel sources, including conventional fuels, LNG and alternative fuels like sustainable aviation fuel (SAF), to increase reliability and uptime, improve efficiency and throughput, and effectively manage and supplement industrial workforces. In the U.S., AI is helping drive grid flexibility to balance energy supply and demand and integrate alternative energy sources.

MIT modeling shows that U.S. AI-enabled solutions could reduce U.S. oil-based fuel production costs by $4 billion per year within five years, and by roughly $14 billion per year by 2050; deployed globally, the savings could reach approximately $55 billion per year in the near term and up to $225 billion by 2050, as AI-enabled technology adoption increases.[10] Additional value will be unlocked with faster project construction, predictive maintenance, real-time quality control, and the use of digital twins, which can compound these gains while improving product quality and reducing downtime.

As energy systems become more interconnected and automated, securing these assets becomes inseparable from securing the energy supply itself. Greater connectivity expands the potential cybersecurity attack surface across the operational technology (OT) and industrial control systems that run refineries, pipelines, LNG terminals, and power generation. In 2025, ransomware groups with reach into OT environments increased 49% with deliberate attempts to disrupt energy operations. Protecting this critical infrastructure through purpose-built industrial cybersecurity, continuous monitoring, and resilient system design can reduce the risk that the efficiency gains of digitalization become a strategic vulnerability.[11] By optimizing industrial processes, these solutions help improve product quality, profitability, and carbon management.





Source: MIT Center for Sustainability Science and Strategy

Policy Priorities – Energy Demand Management & Efficiency:

Accelerate storage deployment: standardize rules across Independent System Operators (ISO) and Regional Transmission Organizations (RTO), fund federal safety and testing standards (BESS Act, H.R. 8706), and remove bidirectional load interconnection barriers through existing and potential FERC authorities so storage paired with intelligent controls can support peak shaving and defer costly new generation capacity.

Support domestic battery manufacturing: maintain and extend federal manufacturing incentives for domestically produced battery cells, modules, and critical minerals (e.g., Section 45X Advanced Manufacturing Production Credit), act on Department of War (DOW) recommendations for battery production tax credits and allied-nation technology partnerships, and improve supply chain visibility to reduce dependence on any single country (e.g., Electric Supply Chain Act, H.R. 3638/S. 3499).

Support AI adoption and cybersecurity: accelerate AI deployment for energy and industrial systems supported by regulatory frameworks that distinguish energy-sector AI from consumer-facing applications (e.g., EO 14318; DOE's Genesis Mission and PermitAI initiatives). Develop cybersecurity standards and voluntary coordination mechanisms building on the AI cybersecutiry clearinghouse (EO "Promoting Advanced AI Innovation and Security," June 2026) and ensure interoperable international standards supportive of U.S. technologies deployed globally.

Diversification of energy resources

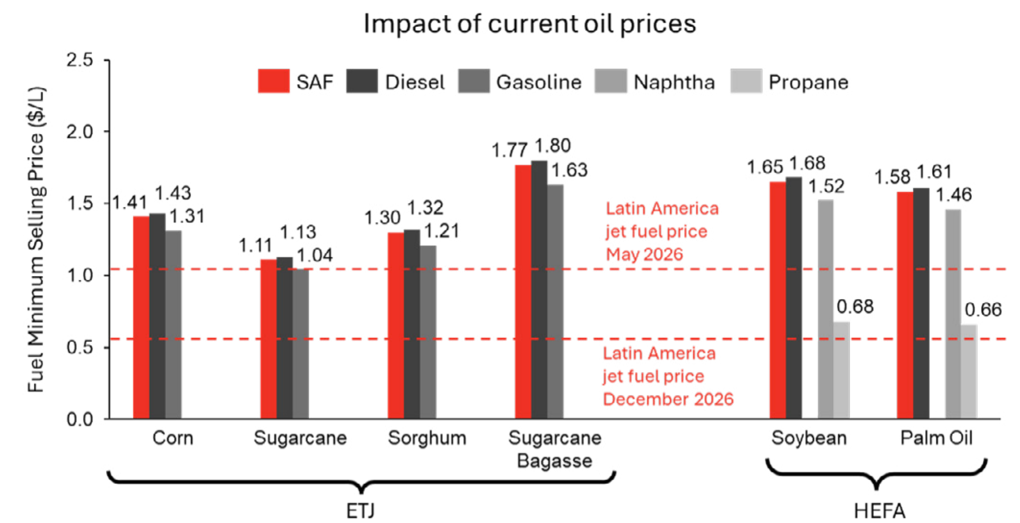
Alternative Fuels

Meeting rising energy demand and addressing energy security will require adding new sources to the energy mix at a faster rate. This includes energy-dense fuels to meet the needs of heavy-duty and long-distance land, air and marine transport. Meeting rising demand responsibly means using a range of feedstocks which provides added resilience and energy security when conventional supply is constrained.

