

WHITE PAPER

Electrification 2030

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Qmerit

Introduction

Tracy K. Price, Founder & CEO, Qmerit

Qmerit, North America's leading provider of installation services for electric vehicle (EV) charging and other electrification technologies for homes and businesses, has been at the forefront of supporting the shift away from traditional fossil fuel-powered systems toward more sustainable, resilient electric technologies.

Qmerit has completed over 269,000 home and business EV charger installations and over 86,700 electrical panel upgrades through our North American footprint of certified electrical contractors. We also developed a unique Qmerit Contribution Index® (QCI®), a scoring system based on the principles of workforce science and human capital analytics for skilled trade workers and material suppliers. QCI® promotes the highest standards of service quality and efficiency – a crucial meritocracy-driven approach from which the Qmerit name is derived.

All of this has been done to fulfill Qmerit's fundamental mission to help create a new, more decentralized clean-energy grid and ecosystem – constituting automakers, auto dealers, EV buyers, EV charger manufacturers, fleet operators, utilities, electricians, homeowners and commercial properties.

To illuminate and analyze the complicated issues involved in this seismic technological and economic change, Qmerit's newly established Electrification Institute has produced this white paper, *Electrification 2030*.

As we have been tackling many dimensions of energy-transition issues routinely in the field, we felt it was a timely civic obligation to also assess these issues in a public document. Because there is much that we have learned, we feel we have much that we should share.

Our experience, indeed, guides every page of this paper. Every day in the EV and clean-energy marketplace we see those things that are working well and those things that are not. We also see the potential solutions for those areas that need improvement.

By presenting our learnings and insights here, we believe that we can contribute positively to the discourse on these complex, daunting matters and help move the needle toward successful outcomes. That is the overarching rationale for this paper.

The paper pinpoints and evaluates those issues that we perceive as pivotal to the creation of a clean-energy grid and ecosystem. They include: ensuring public charging reliability, increasing electrification infrastructure in homes and buildings, creating virtual power plants, expanding the pool of qualified electricians, making electrification more affordable and enhancing public/consumer education.



We hope that one of the paper's takeaways will be a deeper recognition that each of these issues is inexorably linked to the others. To successfully address each of them, we must comprehensively address all of them. Ensuring public charging reliability for EVs, as just one example, will be a bridge too far if we lack an adequate pool of trained electricians to service and maintain public charging stations.

As the emerging clean-energy ecosystem encompasses multiple business sectors, we have enlisted executives of Qmerit partner companies from these same sectors – General Motors, JLL, Schneider Electric and Wheels — and leading labor market and workforce management expert Haig Nalbantian to share their distinct perspectives in Part II of the paper.

We should also note that we selected the year 2030 as a focal point of the paper because multiple governments and businesses, especially leading automakers, have targeted 2030 as a milestone in shifting to production and adoption of EVs and in achieving key clean-energy goals.

One of this paper's goals is to help sharpen the focus on and facilitate the analysis of the full spectrum of topics presented here.

For if we are to realize substantial progress by 2030 in transitioning to a clean-energy electric grid and a net-zero emission economy — and eventually to complete that transition — a clarity of vision, ideally free of extreme political and ideological blinders, will be imperative. So will be a concerted effort among marketplace stakeholders to sustain that vision.

We must also do a better job of highlighting not just the longer-term stakes involved in shifting to EVs and a clean-energy grid, but also some of the more immediate, short-term benefits: creation of new jobs, enhancement of America's economic competitiveness and improvement of public health and quality of life through reducing pollution. California offers a compelling example.

A [2023 study from the University of Southern California's Keck School of Medicine](#) found that in California, "every 20 zero-emissions vehicles per 1,000 people in a given zip code led to a 3.2 percent drop in the rate of emergency room visits due to asthma." Moreover, 2023 is "tied for Los Angeles's [cleanest in the last decade based on the Air Quality Index.](#)"

"We do not inherit the earth from our ancestors, we borrow it from our children," states a purported Native American proverb. Helping us ensure a more livable world for our children and grandchildren tomorrow will likely be the greatest benefit from speeding the shift to clean-energy technology today. That benefit is, inarguably, priceless.

We hope that all sectors of the American marketplace will harness their most time-honored values to meet these time-sensitive challenges.

Executive Summary

Part II of this paper presents perspective pieces authored by executives from General Motors, JLL, Schneider Electric and Wheels, and by leading labor market and workforce management expert Haig R. Nalbantian. Below are brief descriptions of these pieces.

Section A: Improving Public Charging Reliability

- Widespread access to reliably functioning public EV chargers is a prerequisite to the mass adoption of EVs and the transition to a cleaner energy grid.
- Substantial investments – encompassing manufacturing, operations & maintenance (O&M), technology and marketing – in both public and private charging may help each one stimulate further investments in the other, and ensure that both, in concert, can help engender a viable charging infrastructure.
- Public EV charging is now an issue of both quantity and quality. New, heretofore unreleased, national data from EV Connect finds that the common reasons for unsuccessful EV charging sessions are due to station connectivity (55%) and internal station faults/errors (38%), as well as the connector/cable (4%), credit card reader (1%) and screen (1%)*.

**Based on 2023 network data monitoring across the United States*

Section B: Increasing Electrification Infrastructure in Homes and Buildings

- Broader U.S. EV adoption will demand significantly upgraded home-charging capacity because many older, non-renovated American homes cannot accommodate faster EV charging (Level 2) and other electrification technologies. As more homeowners update their electrical panels to accommodate EVs, they will obtain the capacity to handle not just EVs but a full suite of electric appliances, water heat pumps and heat pumps for space cooling and heating.
- The transition toward mass adoption of EVs and other supporting electrification technologies is not likely to always follow a straight and predictable path. Consumer expectations about EV costs and capabilities may not always match realities and could create a more circuitous road to EV adoption than some predict.
- Over time, solar generation and newly emerging bidirectional charging technology will help reduce EV usage costs for consumers, while helping accelerate the transition to a clean-energy grid. As America's turn to EVs continues to accelerate, more homes and buildings will likely become fully electrified — and in a way that could advance the progress of nano and microgrids and virtual power plants.

Section C: Creating Virtual Power Plants

- The electrification components that individuals and businesses are currently installing — electric vehicle chargers, solar panels, wind turbines, battery storage, etc. — are setting the stage for America to implement virtual power plants (VPPs) as a

complement to America's energy landscape. Virtual power plants use artificial intelligence and data analytics to aggregate these energy assets into a software-based solution that better assimilates them into the traditional grid and the wholesale buy/sell energy markets.

- Virtual power plants could support America's broad shift to electrification while making the grid more resilient. For example, they could leverage the aggregate stored energy from a fleet of vehicles and trigger a scheduled discharge as needed. Or VPPs could pivot to utilizing the sun and wind when they are generating the most usable energy.
- These benefits could be achievable if America's energy stakeholders can come together in a way that raises support for VPPs at a grassroots level while informing policymakers and influencers on their ability to democratize energy production and distribution in ways that work with our current energy system.

Section D: Expanding the Pool of Qualified Electricians

- The need for electrification workers will accelerate between now and 2030, a phenomenon driven by such factors as the Inflation Reduction Act's electrification stimulus, automakers churning out more EV models at lower prices (which should increase demand for charging installation and maintenance) and ongoing public concerns over pollution and environmental degradation.
- However, a lack of qualified electrical workers could impede America's quest to achieve a new energy paradigm by 2030: electrification installations and maintenance for homes, businesses and public charging stations will experience months-long delays, rising prices and increased risk of thermal events and similar dangers if frustrated customers turn to non-qualified sources for the work.
- America can reverse the worker shortages with a multifaceted approach that emphasizes government funding more targeted to electrical contractors and more streamlined certification processes that are aligned to specific job categories as well as education efforts that reach students earlier in their development regarding the personal benefits and societal value of a career in electrification.

