The Great Re-Wiring: Burying the Electrification Lead

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The Great Re-Wiring: Burying the Electrification Lead

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1. EVready Summary

Over the past decade, a visit to Linkedin to learn about electrification will yield countless opinions, most of them are political, opinionated, and focused on popular industry topics. This can include electric vehicle (EV) charging vendor performance, consumer EV demand, battery performance (as it relates to vehicle range), vehicle cost implications, time to charge based on only fast-charging, EV versus gas lifestyle changes, and infrastructure challenges to create long road trips or local city consumer confidence.

While all of these are relevant topics, the largest topic is typically over-simplified and misrepresented, but with certainty spoken about less frequently or mischaracterized. Some will say the electric grid can handle EVs. Others will say it cannot. Sometimes the topic is over-simplified for political purposes. Other times the equation is calculated with poor assumptions around existing gas lifestyles. The reality is, utility grid capabilities are a more complex problem and opportunity than it is given credit.

Problem:

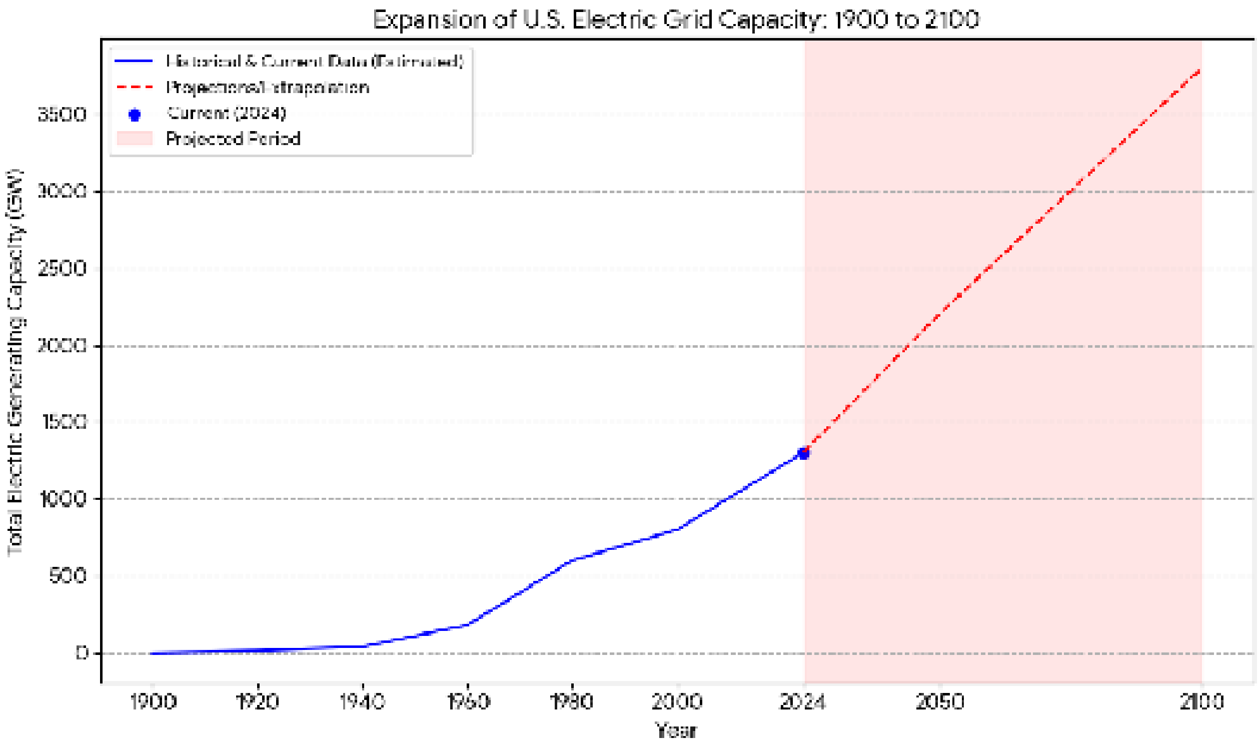


Figure 1: Figure 1

The North American electric grid is going through an immense overhaul in consumption with nearly double the capacity needed over the next 75 years. With growing electric demands requires a more complex energy system. Until the modern century, the electric grid has been an out-of-date, one way transmission and distribution system. This causes incredible inefficiency in the electric grid that creates resiliency, sustainability, security and economic issues tied to the electric grid.

On an electric grid level, utilities have all the reason to slow-roll major grid adjustments. As utilities maintain control and generally a monopolistic setup, incentive to change is minimal or slow at best, especially where consumers, their customers, generally lack understanding of what they are actually paying for.

On a consumer level, an acceptance exists around current circumstances, because it is complex and hard to understand. There is a feeling that you must pay your electric bill, even if it is too much. It is a problem too complicated to think about and largely ignored.

For that reason, you dont hear the public shouting from the rooftops about this topic like other popular mainstream things, even though it is probably the most critical component of modern civilization today.

How Today's Grid Works:

Here is a picture illustrating the traditional, largely one-way flow of electricity across the U.S. electric grid.

How the Traditional Utility Electric Grid Works (One-Way Flow):

1. **Supply/Generation:** Electricity is produced at large power plants (e.g., coal, natural gas, nuclear, hydroelectric dams, large wind farms, solar farms) located far from population centers. These are the "supply" side.

2. **Transmission (High Voltage):** From the power plants, electricity is stepped up to very high voltages by transformers and sent across long distances via large transmission lines (the tall, prominent towers

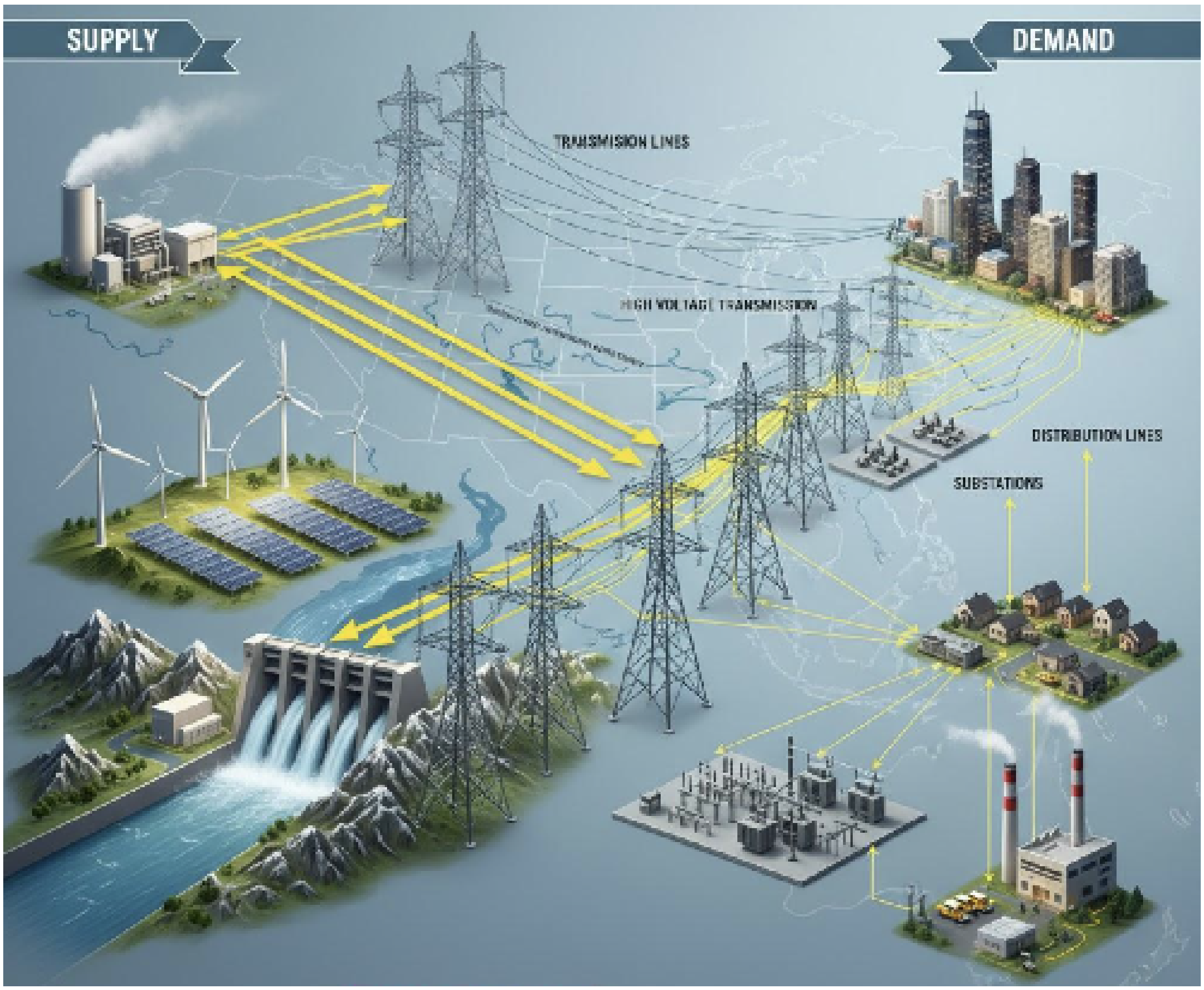


Figure 2: Figure 2

with multiple wires). These lines form the backbone of the grid, moving power across regions and even states.