Globally, multiple regions and countries have taken steps to expand fuel production through incentive plans and policies, including the EU Fuel Directives, Brazil's Fuels of the Future Law, China's 15th Five-Year Plan, as well as targets set by organizations like International Maritime Organization (IMO), International Civil Aviation Organization (ICAO), and International Air Transport Association (IATA). However, existing and planned supplies globally are insufficient to meet projected demand growth.

Innovative technology is helping to meet these needs by converting a broader range of low-cost feedstocks into viable fuels, addressing both the cost and feedstock availability barriers to scaling SAF production. This includes ethanol-to-jet, methanol-to-jet, Fischer-Tropsch, and biocrude upgrading, which allows producers to match the feedstock of their respective region, thereby increasing energy security. Today, production of these fuels is expensive, but costs will fall sharply as technology matures. MIT modeling shows the cost to produce sugarcane alcohol-to-jet fuel declining from \$2.51 to \$1.11 per liter, and corn-based pathways from \$3.19 to \$1.41 per liter, as operating plants move from first-of-a-kind to mature, nth-of-a-kind operations.[12] In 2026, elevated jet fuel prices made several mature SAF pathways more competitive with conventional fuel.

The U.S. has one of the most robust agricultural sectors in the world with vast energy and industrial crop feedstocks, positioning it to be a leader in this sector. This provides a channel to create new jobs and drive economic growth through export of excess ethanol and other alternative fuels as well as support new U.S. technology deployment globally. Data demonstrates that the market for export exists in the U.S., however there is a need for increased support for domestic production and stable policy and regulatory frameworks to create long-term certainty for producers, helping the U.S. benefit from its advantaged feedstock and technology position.



Source: MIT Center for Sustainability Science and Strategy

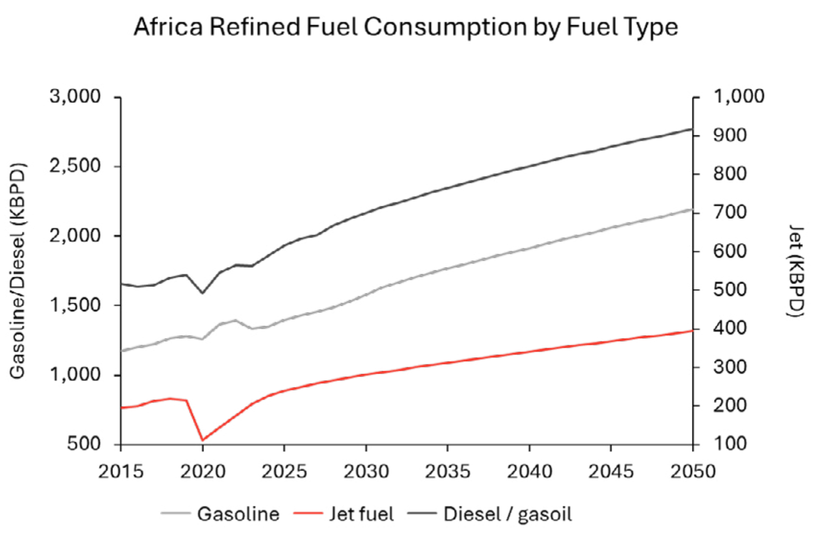
Regional Infrastructure Investment

Recent geopolitical events have underscored the integrated nature and vulnerability of the global energy system as well as its heavy dependence on key regions and shipping lanes. This is highlighted by sharp increases in Brent crude prices of roughly 45%, the near doubling of jet fuel cost and widespread supply chain disruptions.[13] Developing new, country-specific energy infrastructure can insulate both the U.S. and other regions from current and future volatility, enhance resilience, and unlock long-term economic potential while reducing the world's dependence on any single region.

Many countries and individual companies in the energy supply chain are actively looking beyond the Middle East to secure energy independence. This includes seeking new supply sources from countries like Venezuela, which holds vast heavy crude reserves. If output recovers from its sharp decline, its oil can provide U.S. refiners with another source of heavy crude and strengthen the Western Hemisphere's overall supply stability and resilience, subject to applicable U.S. sanctions, licensing and trade controls.

Africa has significant oil resources but limited refining capacity, leaving its markets exposed to volatility. By 2050, the continent's population is projected to grow by roughly one billion, reaching nearly 2.4 billion, and refined-fuel demand expected to surpass 6 million barrels per day,[14] expanding domestic downstream capability can enhance African energy independence, stimulate industrial growth, and drive demand not only for fuels but also for chemicals and other process-related technologies.