Section E: Making Electrification More Affordable and Accessible

- While public funding provides an essential kick-start to electrification affordability, market-based and consumer-oriented innovations are needed to make electrification sustainable over the long horizon.
- Two market-based concepts could be harnessed in the effort to make electrification more affordable — low-interest financing and electrification-project financing. Low-interest financing enables consumers to share the benefits that traditional industries enjoy concerning their borrowing power. Electrification-project financing brings integrated solutions to the consumer to make electrification simpler and more affordable at the point of sale.
- As an example of low-interest financing, utilities could divert part of their capital to help homeowners upgrade their electrical panels as part of transitioning to whole-home electrification. The utility uses its cheaper-sourced capital to subsidize the cost in a way reflected on the owner's monthly electric bill.

- As an example of electrification-project financing, finance and electrification firms could collaborate in offering consumers a mortgage or home equity plan that bundles the acquisition of electrification updates, e.g., EV charging, solar panels and battery storage.

Section F: Enhancing Public/Consumer Education

- The speed and scope of America's shift from fossil-fuel autos toward broad adoption of electric vehicles (EVs) and other electrification technologies will likely continue to hinge on the depth, or lack thereof, of public willingness to utilize these technologies.
- For multiple reasons, many consumers remain decidedly ambivalent toward EVs and clean-energy technologies. That, in turn, will necessitate an expanded, sustained effort to educate and engage the public on the stakes involved and the long-term benefits that will accrue as we transition away from fossil fuels.
- Recommended guiding principles for public education initiatives on electrification: leverage trusted parties; focus on consumers' immediate needs and concerns; expand the marketplace's pool of clean-energy advocates; adopt long time horizons; viralize corporate sustainability communications; identify and share successful outcomes and practices; and harness simplified messaging.

Perspective Pieces from Leading Partner Companies

Vice President of General Motors Energy Wade Sheffer uses his perspective piece to argue for a "holistic approach" to accelerate EV adoption. "While there are clear benefits to an all-electric future, mass EV adoption will not simply happen by chance. Rather, it will result from a strategic and holistic approach to addressing the current barriers to adoption, head-on."

Annette Clayton, CEO of Schneider Electric North America, discusses in her piece why "a prosumer future should be built on open systems." "[I]n order to meet our climate goals we need to electrify 336,000 homes every month confident that emerging digital energy technologies running on open systems are what will democratize and quicken this transition."

Steve Young, Vice President of Operations at Wheels, Inc., focuses his piece on fleets, EVs and public charging. "[T]he Federal Highway Administration should work with states to ensure — as a matter of routine formal policy — that charging installations are tailored for the needs of both the consumer and professional driver."

Leading labor market and workforce management expert Haig R. Nalbantian, in his piece, discusses the basic economics of job matching and productivity within the context of the EV sector's electrician shortages. "Efforts to quickly expand the supply of qualified labor and to improve 'job matching' are essential to strengthen the ability of labor markets to support the transition to electric vehicles."

In their joint piece, **Greg Bolino, JLL's Head of Sustainability Consulting, and Josephine Tucker, JLL's Head of Clean Energy and Infrastructure Advisory**, address the need for commercial real estate to adapt to the electric grid of the future. "JLL research shows 36% of corporate occupiers have leases that include EV charging today and an additional 42% would like to include it in their leases upon renewal."

Key Drivers for America's Successful Electrification Journey

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A Improving Public Charging Reliability

By Greg Sowder, President, Qmerit Network

Widespread access to reliably functioning public EV chargers is a prerequisite to the mass adoption of EVs and the transition to a cleaner energy grid. America still has some mileage to accumulate before realizing those milestones – and both consumers and businesses appear to be keenly aware of that fact.

Though about 80% of EV charging is done at home, and consumers appear to prefer that arrangement, there is, and will continue to be, a symbiosis between public and private (home and business) EV charging. Substantial investments – encompassing manufacturing, operations & maintenance (O&M), technology and marketing – in both public and private charging may help each one stimulate further investments in the other, and ensure that both, in concert, can help engender a viable charging infrastructure.

Until public EV charging becomes reliably available, consumers may still suffer from “range anxiety,” limiting EV purchases – and, correspondingly, home and business EV charging installations and panel upgrades may equally slow.

Public EV charging is now an issue of both quantity and quality. The country urgently needs many more

public charging stations and upgraded chargers that can consistently serve their purpose. In [public charging capacity](#), America is significantly behind China, boasting 1.2 million charging ports, and Europe, providing 400,000 public charging ports. (See discussion in the next section on specific charger capabilities.)

A [May 2023 J.D. Power report](#), illustrating the public charger quality problem all too well, found that “through the end of Q1 2023, 20.8% of EV drivers using public charging stations experienced charging failures or equipment malfunctions that left them unable to charge their vehicles.”

EV charging networks use proactive remote monitoring systems, such as a Charging Network Operations Center (C-NOC), to solve common EV charging issues faster with deep hardware-software integration with OCPI logs and error messages. (OCPI refers to an Open Charge Point Interface – an open protocol used to connect EV charge station operators with service providers, permitting automated roaming for EV drivers across EV charging networks.)

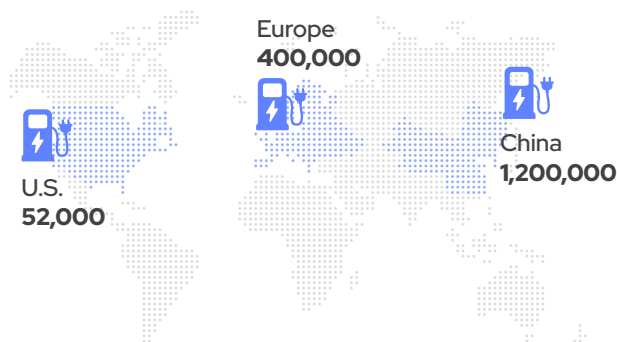
New, heretofore unreleased, national data from EV Connect finds that the common reasons for unsuccessful EV charging sessions are due to station connectivity (55%) and internal station faults/errors (38%), as well as the connector/cable (4%), credit card reader (1%) and screen (1%)*.

With a sophisticated technology platform and support services, nearly all EV charging session issues can be diagnosed and solved remotely to ensure driver uptime while avoiding the need for a truck roll. This enables operations and maintenance teams to spend time on the most critical issues for in-person repairs.

*Based on 2023 network data monitoring across the United States

Public Charging Stations

As of November 2022, according to the Alternative Fuels Data Center,



Unsurprisingly, according to a [2022 Momentive survey of U.S. adults](#), 73% identified battery life and 71% named the availability of charging stations as among their greatest worries with EV use. A July 2023 Pew Research survey found that 53% of Americans are “not too or not at all confident” that the U.S. “will build the necessary infrastructure to support large numbers of EVs on the roads.” And the aforementioned J.D. Power report revealed that “overall customer satisfaction with Level 2 public charging – which represents 71% of all U.S. EV charging” dropped 11 points during this year’s first quarter.

A [2022 research study of San Francisco public chargers](#) discovered that nearly 23% of them were non-functioning due to “unresponsive or unavailable screens, payment system failures, charge initiation failures, network failures, or broken connectors.”

Perhaps the most striking recent data point on public views toward public charging originates from a [2023 survey, by the Energy Policy Institute and the Associated Press-NORC Center for Public Affairs Research](#), that reported that almost 80% of the public blamed “the lack of charging infrastructure as a primary reason for not buying an EV.”

Major automotive companies who are busy ramping up EV production are deeply aware of the public’s concerns over public charging. Ford Motor Company CEO Jim Farley in September 2023 observed: “We’re going into the mass consumers who have a lot of charging anxiety. They don’t have range anxiety; they have charging anxiety.”

Businesses that will continue to rely heavily on public charging – especially, of course, fleet owners – are acutely, and justifiably, concerned about the buildout, or lack thereof, of charging station infrastructure. Fleet owners account for over 2.5 million vehicles now on the road.

