Perspectives on the Transforming U.S. Power & Electricity Landscape

White Paper

March 2025

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Why this topic matters to us

We are a specialist private equity group investing in businesses providing critical parts, services, and equipment within the advanced industrial economy. We have significant experience investing and operating across the electrical infrastructure landscape, and have developed this white paper to share our perspectives on trends impacting our sector

About Cogenuity Partners:

We bring **Collaboration and Ingenuity** to partner with management teams to **build advanced industrial businesses**

We are more than simply a source of capital – we are collaborative investment and operating partners with decades of relevant experience across the advanced industrial market

Our Cogenuity **Collaborative Operations (CoOp) Program™** is a **multi-phased, growth-oriented resource** that combines sector experience, hands-on resources, and strategic networks to help management teams achieve their strategies

Please see page 23 for additional information

Our strategy:

- Collaborative partnership
- Customized approach to growing and transforming businesses
- Investing in people, equipment, and systems
- Pursuing organic expansion and high-impact acquisitions

Power & infrastructure – how we can help

We combine **deep industry experience** with **active capital** to accelerate growth for businesses **that power our critical infrastructure**. **We have decades** of investing and operating experience **across our infrastructure**

1. **Grid infrastructure:** substation, transformer, and protection and control services
2. **Critical components:** valves, filtration, sealing systems, and surface protection
3. **Smart infrastructure:** tech-enabled services for water, gas, and utilities

Our edge: Proven operational playbooks, extensive industry networks, and flexible capital to accelerate growth

Let's build the future of the power infrastructure - together

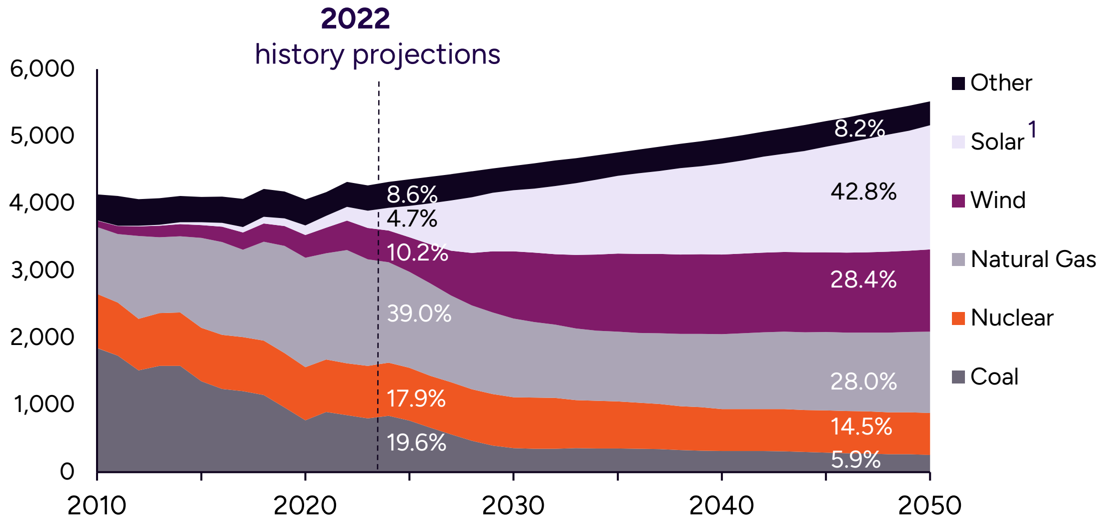
Executive summary

- The U.S. power sector is undergoing a **significant transformation** as electricity demand reaches record highs, driven by new load sources, and increasingly utilized **decentralized generation** in the form of **renewables and microgrids**
- After a decade of low growth, U.S. electricity consumption is expected to go on a **multi-decade growth trajectory**, driven by:
  - rapid **data center expansion** (especially for cloud and AI computing)
  - continued adoption of **electric vehicles** (EVs)
  - broad **electrification trends** reshaping industrial demand patterns
- At the same time, renewable energy deployment continues at pace, bringing both opportunities and challenges including:
  - integrating **intermittent resources**
  - advancing **long-duration energy storage**
  - new technologies including **floating solar photovoltaics** and **next-generation wind turbines**
- North American Electric Reliability Corporation (NERC) has noted that **peak demand growth is outpacing supply additions** in some regions, and could raise **reliability concerns** for extreme weather peaks
- The grid is becoming more decentralized with the rise of **microgrids** that bolster resilience
- We believe these changes are impacting not just technology and infrastructure, but also the **workforce** (where labor shortages and new skill needs are evident) and the **investment landscape** (with heightened M&A activity in critical power services and power equipment companies)

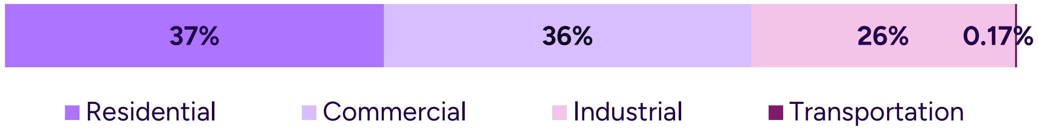
Introduction to U.S. power sector

Decades of flat demand and supply are being challenged by new demand growth, and shifting generation sources

U.S. net electricity generation by fuel (Bn KWh, 2010-50)



U.S. electricity consumption by sector (%, 2023)



Key drivers

Industrial and Residential Electrification	*Growth of EVs*	*Data Centers (DCs)*

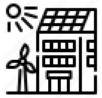
Speed of commissioning new renewable sites compared to building new power plants likely impact shifting generation sources

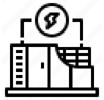
Value chain

Generation	***Transmission and Distribution***	***Storage***

Key innovations

Distributed Energy Resources (DERs), Virtual Power Plants (VPPs)	***Microgrids, Smart Meters***	***Battery Energy Storage System, Pumped Storage Hydropower***



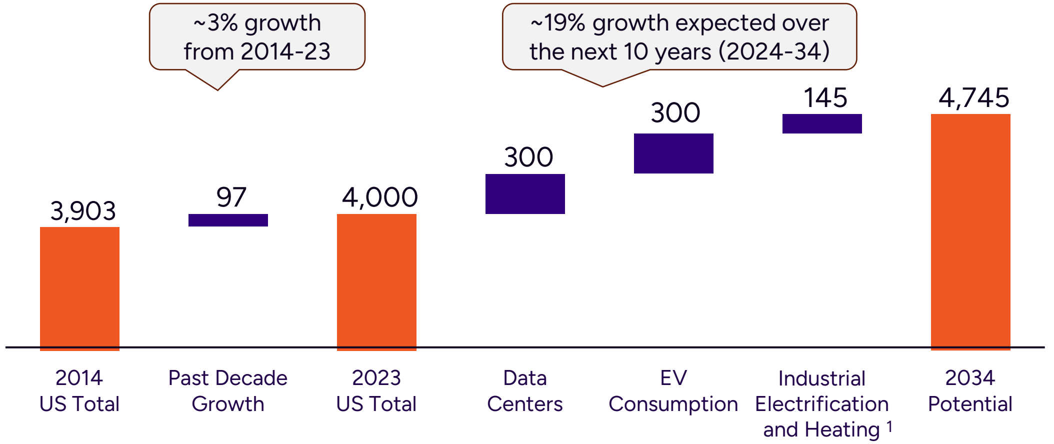


Note: (1) Includes utility-scale and end-use photovoltaic generation and excludes off-grid photovoltaics
Source: EIA, IEA, Industry Articles

Evolving electricity demand

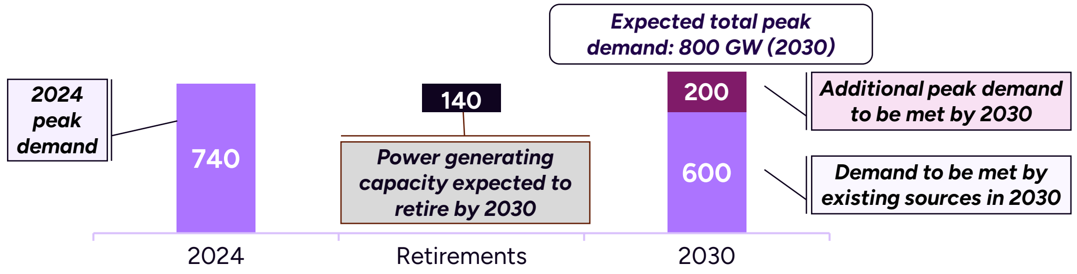
Over the next 10 years, electricity demand is expected to increase by ~19%, driven primarily by data center growth and electric vehicles (EVs), creating additional reliability challenges