3. **Substations:** As electricity approaches population centers, it enters substations where the voltage is "stepped down" to lower levels.

4. **Distribution (Lower Voltage):** From the substations, electricity travels through smaller distribution lines (the poles and wires you see in neighborhoods) to homes, businesses, and industries, where it is used.

Why One-Way Flow is Not Efficient:

The traditional grid's design for one-way flow leads to several inefficiencies:

- **Generation Must Match Demand Instantly:** Electricity cannot be easily stored on a large scale. In a one-way system, power plants must constantly adjust their output to precisely match real-time demand. If a large plant unexpectedly goes offline, or if demand spikes, there's a risk of power outages.

- **Wasted Renewable Energy:** Renewable sources like solar and wind are intermittent. If a large solar farm generates excess power on a sunny, windy day when local demand is low, and the one-way grid cannot easily send that power back upstream, store it, or reroute it efficiently to other areas that need it, that clean energy can be curtailed (wasted).

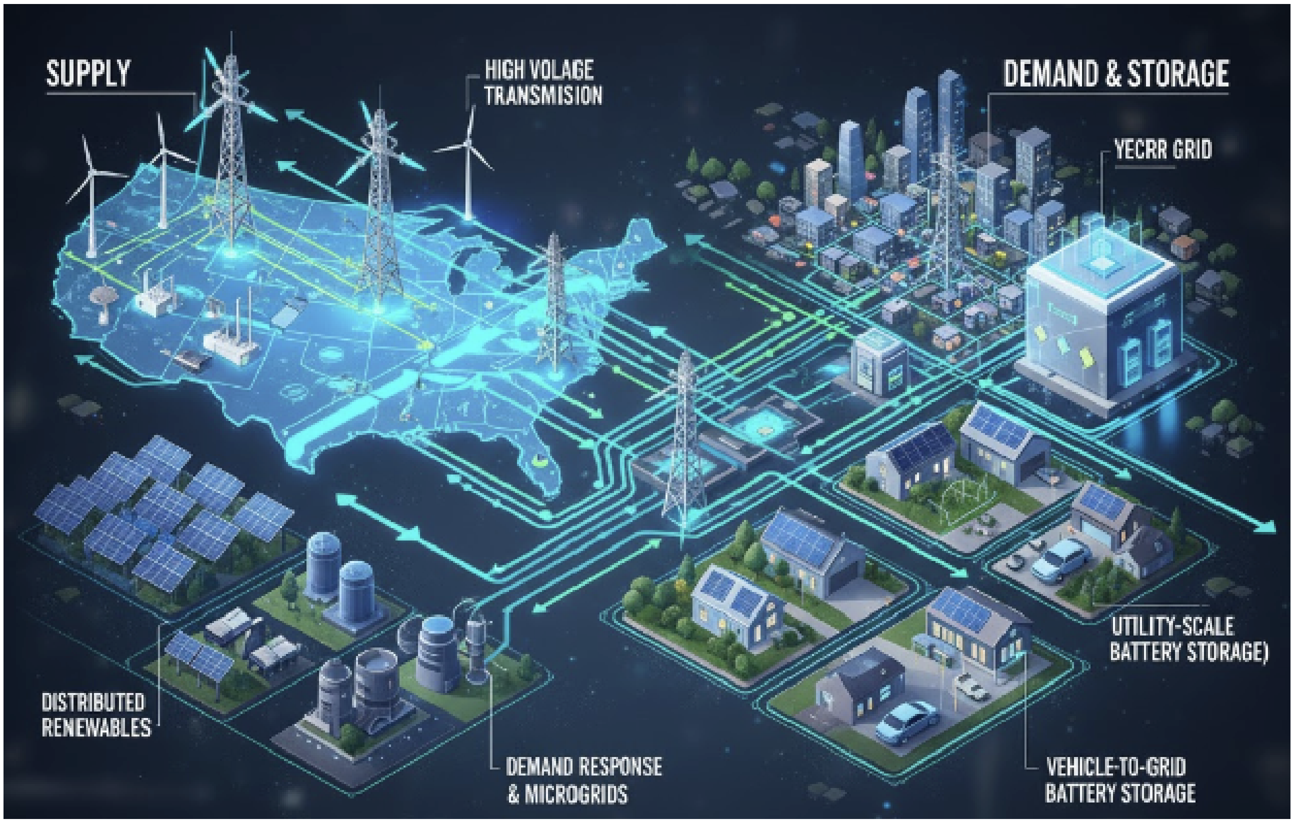
- **Limited Integration of Local/Distributed Generation:** With a one-way design, it's challenging to integrate smaller, local power sources like rooftop solar panels or electric vehicle batteries that could potentially feed power back into the grid. These "distributed energy resources" (DERs) are harder to manage in a system designed only for outflow.

- **Vulnerability:** A centralized, one-way system can be more vulnerable to large-scale outages if major transmission lines or power plants are disrupted.

- **Transmission Losses:** While high-voltage transmission minimizes losses, some energy is still lost as heat during long-distance travel. If power could be generated closer to where it's consumed, these losses could be reduced.

Modern grids are moving towards a **"smart grid"** concept, which includes two-way flow, advanced monitoring, and energy storage, to address these inefficiencies and better integrate renewable energy and distributed resources.

Proposed Solution: Smart Bi-Directional Utility Grid



The implementation of a **bidirectional smart energy management system** (often referred to as a "Smart Grid") provides a massive leap in functionality and efficiency over the traditional, one-way electric grid.

The core benefit is **flexibility**, which modernizes the grid to handle the challenges of intermittent renewable energy and the growth of electric vehicles.

Here are the key benefits across the three pillars of modern grid planning: **Resiliency, Economics, Sustainability, and Security.**

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2. Benefits of a Bidirectional Smart Energy Management System

1. Enhanced Resiliency and Reliability

A bidirectional system makes the grid stronger and better able to withstand disruptions.

- **Self-Healing Capabilities:** Smart sensors and automated controls can instantly detect a fault (like a downed line) and automatically re-route power around the problem area to minimize the size and duration of outages.

- **Reduced Centralized Risk:** By integrating **Distributed Energy Resources (DERs)** like rooftop solar and local batteries, the grid relies less on a few massive, faraway power plants. If a main transmission line fails, local microgrids can disconnect and keep power flowing to specific communities (islanding).

- **Grid Stabilization:** Bidirectional flow allows DERs and stationary batteries to instantly absorb or inject power to maintain the proper frequency and voltage, preventing widespread instability or blackouts.

- **Vehicle-to-Grid (V2G) Backup and Monetization:** Electric vehicle batteries can be used to send power back to the home or local grid during emergencies, turning a large fleet of EVs into a massive, distributed backup power source and revenue asset.

2. Economic Efficiency and Optimization

A smarter, two-way grid ensures power is generated and consumed at the most cost-effective times.

- **Supply-Demand Matching:** Instead of power plants constantly chasing unpredictable demand, the system can use **Demand Response** signals to temporarily reduce non-essential usage when prices are high (peak demand).

- **Asset Utilization:** Advanced monitoring provides detailed data, allowing utilities to optimize the performance of existing infrastructure (lines, transformers, substations) and delay costly, unnecessary upgrades.

- **Energy Arbitrage (Storage):** Energy storage (batteries) can buy power when it is cheapest (e.g., when the sun is brightest or wind is strongest) and discharge it during high-demand, high-price hours, lowering energy costs for everyone.

- **Reduced Line Losses:** By allowing generation closer to where it is consumed (local solar/wind), the system reduces the distance electricity must travel over transmission lines, cutting down on energy lost as heat.

3. Sustainability and Decarbonization

Bidirectionality is essential for integrating high volumes of clean energy into the grid.

- **Maximized Renewable Integration:** The two-way flow and flexible storage (batteries) solve the intermittency problem of solar and wind. Excess clean power generated during off-peak times can be stored and used later, preventing the need to wastefully "curtail" (shut down) renewable generation.

- **Support for Distributed Renewables:** The system easily handles power flowing back *into* the grid from millions of small, clean generation sources (e.g., residential rooftop solar, community storage), accelerating the shift away from fossil fuels.