In April 2023, the [Ceres Corporate Electric Vehicle Alliance and the NAFA Fleet Management Association issued a letter](#) urging state departments of transportation “to strongly consider commercial and public fleets in their plans for electric vehicle (EV) charging infrastructure in their respective states.” The letter also called “for the design and installation of charging infrastructure that supports the charging of medium- and heavy-duty vehicles (MHDVs).”

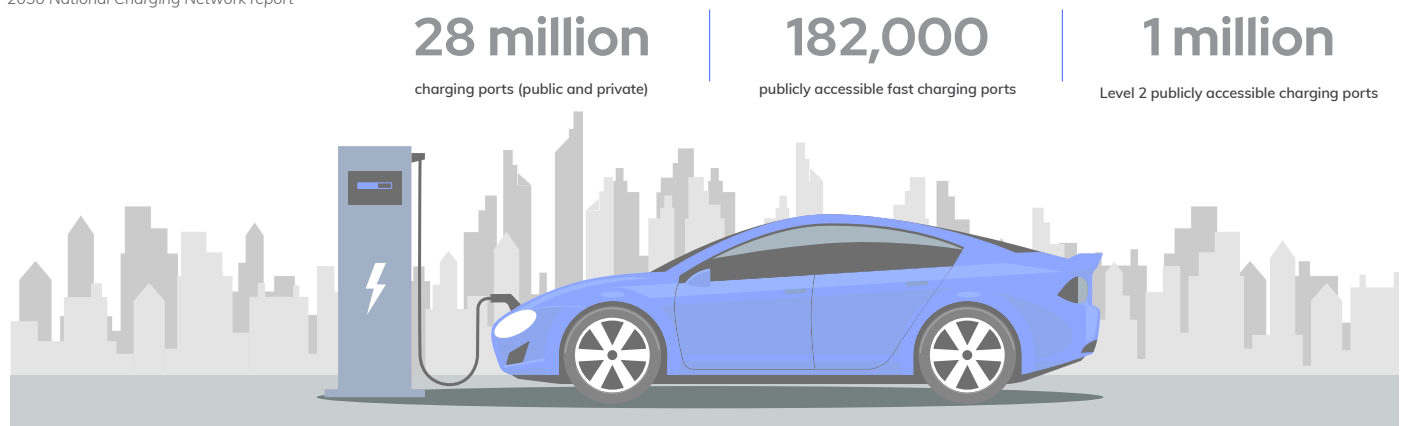
An [Alliance survey](#) provided data support for this outreach: It found that “26% of fleet EV charging is expected to take place at fleet depots and 42% at employee homes, leaving a gap of 32% to be filled.”

What is the public, and private, charging capacity necessary to accommodate far greater EV adoption by 2030?

Assessing the nation’s overall need for EV charging capacity by 2030, the [National Renewable Energy Laboratory’s 2030 National Charging Network report](#) determined the following: “to support a mid-adoption scenario of 33 million EVs on the road by 2030, the nation will need 28 million [public and private] charging ports...182,000 publicly accessible fast charging ports to enable long-distance travel and ride-hailing electrification and to support those who lack access to residential charging [and] 1 million Level 2 publicly accessible charging ports

Nation’s Overall Need for EV Charging Capacity by 2030

National Renewable Energy Laboratory’s
2030 National Charging Network report



accessible locations — including high-density neighborhoods, office buildings, and retail outlets.”

The report also stated that “because EV drivers strongly prefer the convenience of overnight charging, private residential chargers will form the core of the national ecosystem, but they will need to be complemented with reliable public fast charging.”

Global management consulting firm [McKinsey & Company projects a scenario](#) in which demand for electricity to charge EVs could “surge from 11 billion kilowatt-hours (kWh) to 230 billion kWh in 2030” and that “America would require 1.2 million public EV chargers and 28 million private EV chargers by that year” – meaning the U.S. “would need almost 20x more public and private chargers than it has now.”

Similarities can be identified between today’s transition to EVs and with the shift from horsepower to the gas-powered automobile over a century ago.

Then, too, there were quite justified concerns about whether there would be sufficient infrastructure to support that shift. While the first gas-powered car was patented by Germany’s Karl Benz in 1886 and America’s first mass-market-targeted auto, the Ford Model T, was unveiled in 1908, America’s roads were barely ready: only about [141 miles of U.S. rural roads were paved](#) in 1904 – which created an early version of “range anxiety” and served as a massive damper on wider adoption of autos.

And like today, the national government intervened to help facilitate the public’s adoption of the automobile. Federal funding for new road construction was provided through enactment in 1916 of a seminal new law, the Federal Aid Road Act. The new law had its intended effect: By 1917, all 48 U.S. states had created highway agencies to administer the spending of federal funds.

Advocating for the law’s passage was a new organization – the American Automobile Association – formed just 14 years before by nine motor clubs and fewer than 1,500 members.

Servicing EV Charging Systems

An important dimension to charging reliability that is quickly emerging is how to ensure that EV charging systems are serviced and maintained according to the highest industry standards that emphasize that both qualified contractors and qualified electricians are essential for servicing and maintaining EV supply equipment. All electrical operations and maintenance activities must be performed by licensed electricians who meet the protocols established by the National Fire Protection Association (NFPA), including the following installation standards:

- NFPA 70, the National Electrical Code (NEC)
- NFPA 70B, the Standard for Maintaining Electrical Equipment
- NFPA 70E, the Standard for Electrical Safety in the Workplace

These three national ANSI accredited codes and standards form an electrical safety trilogy and are the legally adopted requirements for the safest and sound installation of such equipment nationwide.

Sound professional growth in this sector through development and publishing of ANSI-accredited standards are directly based on this subject. Three quality and performance National Electrical Installation Standards published by the National Electrical Contractors Association (NECA) are:

- NECA 413 Standard for Installing and Maintaining Electric Vehicle Supply Equipment
- NECA 701 Standard for Energy Management, Demand Response, and Energy Solutions
- NECA 416 Standard for Installing and Maintaining Energy Storage Systems.

According to David Long, Chief Executive Officer of the National Electrical Contractors Association (NECA), these standards provide the keys on how to accomplish the prescriptive requirements in adopted minimum codes and standards. They go a step beyond and address quality, performance and workmanship aspects that owners and consumers seek.

New in the 2023 NECA is Section 110.17 that directly addresses servicing and maintaining of electrical equipment. As the industry is dynamic, continuous training is implemented to provide up-to-date expertise.

While auto sales in America subsequently boomed during the “roaring” 1920s, even by the end of the 1930s, just 25 percent of U.S. roads were paved. Arguably, it was not until the implementation of the national government’s sweeping National Interstate and Defense Highways Act of 1956, which established an interstate highway system, that America’s infrastructure truly caught up with the automobile.

We must stress that if we are to migrate completely to EVs as we did to gas-powered autos during the last century, we must scale operations and maintenance solutions. Similar to gas pumps, EV charging stations will need robust maintenance and service to achieve the reliability that Americans will require and demand.

In California, additional steps have been taken to ensure public charger reliability as part of the state’s regulations for charging stations. All AC and DC public chargers

as defined effective July 1, 2023, that dispense energy will require commissioning post installation and annual certification by the California Division of Measurement Standards. This certification of chargers is analogous to the certification required for gasoline and diesel at consumer gas-pumping stations. This action will help ensure the reliability and efficacy of public EV charging stations while bolstering consumer confidence in them.

While technological change and its attendant social and economic effects materialize faster today, the past events discussed here remind us that building an entirely new transportation system to serve the nation as a whole must also be supported by the nation as a whole, public and private sectors alike.

B Increasing Electrification Infrastructure in Homes and Buildings

By Tom Bowen, President of Qmerit Solutions

It All Starts at Home

As America transitions toward a clean-energy electrical grid, the focus will be on power plants, transmission lines, substations, transformers and distribution lines, all grid components that will likely need to be revamped. Remarkably, much of this sweeping transition will hinge primarily on what activity starts at the home – where about 80% of EV charging is done today and where tens of millions of new or replacement EV chargers, batteries, smart panels, solar panels and heat pumps will need to be installed.

