The Impact of Reindustrialization in the United States on the Power Sector

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Introduction
Context & Scope

U.S. Reindustrialization Drivers

A 2023 EPRI white paper (3002027930) explored the revitalization of U.S. manufacturing and possible impacts on the electric sector.

Background

The U.S. economy is undergoing an industrial transformation catalyzed by supply chain disruptions from the COVID-19 pandemic, conflict in Europe causing fluctuations in energy markets, and commitments to economic security and decarbonization. (1)

The COVID-19 pandemic

Decarbonization commitments

The conflict in Europe

Broadly, newfound appreciation for supply chain, security, and climate risks helped change the calculus across business and government regarding the offshoring of manufacturing and raw materials production and processing, as well as the reliance on fossil fuels for power generation, heating, and transportation.

U.S. policymakers enacted three major pieces of legislation in 2021-2022 focused on improving domestic supply chain resilience, sharpening industrial competitiveness, and upgrading infrastructure while supporting progress toward net-zero goals.

Creating Helpful Incentives to Produce Semiconductors and Science Act (CHIPS)

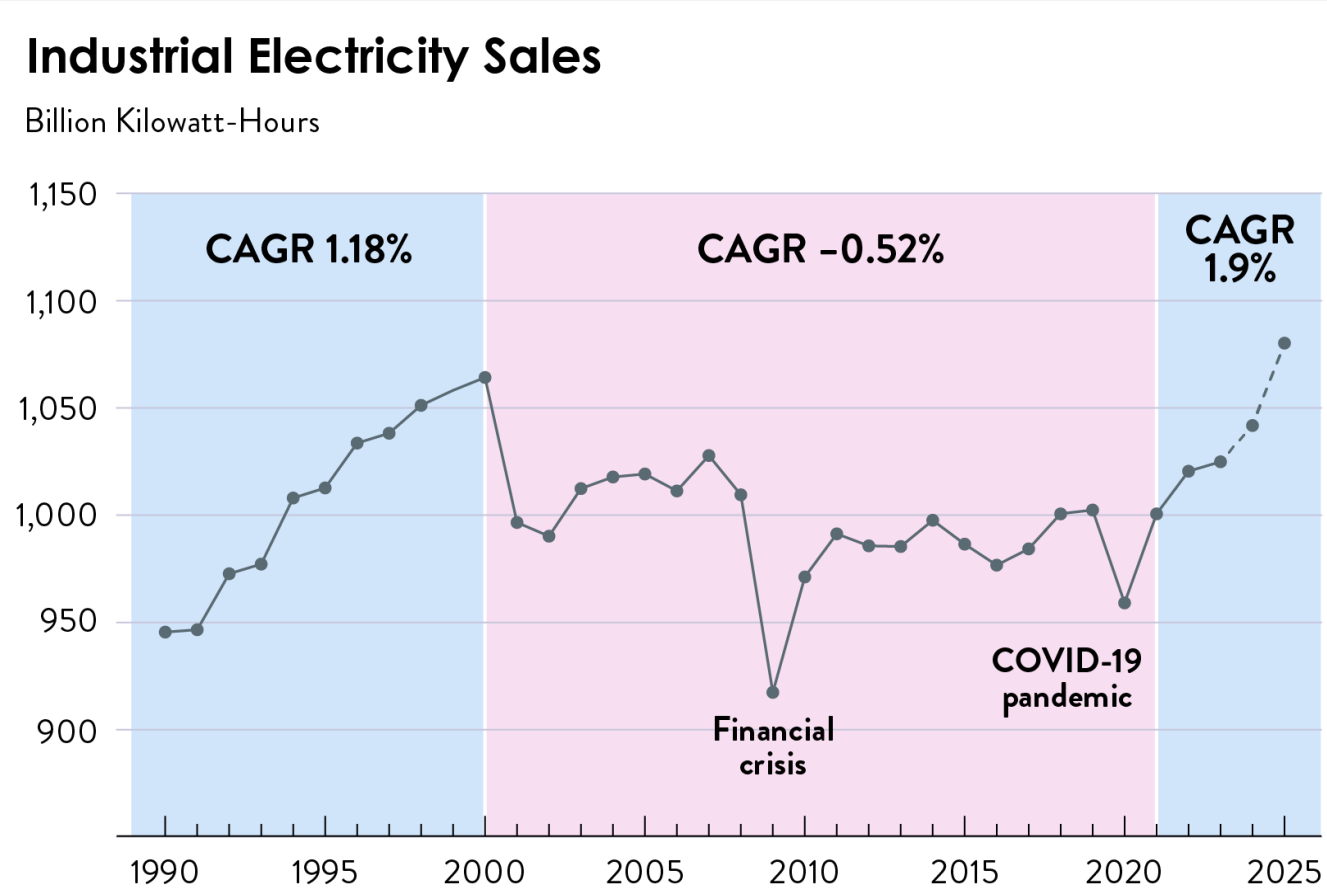
Infrastructure Investment and Jobs Act (IIJA)

Inflation Reduction Act (IRA)

Industrial Load Growth Trends

U.S. industrial electricity sales are growing after two decades of stagnation and are projected to reach an all-time high in 2025.

Background



Data Source: U.S. Energy Information Administration (EIA) (5)

1 Steady Rise

From 1990 to 2000, U.S. industrial electricity sales increased at a cumulative annual growth rate (CAGR) of 1.18%.

2 Stagnation

Industrial sales declined in 2001, due in part to the offshoring of manufacturing. After a pandemic-driven dip in 2020, sales rebounded.