- **Electrification Enablement:** By dynamically managing and stabilizing the load, the smart grid can reliably handle the massive new electricity demand from widespread vehicle electrification and electrified home heating (heat pumps).

The shift from the one-way grid to a **bidirectional smart energy management system** changes the customer from a passive consumer to an active participant, resulting in a more resilient, economical, and sustainable energy future.

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3. The Electric Grid and How My Perspective Evolved over Time

For most people, electricity is simply a given. It's the quiet force that makes dinner for a family, opens a coffee shop, and lights a classroom. We pay for it, rarely questioning the cost or the crumbling infrastructure of leaning poles and sagging lines that bring it to us. It's so commonplace that we take it for granted.

This was my reality until I entered the **EV charging industry**. Before then, the electrical grid was an obscure, uninteresting topicsomething that just "existed." But when I started to ask how the massive growth of electrification would impact the U.S. electrical grid, everything changed. I moved past the shallow debates about car models and politics and began to understand how deeply this infrastructure affects economic circumstances, personal values, and business operations. My philosophical outlook shifted completely, revealing that focusing on infrastructure is not only crucial but also more foundational than any other aspect of the EV revolution.

The U.S. electric grid is a living relic, a century-old organism that powered a global revolution. While many believe electric cars are a recent invention, they existed long before gasoline vehicles. The problem was that the grid couldn't support them, and gasoline offered a freedom that shaped our automotive culture for decades. Today, with the resurgence of EVs and technologies like heat pumps, our aging grid is facing its next great challenge.

We often rely on old habits to predict the future. For instance, people assume that the EV charging infrastructure must mimic the gas station model. While public DC fast charging has its place, its a misconception rooted in the “gasoline lifestyle.”

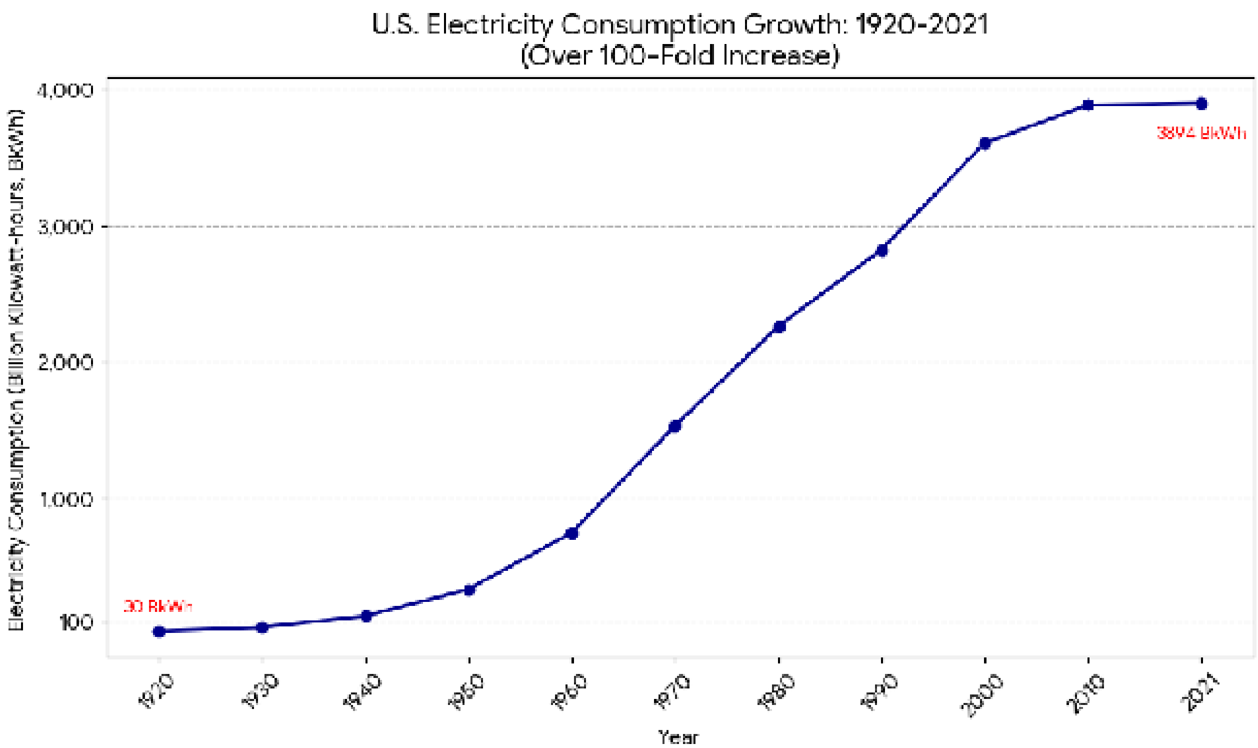
The grid was originally built as a simple, one-way system. Now, with the advent of smart energy management and bidirectional power, it’s about to undergo a dramatic, decades-long transformation.

Unlike gas cars, EVs can be **grid assets**, capable of sending power back to the system to increase its sustainability and resilience. This change will not be easy and won’t happen overnight. EVready is here to lead the way, improving the experience for businesses and utilities by managing everything from solar and battery storage to HVAC and the most intricate part of this transition: EV charging impacts.

Defining North American Electric Grid

The North American electric grid is a complex, interconnected network of power plants, transmission lines, and distribution systems that delivers electricity to consumers across the continent. It’s not a single entity but is instead divided into three major interconnections: the Eastern Interconnection, the Western Interconnection, and the Electric Reliability Council of Texas (ERCOT).

Growth of the Grid



1920 to 2021: US electricity consumption grew by over **100 times**.

1900: The early 20th century was the beginning of the modern electric industry, with a focus on local power plants and direct current (DC) systems. Capacity was very low, serving only a few urban areas.

- 1950: Following a period of rapid expansion and the development of alternating current (AC) technology, the grid grew significantly. Hydropower and fossil fuels were the main sources of generation.

- 2000: Generation capacity has grown dramatically, driven by the construction of large-scale coal, natural gas, and nuclear power plants to meet growing demand.

- 2050: Projections indicate that US electricity demand could grow by as much as 50% by 2050, driven by the electrification of transportation and the growth of data centers. This will require a massive increase in generation capacity, especially from renewable sources like solar and wind, and a significant upgrade to the grid's transmission capabilities.

- The grid will be a highly decentralized, two-way system with a massive capacity to support an entirely electrified economy.