If the nation is to meet the ambitious but crucial goals of engendering a carbon and pollution-free electric power sector plus a net-zero emissions economy, consumers will have to increasingly adopt this array of clean-energy and transportation technology. Businesses, of course, will need to do the same.

Befitting its revolutionary nature, the scale and scope of this transition will be enormous – involving in some way most of the nation’s physical capital, encompassing factories and industrial buildings, commercial buildings and all types of housing. As of 2021, the U.S. had about 128 million housing units, of which 81.7 million were detached, 8.2 million attached single-family homes, and about 31.8 million multifamily apartment units.

A 2021 Pecan Street study, focusing exclusively on residential electric capacity, determined that as many as 48 million of those single-family homes will need electric service panel upgrades “before they can fully electrify.” Data from the National Renewable Energy Laboratory (NREL) further underscores the massive task required to upgrade U.S. housing to accommodate Level 2 chargers: As of 2022, NREL found just 1246 EV charging ports at all private U.S. multifamily residences (most being Level 2 chargers).

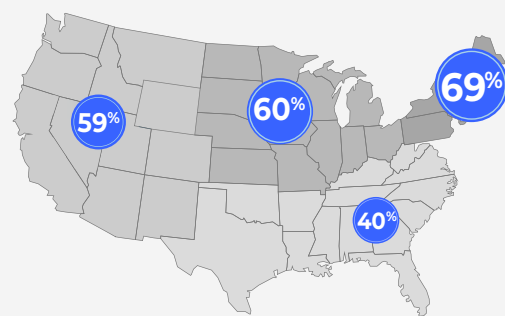
Broader U.S. EV adoption will indeed demand significantly upgraded home-charging capacity because many

older, non-renovated American homes cannot accommodate faster EV charging (Level 2) and other electrification technologies. Specifically, most homes have electric panels of 100 to 150 amps in capacity. Electric vehicles will take up a big chunk of this amperage – electric cars require a 40- to 60-amp dedicated breaker and trucks up to a 100-amp breaker.

This means homes usually need a 200- or 300-amp panel to support EV charging. However, there are load management or load shedding technologies that enable a home with less than a 200-amp panel to support a charger whenever the home is using less than 80% of its capacity. About 4.6% of Qmerit’s customers obtained this technology from Qmerit as part of their EV charger installation service.

The graphic below shows that older homes are more concentrated in the U.S. Northeast, Midwest and West.

Homes Least Ready for Fast EV Charging



The older the home, the more it generally costs to install Level 2 EV charging.

The Northeast, Midwest and West have the highest concentration of homes built before 2000. The South has the least.

The Northeast, unsurprisingly, leads the pack with the highest concentration of older homes. This data is presented on a state-by-state basis in the Appendix. The Appendix also has national and state data from Qmerit's customer base that suggests how far along U.S. homes are in installing such electrification infrastructure as solar panels, battery storage and EV chargers.

EV Chargers, Consumer Costs, Solar Panels & Bidirectional Technology

In June 2023, the National Renewable Energy Laboratory (NREL) released its “2030 National Charging Network” study assessing EV charging of all types at residential and commercial properties. The study projects that “to support... a scenario of 33 million EVs on the road by 2030” the national charging infrastructure will

require: “26 million Level 1 and Level 2 charging ports at privately accessible locations—including single-family homes, multifamily properties, and workplaces, and 1 million Level 2 charging ports at publicly accessible locations—including high-density neighborhoods, office buildings, and retail outlets.”

S&P Global Mobility also predicts that by 2030, “a total of around 2.13 million Level 2 and 172,000 Level 3 public chargers will be required, in addition to home EV chargers” to serve the 28.3 million EVs projected to be traversing U.S. roads.

We should stress that Level 2 chargers are generally the best option whenever drivers desire overnight or all-day charging EVs to recharge within a reasonable timeframe. They offer a charging rate of 20-40 miles of range per

EV Charger Levels

Level 1

Volts: 120 volts, the amount used in standard household outlets.

Connection: Uses J1772 or Tesla connectors.

Charging Speed: Three to five miles of battery range per hour.

Wiring: Does not require any special wiring, uses alternating current (AC), and comes with all EVs

Summary: Level 1 charging overnight or at work is adequate for short commutes but is too slow for traveling across town or more.

Level 2

Volts: 208-240 volts on a 32-48 amp charger. New chargers are coming out at 64 & 80 amps.

Connection: Uses J1772 or Tesla connectors.

Charging Speed: 12 to 80 miles of battery range per hour.

Wiring: Uses AC, but requires a dedicated circuit and a supply line from the breaker box, much like air conditioners and clothes dryers. Homes may require electrical circuit box upgrades.

Summary: Most EV drivers use Level 2 charging for daily or overnight charging. Home installation of the necessary equipment is relatively inexpensive. Many public places, like shopping centers, also host Level 2 chargers.

Level 3

Volts: 400-900 volts (DC Fast Chargers and Tesla Superchargers) with a 100 to 400 amp current.

Connection: Connectors vary (Combo, CHAdeMO or Tesla).

Charging Speed: 3 to 20 miles of battery range per minute.

Wiring: Designed for commercial use, these chargers require a much higher voltage than is normally available in a residential area. Even if your area allows the voltage, a Level 3 charger can cost as much as or more than an EV.

Summary: Level 3 EV chargers are remarkably fast, completely charging a car in less than an hour. Level 3 public chargers cost more to use, but they enable travelers to make quick stops to recharge. However, these chargers are not recommended for daily use, and not all EVs can use them as some EVs have batteries too small to accommodate fast chargers.

Source: Qmerit Electrification Institute

hour, in stark contrast to a Level 1 charger providing just 2-5 miles of range per hour.

Level 3 charging stations, also known as DC Fast Charger or DCFC, enable a significantly faster charging experience, offering a charging rate of 60-250 miles of range per hour. This charging is ideal for high-traffic locations or situations where users require a quick charge to continue their journey promptly. However, DCFC charging stations demand substantial electrical infrastructure upgrades and may not be supported in all areas.

Since Level 2 chargers operate at a lower voltage than DCFC chargers, they are more compatible with standard electrical installations. The electrical infrastructure of a commercial property, to illustrate, can more easily accommodate Level 2 charging stations without requiring extensive upgrades to the electrical infrastructure.

The information at hand makes it abundantly clear that the transition toward mass adoption of EVs and other supporting electrification technologies is not likely to always follow a straight and predictable path.

Consumer expectations about EV costs and capabilities may not always match realities could create a more circuitous road to EV adoption than some predict.

For example, a [2022 Bloomberg survey](#) found that EV buyers sought EVs “with a range of at least 300 miles” and that less than 10% would purchase an EV with a range of 200 miles or less, even though “95% of car trips in the U.S. are 30 miles or less.”

And Bloomberg notes that “an EV that has a range of 300 miles takes 91 kWh of battery, which costs auto-makers nearly \$11,000 to make, and that battery weighs more than 1,100 pounds.”

A [2022 Boston Consulting Group survey](#) of 1,000 electric vehicle owners across the U.S., Europe and China determined that EV owners are willing to “pay a lot more to power up their cars at fast-charging public facilities.” But the survey noted that “[t]his sentiment may be short-lived, though.” It added:

It added: “Most EV owners today are relatively wealthy—the cars tend to be costly—and are not overly price sensitive. Thus, for them the convenience of a fast charge likely more than outweighs the expense. But in the coming years, as EVs drop in price and reach mass adoption, less well-heeled drivers may balk at the increased expense of fast charging and lean more toward slower public charging facilities.”

The good news is that over the longer term, solar generation and newly emerging bidirectional charging technology will help reduce EV usage costs for consumers while helping accelerate the transition to a clean-energy grid. By installing solar panels and battery storage alongside EV charging stations, it is possible to provide charging capabilities where the grid may not otherwise be able to support it. Moreover, bidirectional charging technology can provide a way to store excess solar energy during the day and use it to charge EVs, homes and even businesses at night, a concept known as vehicle-to-home (V2H).