U.S. key sources of electricity demand growth (TWh, 2014-34)

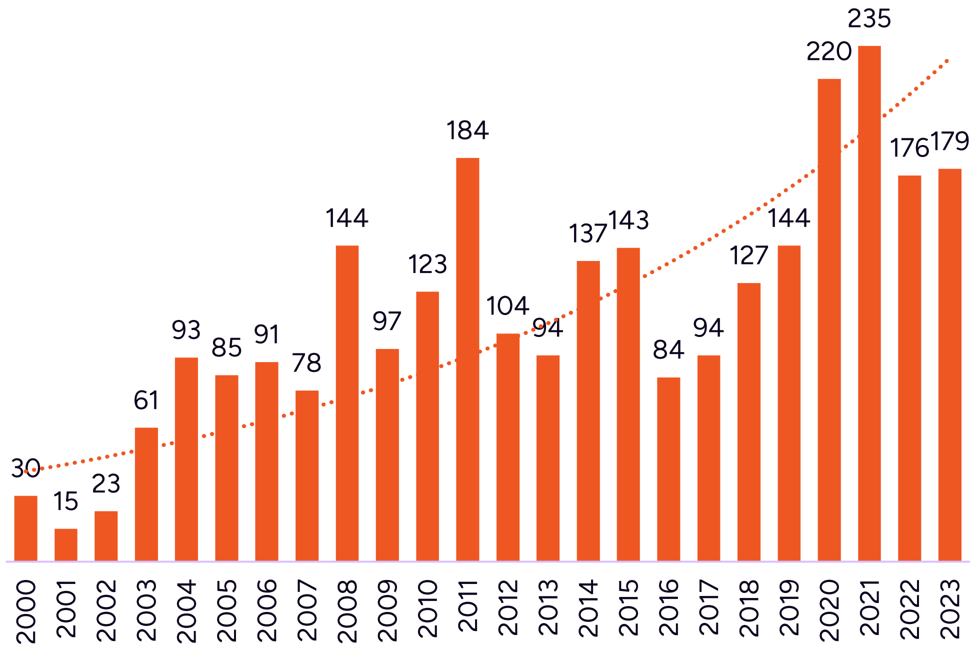


Peak demand growth is outpacing supply additions and expected to compound already rising reliability concerns

U.S. peak electricity demand (GW)



Number of major disturbances in the U.S. (2000-23)[2]



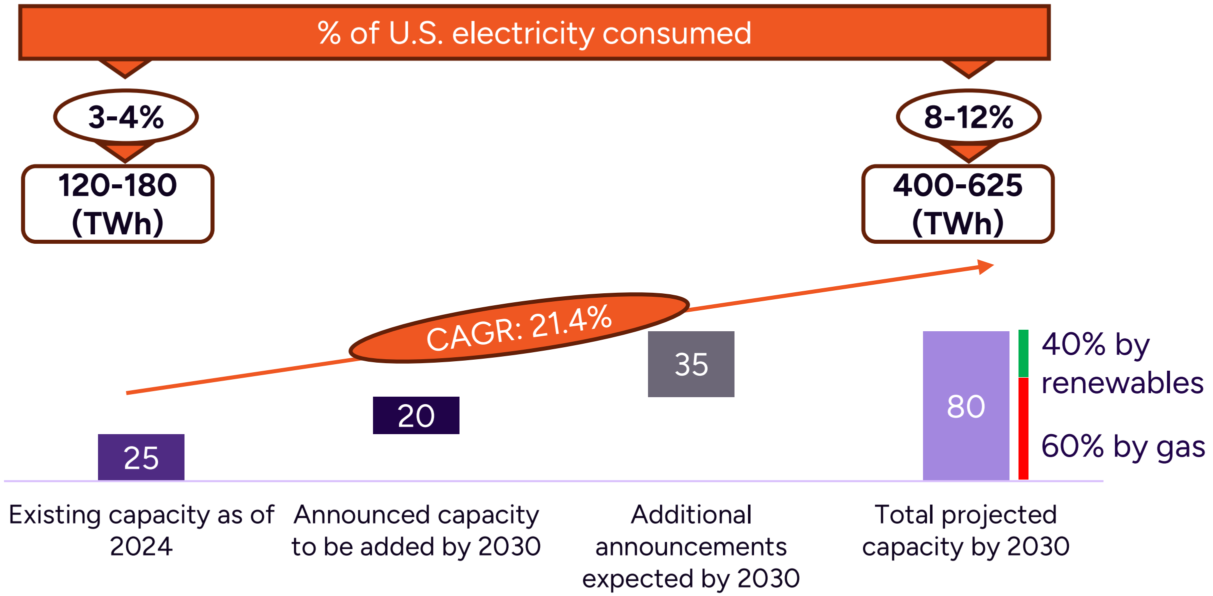
Grid reliability in the U.S. has been decreasing as demand and complexity increase

Note: (1) Industrial electrification and heating includes: semi conductors, battery manufacturing, and buildings and industrial electrification; (2) U.S. Dept. of Energy / EIA; 2023 represents data through Oct 2023
Source: U.S. Dept. of Energy, CSIS, Wood Mackenzie, IEA, Industry Articles

Data centers – proliferation

Further, proliferation of data centers in the U.S. may consume up to 12% of U.S. electricity power with 40% coming from renewable sources by 2030

U.S. data center power demand (GW, 2024-2028E)



Microsoft, with Blackrock, Global Infrastructure Partners (now a part of Blackrock) and MGX, has set up Global AI Infrastructure Investment Partnership which seeks to mobilize $100 Bn to meet the rapidly growing energy supply needs of the booming AI industry

Innovative efficiency solutions being implemented

Energy efficiency – Hyperscale DCs are implementing energy efficiency measures; average power efficiency (PUE) of new hyperscale DCs improved in 2024, meaning less electricity wasted as heat

Use of AI – Using AI systems to analyze large volumes of operational data to identify inefficiencies, predict demand fluctuations, and optimize resource allocation in real time

Energy sources – DCs are deploying diverse clean energy portfolio – solar, wind, geothermal (e.g., Google, Meta) or nuclear – through PPAs

Some are colocated with renewable projects (sign off-site PPAs) to help ease the strain on local grids and gain the security of power

- Challenges: Infrastructure and operation of both projects need to be carefully coordinated to avoid capacity issues, supply-demand imbalances, or interruptions

amazon – *960-MW data center campus in Pennsylvania to be directly powered with nearby nuclear energy*

Google – *Signed long-term PPAs for over 700 MW of solar projects in Oklahoma, with one installation less than a mile from their Pryor data center*

Data centers – power purchase agreements

Operators like Meta, Microsoft, and Google are investing heavily in renewable energy purchases to ensure power…

Multiple sources to meet increasing power demands

PPAs

Company forms an agreement with an energy provider to invest in a renewable energy project and procure the output for its data centers once the project is live

Onsite PPAs

- Install renewable energy infrastructure at a company's location to feed power directly
- Less common and usually smaller scale (500kW to 3MW); may come from rooftop solar panels or small-scale wind turbines

Small modular reactors (SMRs)

Nascent Technology

- Advanced small nuclear reactors (300 MW(e) per unit)

Off-site PPAs

- Up to hundreds of MW per deal
- Long-term

Physical PPAs

- Companies agree to off-take the output of specific projects

Virtual PPAs

- Companies buy from provider without linking it to specific projects

Sleeved PPAs

Utility provider acts as intermediary

- Data center company enters a PPA with a green energy developer; however, instead of directly receiving the energy from the project, the utility provider "sleeves" the energy through its grid, mixing it with other energy sources

Recent initiatives for clean energy by big tech

Google

- 2024: Partnered with Apex Clean Energy on a 189 MW solar farm in Virginia dedicated exclusively to powering Google's data centers in the region
- 2023: Signed a deal to purchase energy from a planned small modular nuclear reactor (SMR) in Tennessee

Microsoft

- 2024: PPA with Constellation Energy which plans to restart Palisades nuclear plant in Michigan by 2028; no plans to colocate, however
- 2024: Hired a director of nuclear technologies to oversee a program to develop SMRs to power datacenters

amazon

- 2024: PPA to source power from AES's new solar-plus-storage power plants in Adelanto, California
- 2024: In Washington, signed an agreement with Energy Northwest, a consortium of state public utilities, that will enable the development of four advanced SMRs

Meta

- 2024: Signed renewable energy PPAs to support data center operations in Idaho and Texas
- 2024: launched RFP for development of 1-4 GW of new nuclear generation capacity in the U.S.