3 Resurgence

According to EIA's August 2024 *Short-Term Energy Outlook* (STEO), industrial sales remain on the rise and are expected to increase at a CAGR of ~2% from 2021 to 2025. (5)

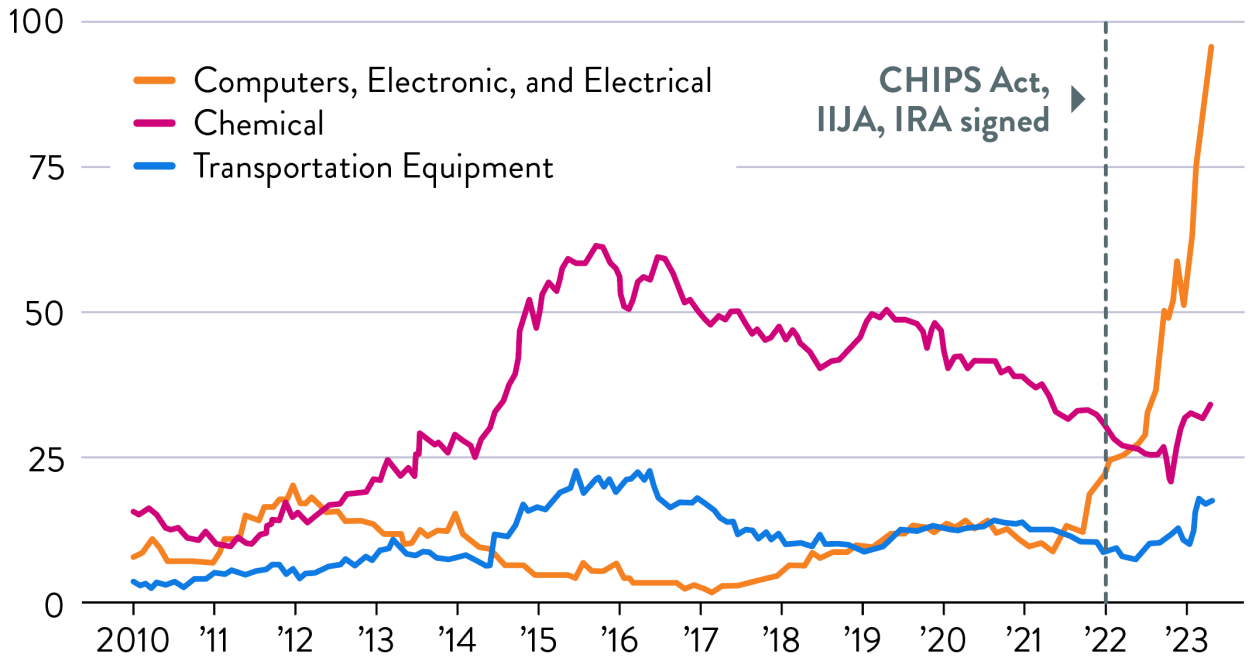
Supply Chain and Climate Risk Reassessment

Increases in economic activity observed after the enactment of major legislation signal a revitalization of the U.S. manufacturing sector.

Background

Real Manufacturing Construction Spending by Type

Billions of 2022 U.S. Dollars



Notes: Value of Private Construction Put in Place for Manufacturing, U.S. Census Bureau, decomposed by Detailed Type. Monthly at a seasonally adjusted, annualized rate. Nominal spending deflated by the Producer Price Index for Intermediate Demand Materials and Components for Construction, Bureau of Labor Statistics.

Data Source: U.S. Department of the Treasury (2)

1 Increased spending on manufacturing construction

Since January 2022, monthly U.S. spending on factory construction has more than doubled. In July 2024, the manufacturing sector accounted for almost 11% of total construction spending—a level last achieved three decades ago. (3)

2 Job growth in the manufacturing sector

Since January 2022, manufacturing sector employment has increased by about 350,000 jobs. (4)

Methodology

EPRI's bottom-up analyses of reindustrialization and load growth are based on media reports and public announcements regarding new and expanded manufacturing facilities across the U.S. since January 1, 2021. Building on the analysis reported in the 2023 white paper (3002027930), EPRI's 2024 study focused on sectors addressed by CHIPS, IIJA, and IRA. Through May 1, 2024, 524 facility announcements were identified across the clean energy, semiconductor, transportation, and heavy industry sectors. Annual load was estimated for 247 facilities based on announced production capacities and process-specific electricity inputs per unit of production. For 272 facilities, estimated load was calculated based on average-facility electricity consumption for the relevant North American Industry Classification System (NAICS) categories. For the five largest new loads, estimated annual use was based on public information. Annual consumption estimates were averaged across the year to calculate continuous per-facility demand in megawatts (MW).

Clean Energy

- Solar Energy
- Wind Energy
- Energy Storage
- Hydrogen Electrolyzers & Fuel Cells
- Heat Pumps & Other Heating, Ventilation & Cooling (HVAC)

Semiconductors & Electronics

- Semiconductors
- Other Electronics

Transportation & Mobility

- Electric Vehicles (EV)
- Battery Materials
- EV Batteries
- EV Chargers
- Other Transportation

Heavy Industry

- Chemicals
- Plastics & Fuels
- Metals
- Materials Recycling

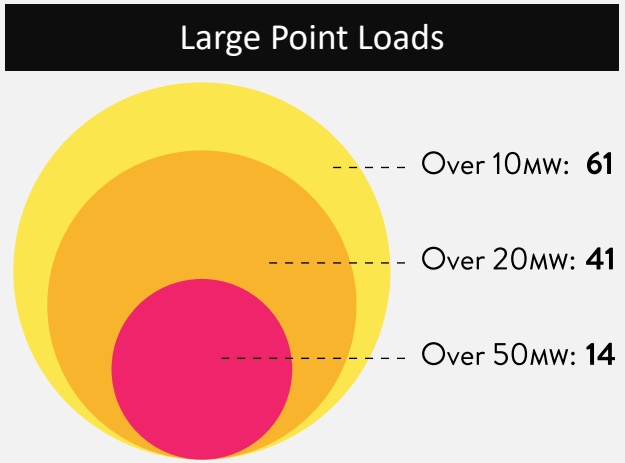
Results and Discussion

Reindustrialization – By the Numbers

U.S. policies have stimulated reindustrialization in selected industries and are beginning to support load growth.