With bidirectional charging and battery storage, EV batteries can also receive energy from the grid and discharge it back into the grid, essentially using EVs as a mobile energy storage system that can feed excess electricity into the grid during high demand, a concept known as vehicle-to-grid (V2G). This helps stabilize the grid and avoid blackouts while providing a revenue stream for EV owners.

Bidirectional charging will also help reduce EV ownership costs by allowing owners to sell any excess stored energy in their vehicle back to the grid or use it to power their homes during peak hours when electricity prices are higher.

Smart Panels & Wider Adoption of Electrification Technologies

As more homeowners update their electrical panels to accommodate EVs, they will obtain the panel capacity to handle not just an EV but a full suite of electric appliances, including stoves, ovens, water heat pumps and heat pumps for space cooling and heating (HVAC systems). Additional marginal infrastructure capacity will be created for America to transition away from things that run only on gasoline, natural gas and oil.

As [Qmerit outlines in a post](#) on whole-home electrification, installing electric HVAC and water-heating systems

is particularly impactful to the nation's ability to reduce the environmental footprint of homes and buildings. About 25% of a home's energy consumption, for example, goes to heating the structure while 10% goes to heating the water. Likewise, buildings and commercial properties deal with similarly high uses.

Electric HVACs and heat pumps can also bring individual benefits to the home or building. An all-electric HVAC system can reduce home energy costs by an average of \$1,000 annually according to [Carbon Switch](#), while a water heat-pump solution can save an average of \$330 per year, states [Consumer Affairs](#).

According to a [July 2023 Rocky Mountain Institute \(RMI\) assessment](#), "In states across the country ... heat pumps reduce emissions across their lifetime by up to 93 percent compared with gas furnaces."

Of course, any transition to new technologies brings challenges. The upfront costs of an electric HVAC system may be higher than a traditional system, but over the long term, the former brings lower operating costs and long lifespans of up to 20 years with proper maintenance.

One potential drawback to heat pumps is they may not work well in extremely cold temperatures as they function by drawing warmth from the air or ground. For northern regions, a hybrid system may be best, one that can turn to a traditional unit when temperatures dip. On the plus side, heat pumps are simpler in design and tend to last longer, plus they are relatively easy to install by a certified installer. (Interestingly, while a [2022 Consumer Reports survey](#) of U.S. adults found that 49% "would 'maybe' consider" installing a heat pump, just 9%

"replied with a clear-cut 'yes'" — perhaps highlighting the need for more vigorous consumer education efforts.)

Office buildings and commercial properties will also need to pivot to updated electrical panels and switch-gear to accommodate their customers' demand for EV charging. The [U.S. Department of Energy's "Better Buildings" fact sheet](#), citing previous studies, indicates that about 72% of Level 2 building installations may require load center upgrades.

Panel upgrades, as noted, provide the additional capacity needed to support a greater use of electrical devices. But integrating the use of these products into a larger solution for society requires load centers that also have advanced sensing and data processing capabilities. Such "smart panels" are a nerve center that manages how energy is received, produced and distributed – all from a smartphone or computer.

More details about smart panels are in this April 2023 [Qmerit post](#). Here we emphasize their potential to transform homes and buildings into nano and micro-grids. Smart panels can paradoxically reduce a structure's dependency on the grid while creating improved connectivity with utilities. The panel 'talks' with the home or building's smart thermostat, EV charger and appliances in managing how energy flows internally. It also liaises with the utility in sharing its cleanly generated power based on wider needs and regardless of weather. Incidentally, this can give the home or business the ability to sell back its energy when utilities pay the highest price based on their rate structures.

As discussed in Section C of this report, these capabilities are key for America to realize the revolutionary



Thinking of installing Level 2 charging in your office building or commercial property?

72%

of Level 2 building installations may require load center upgrades

U.S. Department of Energy's Better Building Fact Sheet

potential of nano and microgrids and their ability to feed into a system of virtual power plants (VPPs). VPPs may be able to handle America's rising demand for electricity in a market-based way that reduces carbon while promoting equity and grid resiliency.

In getting to this destination, we know that the rollout of home and building infrastructure will not uniformly follow

the pattern described above. There were solar and wind installations well before EVs hit the scene. And there is something to be said for bundling several electrification upgrades into one project to realize efficiencies.

Qmerit data reveals a great potential for expanded consumer and business adoption of electrification technologies. In 2021, only 16% of Qmerit customers

Infrastructure and the Creation of Nano and Microgrids

As this section demonstrates, obtaining the infrastructure to support full electrification involves a range of installation-level complexities. Having a "CliffsNotes" summary of these intricacies can help stakeholders advance these buildouts in the days ahead.

It's also important to know how infrastructure fits into the larger vision of America's energy future. Entities having the equipment to generate their own clean-sourced power become less dependent on fossil fuel from their utility. Houses and smaller buildings which do this are known as nano grids, whereas larger complexes like an airport or mixed-use development are called microgrids. Microgrids have deep roots: Thomas Edison's first commercial power plant, built in 1882, was actually a direct current microgrid. His first residential customer was JP Morgan, in whose basement he installed the first "dynamo" to power 400 electric light bulbs in the financier's home.

As outlined in this [Qmerit post](#), the basic elements of an "effective" nano or microgrid involve the installation of distributed energy resources (DERs) – typically photovoltaic cells, wind turbines and electric vehicle charging systems – and integrat-

ing them with onsite battery storage.

If this setup is combined with an upgraded electrical panel, it has the capacity to cleanly power a full suite of machines that use electricity versus gasoline, natural gas or oil, including cars, stoves, water heat pumps and HVAC systems. If the structure has a smart panel, the nano or microgrid now has a nerve center that manages energy flows, allowing for reductions to inactive parts of the structure and increases for priority areas.

The excess can also be rerouted to the utility at any point during the day and regardless of weather. Nano and microgrids can therefore fortify the grid during peak demand or climate stress while shoring up the home or a building's resiliency during outages. And they enable energy to be sold during times when utilities pay the most, which helps with the return on investment.

The public needs to appreciate the personal benefits here. Battery storage

along with solar or wind generation gives the home or building a consistent source of power, regardless if the sun is shining or the wind blowing. The battery collects the excess energy produced by solar and turbines for later use. This "islands" the structure, making it less affected by changes in weather or natural disasters.

And from a societal perspective, the more a utility knows which homes or buildings can be "islanded," the better it can respond to outages by routing its limited capacity to those that don't have the benefit of battery storage.

Also from a macro perspective, the more that battery-supported nano and microgrids proliferate, the more distributed energy resources (DERs) society has to underpin the formation of virtual power plants (VPPs). As discussed in Section C, VPPs aggregates both DERS and traditional power plants with utilities and the wholesale buy/sell markets. This creates an ecosystem that brings all of America's energy resources into a cohesion that could reduce carbon, increase capacity and open new doors to affordability and equity.

Electrical infrastructure improvements therefore don't just upgrade the home or building, it sets the foundation for individuals and America to embark on a transformational approach to producing and managing energy.



Battery storage along with solar or wind generation gives the home or building a consistent source of power, regardless if the sun is shining or wind blowing.

seeking Level 2 charging already had solar. That means a full 84% had the potential to add solar after the installation, or during. Batteries were scarcer, with just 2% having that technology, indicating that solar and wind installations were happening before that of batteries. More recent data tells a similar story: Qmerit's 2023 statistics through June 30 found that 20% of its EV charging installation customers already had solar, while only 3% had battery storage.

As America's turn to EVs continues to accelerate, it could kick-start the process of putting the right pieces in place to get homes and buildings more fully electrified — and in a way that advances the progress of nano and micro-grids and virtual power plants. The more we understand what the infrastructure looks like, what it can do, and how it could roll out — the more we as stakeholders can come together to provide the services, education and incentives to make it happen.