Source: Industry articles

Data centers – energy efficiency methods

…and new technologies (like advanced cooling and hydrogen fuel cells) to make these facilities more efficient, especially as power demands increase with AI

Advanced methods for energy efficiency

Hydrogen Fuel Cells

- Hydrogen fuel cells are used as backup power sources, replacing traditional diesel generators
  - Hydrogen fuel cells can achieve **~40-60%** efficiency, and with waste heat recovery systems, efficiency can **exceed 80%** while diesel generators typically run at **30-40%** efficiency

Battery Energy Storage Systems

- Battery Energy Storage Systems (BESS) are replacing diesel gensets as short-term backup power supply
- According to International Data Corporation (IDC) data, lithium-ion UPS systems in data centers saw a sales share increase **from 2% in 2021 to 8% in 2022**, reflecting growing adoption

Liquid Cooling

- **Immersion cooling :** Servers and other IT equipment are submerged in a thermally conductive but electrically non-conductive liquid-dielectric fluid; can reduce cooling **OPEX by up to 95%**
- **Direct to chip cooling:** Cold plates placed directly on the high-heat components; dielectric fluid flows through these plates, absorbing heat

Heat Reuse Technologies

- Capturing waste heat generated by servers and repurposing it outside the facility to heat nearby buildings, provide hot water, or support industrial processes, contributing to energy efficiency on a broader scale beyond just the data center

Leaders at the forefront:

amazon | Google | Meta | Microsoft

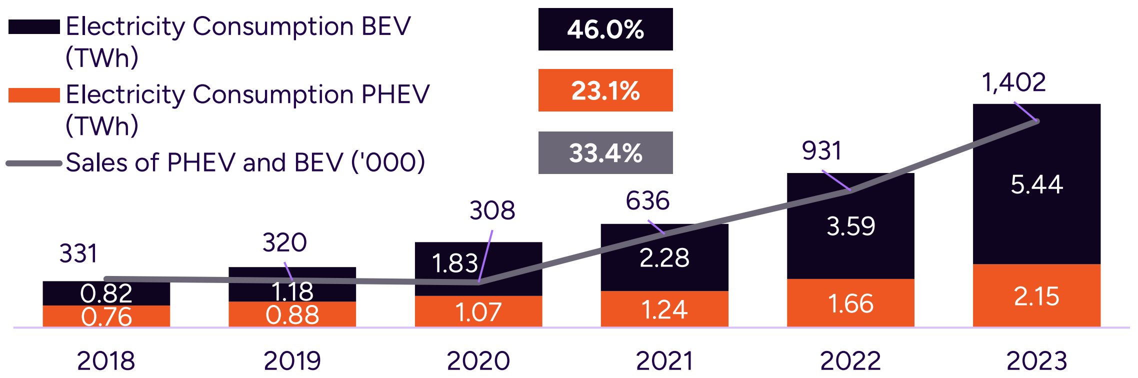
Advanced cooling methods for energy efficiency are being deployed at an increasing scale. Leading companies like Amazon, Google, Meta, and Microsoft are not only testing and refining these solutions but also securing patents for improved designs. These effective innovations are already being integrated into their data centers and infrastructure, demonstrating what we believe is a clear shift toward large-scale, high-efficiency technologies especially as power demands increase with AI

Source: Industry articles

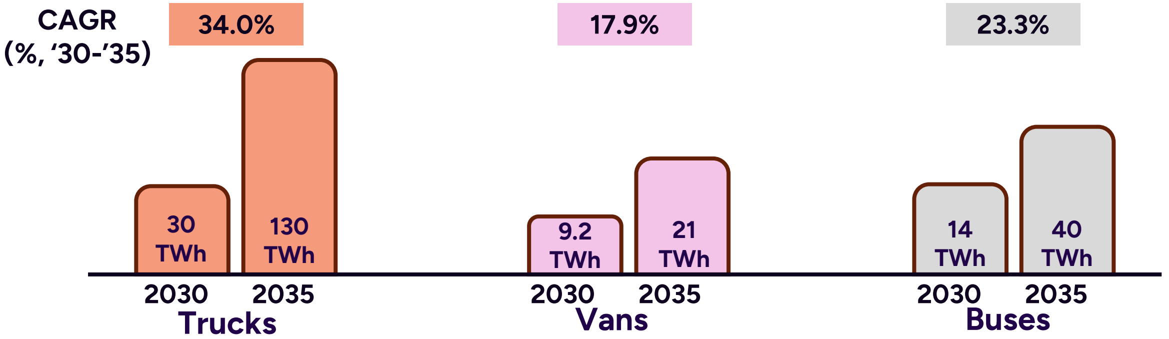
Vehicle electrification

EV adoption in both private and commercial sectors is set to significantly increase electricity demand, with projections showing a substantial rise by 2030 in both low and high cases

U.S. light-duty EVs electricity consumption & sales (2018-23)



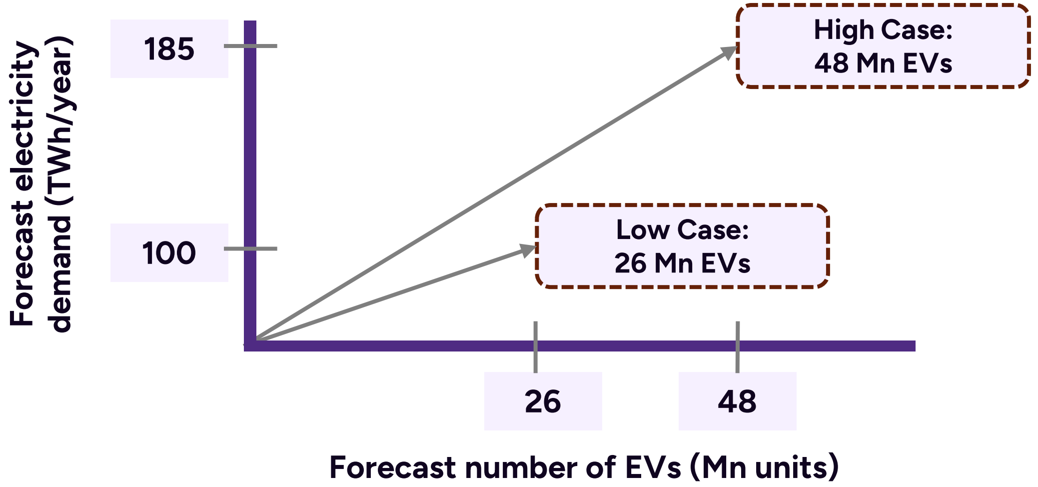
U.S. electricity demand - Trucks, vans, buses (2030, 2035)



Source: EIA. IEA, Bureau of Transportation Statistics, Rabobank

U.S. light-duty EVs electricity demand forecast (2030)

By 2030, EV adoption in passenger vehicles expected to drive substantial increase in electricity demand, requiring between **100TWh** and **185TWh** annually, i.e., **between 2.5% and 4.6%** of the U.S. total electricity consumption