Grid Operation: Independent Services Operators & Utilities

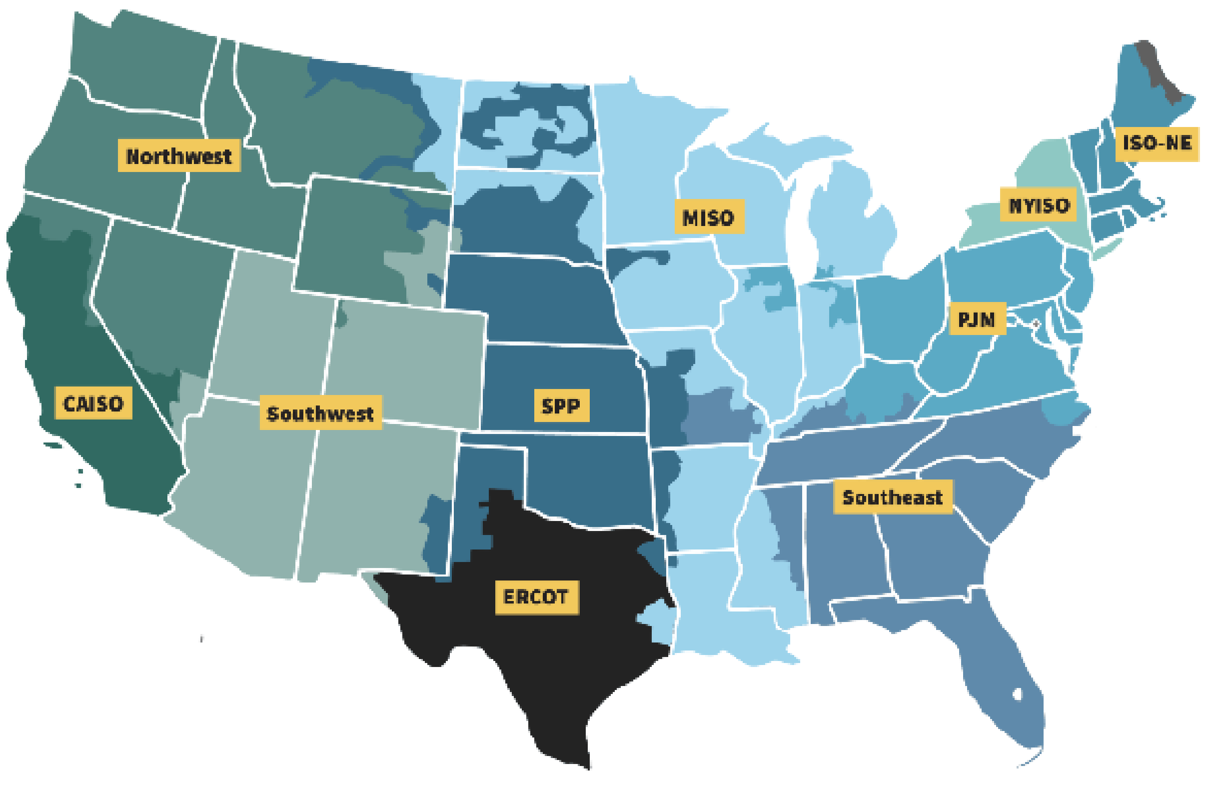


Figure 3: Figure 5

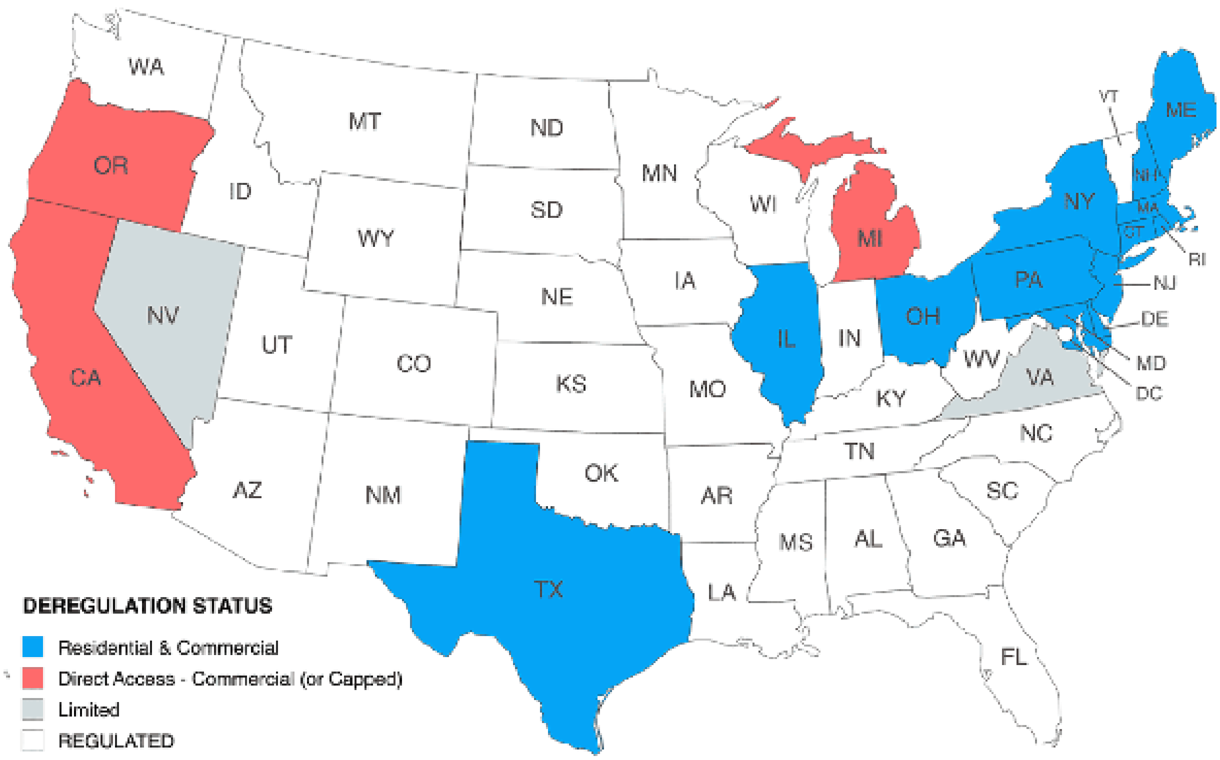
The North American grid is operated by a combination of Independent System Operators (ISOs) and electric utilities. They have distinct roles but must work together.

- Independent System Operators (ISOs): These are federally regulated, non-profit organizations that oversee the high-voltage transmission system across wide geographic areas (like air traffic controllers). There are currently seven ISOs/Regional Transmission Organizations (RTOs) in the US, including ISO New England, NYISO, PJM, MISO, SPP, ERCOT, and CAISO.
  - Function: ISOs manage the wholesale electricity markets, ensuring grid reliability by balancing electricity supply and demand in real-time. They do not own the physical transmission lines but control their use to ensure fair and open access for all market participants. They also handle billing and long-term regional planning for the transmission grid.

- Utilities: These are companies that own and maintain the local distribution system (the power lines and equipment that deliver electricity to your home).
  - Role and Function: In a regulated market, a utility is a vertically integrated monopoly, meaning it owns the generation, transmission, and distribution systems and serves all customers in a specific area. In deregulated markets, a utility's primary role is limited to distribution, maintenance, and billing.

- How They Work Together: ISOs and utilities must coordinate to ensure reliable service. The ISO manages the flow of high-voltage power over the regional transmission network, while the utility handles the final, low-voltage delivery to end-users. The utility's distribution system connects to the ISO-managed transmission system at substations. This collaboration is essential for managing the grid's stability.

Electricity Supply and Deregulated Markets



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In the US, electricity is supplied through two main market structures: regulated and deregulated.

- Regulated States: The local utility acts as a monopoly, handling all aspects of electricity from generation to delivery and customer service. The price is regulated by a state public utility commission.

- Deregulated States: The market is "unbundled," separating the generation and retail supply of electricity from the transmission and distribution.
  - Why they exist: The goal of deregulation was to introduce competition and innovation into the electricity market, hoping to lower prices and improve service for consumers.

  - Benefits: Proponents argue that deregulation gives consumers more choice of suppliers, encourages competitive pricing, and promotes the use of renewable energy.

- Deregulated Supply Contracts: In a deregulated state, a consumer can choose a Retail Electric Provider (REP). This company offers a contract to supply electricity at a specific rate for a set period (e.g., fixed-rate or variable-rate plans).
  - How they work: The contract covers the "supply" portion of your bill, which is the cost of the electricity itself. The local utility still owns the "transmission and distribution" infrastructurethe poles, wires, and metersand charges a separate fee for delivering the electricity from the grid to your home. Your monthly bill will typically include charges from both your chosen REP (for the energy) and the local utility (for delivery and maintenance).

National Security Vulnerabilities

The grid is a high-value target for both physical and cyber attacks. Just recently, 60 Minutes highlighted Littleton Power and Light in Littleton, Massachusetts, where the Chinese government infiltrated their systems, an intrusion capable of shutting down the grid and dirtying the city's water supply. This small infiltration is a dire US security risk.

- **Cybersecurity Risks:** The increasing use of smart grid technology and interconnected systems has expanded the "attack surface," making the grid more vulnerable to cyberattacks from foreign states and other malicious actors. Many utilities use outdated software, and a coordinated attack could be devastating.

- **Physical Attacks:** The vast and largely unguarded nature of the grid's infrastructure, like transmission lines and substations, makes it susceptible to physical attacks. There has been a rise in reported instances of vandalism and sabotage, highlighting this vulnerability.

- **Cascading Failures:** Because the grid is an interconnected network, a localized attack or failure can trigger a cascading effect, leading to widespread outages that affect critical services like hospitals, water treatment, and emergency response systems.

Cost Challenges and Increased Capacity

Modernizing the grid to meet new demands is a monumental and expensive task.

- **Modernization Costs:** The National Council of State Legislatures estimates that the US will have to spend up to **$2 trillion** on grid modernization by 2030 just to maintain reliability.

- **Aging Infrastructure:** Over 70% of the grid's transmission lines and transformers are more than 25 years old. The cost of replacing and upgrading this infrastructure is projected to be in the **trillions of dollars** over the next few decades.

- **Rising Demand:** The grid must prepare for a significant increase in electricity demand from the electrification of transportation (EVs), heating (heat pumps), and the rapid growth of data centers. This requires substantial capital investment in new generation and transmission capacity.

- **Grid Congestion:** A key inefficiency is the lack of adequate transmission capacity to move power from where it's generated (often in remote areas with high solar or wind resources) to where it's needed. This grid congestion cost consumers an estimated $20.8 billion in 2022.

Trade-offs of Cost and Sustainability Mandates

Federal and state mandates aim to reduce emissions, but they introduce complex economic trade-offs.

- **Intermittency of Renewables:** Many sustainability mandates require a shift to renewable energy sources like wind and solar. While clean, these sources are **intermittent**, meaning they only generate power when the sun is shining or the wind is blowing. This requires costly investment in energy storage solutions (like large-scale batteries) and backup "firm" generation (like natural gas plants) to maintain a reliable power supply.