- **The scale of reindustrialization has increased as CHIPS, IIJA, and IRA have been implemented:**
- **Total estimated reindustrialization load in these industries has more than doubled in the past year.**
- **Facilities planned to be operating in 2025 could, by themselves, increase U.S. industrial load by 2.3% relative to 2022.**
- **More than 80% of the total reindustrialization load is attributable to 61 *large point loads*, defined as having estimated annual use equivalent to at least 10 MW of continuous demand.**

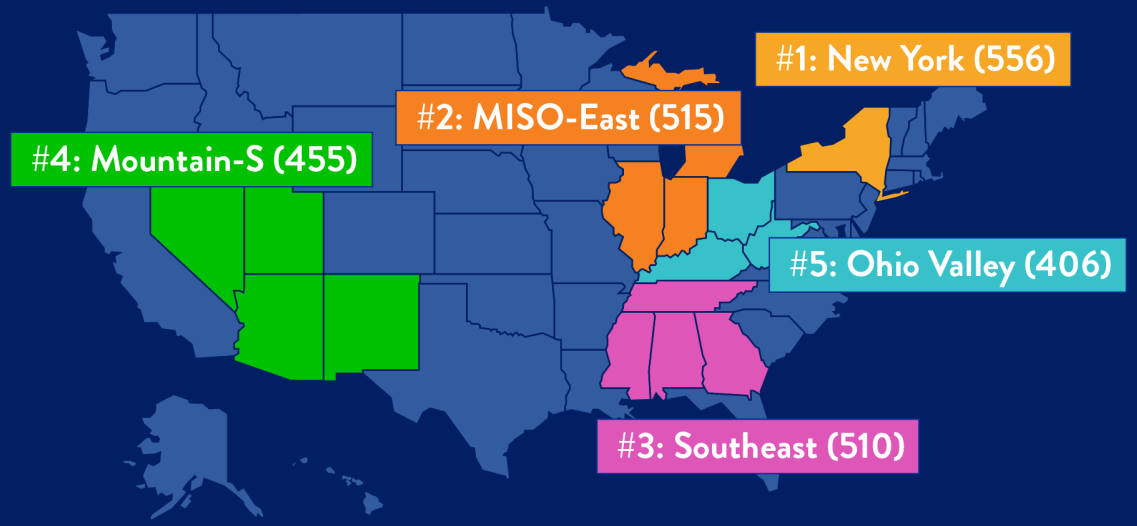
	2023 Study	2024 Update
Announced facilities	150	524 (+249%)
Total load, TWh/yr	13	31.3 (+141%)
Point loads >10 MW	38	61 (+61%)



Leading Sectors & Geographic Areas

Reindustrialization activity and estimated new load vary significantly by grid control area, state, and sector.

TOP GEOGRAPHICAL AREAS BY LOAD (MW)



TOP STATES BY LOAD

WHICH SECTORS WILL HAVE THE LARGEST LOAD?

#1 Semiconductors

#2 EV Battery

#3 Solar

WHICH INDUSTRIES WILL OPEN THE MOST NEW FACILITIES?

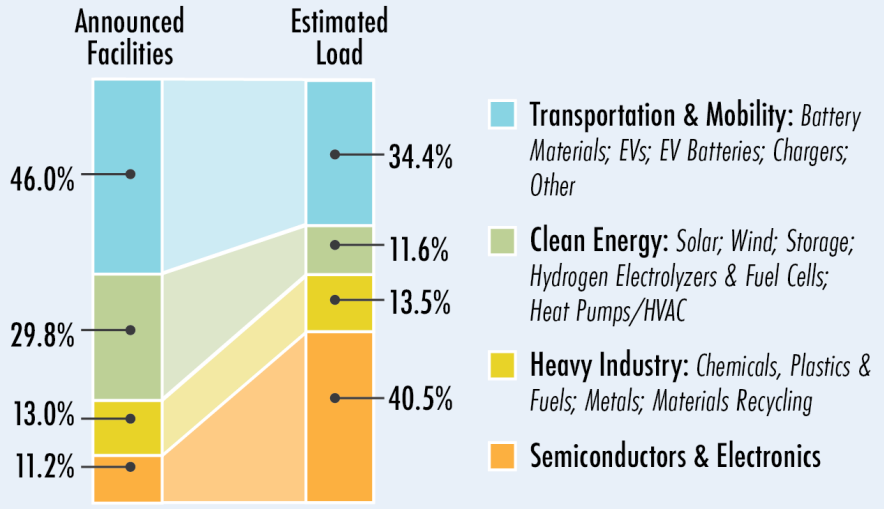
Solar	88
EV Battery	87
Electric Vehicles	69
Battery Material	53
Semiconductors	42

Impacts by Sector & Scale of Large Point Loads

Focused policies are creating new demands on the grid while revitalizing domestic industries in which the U.S. was once a world leader.

The semiconductor and electronics industry accounts for the largest share of estimated reindustrialization load but the smallest number of announced facilities.

Clean energy and transport electrification together encompass more than three-quarters of facilities and 45% of new load.



The largest factories can consume as much electricity as tens of thousands to hundreds of thousands of homes.

SCALE OF POINT LOADS

	MANUFACTURING SECTORS BY: TOTAL ANNUAL LOAD	NUMBER OF FACILITIES	AVERAGE DEMAND OF 3 LARGEST ANNOUNCED FACILITIES	POINT LOAD EQUIVALENT IN U.S. HOMES (= 10,000 HOMES (12.3 MW))
1	Semiconductors	42	293 MW	
2	EV Batteries	87	55 MW	
3	Solar Energy	86	23 MW	
4	Chemicals, Plastics & Fuels	21	51 MW	
5	Metals	15	48 MW	
6	Battery Materials	53	18 MW	
8	EVs	68	16 MW	
9	Wind Energy	24	18 MW	
10	Hydrogen Electrolyzers & Fuel Cells	16	10 MW	

Large manufacturing facilities join data centers, fleet and truck charging depots, and hydrogen electrolyzers as large point loads.

The top nine reindustrialization loads include six semiconductor plants, two EV battery plants, and a plastics plant.

A single EV charger plant represents the 10th largest load and accounts for 94% of total load in this emerging sector.

EV battery manufacturing accounts for more than half of the Top 50 point loads

Reindustrialization – By Location & Industry

New and expanded manufacturing facilities are widely distributed across the U.S., and clusters exist in several areas and across regions.