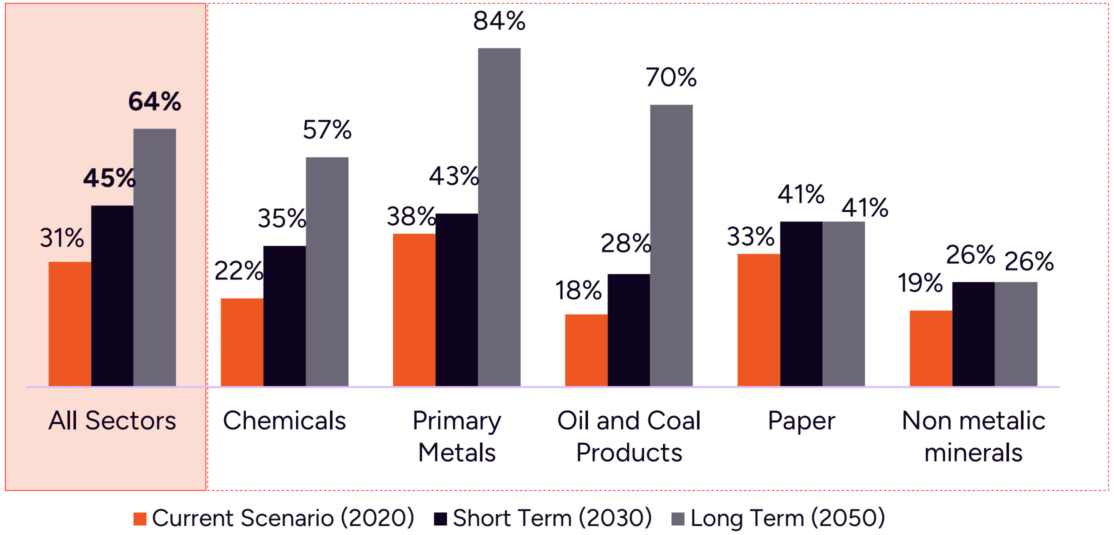
The complexity of EV charging comes from both higher electricity demand and alignment of unpredictable EV charging patterns with existing grid loads

Industrial electrification

Industrial electricity consumption is expected to increase due to continued Internet of Things (IoT) adoption, robotics and manufacturing (R&M), and industrial onshoring/reshoring trends

U.S. industrial potential electrification (%, 2020, 2030, 2050)

These 5 sectors, considered "hard to abate" because decarbonizing them at scale is difficult , account for ~75% of energy demand



As of 2020, the industrial sector's electrification rate stood at 31% - it is projected to rise to 45% by 2030 and further increase to 64% by 2050

Examples of industrial electrification in the U.S.

Chemicals
- Electrification of compressors and process heating replacing fossil fuel steam generation and pneumatic systems

Food & Beverage
- Industrial heat pumps and thermal batteries replacing fossil fuel-powered boilers and steam systems

Steel and other metals
- Electric arc furnace replacing blast furnaces; use of electric roller hearth furnaces, electric annealing and galvanizing lines

Paper
- Power-to-Heat electric boilers replacing fossil fuel-based boilers

Cement
- Electric kilns replacing rotary kilns powered by fossil fuels

Industrial onshoring fueling electricity demand

13K GWh/yr	Total new load from **155** new/expanded U.S. manufacturing facilities that were announced, began construction, or initiated commercial operation between Jan'21-Mar'23

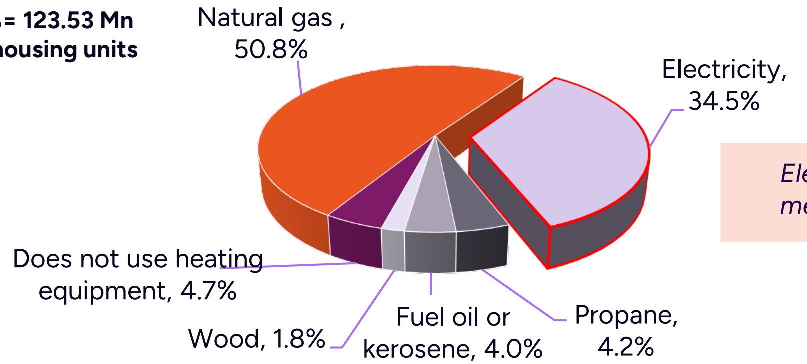
Source: Schneider Electric, EPRI, Industry Articles

Electrification of space heating

Electrified space heating is projected to power a significant portion of homes by 2050 with increasingly lower costs of ownership than traditional heating methods

U.S. homes space heating by equipment (%, 2020)

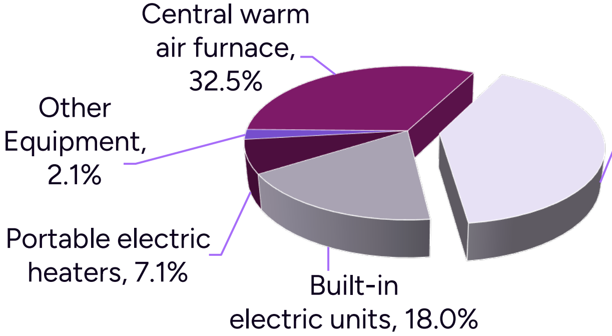
100%= 123.53 Mn U.S. housing units



Electricity is the 2nd most used method for heating homes

U.S. electric space heating breakdown (%, 2020)

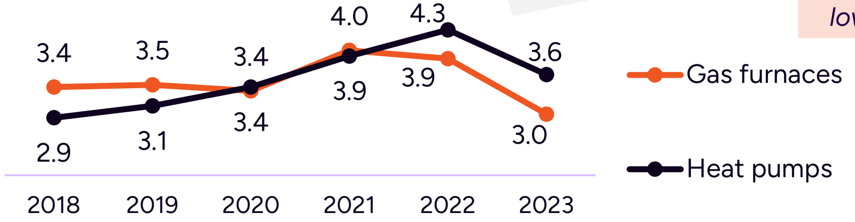
100%= 42.57 Mn U.S. housing units



*~**14%** of U.S. homes already use electric heat pumps*

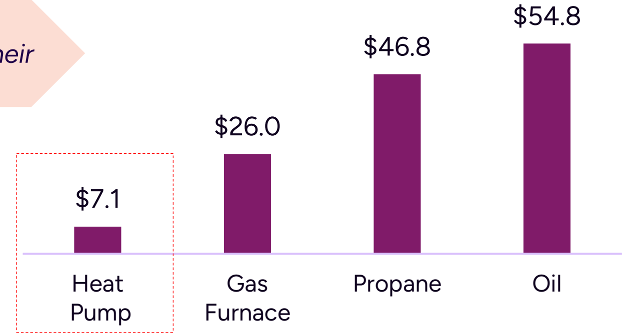
Annual U.S. heat pump and gas furnace sales (# Mn, 2018-2023)

Heat pumps are rising in preference; however poor macroeconomic conditions in the U.S. weighed on sales of these two heating equipment technologies



Heat pump sales overtook gas furnace sales in 2022 owing to their lower total cost of ownership

Total cost of ownership of space heating equipment ($ 000's, 2023)



100% By 2035, all heating equipment sold expected to be electric heating pumps

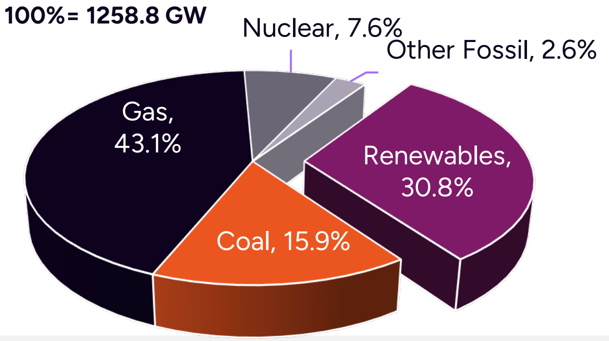
100% By 2050, all U.S. homes are expected to use heat pumps for space heating

Source: EIA, Harvard Business School, Rewiring America, Industry Articles

Renewable capacity and consumption

Renewables are playing an important role in supply expansion, supported by their declining levelized cost and rising preference for renewables across key sectors