- **The "Last Few Percent" Challenge:** Getting to 80-90% clean energy is relatively cost-effective. However, reaching 100% clean energy mandates can cause a **nonlinear spike in costs**. The final few percent is the most difficult and expensive to achieve, as it requires overbuilding capacity and investing heavily in technologies to fill the gaps during low-generation periods.

- **Cost Allocation:** The costs of building new transmission lines to support renewables are often a point of contention. State regulators, who control the physical siting of most of the new transmission, are sometimes hesitant to approve projects if they believe their constituents will bear a disproportionate share of the cost, even if the benefits are regional.

The transition to an electrified transportation sector, primarily through the widespread adoption of electric vehicles (EVs), will have a profound impact on the U.S. electric grid, presenting both challenges and opportunities.

Challenges

- **Increased Demand:** EVs will significantly increase electricity demand, especially during peak hours. If not managed, simultaneous charging by millions of vehicles could strain the grid, leading to brownouts or blackouts, and increased energy costs for consumers.
  - EVs will cause a significant spike in electricity demand. Unmanaged, this could add **100 to 185 terawatt-hours (TWh)** to national electricity demand by 2030.

- **Grid Infrastructure Strain:** The current grid, particularly the local distribution system, was not designed to handle the concentrated, high-power loads of EV charging. This can lead to issues like:
  - **Transformer and Line Overloads:** Local transformers and power lines can be overloaded, shortening their lifespan and potentially causing outages.

  - **Voltage Instability:** High demand from chargers can cause voltage drops in neighborhoods, affecting the quality and reliability of power for all consumers.

- **Intermittency of Renewables:** While EVs are essential for decarbonization, their widespread adoption complicates the integration of intermittent renewable energy sources like wind and solar. To meet the new demand, the grid must have enough "firm" generation or energy storage to provide power when renewables are not generating.

Opportunities

- **Load Management:** Smart charging technologies can manage EV charging sessions to benefit the grid.
  - **Demand Shifting:** Smart chargers can automatically shift charging to off-peak hours (like overnight), when electricity is cheaper and more plentiful. This helps balance the grid's load and reduces the need for costly infrastructure upgrades.

  - **Peak Shaving:** By dynamically controlling charging speed, utilities can prevent a massive spike in demand during the evening peak.

- **Grid Assets:** EVs, with their large batteries, can become **"grid assets"** through **Vehicle-to-Grid (V2G)** technology. This allows them to:
  - **Provide Power Back to the Grid:** During periods of high demand, EVs can discharge power back into the grid, acting as a decentralized energy storage resource and energy asset.

  - **Support Renewables:** V2G can help balance the intermittency of wind and solar by absorbing excess energy when it's available and releasing it when it's needed.

- **New Revenue Streams:** Smart charging and V2G create opportunities for utilities and consumers. Customers can earn money for participating in demand response programs, and utilities can avoid expensive investments in new generation and transmission.

The impact of EV charging on the US electric grid

Projected Growth of EV Charging Demand

- By 2030: The National Renewable Energy Laboratory (NREL) projects that there could be 30 to 42 million EVs on the road. This rapid growth could add 100 to 185 TWh to the national electricity demand by 2030, which is an increase of 2.5% to 4.6% of anticipated total consumption.

- By 2050: Projections are more varied, but the impact will be far more substantial. The National Electrical Manufacturers Association (NEMA) anticipates a 9,000% projected growth in e-mobility power consumption through 2050, as electrification becomes widespread across all vehicle classes.

Quantitative Grid Impact

- Total Load: While EV charging will increase overall electricity consumption, the main concern is not the total amount of energy but the timing and location of the demand. Unmanaged, simultaneous charging by millions of vehicles during peak evening hours could cause significant strain on the grid.

- Grid Infrastructure Strain: The most pronounced impact will be on the local distribution system. For example, a typical residential feeder circuit serving 150 homes could see its peak load increase by approximately 30% with a 25% local EV penetration rate. This could overload local transformers and power lines, requiring billions of dollars in upgrades.

- New Capacity: To meet the new demand, the grid will need substantial new generation and transmission capacity. Studies show that EV adoption will drive investments in new wind, solar, and energy storage. Some estimates suggest that electrifying the world's vehicle fleet could account for 15-21% of global electricity demand by 2050, requiring a massive expansion of the grid.

How Do Grid Operators Deal with Changing Costs?

To handle the impact of electrification, utility grid operators are shifting from a passive "one-way" delivery system to an active, modern grid that can manage two-way energy flow. Their approach to EV charging infrastructure is focused on three key areas: managing demand, upgrading infrastructure, and incentivizing beneficial behavior.

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1. Managing EV Charging Demand

Utilities are using smart grid technologies and pricing strategies to control when and where charging occurs, preventing stress on the grid. This is their primary tool for turning a potential challenge into a benefit.

- Managed Charging Programs: This is a crucial strategy. Customers can remotely control the charging of a vehicle or a fleet of vehicles to avoid charging during periods of peak demand. Utilities often offer incentives to customers who enroll.

- Time-of-Use (TOU) Rates: TOU pricing offers lower electricity rates during off-peak hours (e.g., overnight) and higher rates during peak hours (e.g., late afternoon and early evening). This incentivizes EV owners to charge when the grid has excess capacity.

- Vehicle-to-Grid (V2G) Pilot Programs: While still in early stages, some utilities are testing V2G technology that allows EVs to send power back to the grid during peak demand. This transforms EVs from a simple load into a grid asset, providing a distributed energy storage solution.

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2. Upgrading Infrastructure

The "last mile" of the gridthe local distribution systemwasn't built for the high, concentrated power loads of EV charging. Utilities are making strategic, data-driven upgrades.

- "Make-Ready" Programs: Many utilities are offering incentives and rebates to help businesses, developers, and homeowners install the necessary electrical infrastructure (e.g., transformers, wiring) needed for EV chargers. This reduces the upfront cost for customers and helps ensure the upgrades are done correctly.

- Targeted Upgrades: Using advanced analytics, utilities can pinpoint areas with high EV adoption and proactively upgrade transformers, feeders, and substations. This prevents the costly and disruptive process of reacting to outages caused by overloaded equipment.

- Grid Modernization: This broader effort involves integrating digital technologies to improve visibility and control of the grid. It allows operators to monitor real-time energy flow, helping them more effectively manage EV charging alongside other distributed energy resources like solar panels and battery storage.

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3. Incentivizing EV Adoption and Infrastructure

To manage the transition, utilities are taking a proactive role in shaping the EV ecosystem through various programs.

- Financial Incentives: Utilities offer rebates or credits for purchasing and installing home and commercial EV charging stations. This helps lower the financial barrier to adoption for consumers.

- Partnerships: Utilities are collaborating with EV manufacturers, charging network providers, and local governments to strategically place public charging stations in high-traffic areas, ensuring a reliable network.

- Educational Campaigns: Many utilities are providing information to customers about the benefits of EVs, how to save money with TOU rates, and how to access available incentives.

Electricity Cost Challenges

Continued growth in electrification, particularly from EV charging, will lead to a significant increase in commercial electricity costs on the demand charge side. This is because demand charges are designed to recover the costs of building and maintaining grid capacity to meet a customer's single highest spike in power usage during a billing period.

Heres a breakdown of the impacts:

- **Increased Demand Spikes:** Commercial EV chargers, especially DC fast chargers, draw a large amount of power over a short period. If multiple vehicles charge at the same time, it creates a high, short-term demand spike. This is a very different load profile from a typical business's energy use and can trigger a significant increase in demand charges.

- **Disproportionate Cost:** Demand charges can already account for **30% to 70%** of a commercial electricity bill. Without proper management, the addition of EV chargers can make these charges even more pronounced, making a commercial EV charging operation unprofitable.

- **The Demand Charge Holiday Problem:** Some utilities have offered "demand charge holidays" or special EV rates to help businesses get charging stations up and running. However, these are often temporary. When the introductory period ends, businesses can face a sudden and dramatic increase in their electricity costs if they haven't implemented a long-term strategy.

To manage this, businesses are turning to solutions like:

- **Load Management Systems:** Software that controls and manages the charging of multiple vehicles to prevent high demand spikes.

- **On-site Energy Storage:** Batteries that charge during off-peak hours and then discharge to power EV chargers during the day, "shaving" the peak demand and significantly lowering costs.

- **New Rate Structures:** Utilities and regulators are exploring new rate designs that better align with the needs of EV charging, such as subscription-based models or rates with reduced demand charges.