Creating Virtual Power Plants

By Scott Harden, Chief Technology Officer, Innovation, Schneider Electric

To illustrate what it could mean to be a utility in a zero-carbon, electrified world, consider the seemingly unrelated fact that each day in Los Angeles, as many as 80,000 cars are driven to the L.A. International Airport and parked in relatively close quarters.

If all these cars were electric — not too fanciful a thought given California's EV mandate — and if they were charged overnight via a home system that included Level 2 charging and rooftop solar — then each day the airport has bunched on its property tens of thousands of clean-sourced energy units that could help power the property or other parts of the city, state or even nation.

Rise of the “Prosumer”

Electrification, as this airport example shows, is opening new possibilities for how energy can be sourced and distributed. Utilities — once monopolistic organizations that pushed in one direction a predictable supply of energy produced by fossil-based plants — will likely find themselves in the years ahead in a climate-conscious world where people and businesses not only consume energy but produce it, too. These “prosumers” will drive electric vehicles, charging them at night and leaving them at work, airports or other sites. They will have solar panels or wind turbines. They will have the capability to store excess energy and use smart technology to have it redirected and reimbursed.

In addition to the rise of the prosumer, utilities are dealing with new institutional power generators coming online. Think of the miles-long rows of wind turbines and solar panels dotting our land.

How will this scattershot of expansion affect utilities and the traditional grid? Can it all gel in a way that enables America to handle the surge in demand that comes with electrification while addressing the need to purify our environment?

We express a cautious “yes” as to whether the concept of virtual power plants (VPPs) can be elevated as a national priority for America's energy agenda.

VPPs – Creating Power Through Cohesion

Virtual power plants (VPPs) use artificial intelligence and data analytics to aggregate thousands of prosumer assets and activities. This involves not only the equipment to capture energy but possibly intelligent electric panels. VPPs can also participate in the energy generation mix much like a traditional coal or nuclear generator and play into the energy wholesale markets that determine clearing prices and distribution sources for the states.

That's a lot of connections. And it's why VPPs should be seen as different from nano and microgrids, which are more closed-loop systems like a commercial property leveraging parked EVs or a metro transit system powering its buses via onsite solar. Nano and microgrids are critical to America's energy evolution, but as distributed energy resources (DERs) that exist “out on the edge” they need to be wrapped into a software-based solution that better assimilates them into the traditional grid and wholesale buy/sell markets. This could give utilities unprecedented flexibility on how and when to source and distribute power.

Consider that when Americans debate the question of grid capacity, the conversation can grind around the need for more plants, lines and transformers, and with that a decommissioning of aging infrastructure.

That's of course a challenge that's very real. But less discussed is the enormous impact that DERs and better timing and flexibility can have on grid resiliency and

carbon reduction. For example, VPPs could leverage the aggregate stored energy from a fleet of vehicles and trigger a scheduled discharge as needed. Or they can pivot to certain renewable sources when the sun and wind are doing the most to produce it efficiently.

Crucially, an abundance of recent studies exist that confirm the grid's capacity to fully accommodate mass usage of EVs and other emerging green technologies. [Energy Innovation conducted a meta-analysis](#) of 11 different studies issued since 2020 and overseen “by researchers at prominent universities, think tanks, nonprofits, and energy consultancies.”

Energy Innovation stated: “[t]hese 11 studies collectively affirm that achieving 80 percent clean electricity by 2030 is feasible, affordable, critical to meeting national climate goals, and deeply beneficial to the economy and public health—all without compromising power system reliability.” Energy Innovation also notes that “[a]ll studies collectively suggest a 70 to 90 percent clean electricity system would be dependable (e.g., able to match supply and demand), including five studies that provide rigorous reliability checks of the grid under stressful weather and demand conditions.”

Windfall of Results for Utilities

The Rocky Mountain Institute (RMI) projects that VPPs could reduce U.S. peak demand by 60 gigawatts by 2030 via their ability to pull on prosumer sources. That is the average amount of power consumed by 50 million of the nation's 123 million households. And when it comes to net-zero considerations, RMI estimates that by 2050 VPPs could avoid 44 to 59 million metric tons of CO₂ per year.

Regarding cost savings, the Brattle Group, in a [report](#) prepared for Google, estimates that the “net cost to the utility of providing resource adequacy from the VPP is only roughly 40% to 60% of the cost of the alternative options.” Brattle further states that “a 60 GW VPP deployment could meet future resource adequacy needs at a net cost that is \$15 billion to \$35 billion lower than the cost of alternative options over the ensuing decade.”

Plugging in Consumers

Much has been written about VPPs from a technical sense, how they work, and their relationship to nano grids and microgrids, including this [examination](#) by Schneider Electric. Brattle Group also lays out the

Grid Reliability & Consumer Education

Broader adoption of EVs and other clean-energy technologies will make consumer education on electric grid reliability particularly important because guaranteeing grid reliability will hinge somewhat on changing consumer behavior – and because so many consumers now appear undereducated about these matters. Consumers must not only become better aware of how these technologies will bring benefits into their own lives, but also how they can help ensure that they obtain those benefits — through doing such relatively simple things as charging EVs at night to reduce grid strain.

Survey data seems to suggest that there is nothing close to a monolithic opinion among the American public regarding the impact on the grid of shifting to clean-energy technologies.

A [2022 Pew Research survey](#) found that only a minority viewed the potential impact of such technologies negatively. According to the survey, “[a] slightly larger share of U.S. adults say transitioning from fossil fuel to renewable sources would have a positive rather than negative effect on the reliability of the electrical grid (38% vs. 31%)” and “[a]bout three-in-ten think an energy transition would not have much of an effect on the reliability of the electrical grid.”

Pew's survey also reported that more Americans “say a renewable energy transition would make the frequency of extreme weather events better than worse in the U.S. (37% vs. 11%), though 50% say they don't think it would have much of an effect.”

38%

say transitioning from fossil fuel to renewable sources would have a positive rather than negative effect.



barriers holding back VPP adoption, including the complex rules states have for entry into their wholesale markets and a utility regulatory model that doesn't financially incentivize VPPs.

For this report, we emphasize the need to ramp up awareness at the grassroots level. The concept of a VPP needs to come down from the ivory tower of academics and energy insiders and become embedded in the hearts and minds of consumers and businesses. That, in turn, can create the groundswell of support that drives policy and other institutional changes in favor of VPPs.

The federal government, for example, could deem that a tiny fraction of the Inflation Reduction Act's \$9 billion for state energy offices (SEOs) be reserved for state-based awareness campaigns that educate citizens on VPPs and what's "in it for them" as it relates to electrical bills, energy monetization, energy equity and dependable power.

Maybe utilities and prosumer providers – the makers and installers of home and building electrification systems – can team up to include VPP awareness as part of their interactions with consumers and businesses. Some could even collect commitments from those interested in receiving more information about VPPs and possibly taking part in a pilot program. Nothing moves policymakers more than thousands of signatures expressing support for an issue.

Certainly, those companies playing a major role in building out our electrification ecosystem can use their channels, connections and lessons learned in the field to increase awareness and sponsor education initiatives and convenings. (Consumer education on these issues is addressed in more detail in Section F of this report.)

Qmerit for example has extensive experience installing electrification systems for homes and buildings, in addition to partnerships with utilities that have VPP pilots

Bolstering Grid Resiliency Through Holistic Load Management

As discussed here, virtual power plants, along with micro and nano grids, put a new light on grid resiliency – a prosumer way to look at the question of “how the grid will handle an influx of electric vehicles and appliances?”

Another answer that is crucial, yet not surfacing enough in the national discourse on electrification, is the value of homes and buildings adopting holistic energy efficiency programs rooted in the load management concept.

Load management refers to activities used by structures to influence energy consumption and distribution, including the amount of electricity pulled from the grid. This is accomplished not only via innovative approaches born out of today's electrification movement but also through “older” means like installing energy-efficient products and systems, including those involved in LEED certifications, can help reduce energy consumption.