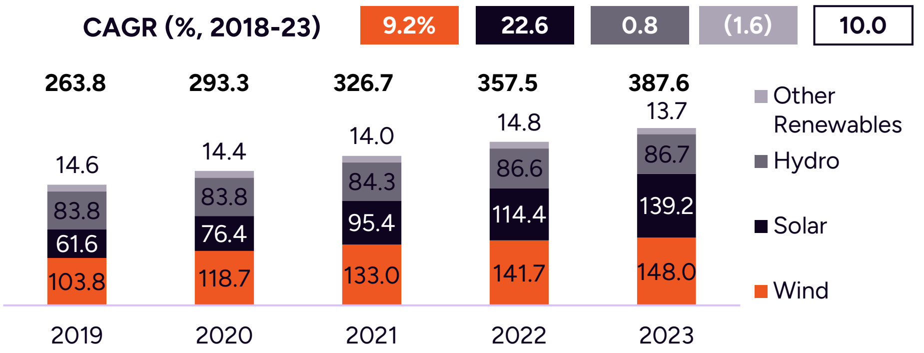
U.S. installed electricity capacity by source (GW, 2023)



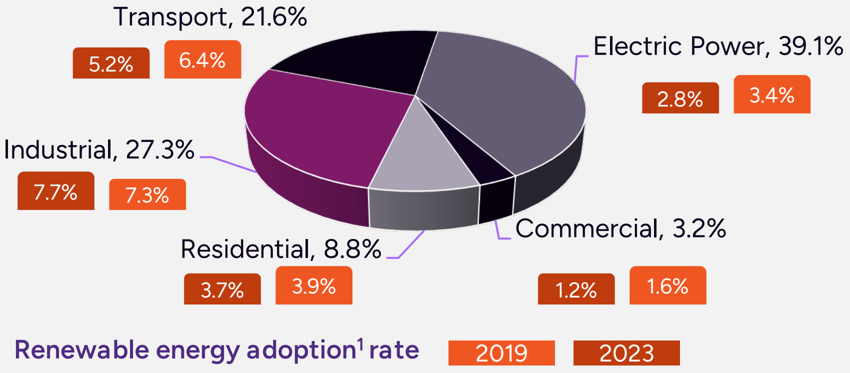
Share of renewables in installed capacity has steadily increased

U.S. installed renewables electricity capacity (GW, 2019-23)

This rise stems from falling levelized cost of renewables



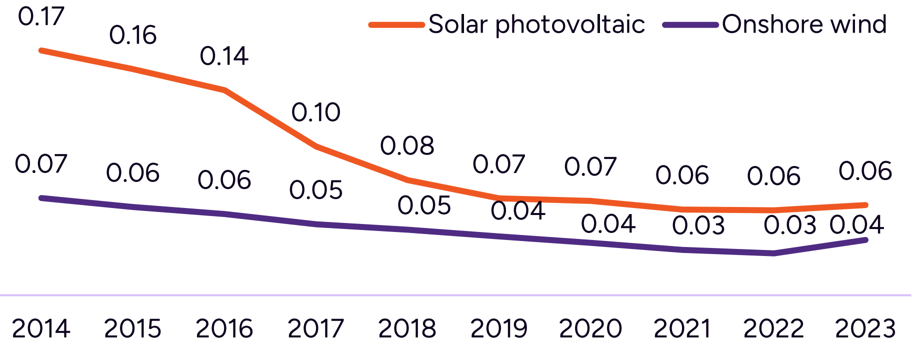
Renewable energy consumption across sectors (%, 2023)



The adoption of renewable energy in the transport and electric power sectors has witnessed a notable surge, driven by a heightened focus on sustainability from data centers and EVs

Levelized cost of energy for renewables U.S. ($/kWh, 2014-23)

Levelized cost of energy of solar photovoltaics has dropped ~65%, while onshore wind has dropped ~43%, from 2014 to 2023



Note: (1) Adoption rate is calculated using: (Renewable energy consumed by the sector) / (Total energy consumed by the sector)
Source: DOE, Industry articles

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Innovation in renewables

Storage innovations are enabling renewable energy consumption by helping to manage supply and demand peaks – but long-duration storage necessary to support broad, grid-scale adoption remains undecided

Storage solutions for renewables

PSH amounted for 70% of all utility-scale electrical storage capacity in the U.S. in 2022, followed by battery storage, while in terms of energy storage capabilities, PSH accounted for 96% of total capacity of storage devices

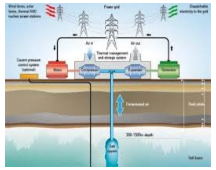
Dominant storage technologies

Pumped Storage Hydropower (PSH):
Complements wind and solar by storing excess electricity; in 2022, U.S. had **43** PSH systems with installed capacity of **22 GW,** estimated energy storage capacity of **553 GWh** with a median storage duration of **12 hours**

Lithium-ion battery storage:
Store surplus wind/solar energy for rapid discharge during short demand; in 2022, U.S. had **445** utility-scale battery installations with installed capacity of ~**9 GW** with median storage duration of **2 hours**

Next gen storage technologies

Flow batteries: (In development stage)
Vanadium redox flow batteries, a developing grid-scale storage solution, offer **600 kW power** and **2.2 MWh** capacity in a shipping container-sized unit



Compressed Air Energy Storage (CAES) and Gravity storage : (In development, Early adoption stage)
Enhance renewable energy balancing; CAES compresses air into reservoirs with **<50 MW** capacity for long-duration needs, while gravity storage lifts masses for **20 MWh at 500m**, scaling to **<100 MW at ~$50/kWh**

Iron Air Battery storage: (In development stage)
Harnesses rusting iron to store energy for **over 100 hours at ~$50/kWh**, with costs expected to be **5–10x below lithium-ion**

New technologies driving growth for renewables

Floating Photovoltaics (FPV):

- In 2022, research FPVs generated **0.6–4.4%** more energy than land-based systems with efficiency gains ranging **0.1–4.45%** due to water cooling; expected to grow in coastal states like California
- In 2023, Cohoes, New York, city county invested **$6.5m**, FPV system on a reservoir, expected to power all municipal buildings and streetlights, saving approximately **$500k** annually

Next-Generation Wind Turbines:

- Next-gen turbines to feature larger rotors of **>150m** diameters and taller towers of **>160m** height, boosting conversion factor to **>40%**
- New technology designed to make wind viable in lower-speed regions like Southeast U.S., unlocking **80%** more economic potential
- Vineyard Wind 1, located in Massachusetts has a 220m rotor, and 107m blades, with total generating capacity of 800 MW

Long-duration energy storage remains an evolving solution due to ongoing challenges in cost, efficiency, and scalability, particularly for grid-scale renewable adoption

Source: DOE, Industry articles

Overview of DERs, VPPs and Inverters

DERs, paired with VPPs and advanced inverters, enhance grid resilience and enable dynamic energy management

DERs

Distributed energy resources (DERs) are equipment located on or near the site of end-use that can provide electricity demand, generation, storage, or other energy services at a sub utility scale

Annual expected DER additions (2025–30)

Electricity Generation

- **Distributed Generation: 20–35 GW** of nameplate[1] generation capacity from solar panels and fuel generators

Storage

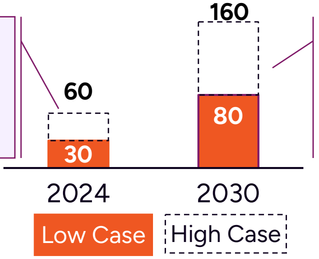
- **EV Batteries: 300–540 GWh** of nameplate storage capacity from energy stored in EV batteries
- **Stationary Batteries: 7–24 GWh** of nameplate storage capacity from fixed batteries for energy storage

- Additional DERs will be added to the grid to supply the **20–90 GW** of nameplate demand capacity needed for EV charging infrastructure
- Moreover, the grid will gain an additional **5–6 GW** of flexible demand from smart devices[2] which adjust their power usage to support grid stability

Virtual power plants (VPPs)

Virtual Power Plants (VPPs) integrate DERs to operate as a single power plant, providing a flexible and cost-effective way to balance the grid; they are designed to enhance grid resilience by using a diverse mix of energy sources

Current peak electricity demand met by VPPs



Forecasted peak electricity demand to be met by VPPs

Companies operating VPPs[3]: AutoGrid, Google, OhmConnect, swell, CPower

Advanced inverters

Smart/Advancer inverters are an emerging technology that help integrate solar energy and other DERs into the electric grid