Where the Private ENergy Sector is Focusing

Demand response (DR) is a program that incentivizes consumers to temporarily reduce or shift their electricity use during periods of high demand to help balance the grid and avoid costly infrastructure upgrades or blackouts.

It allows the grid to treat energy reduction like a new source of supply.

4. Distributed Energy Resource Management Systems (DERMS)

A Distributed Energy Resource Management System (DERMS) is a software platform used by utilities and grid operators to monitor, manage, and optimize a wide range of distributed energy resources (DERs). These resources, which are located on the customer side of the meter, include:

- Rooftop solar panels
- On-site battery storage systems
- Electric vehicles (EVs) and their chargers
- Smart thermostats, and other smart appliances

A DERMS platform aggregates these small, decentralized assets and coordinates their operation to provide grid services, such as reducing peak load, maintaining voltage stability, and supporting the integration of intermittent renewables.

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5. Private Sector Collaboration

The private sector, particularly technology companies and energy service providers, is working closely with utilities to advance DR and DERMS programs. Utilities often lack the in-house technology and customer engagement platforms to manage millions of small DERs. Private companies fill this gap by:

- Aggregating Assets: Companies known as "aggregators" or "virtual power plant (VPP)" operators enroll customers with DERs into a single, cohesive network. They then sell the collective load reduction or power output from these assets to the grid operator or utility as a single resource.
- Providing Technology: Private firms develop the software and hardware that form the core of a DERMS. This includes advanced analytics, machine learning algorithms, and secure communication protocols that allow utilities to see and control what's happening at the grid's edge in real time.
- Customer Engagement: Private companies are often more adept at engaging with customers. They create user-friendly applications and offer direct incentives, making it easier for homeowners and businesses to participate in demand response programs.

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6. Energy Market Opportunity for Businesses

For businesses, participating in demand response programs represents a significant market opportunity, particularly as the grid becomes more decentralized and electrified.

- Financial Incentives: Businesses can earn revenue by reducing their electricity consumption during "demand events." This can be a new, predictable revenue stream that helps offset energy costs.
- Cost Management: By proactively managing their energy use, businesses can avoid high demand charges, which are a major component of commercial electricity bills. A DERMS program can automate this process, ensuring savings without disrupting operations.
- Market Growth: The demand response market is projected to grow significantly. The global smart demand response market, which includes the technology and services for these programs, is estimated to reach $222.3 billion by 2035, up from $40.7 billion in 2025. This explosive growth is driven by the need to integrate renewables, manage load growth from EVs, and avoid the cost of building new power plants and transmission lines. This growth means more funding and opportunities for businesses to participate.

The Untouched Market Map

EV charging station owners, particularly those with DC fast chargers, are at high risk of excessive demand charges because of the unique way these fees are structured. Demand charges are based on the highest instantaneous power spike a customer pulls from the grid in a single billing period, not on the total energy consumed.

- High Power, Short Duration: DC fast chargers can draw as much power as a small building for a few minutes. If a site has multiple fast chargers and several EVs plug in and begin charging at the same time, it creates a massive, short-term spike in demand. This single spike sets the demand charge for the entire month, even if the total energy usage is low.

- Low Utilization Paradox: In the early stages of EV adoption, a charging station may have high demand spikes but low overall utilization. This creates a situation where a few charging sessions can result in extremely high demand charges, making the cost per kilowatt-hour sold to a customer very high and often unprofitable.

Why Car Dealerships Are at Specific Risk

Car dealerships are uniquely vulnerable to utility grid issues and excessive costs because of their specific needs for EV charging.

- Need for On-Site Fast Charging: Dealerships must have fast charging capabilities to quickly service new EVs, prepare them for sale, and demonstrate them to customers. This requires significant electrical infrastructure upgrades that can be very costly.

- Unpredictable Demand: The charging load at a dealership is unpredictable. Vehicles might need charging at the same time during business hours, when grid demand is already high, leading to significant demand spikes. This can put a huge strain on the local grid and result in excessive demand charges.

- Inadequate Infrastructure: Many car dealerships are located in older commercial areas with electrical infrastructure that was not designed for the high-power needs of EV fast charging. This can lead to costly and time-consuming electrical upgrades, and in some cases, the local grid may not be able to support the required load without a major utility-led infrastructure project.

Policymakers and utilities are working together to lower the cost of the U.S. electric grid and mitigate price hikes for customers, particularly businesses. Their approach involves both federal funding and innovative state-level policies.

7. Federal Actions

- Infrastructure Funding: The federal government, through initiatives like the Bipartisan Infrastructure Law, is providing billions of dollars in grants for grid modernization. This funding helps utilities upgrade aging infrastructure and build new transmission lines without solely relying on customer rate increases.

- Streamlining Permitting: Policymakers are working to accelerate the approval process for new transmission projects. A faster build-out of the grid helps get new, low-cost power sources (like renewables) to market and reduces development costs.

State and Utility Actions

- Time-of-Use (TOU) Rates: Utilities are increasingly implementing TOU rates, which charge less for electricity during off-peak hours (e.g., overnight) and more during peak hours (e.g., late afternoon). This incentivizes businesses to shift energy-intensive activities, like EV charging, to times when grid capacity is plentiful and power is cheaper.

- Demand Response Programs: These programs offer financial incentives to businesses that agree to reduce their electricity use during periods of high demand. This helps utilities manage grid stability and avoid building expensive “peaker plants” or costly infrastructure upgrades.

- Cost Allocation Reform: State regulators are working to ensure that new, high-demand loads, such as data centers and large EV charging hubs, pay for the infrastructure required to support them. This prevents the costs from being passed on to all other customers.

- Incentives for Distributed Energy Resources (DERs): Utilities and states offer rebates, tax credits, and grants for businesses to install DERs like solar panels and on-site battery storage. These systems help businesses lower their own electricity bills while also providing a valuable resource to the grid, reducing the need for new utility-owned infrastructure.

Political development

Accelerated electrification policies in the U.S. will likely continue to face political challenges due to a partisan divide, but a demographic shift in the electorate could favor future policies. The political landscape is heavily influenced by age, with younger generations generally supporting climate-focused electrification efforts and older generations being more hesitant.

Political Positions on Electrification

The two major parties have distinct positions on electrification efforts.

- **Democrats:** The Democratic Party, as outlined in policies like the Inflation Reduction Act, strongly supports electrification as a key strategy to combat climate change. They advocate for tax credits for EVs and home energy efficiency, investments in a nationwide charging network, and an overall decarbonization of the economy. For Democrats, electrification is a matter of public health, economic competitiveness, and national security.

- **Republicans:** The Republican Party’s position is generally more cautious. While many Republicans support nuclear energy and acknowledge the need for clean air, a majority still prioritize fossil fuel development. They often express skepticism about the cost and feasibility of a rapid transition to a fully electrified economy, and their support for clean energy has declined since 2020.

The U.S. Electorate: Demographics and Views

The U.S. electorate is not a monolith, and voting patterns are heavily influenced by age.

- Older Voters (60+): This group is the most politically active and votes at the highest rates. In the 2024 presidential election, voters aged 65 and older had a turnout rate of nearly 75%. This demographic has a clear Republican advantage, and they are generally more skeptical of aggressive climate policies and the costs associated with them.

- Middle-Aged Voters (30-59): This is a politically divided group. Voters in their 40s and 50s are about evenly split between the two parties. This segment’s voting behavior often determines election outcomes, making their views on electrification and energy policy crucial.

- Younger Voters (18-29): This group has a significant Democratic advantage, with about two-thirds of young voters associating with the Democratic Party. They are the most likely to view climate change as a critical issue. However, this demographic has the lowest voter turnout, which diminishes their political power.

The Future of Electrification Policy

The future of electrification policy will likely be shaped by a generational shift. As older, more conservative voters are replaced by younger, more progressive voters, the overall electorate's views will shift.

- Generational Replacement: As the oldest voters die and are replaced in the electorate by younger generations, the median age of the electorate will drop, and the electorate's views on climate change will become more aligned with the Democratic Party. While this is a slow process, it will likely increase the political feasibility of accelerated electrification policies in the long term.

- Potential for Accelerated Policy: Given the current political climate, aggressive federal-level electrification policies will likely be tied to which party controls the presidency and Congress. However, regardless of who is in power, the private sector is already heavily invested in electrification, and this market momentum will continue to drive growth.

Why EVs Are Inevitable

The continued increase of vehicle efficiency and emissions standards, as seen with CARB's regulations, makes the transition to EVs inevitable. As these standards become stricter, it becomes harder and more expensive for automakers to meet the requirements with gasoline-powered vehicles.

- The Efficiency Gap: Because EVs are already so much more efficient, they can easily meet and exceed any future efficiency standards. The only way for gasoline cars to get more efficient is through incremental improvements, whereas EVs start from a much higher baseline.