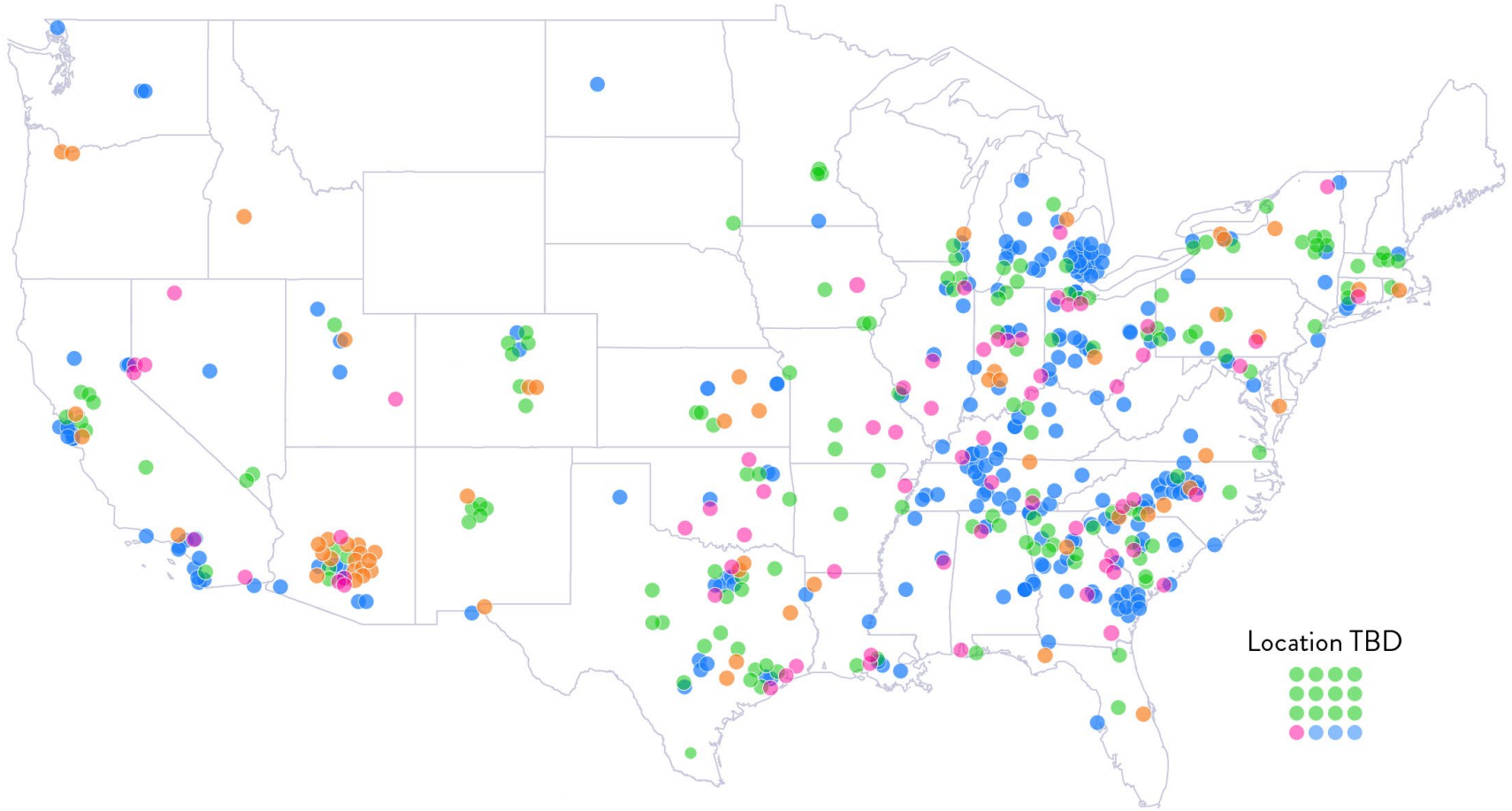
524

Facilities

44

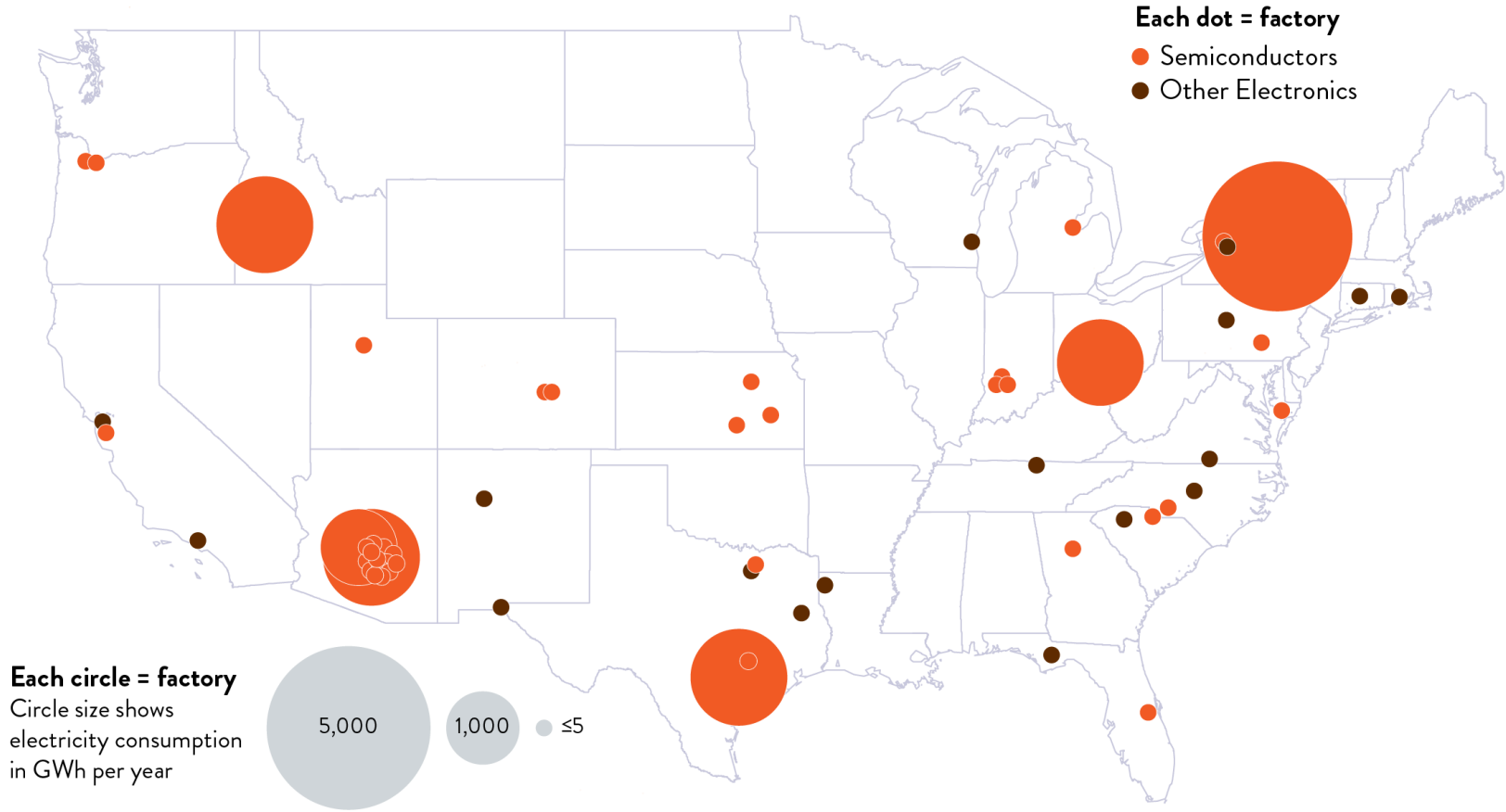
States

As of May 1, 2024



Sector-Level Findings

Semiconductors & Electronics – Facilities by Location, Sector & Load

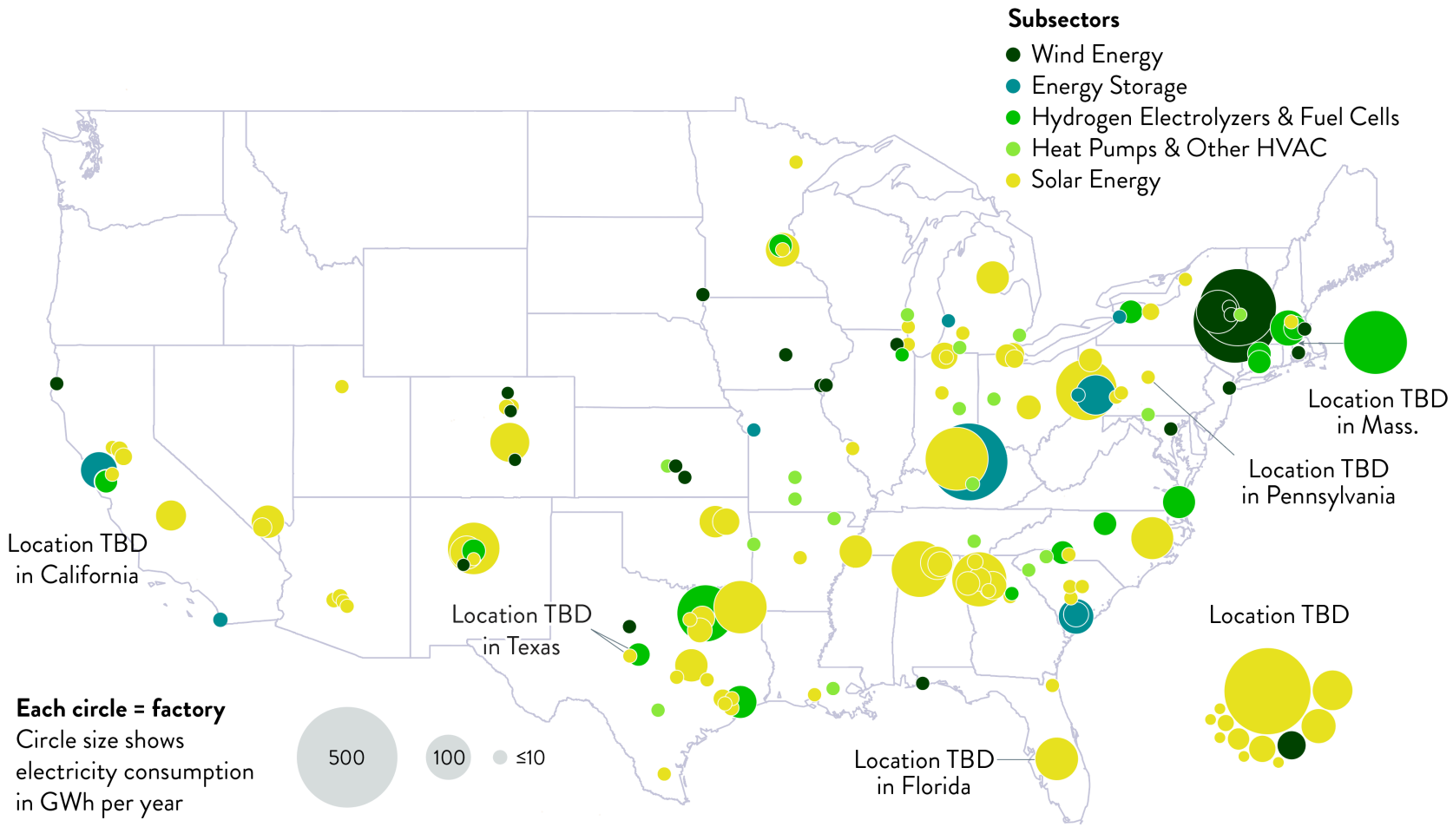


Semiconductor Plants Drive Load Growth

The U.S. is set to attract over 25% of the world's capital expenditures in wafer fabrication between 2024 and 2032. (8)

Among 42 semiconductor manufacturing facilities, the top six—Micron Technologies (2), TSMC, Samsung Electronics, Intel, and JX Nippon Mining & Metals USA—alone are projected to consume almost 12 TWh per year. This is equivalent to the annual energy consumption of more than 1 million average U.S. homes.