Convergence of technologies

The convergence of DERs, VPPs, and advanced inverters points to an intelligent, decentralized, and resilient energy grid:

- **Synergy:** DERs provide the raw capacity, advanced inverters ensure grid compatibility, and VPPs orchestrate the system for maximum efficiency
- **Decarbonization:** Together, they are expected to reduce reliance on fossil fuels by integrating renewables at scale, potentially cutting power sector emissions significantly by 2050

Challenges

Technical barriers (e.g., cybersecurity, interoperability), regulatory lag, and consumer education must be addressed to unlock their full potential

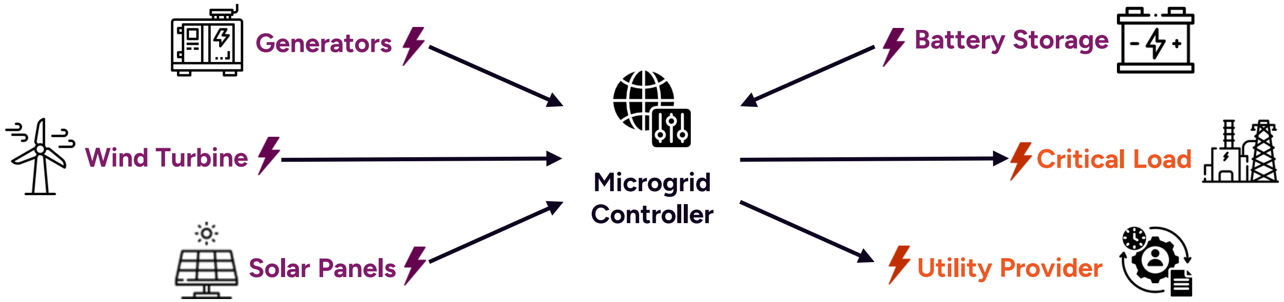
Note: (1) Nameplate capacity refers to the maximum rated output of a power generation, demand, or storage system under ideal conditions; (2) Smart thermostats, smart water heaters, and non-residential DERs; (3) The list is indicative
Source: DOE, NREL, Industry articles

Microgrids overview

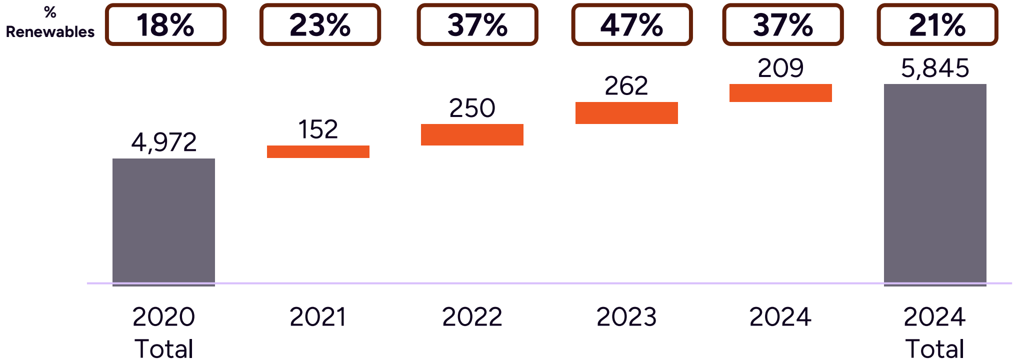
Further, microgrids boost resilience, decentralization, and disaster recovery with localized, independent power

Overview

- A microgrid is a network of distributed energy resources and loads that can disconnect and re-connect to the larger utility grid as a single entity, allowing the connected loads to be served during utility outages
- Regulatory hurdles in the U.S., including inconsistent state policies, utility resistance, and unclear frameworks, are slowing microgrid deployment despite their potential to enhance resilience and renewable integration



U.S. microgrid installations capacity (MW, 2020-24)



Top 5 state/territory with microgrid installation (MW, 2024)

Texas	California	Alaska	New York	Massachusetts
1,002.5 MW	703.1 MW	710.1 MW	580.6 MW	456.5 MW

Decentralization – a key characteristic

- **Microgrids decentralize power generation**, transitioning from centralized models to distributed, localized energy systems
  - **Local power sources and storage** minimize reliance on external sources and reduce transmission losses
  - **Peer-to-peer energy trading within microgrids** enhances community energy autonomy, sustainability, and carbon footprint reduction

Enhances energy resilience

- Microgrids enhance energy resilience by operating independently from the main grid
- Use of AI-powered monitoring for real-time threat detection and mitigation is also common with microgrids
- **Disaster recovery:** Microgrids provide a pathway to disaster resilience by ensuring essential services such as hospitals, emergency shelters, and communication centers continue to function during and after natural disasters

Source: DOE, Industry articles

Microgrids' role and financing mechanisms

Microgrids are obtaining financing as they are increasingly becoming critical for energy resilience in data centers, corporate campuses, and rural electrification initiatives

Data centers

- New data center designs use microgrids to **reduce grid stress** and **enhance clean energy use**, separating critical and noncritical loads while potentially **cutting energy costs by 50%-60%** with modular centers located within microgrids
- Example: In Dec'23, Microsoft announced that its San Jose data center will use a resiliency microgrid

Corporate campuses

- Many corporations integrate renewable energy sources into microgrids to **meet sustainability goals**. By generating and storing power on-site, they **reduce downtime** and protect critical systems
- In 2023, Apple completed a microgrid project at its Cupertino, California headquarters, Apple Park

Rural electrification

- Microgrids drive rural electrification by **offering reliable, cost-effective power**, especially with renewables like solar
- To help rural communities with the upfront costs of clean energy projects, including microgrids, **the Infrastructure Investment and Jobs Act allocated $1 Bn** to the Energy Improvements in Rural or Remote Areas (ERA) program

Financing mechanisms for accelerating microgrid deployments

Traditional microgrid financing often uses **direct purchases** and **power purchase agreements (PPAs)**. However, new approaches are emerging to overcome the limitations of conventional methods, addressing high costs, complex project structures, and perceived risks, thus paving the way for broader microgrid adoption

Traditional financing mechanisms

Direct purchases	Power purchase agreements (PPA)
Buying **microgrid outright**, giving the owner **full control and responsibility** for its costs and operations	Commits to **purchasing microgrid generated power over a fixed term**

New financing mechanisms

Private public partnerships (PPPs)	Enhanced infrastructure financing districts	Financial bundling
The public sector **brings policy support, public funding, and understanding of community needs**; private sector contributes **technological expertise**, **management skills**, and **access to capital markets**	**Modern alternative to traditional tax increment financing (TIF),** allowing for **increased property tax revenue** generated within the district to be **reinvested** in operations, maintenance, and expansion of microgrid projects	**Aggregates multiple projects into a portfolio** to attract **more investment and reduces transaction costs** through standardization and creates economies of scale

Source: Environmental and Energy Study Institute, NREL, Industry Articles

Supply chain challenges and innovations

While load forecasting and AI innovations were key themes at Distributech 2025 to improve load efficiency, core operational assets to expand capacity remain challenged with supply chain imbalances

AI-driven Load Forecasting

Utilities are employing AI for electric load forecasting to estimate the future electricity demand based on historical and probabilistic data

Improved Accuracy and Efficiency

AI models analyze vast amounts of historical load data, real-time grid performance, and weather patterns to provide highly accurate load forecasts helping utilities optimize their operations and reduce costs

Enhanced Grid Management

AI enables utilities to predict and manage grid stress points more effectively. For example, during extreme weather conditions, AI can forecast transformer stress and prevent failures by suggesting timely maintenance

Companies operating in the Space

Hitachi Energy, thinkbridge, innowatts (Powering Energy Forward™), AMPERON, QuantRisk, Ogre, ABB

Source: NREL, Infosys, Industry Articles

Ongoing supply chain disruptions challenge expansion

Key components facing recent and projected short-term disruptions

Transformers | Switchgear | Smart meters | Cables

Causes of bottlenecks in components' supply chain

- ✓ Increased demand due to deployment of renewable energy and modernization of aging infrastructure
- ✓ Manufacturing shutdowns slowed global supply chains during Covid-19
- ✓ Shortage of key materials such as grain-oriented electrical steel, aluminum, copper, etc.