- Compliance Costs: The costs for automakers to continue developing and producing internal combustion engine vehicles that meet these tightening standards will eventually outweigh the cost of simply switching to EV technology.

- Regulatory Momentum: The CARB ZEV mandate, which has been adopted by a number of other states, creates a significant market signal. Automakers, needing to sell vehicles in these key markets, must invest heavily in EV production, which further accelerates the transition and lowers costs.

CARB Vehicle Efficiency Standards

The California Air Resources Board (CARB) has been a leader in setting strict vehicle emissions and efficiency standards for decades. Other states can choose to adopt these standards under the Clean Air Act. CARB's latest regulations, known as Advanced Clean Cars II, are designed to significantly reduce tailpipe emissions by rapidly scaling down permissible pollution levels. The most impactful part of this regulation is the Zero-Emission Vehicle (ZEV) mandate, which requires a steadily increasing percentage of new vehicles sold in California to be ZEVs. By 2035, the mandate requires that 100% of new passenger cars sold in the state be zero-emission. This policy effectively forces automakers to transition their fleets away from internal combustion engines.

EV Efficiency vs. Gasoline Cars

EVs are vastly more efficient than gasoline cars. Gasoline-powered cars convert only about 12-30% of the energy stored in gasoline into power that moves the wheels. The rest of the energy is lost as heat. An electric vehicle, on the other hand, converts about 77% of the energy from the grid to the wheels. This difference is due to the simple and highly efficient design of an electric motor compared to a complex internal combustion engine with hundreds of moving parts. Additionally, EVs can use regenerative braking to recapture some of the energy that is lost as heat in gasoline cars, further increasing their efficiency.

Global EV Adoption and Acceptance

- China: China is the global leader in EV adoption and acceptance. In 2024, battery electric vehicles (BEV) had a market share of 27%, with total EV sales exceeding 11 million. This is driven by strong government policies, a robust charging infrastructure, and a focus on affordable, domestically-produced vehicles.

- Europe: Europe is ahead of the US but is experiencing a temporary slowdown due to reduced government subsidies. In 2024, the BEV market share was 13%. However, with tightening CO2 emission standards, sales are expected to rebound, with projections for EVs to surpass gasoline and diesel cars by 2028.

- United States: The US lags behind both China and Europe, with an EV market share of around 8% in 2024. Adoption has been slowed by factors like higher costs, a less developed charging infrastructure, and a political divide over electrification policy.

Automotive R&D Cycles

Automotive manufacturers have traditionally operated on long R&D cycles, often 48 to 54 months, to develop a new vehicle platform from concept to production. This process is hardware-centric and involves extensive testing and validation.

However, the rise of EVs, especially from new players like Tesla, has forced a change. EV platforms are less mechanically complex, allowing for shorter development cycles. These new manufacturers operate on a software-first approach, using over-the-air (OTA) updates to continuously improve vehicles after they are sold. This has pressured traditional automakers to shorten their own development timelines.

The Necessity of Transition

For automakers, the transition to electric vehicles is no longer a choiceit's a necessity for global participation.

- **Regulatory Compliance:** Major global markets like China and Europe have established mandates that require a steadily increasing percentage of new vehicle sales to be zero-emission. Automakers that fail to transition their product lines risk being shut out of these profitable markets and facing steep fines.

- **Market Share:** As consumer preferences shift, particularly among younger, environmentally-conscious buyers, automakers that do not offer a compelling range of EVs will lose market share to competitors who do.

- **Competition:** New EV-focused manufacturers have emerged and are rapidly gaining market share. For traditional automakers to remain competitive, they must invest heavily in EV technology, battery development, and new manufacturing processes.

- **Global Supply Chains:** The automotive supply chain is rapidly shifting to support electrification, with significant investment in battery manufacturing and raw material sourcing. Automakers must adapt to these new supply chains to maintain a reliable and cost-effective production model.

Reducing the Impact of Charging on the Electric Grid - EVready Guardian

Figure 4: Figure 7

EVready Guardian: A Unified Energy Management Hub

Figure 5: Figure 8

EVready Guardian revolutionizes site-level control by serving as an advanced Building and Energy Management

System. Our proprietary software seamlessly integrates with any OCPP-compliant EV charging station, enabling centralized management through a single, intuitive dashboard. This flexibility preserves prior infrastructure investments while unlocking innovative features like dynamic load control and active demand response. Paired with the EVready Nodea state-of-the-art hardware deviceGuardian captures real-time building power data and connects effortlessly to HVAC, lighting, and other systems via MODbus (TCP, RTU), BACnet (IP, MS/TP), and MQTT protocols. This interoperability ensures Guardian scales with future smart building upgrades, such as lighting retrofits or HVAC modernizations, positioning sites for sustained efficiency and adaptability.

EVready Guardian software platform includes AI functionality:

Fault Detection Diagnostics (FDD):

1. Features:
    1. Automated Deficiency Identification: Leverage system operation data to autonomously pinpoint inefficiencies

    2. Optimized Fault Resolution: Streamline resolution by distinguishing primary causes (e.g., fan malfunction) from secondary effects (e.g., temperatures deviating from setpoint), and intelligently linking cause-and-effect related faults to prioritize necessary actions

System Optimization (SO):

1. Features:
    1. Data-Driven Optimizations: Utilize self-generating modeling of systems and equipment performance to drive continuous system improvements

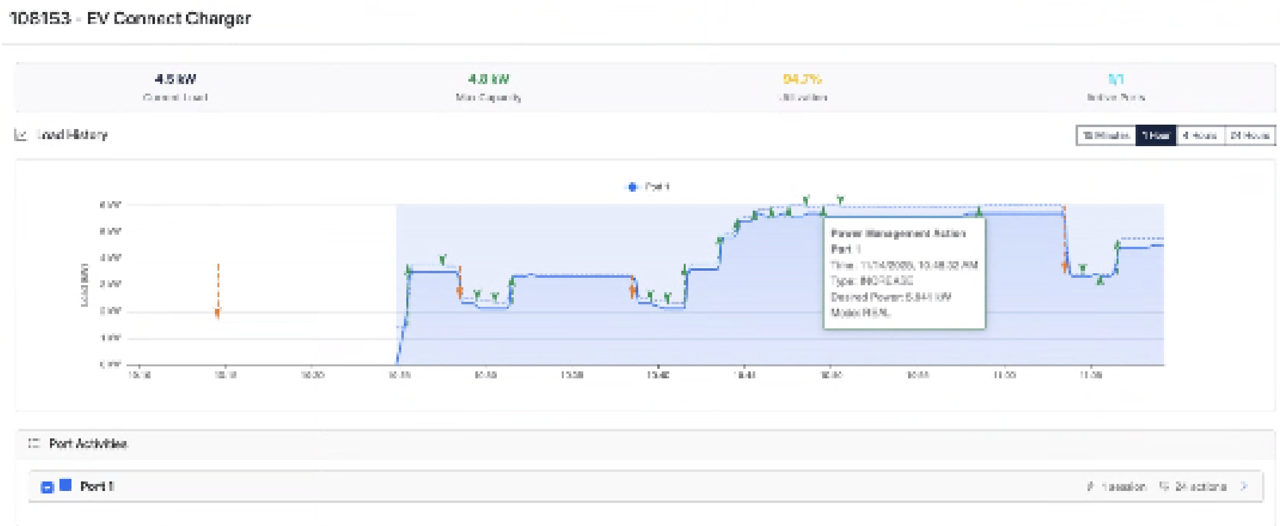
    2. Autonomous Identification and Application: Leverage mechanical system configuration info to independently identify and implement optimizations that both enhance operational performance and energy efficiency of systems

Asset Management (AM):

2. Features:
    1. Asset Enrichment: Enrich basic nameplate information (e.g., manufacturer, model, serial) with metadata - including specifications, features, and performance levels (e.g., filter/belt size, CoP, expected useful life) - through AI-powered optical character recognition (OCR) of OEM-published manuals and specifications

    2. Lifecycle Tracking & Depreciation: Pair installation dates with expected useful life to autonomously calculate asset depreciation, supporting proactive budgeting and data-driven capital planning