Clean Energy – Facilities by Location, Sector & Load



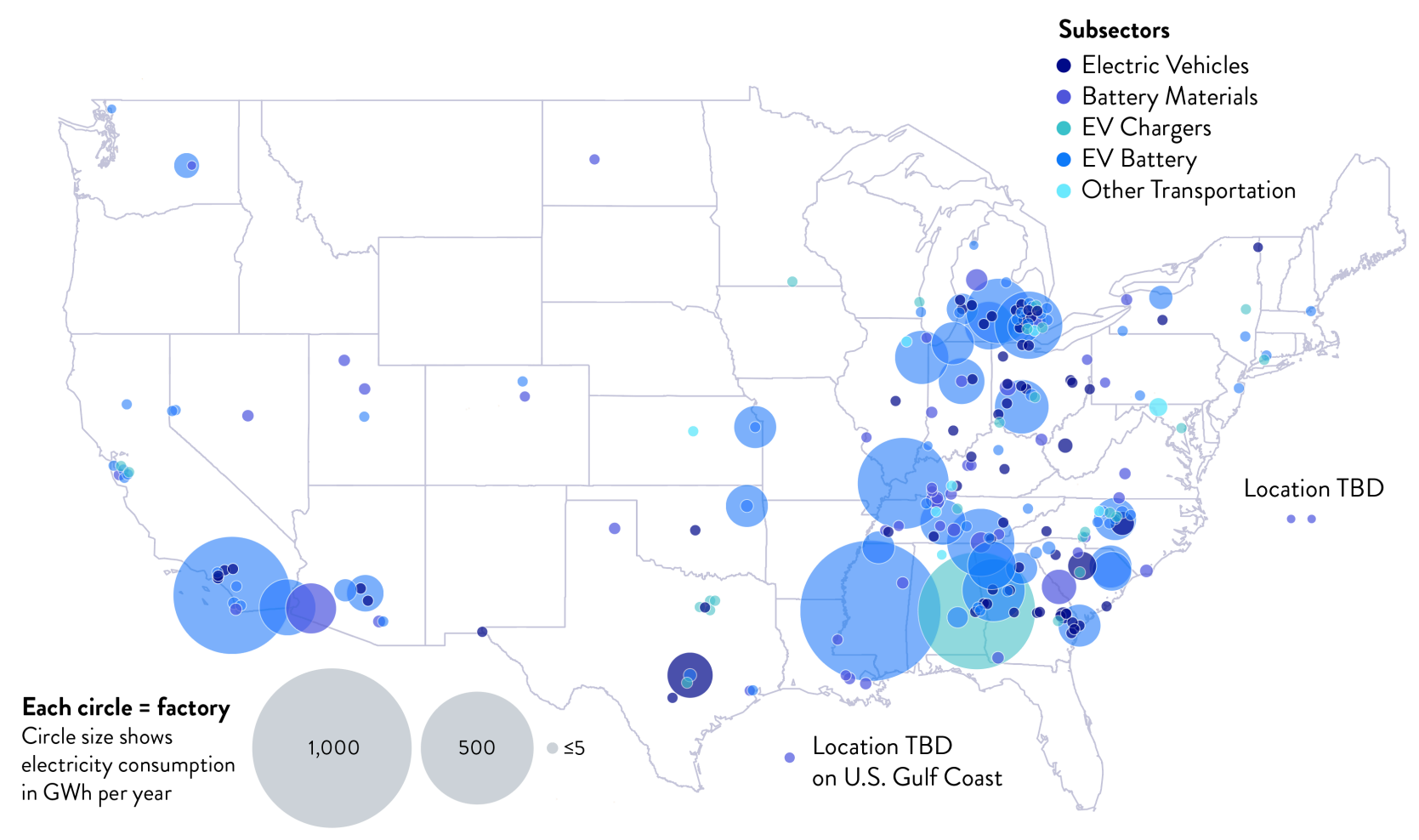
Solar Energy Powers the Way

Out of 156 total clean energy announcements, the solar energy sector accounted for 86, fueled by generous federal incentives and continued high levels of deployment.

The 24 wind energy announcements, sited in resource-rich areas of the Midwest and along the coast, span turbine components for both onshore and offshore projects.

The 11 facilities specific to battery energy storage system components are augmented by battery materials processing plants categorized as transportation and recycling facilities.