Impact	Project delays	Rising component prices hindering transmission grid development	Threats to grid stability and reliability

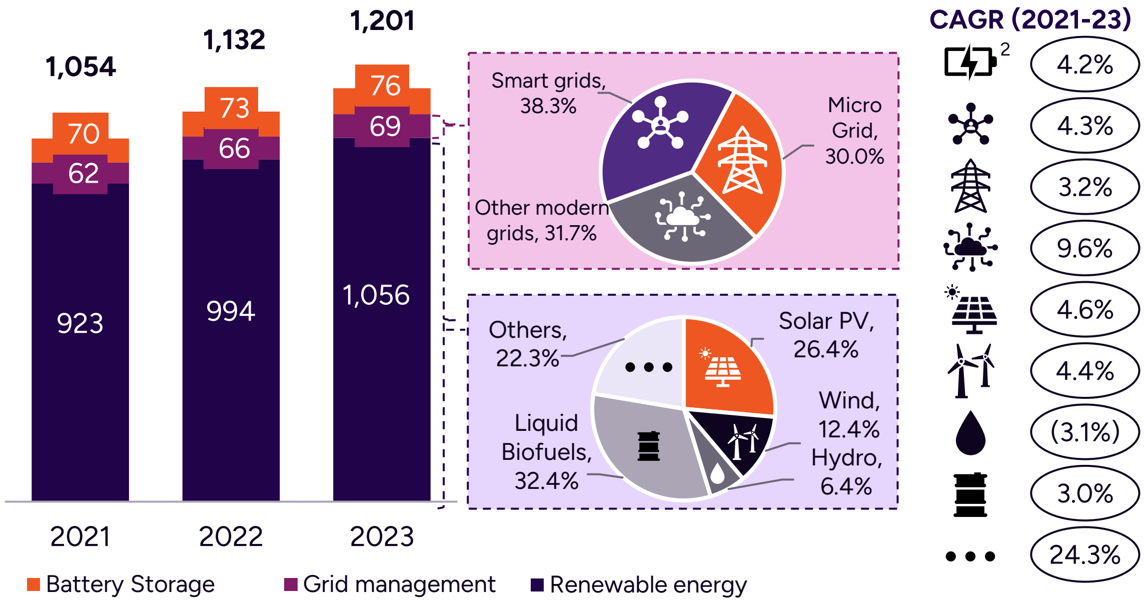
Mitigation strategies

- *Accurate Demand Forecasting*
- *Creating "storm stock" inventories of key infrastructure*
- *Longer-term agreements between stakeholders*

Workforce availability and skill development

Companies in the sector are finding it challenging to find skilled talent, while needs for qualified technicians and engineers continues to increase

U.S. energy employment market[1] (Mn units, %, 2021-23)



Overall demand for engineers

- *Demand for utility and renewable engineers increased by 90% from 2018-23*
- *In 2023, around 20% of engineers in the U.S. were estimated to be involved in energy-related projects*

Current U.S. energy workforce market overview

Challenges

- 50% of current workforce in the power industry likely to retire in next 5-10 years
- *71% energy sector companies struggle to find the skilled talent*
- *Shortage of skilled solar PV installers and windtechs raising installation costs*
- Labor shortages in *mining, welding, and electricians* threaten to slow energy transition

Steps taken

- Mass hiring supported by apprenticeship programs and trade school partnerships
  - conEdison: *Hired ~1,600 new employees in 2024 in New York to address retirements and support grid upgrades*
- Mentorship programs by pairing seasoned professionals for knowledge transfer
- *Courses for solar workers offered by Unions and workforce organizations*
- "Earn while you learn" apprenticeship programs by Inflation Reduction Act (IRA) to help workers transition into clean energy roles

Note: (1) Grid management does not include EV charging technology (2) Denotes battery storage
Source: Energy.gov, IRENA, Industry articles

Impact of automation on workforce

Automation is creating specialized roles, and upgrading technician skills to increase efficiency and scale

Impact of automation on workforce

New job roles created by automation

Roles requiring hardcore expertise to integrate new technology into existing systems would be created

- **AI & ML specialists:** managing and integrating automation in renewable energy, battery, and grid projects
- **Integration engineers:** linking drone and AI tech with existing grid systems for smooth operation

Job roles that require upgrade due to automation

Technician roles that use AI, drones and robotics would require substantial upgrades due to proliferations of these technologies

- **Renewable energy & energy storage engineers:** enhance renewable designs using robots, AI, and drones
- **Data analysts:** analyze big data from AI and drone inspections to boost performance and predict maintenance
- **Cybersecurity experts:** protect AI, drones, and robotics from threats and securing their data
- **Systems engineers:** develop AI and ML skills to design and sustain automated systems

Roles with specialization from innovation

Technology-enabled manufacturing and services could increase efficiency, requiring specialized skills to operate

- **Renewable manufacturing:** robots in solar panel, battery and wind turbine manufacturing
- **Inspection services:** tech-enabled services with AI and drones for grid monitoring
- **Surveying:** drones with imaging tech for energy project land surveys

Source: World Economic Forum, Industry articles

Impact of Administration policies on transition

Policy shifts between Administrations can impact speed of the U.S. grid transition

Impact of changing Administrations on energy transition in the U.S.

Changing priorities / philosophies from Administration to Administration creates short term uncertainty but unlikely to impact long-term trends, with the current Administration articulating a clear agenda favoring traditional fossil fuels over renewable energy initiatives. Key policy proposals and actions implemented through March 2025 include:

Renewables

- **Federal funding:** Reallocation of unused IRA funds on fossil fuel infrastructure, phaseout of Production Tax Credit (PTC) and Investment Tax Credit (ITC) by 2027
- **Fossil fuels:** DOE loans reprioritization to fossil fuels
- **Regulations:** Permitting delays and halting approvals of wind and solar projects
- **Paris Exit:** Withdrawal from Paris Climate Agreement

Grid Transition

- **Fossil fuel funding:** Declaration of "energy emergency" and redirection of funds from grid modernization to fossil fuels
- **Fossil fuel plant upgrades:** Launch of Coal-First Program and proposal of Grid Reliability Act for coal/gas upgrades
- **Regulations:** Federal Energy Regulatory Commission prioritization of fossil fuels in interconnection queues

EVs

- **Funding:** Proposal for eliminating $7,500 EV tax credit and halting federal EV fleet transitions
- **Regulations :** Review to relax Environmental Protection Agency's tailpipe standards

Clean energy sector faces a short-term slowdown as financing, grid access, and federal support shrink, tilting U.S. energy toward fossil fuels. However, the ultimate impact of these administrative actions is still under debate, and are expected only to be realized in the long run

Potential impact

- ➔ Electricity costs
- ➔ Grid reliability
- ➔ EV adoption
- ➔ EV costs
- ➔ Infrastructure modernization

Outside factors

- ➔ Impact of PTC/ITC changes
- ➔ Congressional approval of tax credit rollbacks
- ➔ Market-based dynamics

Source: Natural Resources Defense Council, Franklin Templeton, Wood Mackenzie, Reuters, Industry Articles

Key action items for stakeholders

Stakeholders must balance fossil fuel expansion with renewable growth, invest in technology and modernize infrastructure

Key action items for policymakers, utilities, investors, and technology providers

Policymakers

Balance energy mix: Balance fossil fuel expansion while maintaining momentum on renewables investments for long-term stability

Grid modernization: Strengthen infrastructure to integrate diverse energy sources and enhance reliability

Market confidence: Provide regulatory clarity and support grid enhancements

Investors

Fossil fuel upside: Leverage short-term gains in coal, natural gas, and infrastructure, while seeking to maintain strategic positions in clean energy to mitigate long-term transition risks

Monitor technological innovations: Stay informed and actively invest in advancements in energy technologies, such as small modular reactors and energy storage solutions

Infrastructure modernization: Invest in modernizing the grid to support energy mix shifts and enhance reliability

Utilities

Diversify energy portfolio: Balance investments between traditional fossil fuels and renewable energy sources in an effort to support efficient supply expansion and meet growing demand