Technology is essential to unlocking energy diversification, both in terms of feedstock diversity and in strengthening energy security in regions across the globe, and the U.S. is in a strong leadership position to drive this development and growth. Harmonized and consistent global standards for the export of the underlying technologies driving this expansion are needed to help improve fair competition in global exports. In addition, expansion of U.S. investment and technologies in diversified regions will take significant and deliberate planning and will require supportive policies that enable the export and deployment of these technologies. Quick action will reinforce the U.S. leadership position in responsible energy expansion by strengthening partner nations and enhancing energy security.



Source: S&P Global

Policy Priorities – Diversification of Energy Resources:

Sustain U.S. competitiveness in alternative fuels: maintain Section 45Z clean fuel production incentives, finalize Treasury's 45Z implementation rules, and support clean hydrogen production through the 45V credit and the Department of Energy (DOE) Regional Hydrogen Hubs program.

Export U.S. energy investment and strengthen supply chains: leverage U.S. Export Import Bank financing, global development finance institutions, pursue harmonized consistent global standards that prevent barriers to U.S. technologies, and reduce concentrated dependence on any single country for critical energy inputs by deepening partnerships in strategically important regions.

Expand markets for U.S. fuels: the bipartisan Renewable Fuel for Ocean-Going Vessels Act (S.881/H.R.1896) would add marine fuel to the Renewable Fuel Standard, letting biodiesel and renewable diesel earn RINs and opening new demand for American producers and farmers.

Conclusion: policy agenda for enabling responsible energy expansion

Today's energy decision-makers face challenging geopolitical dynamics, and energy shocks have become a reality.

For the U.S. to maintain an energy leadership position, it needs to look holistically at strategies that will further strengthen energy security and responsibly expand domestic energy production and capacity to meet growing demand at home and abroad.

This includes adding more to the portfolio of technologies being deployed domestically and abroad, including the technologies covered in this paper.

Combined with effective policy, this will allow producers and developers to strategically meet demand more dynamically and at a lower cost, driving necessary energy expansion. Supporting and enacting policies that advance energy-production innovation, support critical skill development, drive AI adoption in the energy sector, and encourage the global adoption of U.S.-developed technologies can make existing facilities more efficient, shorten time-to-market for new projects, and drive down the overall cost of production. For policymakers, who are rightly focused on lower costs for customers, job creation, national security and a strong economy, these actions support domestic job growth, affordable and reliable energy supply and expansion of exports, helping sustain continued U.S. technology and energy leadership, benefiting generations of Americans and allies globally for years to come.

To sustain U.S. energy leadership and ensure an affordable and secure supply, policymakers should prioritize actions across three areas:

Energy Supply:

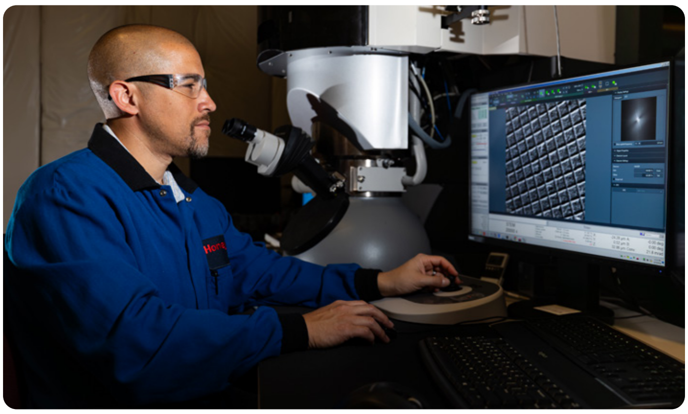
- Establish stable regulatory frameworks for LNG exports and on-site power generation that give investors the confidence to commit capital
- Enact comprehensive permitting reform that streamlines reviews, establishes enforceable timelines, and improves interagency coordination
- Build and upskill the energy workforce through apprenticeships and employer-led training in the skilled trades required for LNG and power generation

Energy Demand Management and Resilience:

- Accelerate storage deployment through standardized ISO/RTO market rules, federal safety standards, and removal of interconnection barriers
- Support domestic battery manufacturing by extending federal production incentives and improving supply chain visibility to reduce dependence on any single country
- Accelerate AI adoption across the energy sector while establishing enforceable cybersecurity standards for the OT systems protecting critical infrastructure

Diversification of Energy Resources:

- Sustain U.S. competitiveness in alternative fuels by extending clean fuel production incentives and supporting clean hydrogen production
- Expand markets for U.S. fuels, including new demand channels such as marine fuel under the Renewable Fuel Standard
- Enable the export of U.S. energy technology and investment by leveraging export finance, deepening regional partnerships, and reducing concentrated dependence on any single country for critical energy inputs



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