Transportation & Mobility – Facilities by Sector, Location & Load

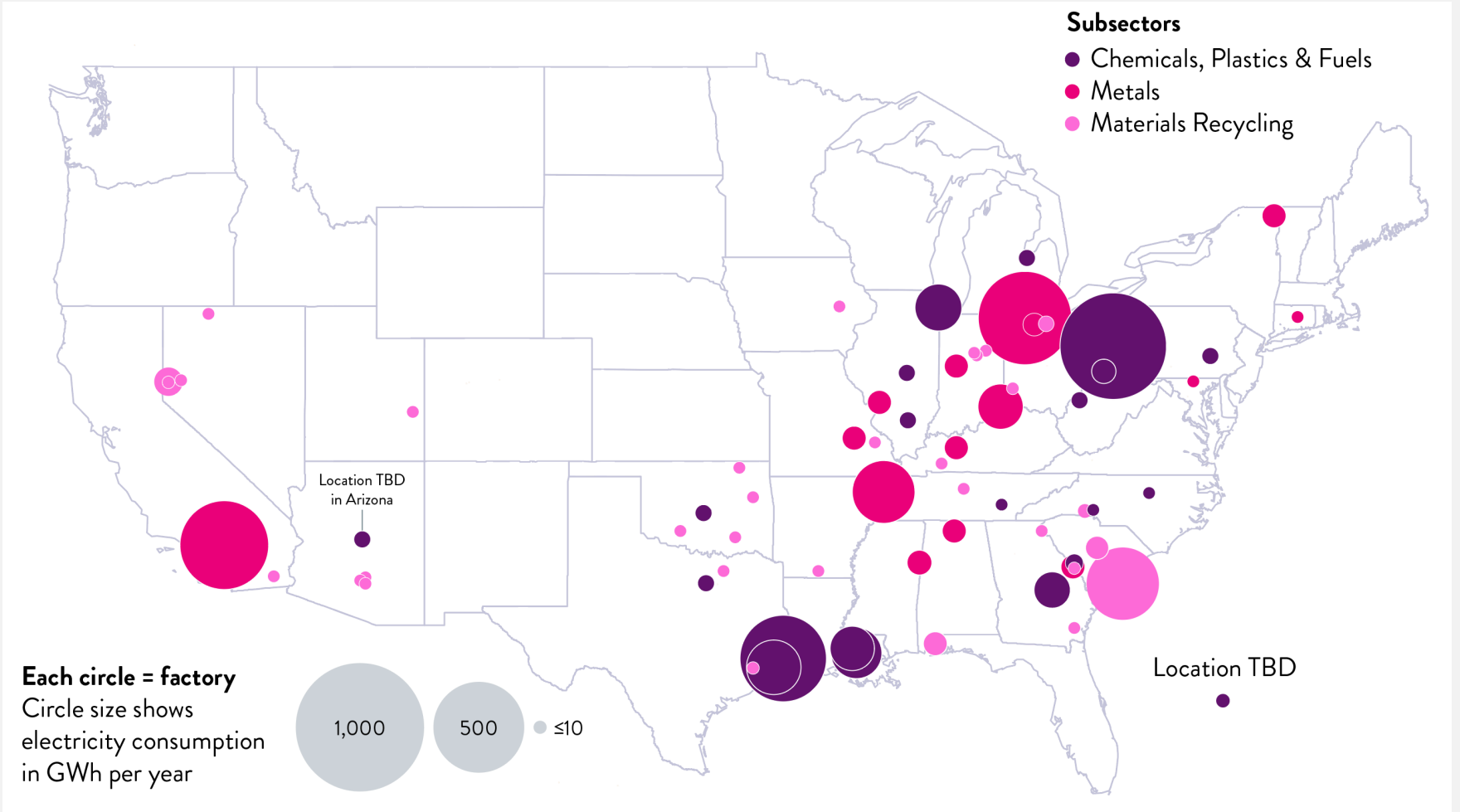


Domestic Supply Chain for EV Batteries Emerges

Transportation accounts for the largest number of announced facilities and the second-largest reindustrialization load. About 33 of these plants are projected to annually average more than 10 MW of continuous power demand, and about 24 facilities will exceed 20 MW.

More than 58% of facilities and 84% of load involve manufacturing of EV battery materials, components, and systems.

Heavy Industry – Facilities by Location, Sector & Load



Heavy Industry Supports Overall Reindustrialization

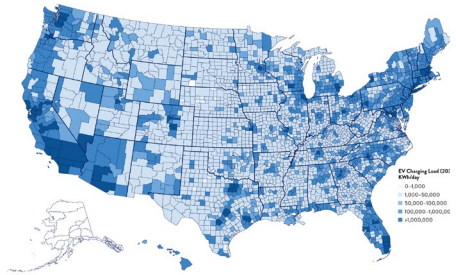
Heavy industries that provide chemicals, plastics, fuels, and new and recycled materials for diverse manufacturing processes are the core of resilient domestic supply chains.

Across 68 announced facilities, 11 are projected to have continuous power demand exceeding 10 MW, including three point loads between 20 and 40 MW and four between 50 and 80 MW.

Implications and Conclusion

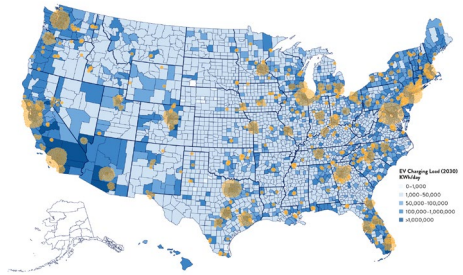
Looking Into Key Load Growth Drivers at High Resolution

EPRI resources provide high-resolution insights into load growth due to reindustrialization, data centers, and EV charging.



Transport Electrification: eRoadMAP™

EPRI's eRoadMAP™ is a first-of-its-kind tool for exploring and understanding future EV charging loads. Interactive graphics show the pace of expected EV penetration and added demand at roughly the individual feeder level.



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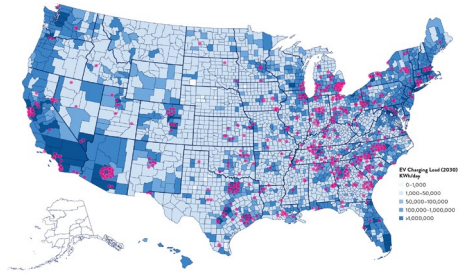
Digitization

EPRI's white paper on AI and data center energy use estimates the grid impacts of point loads and overall demand growth. Opportunities for efficiency improvements also are highlighted. (10)