Data center partnership: Collaborate with data centers to provide sustainable power solutions, capitalizing on their energy demand

Regulatory arbitrage: Capitalize on state-level clean energy initiatives even as federal policies shift

Technology providers

Advance fossil fuel tech: Enhance efficiency in coal, natural gas and carbon capture to align with policy shifts

Next-gen renewables: Develop cost-effective solar, wind, small modular reactors and energy storage solutions to maintain competitiveness

Grid modernization: Innovate smart grid, transmission, and demand-response technologies for a resilient energy mix

Source: World Economic Forum, Rabobank, McKinsey, Industry articles

About Cogenuity Partners

We have been part of private equity for a combined 75+ years, including deep experience in critical products and services across the Power and Infrastructure landscape

Our team:

9 Investment and operating professionals

10+ Transactions within Power and Infrastructure

Select investment criteria:

Revenue:	EBITDA:
$25-250M	**$5-35M**

1) Critical products & services
2) Experienced management teams
3) US or Canada headquarters
4) Strong revenue growth & margins

Our philosophy:

We are **more than a source of capital** – we take **pride in our investment and operating partners** working side-by-side with experienced management teams, industry professionals, and advisors to execute on **value creation initiatives and seek to achieve attractive outcomes**

Power & infrastructure:

We are experienced investors and operators across the power landscape:

- Multiple industry-leading companies providing products and services across **transformer, substation, and protection & control services**
- Designer and engineer of **transformer control cabinets**
- Provider of mission-critical **surface protection** for power generation applications

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Note: Investment criteria is for illustrative purposes only. There can be no assurance Cogenuity will be able to implement its strategy with respect to any or all investments. Actual investment characteristics may vary materially in Cogenuity's discretion.

Appendix - Case Studies

Case Studies

Increasing demand for power sector related services is driving strategic acquisitions

ABM Industries' acquisition of Quality Uptime Services

Market Landscape

AI and cloud computing are driving rapid data center expansion, increasing demand for Uninterruptable Power Supply (UPS) systems and infrastructure reliability. The importance of maintaining uptime has grown significantly, as any downtime can lead to considerable financial losses

ABM's Expansion Strategy

In June '24, ABM Industries, a facility solutions company known for janitorial and building maintenance services, acquired UPS systems provider **Quality Uptime Services for $119 Mn**, integrating it into its Technical Solutions segment. This acquisition:

- **Doubles ABM's mission-critical service revenues** and expands its data center footprint
- **Enhances service offerings**, adding Quality Uptime Services' UPS expertise to ABM's microgrid design and switchgear maintenance
- **Strengthens ABM's market position**, capitalizing on AI-driven data center growth

Impact & Key Takeaways

- **ABM expands service offerings** for data center infrastructure, including power, cooling and facility management
- **Stronger market positioning** in mission-critical power services amid rising AI investments

Asplundh's growth in grid services: Acquisition of Voltyx

Market Landscape

Rising renewable energy adoption and grid modernization efforts have increased demand for substation maintenance, transformer services, and electrical testing. With aging infrastructure and new transmission projects, utilities require specialized expertise to ensure grid reliability

Asplundh's Expansion Strategy

In May'24, Asplundh acquired **Voltyx,** which owns North American Substation Services (NASS) and Electric Power Systems (EPS), two leading providers of electrical testing, substation maintenance, and engineering services. This move:

- **Continues Asplundh's expansion** beyond vegetation management into **substation and transformer services**
- **Adds 1,200+ specialists across 35 locations**, including technical expertise
- **Positions Asplundh for larger grid contracts**, including utility hardening programs

Impact & Key Takeaways

- **Diversification into grid infrastructure,** aligning with industry shift towards renewables and new exposure to data center opportunities
- **Stronger market position,** enabling broader service offering to utilities

Source: Industry articles

Note: For illustrative purposes only. There can be no assurance future investments will be similar in quality or performance. Case studies do not represent any investments made by Cogenuity. Certain members of Cogenuity were formerly officers or board members of Voltyx.

Case Studies

Investments in data centers' energy infrastructure are boosting reliability, growth, and sustainability

Dominion Energy

Dominion Energy's investment to serve data center demand

Market Landscape

Northern Virginia's data center boom has made it one of the fastest-growing energy demand regions in the U.S. Data centers now account for over 25% of Dominion Energy Virginia's load, with 40GW of new projects in the pipeline. Utilities must invest in grid expansion while balancing reliability and sustainability

Dominion's Strategic Investment

Dominion plans to **invest $50 Bn over 2024-2029 in capital expenditures**, with ~80% focused on Virginia to support data center growth, including:

- **Major transmission upgrade,** such as new 500 kV lines finishing in 2025 and 2027
- Renewable energy expansion, including a **2.6 GW Coastal Virginia offshore wind project**
- Evaluating **cost-sharing mechanisms** for data center related grid expansion

Impact & Key Takeaways

- **Sets a precedent** for utility investments in high-growth, power intensive sectors
- **Strengthens Dominion's position** as a key energy provider for data center hubs

Microsoft

Microsoft: Pioneering sustainable data center operations

Evolving Energy Needs of Data Centers

With hundreds of data centers worldwide, Microsoft aims to be carbon negative by 2030 and eliminate diesel backup generators. As demand for sustainable energy grows, Microsoft is leading efforts to integrate clean power, alternative backup solutions, and grid interaction strategies

Microsoft's Sustainability Strategy

For its 2030 carbon-negative goal, Microsoft is transforming its global data center energy strategy by eliminating diesel generators and advancing clean energy solutions. This includes **hydrogen fuel cells**, **large-scale battery storage**, and **real-time energy optimization**.

- Accelerates Microsoft's transition to **fully sustainable**, **diesel-free backup power**
- Integrates **smart energy management** and renewables, enhancing **grid reliability**
- A **blueprint** for **scalable**, **resilient**, and **sustainable** hyperscale infrastructure

Impact & Key Takeaways

- **Sets a benchmark** for sustainable data center operations
- **Aligns sustainability with reliability,** ensuring uninterrupted power through diverse clean energy investments

Source: Industry articles
Note: For illustrative purposes only. There can be no assurance future investments will be similar in quality or performance. Case studies do not represent any investments made by Cogenuity

Case Studies

Companies are enhancing grid performance by focusing on workforce training and deploying microgrids

conEdison

Consolidated Edison: Workforce renewal & training initiatives

Workforce Transition Challenges

With ~20% of its workforce projected to retire by 2025, ConEd needed to replenish talent while developing new skills to support grid modernization, renewables, and electrification

ConEd's Workforce Strategy

- **Largest hiring push since the 1970s:** Recruited **1,700 employees** in 2024, including engineers, lineworkers and IT specialists
- **Expanded apprenticeship programs: 12-month lineworker training** with technical colleges, knowledge transfer stipends for senior employees
- **Technology-driven training: Augmented reality (AR) tools** for safer, more effective field training
- **Focus on diversity:** Increased hiring of **women and minorities** in trade roles

Impact & Key Takeaways

- **Bridges the expertise gap** through structured hiring and training
- **Enhanced grid** resilience by ensuring a skilled workforce for modernization efforts

SDGE™

SDG&E microgrids for wildfire resilience: Decentralization in action

Addressing Climate & Resilience Challenges

Operating in wildfire-prone Southern California, SDG&E has pioneered microgrid deployment to maintain power supply during Public Safety Power Shutoff events

SDG&E's Microgrid Strategy

- **Utility-owned microgrids: Four sites operational as of 2024** with more under development
- **Cameron Corners microgrid: 6 MWh battery and micro-turbine backup powers** an entire rural community
- **Advanced controllers (PXiSE technology):** Enable **remote monitoring, automated operation, and energy sales** to CAISO's market
- **Microgrid Incentive Program:** Encourages **fire stations and community centers** to install microgrids with utility funding

Impact & Key Takeaways

- integrating decentralized energy sources
- **Investor interest in resilience tech**, benefiting suppliers of microgrid controllers, battery systems, and smart grid solutions

cogenuity

Source: Industry articles
Note: For illustrative purposes only. There can be no assurance future investments will be similar in quality or performance. Case studies do not represent any investments made by Cogenuity