Primary Example #1 - Reduction of Charging Loads in Real Time

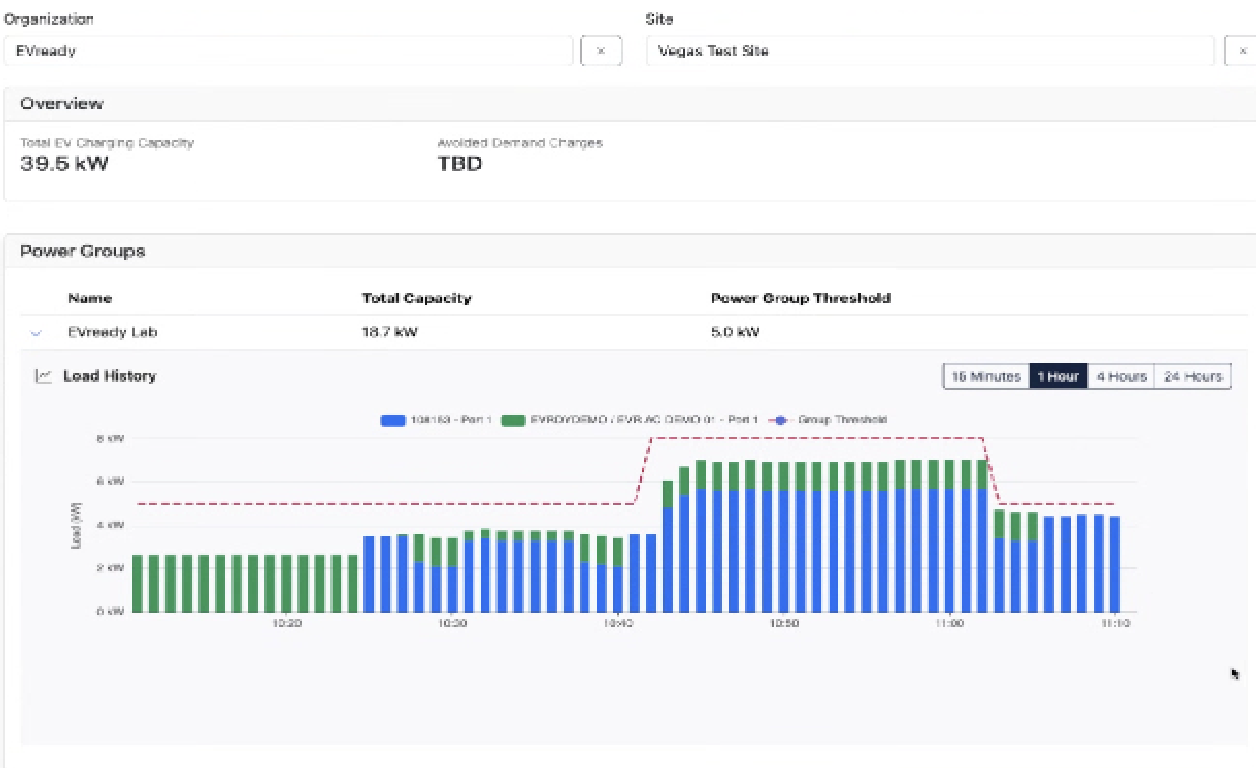


In real time - EVready Guardian software can communicate with multiple charge management, lighting, HVAC, battery, and demand response systems to control power to limit electric costs without interrupting business operations. This allows flexible systems to operate at near 100% capacity, while lowering costs, without impacting business operations.

Primary example #2 - Define the Principle Loads to Control

EVready can stack different loads in real time to define which loads are increasing electric costs, and work to specifically manipulate those loads to lower fees.

Primary example #3 - Define the Principle Loads to Control



EVreadys technology can create aggregate thresholds to (red line) and control all other solutions within those red lines to eliminate fines or excessive costs that can easily be avoided, across multiple energy device assets at once.

Benefits and Advantages - EVready Guardian

EVready Energy's proprietary software, EVready Guardian, is designed as a virtual energy "hub" to strategically reduce a business's total electricity costs, moving far beyond just managing EV charging demand. By integrating with existing on-site systems like lighting, HVAC, battery storage, and solar, the Guardian software uses smart Load Management to look at the total electrical footprint of the facility. This allows it to dynamically control and coordinate the charging speed of EVs, the operation of HVAC units, and the discharge of stored battery power to prevent all these loads from simultaneously creating a massive peak power spike. Since utility costs for capacity, transmission, and distribution are directly tied to that single highest peak usage (kW), the Guardian effectively "shaves" this peak, thereby reducing the calculated maximum load the utility must provide. Lowering this peak load directly translates into a significant reduction in the associated delivery charges (T&D fees) and supply charges (Resource Adequacy/Capacity costs) levied by utilities across the United States.

Guardian customers will also receive EVready Playbook

The EVready Playbook is essentially a comprehensive, expert-driven strategic plan created before any EV charging equipment is purchased or installed, serving as a roadmap to ensure long-term financial viability. It functions by conducting a thorough Existing and Future Charging Analysis to forecast the dealership's power needs as EV sales grow. Crucially, the Playbook performs an in-depth Utility Tariff Review to identify and compare the dozens of complex electric rate schedules available from the utility (like Time-of-Use rates or demand-reducing tariffs). By analyzing current usage patterns against various rate structures, the Playbook selects the optimal tariff and then designs the charging infrastructure strategy to perfectly align with that rate. This upfront planning is key to maximizing cost-savings before the EVready Guardian software even takes over, as it avoids costly mistakes like choosing the wrong site or installing chargers that create unmanageable demand spikes, ultimately projecting the true Total Cost of Ownership and securing available Funding & Incentives to minimize initial investment and operational expense.

8 Stages of Power Management (A multi-year energy management strategy)

Figure 6: Figure 12

Stage 1: Non-Networked Chargers

- Description: Individual chargers operate completely independently, with no ability to communicate with a central system or each other.

- Drawbacks: This results in high operational expenses (OpEx) because there is no control over when or how much power the stations draw. The result is unmanaged, high utility bills.

Stage 2: Static Power Management (Standard OCPP)

- Description: Chargers are networked, typically using a basic protocol like Standard OCPP, but power is managed individually or based on a pre-set, fixed limit.

- Limitation: This approach severely limits charger capability and savings potential because the total power available to the charger group is set far lower than the potential maximum to avoid spikes, throttling charging speed unnecessarily.

Stage 3: L2 Power Groups & L3 Static Management (Standard OCPP)

- Description: Level 2 (L2) chargers are grouped to share power and communicate with each other (group load management) under one Central Management Software (CMS). However, they do not consider the site's overall building load. Level 3 (L3) chargers are still managed statically.

- Limitation: This is not enough to manage site-level power. It prevents internal charger conflicts but ignores the much larger threat of a combined site power spike.

Stage 4: Aggregate L2 & L3 Power Groups (ChargePoint)

- Description: Both L2 and L3 chargers are combined and managed in a single, aggregate power group within one CMS.
- Limitation: The power group is still unassociated with the live building load. The system sets a maximum ceiling for all charging, independent of the HVAC, lighting, or other operational loads.

Stage 5: Integrated Energy Management (EVready Energy)

- Description: L2 and L3 chargers operate in aggregate within one CMS, but are now managed in conjunction with other energy management systems (e.g., solar, battery storage) on the site.
- Advantage: This is the first step toward comprehensive site-level optimization by allowing different energy assets to coordinate their operation.

Stage 6: Multi-CMS Integration (EVready Energy)

- **Description: L2 and L3 chargers operate in aggregate, with multiple CMS platforms communicating with each other, all integrated with other energy management systems.**
- **Advantage: This enables sophisticated management across large or complex sites that may use different charging vendors or systems (e.g., a fleet depot plus employee charging).**

Stage 7: Live Building Load Management (EVready Energy)

- **Description: The complete aggregate charging load (L2 and L3) is managed via a multi-CMS system, in conjunction with other energy systems, but now the optimization is based directly off LIVE building load.**
- **Advantage: This is true peak demand control. The system constantly monitors the facility's main utility meter, dynamically adjusting charging only when the combined total load is about to exceed a costly threshold, maximizing charging speed while eliminating high demand charges.**

Stage 8: Grid-Integrated Management (EVready Energy)

- Description: The most advanced stage, which includes all previous functionality plus integration with ISO (Independent System Operator) and utility demand response (DR) programs.
- Advantage: The site not only eliminates its own peak demand charges but can also participate in programs to earn revenue from the utility by automatically reducing load during grid stress events, turning the charging infrastructure into a profitable asset.

Conclusion

In the year **2000**, businesses could largely get away with simply paying their electric bill without actively managing energy, as rates were relatively stable and costs were dominated by basic consumption. However, in **2025**, this lack of management leads to growing, wasted electricity costs every single yeara trend that will only continue due to soaring **wildfire mitigation expenses**, massive **grid infrastructure investments**, and the explosive, unmanaged **demand spikes** created by EV charging. Businesses that ignore this problem are effectively signing up for perpetual and unpredictable fee increases. **EVready Guardian** is the critical solution, functioning as both the **technology** and the **service** that automatically and dynamically oversees the site's power usage, eliminating costly peak demand spikes across all integrated systems (EV, HVAC, lighting, etc.) so that you can reliably reduce supply and delivery charges and focus entirely on your core business.

Schedule a Consultation