To illustrate the role that holistic home and building energy programs can play in grid resiliency, consider a warehouse that installs solar and battery storage.

The structure now has a dependable source of cleanly produced energy, which reduces the electricity it takes from the grid. This could be achieved to a point at which adding Level 2 or 3 EV charging systems doesn't create an increase on its grid pull.

Consider further if this warehouse also bundled LEED-like efficiency measures as part of its effort, including more efficient systems and equipment for lighting, vents and ducts and HVAC components like boilers, chillers, etc. Now the warehouse has reduced its grid intake while simultaneously providing EV charging to support America's shift to electrified transportation. Moreover, the warehouse saves money on its electrification buildout: it doesn't need as many solar panels and as much battery capacity thanks to the measures it took to reduce consumption.

Our admonition could be, “reduce before you produce.” Americans and electrification stakeholders should realize the power of adding the more time-honored energy efficiency measures to a home or building's electrification infrastructure strategy.

Preserving the grid is not just about embracing new paradigms. It's also about accelerating what's working today, only at scale.



underway, including PGE's 30 MW solar-plus storage VPP to address its summer net peak demand. That can produce valuable cross-sector insights on what VPPs mean for the everyday consumer in terms of ways to participate, needed changes to the home and the potential benefits to enjoy.

Put simply, stakeholders within the ecosystem should publicly promote the possibilities of VPPs in a way that meets consumers where they are in life, versus creating more thought for academics and experts to pursue.

Otherwise, in the final analysis, America's energy transition by 2030 will resemble an interesting patchwork of isolated nano and microgrids. That can still net some level of progress. But to realize transformational results, all of those parked cars and rooftop panels mentioned earlier need to be integrated into an intelligent, utility-based system that multiplies the benefits beyond their immediate walls. And that will change our notion of what it means to be a grid.



Expanding the Pool of Qualified Electricians

By Eric Feinberg, Chief Workforce Officer, Qmerit

In one respect, there’s never been a better time to be an electrician. The funding environment for new projects is flush with nearly [\\$9 billion from the Inflation Reduction Act](#) to support the kind of home electrification work detailed in Section B. Automakers are churning out more EV models and at lower prices, which should increase the demand for the installation and maintenance of public and private charging. And fears for the environment could create a public mood that electrification must continue, and even accelerate.

But against this confluence of developments is the reality that America doesn’t have enough qualified electricians for this potential work. Drawing on data from the U.S. Census and the California Department of Industrial Relations, [Grist Media found](#) that there is roughly one certified electrician for every 478 housing units in California. If this spread holds somewhat true across the states, then we have a national supply-demand mismatch that could stymie the country’s journey to a more carbon-free and electrified world by 2030. The start and completion of home and building projects could be delayed by months. Labor costs will rise. Most concerning, the danger of thermal events and similar risks could rise if frustrated customers turn to non-certified sources to install EV chargers and other clean-energy technologies.

Labor trends paint a worsening picture

Whatever the exact ratio of electricians per household, the situation is trending to get worse, not better, as America looks to 2030. Qmerit estimates that the electrical workforce shrinks by 2% a year, based on data from the Associated Builders and Contractors. That means that the labor pool will decline 14% from 2023 to 2030, just as the need intensifies. To that point, the [Bureau of Labor Statistics](#) (BLS) projects that “employment of electricians” will grow 7% overall from 2021 to 2031, to a total of 761,400 individuals.

It’s possible that the BLS could be underestimating this need because America’s electrification transition is so unprecedented. As this [Qmerit post](#) points out, total U.S. electricity consumption was expected to grow 1.4% from 2021 to 2022, yet initial estimates showed an increase of 2.6%. Given this trajectory, job growth could be as high as 25% by 2030. As an important side note, Qmerit is particularly tuned into the growing need for electrical workers to keep up with the demand for public charging maintenance.

No matter how it’s sliced, it’s safe to say the lines for actual versus needed workers are moving in opposite directions.

Earlier retirements and not enough replacements

The shrinkage in the electricians’ pool is partly because of a phenomenon impacting all industries – the specter of Baby Boomers retiring earlier. [Pew Research](#) reports that people 55 and older exited the workforce in greater numbers in 2020 and 2021, caused to some extent by the pandemic. Even if early retirements were to normalize, the electrical field is still vulnerable to a 2030 employment shock given that *all* Baby Boomers will be 65 or older by the end of the decade.

Younger people don’t want to work in the building trades.

2021 high school and college student survey

16.7%
wanted to obtain construction jobs



76.5%
wanted technology jobs



Another reason for the decline is unique to the field — younger people don't want to work in the building trades. At one point in 2021, only **16.7% of high school and college students** said they wanted to obtain construction jobs, compared to 76.5% who said this about technology. Instead of pursuing a trade school or apprenticeship, young adults more than ever are heading off to colleges and universities. According to **Pew, members of Gen Z**, the age cohort behind Millennials, are more likely to enroll in college than any previous generation.

It takes a village – and a framework

Despite this daunting landscape, the marketplace has tools in its electrification tool belt to address this problem. There's still time to create a workforce environment that supports America's ability to achieve its 2030 goals. What's needed are for stakeholders coming together with all deliberate speed to understand the issue and launch actions that can carry the most impact. Based on Qmerit's marketplace experiences, we identify three particularly influential areas. They can provide an opening framework for exploring more specific initiatives.

Targeted funding. We applaud the Inflation Reduction Act's earmarks of \$200 million for states to train, test and certify residential energy efficiency and electrical contractors. Similarly helpful is the Bipartisan Infrastructure Law's \$40 million allocated for energy auditor training and \$10 million for non-profits, industry and labor groups to collaborate on curriculums related to the installation of energy-efficient technologies. However, governments should complement this "air cover" approach with a more surgical round of support aimed at electrical contractors. Ultimately, it's the contractors who do the most to attract and deploy people into the field. They ensure that workers acquire both general knowledge and specific skills for the new jobs that arise as America's electrification journey becomes more sophisticated. Let's leverage their front-line insights with funding that accelerates contractors' ability to recruit, train and deploy workers. Tax credits could be provided based on wages paid to new hires. In some cases, grants could be steered to the contractors versus only to industry support groups.

Earlier education. It's encouraging to see support going to the states for education and training. Such efforts, though, are aimed toward post-high-school adults, including those displaced from earlier occupations. Let's

engage students earlier in the developmental process with high-impact programs that make electrification come alive for middle and high school students. This could reverse any stigmas young people have about the trades. It could show that electrification is a highly skilled vocation based on technology and that this field is directly addressing pollution reduction and energy equity. For these reasons, millennials in particular could be drawn to this vocation. And from a financial perspective, the advantages speak for themselves. Electricians often come through their training with little or no debt, while the average **college education costs \$120,828** over four years. It also typically takes four years before a graduate can work full-time, gaining experience in their profession. An electrician apprentice will typically earn more than **\$114,300** in that same period.

Again, let's put the hiring agent – the electrical contractor – at the center of any effort, with initiatives that have them engaging students, teachers and parents.

Streamlined certification. Depending on the state, apprentices need 500 to 1,000 hours of classroom work in addition to 8,000 hours of on-the-job training to become a journeyman electrician. This amounts to a four-to-five-year commitment that dampens interest in the field. A tiered approach based on job categories could streamline this bulky process. Instead of having one certification program for electrification as a vocation, states could launch individualized tracts for the different jobs arising out of the current electrification movement. There could be programs for EV charging systems, solar installations, HVAC work and more. This would shorten the time it takes for candidates to gain expertise, which could lead to an influx of workers for the specific jobs needed between now and 2030. Certification programs could also be architected around more practical applications versus an arbitrary set of hours.