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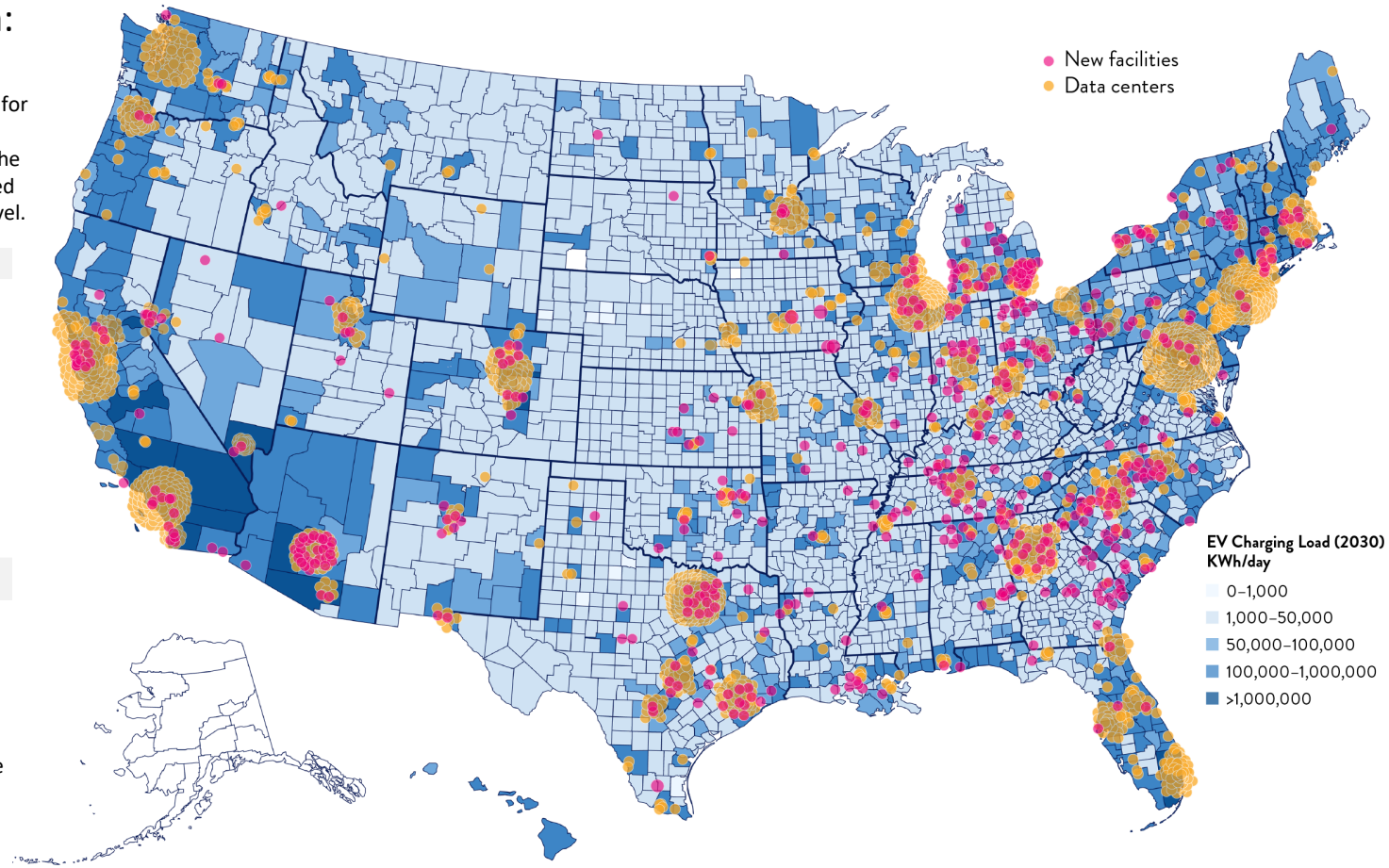
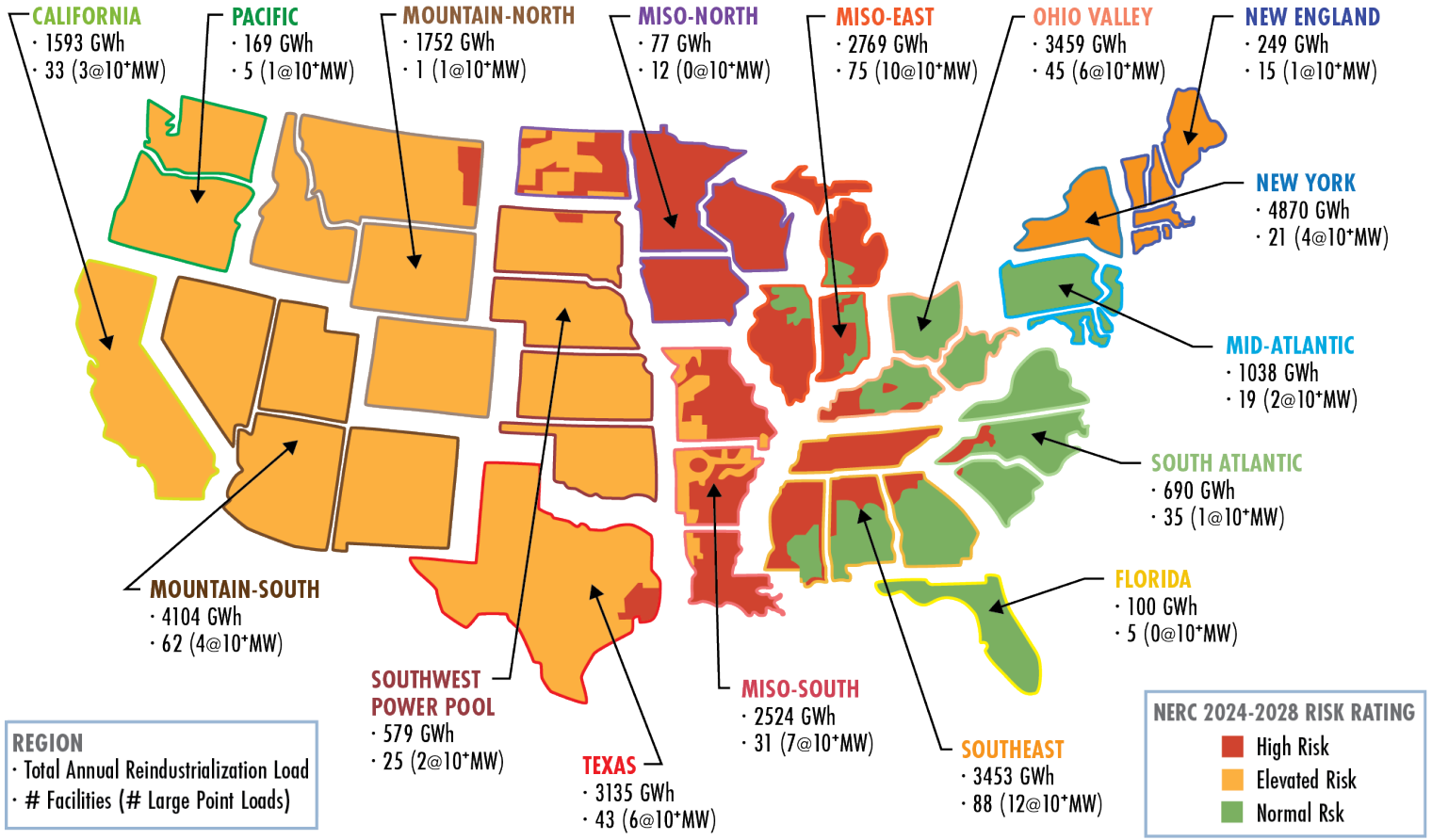
Reindustrialization

EPRI's reindustrialization studies estimate potential load growth as a result of the revitalization of U.S. manufacturing.



Reindustrialization Loads & Resource Adequacy

New manufacturing loads could create additional challenges in regions facing high or elevated risks of capacity and energy deficiencies.



According to the *2023 Long-Term Reliability Assessment* by North American Electric Reliability Corporation (NERC), power grids over the coming years will face increased vulnerability due to rising peak demand and retirement of conventional power generation that delivers capacity, energy, and ancillary services.

NERC Risk Ratings

- **High**: Shortfalls may occur at normal peak conditions
- **Elevated**: Shortfalls may occur in extreme conditions
- **Normal**: Low likelihood of shortfalls

Capacity and energy risks during 2024-28 could be exacerbated in control regions that host significant reindustrialization loads.

Source for Risk Ratings: North American Electric Reliability Council (9)

References & Acknowledgments

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