We should also be more direct in getting training curriculums into the hands of interested individuals. Typically, such programs are accessed through community colleges, industry centers and utility-sponsored venues. All good, but as demonstrated, it's the contractors who have

the most influence on the hiring process. That's why Qmerit is collaborating with the [Electric Vehicle Infrastructure Training Program \(EVITP\)](#) to distribute EVITP curriculum and testing to Qmerit's national network of 12,000 electricians via the Qmerit Resource Center. This will create a multiplying effect in developing a diverse and climate-conscious workforce by enabling our electrical contractors — more than 15% of which are minority and disadvantaged businesses — to deliver training to **their** contacts and networks of individuals looking to begin or repurpose their careers in the electrical field.

Leveraging our developing ecosystem

Understanding the extent of the workforce gap, diagnosing the causes and having a framework of high-impact areas give the marketplace a starting

point for expanding the pool of electricians. It's also encouraging that the electrification ecosystem is more connected than even five years ago. Collaborations have been forged that involve — in various combinations — contractors, workforce groups, utilities, automakers, electrification parts and equipment manufacturers and commercial properties — all to make electrification more streamlined for the consumer. If these efforts can fold in the workforce as a priority that underpins every aspect of the consumer experience, then we leverage avenues already active in making electrification achievable.

After all, if forces can combine to increase the demand for electrification work, then they can be pulled together in a way to raise the supply of labor as well.

E Making Electrification More Affordable and Accessible

By Oliver Phillips, Chief Operating Officer, Qmerit

Affordability looms as a chief barrier to realizing a more carbon-free transportation system in America and, with that, a cleaner, more decentralized way of meeting the county's broader energy needs.

J.D. Power consistently finds that “high purchase price” is a top reason why consumers don’t want an electric vehicle. Their research also shows that attitudes toward home charging are affected by electricity rates. And the costs related to full home and building electrification present another barrier. A [City of San Francisco study](#) found that retrofitting existing homes can range from \$14,363 to \$34,790, which probably represents a higher-end range.

This affordability challenge reflects the classic macroeconomic paradox facing nascent industries having revolutionary potential: How do you develop mature supply chains that over time reduce costs

without a critical mass of consumers with the means to purchase the output of those chains, thus incentivizing their formation and continued improvement?

The initial answer is public funding. We are encouraged by the billions in government support flowing into the economy to stimulate electrification, including the Inflation Reduction Act (IRA) tax credits for new and used vehicles. The IRA is also pumping in \$9 billion for residential energy efficiency and electrification financial programs while the Bipartisan Infrastructure Law (BIL) delivers billions in other forms of support, not to mention support from states and local governments.

But another, perhaps less discussed area, is the value of market-based, consumer-oriented innovations that improve how individuals acquire and pay for electrification within a free-market society. For all the attention on government aid, there seems to be less on how stakeholders within the EV ecosystem can collaborate to make things less costly and easier for consumers at the point of sale.

Based on Qmerit’s interactions in the marketplace, we see two arenas that can produce value on this front, which we will label as 1) low-interest financing, and 2) electrification-project financing.

With the first, low-interest financing, the electrification ecosystem should consider doing more to leverage the borrowing power of the traditional industries playing a vital role in the electrification of everything. Mature industries typically enjoy much lower borrowing costs compared to consumers. For instance, utilities can issue bonds with rates about 1 point above the yield on the 10-year Treasury note. This cheaper source of capital

Retrofitting existing homes can range from

\$14,363 to \$34,790

*City of San Francisco study

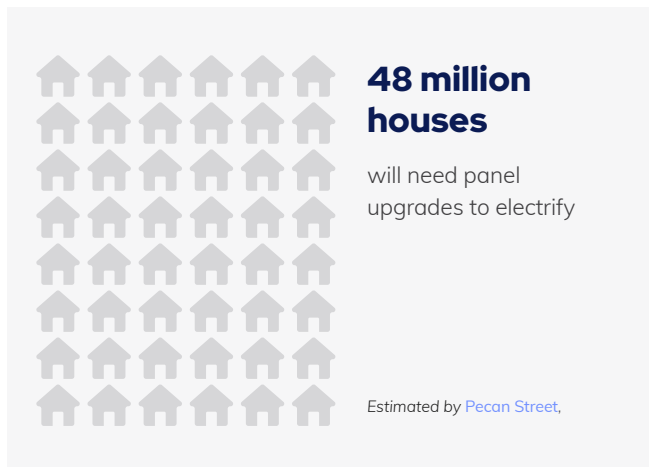


could be deployed in a way that eases consumer costs while allowing the industry to tackle key barriers unique to its electrification journey.

Utilities, as an example, could divert a portion of their capital to help individuals upgrade their electrical panels as part of transitioning to whole home or building electrification. (Section B of this paper explores this topic.) Instead of leaving it up to individuals to pay for a new panel via expensive consumer loans, the utility could use its cheaper-sourced capital to subsidize the cost in a way reflected on the owners' monthly electric bill, an emerging concept known as on-bill financing. The consumer gets a cheaper panel and an easier way to pay for it. The utility gets more constituents with the key ingredient it needs to handle the demand tidal wave that comes with electrification.

With new and smarter panels, utilities can help consumers manage when they pull energy and ensure it comes from renewable sources. They also enable the utility to receive excess energy produced by the home's carbon-zero system. Most American homes, 48 million as estimated by Pecan Street, will need panel upgrades to electrify. This represents an expensive hit for the consumer and a systemic barrier to the energy industry's ability to survive and thrive in a new era.

This win-win model could be employed by other industries – automotive, commercial real estate, construction and charging manufacturers — in ways that lower costs for their customers while at the same time addressing barriers and opportunities unique to the industry's electrification landscape.



The second area, electrification-project financing, refers to different parts of the economy combining complementary outputs into a single offering. From a historical perspective, the quest to electrify is still new; it's likely flush with opportunities for the various players to braid core strengths in a way that improves the purchasing experience and evolves the ecosystem. This could save the buyer from having to figure out the different puzzle pieces that go into a particular electrification solution, such as EV ownership. And avoid financing them separately. For example, automakers, finance organizations and equipment manufacturers could combine to offer a single purchase and payment plan that bundles the car, charger and installation services.

Again, this approach could be replicated in other settings. Collaborations among banks and various original equipment manufacturers (OEMs), could lead to new solutions that encourage consumers and businesses to adopt whole home or building electrification. One or more pieces of the requisite equipment – solar panels, EV charging, upgraded panels, battery storage, electric heat pumps for space heating and cooling, electric hot water heat pumps, etc. – could be tacked onto the consumer's mortgage or home equity credit or bundled into a single electrification finance package. Over time, the market could evolve into a guaranteed savings model for financing retrofit bundles.

Of course, there are other major areas to assess when it comes to affordability. Volumes have been written about the IRA and BIL, what it funds and how it can be doled out. Labor is also a critical driver. Section D of this report addresses how to expand the pool of qualified electricians and technicians needed to implement and maintain the electrification of everything.

Here we spotlight solutions that represent markets innovating to create a better experience where it matters most – the moment of truth when someone decides whether or not to buy. Call it the electrification red zone. Government support can bridge the chicken-and-egg conundrum that comes with a new economic movement. But for electrification to last, the ecosystem will eventually have to take over with a system that creates profitability. That means consumers have the means and easy access to goods and services produced by maturing supply chains that continually drive down costs while elevating quality.



Enhancing Public/Consumer Education

By Ken Sapp, Senior Vice President, Business Development

Inconsistent Views, Complex Issues, Unprecedented Challenges

The speed and scope of America’s shift from fossil-fuel autos toward broad adoption of electric vehicles (EVs) and other electrification technologies will likely hinge on the depth, or lack thereof, of public willingness to utilize these technologies. Mass adoption of EVs and a complete shift toward a clean-energy grid will simply not happen without a public that wants that to happen.

And today, for a variety of reasons, a significant share of the public remains decidedly ambivalent toward EVs and clean-energy technologies.

That, in turn, will necessitate an expanded, sustained effort to educate and engage the public on the stakes involved and the long-term benefits that will accrue as we transition away from fossil fuels.

A successful, impactful public education effort will likely need to be informed by a close reading of the relevant history, guided by an understanding of the complicated issues faced and supported by a deep awareness of consumer attitudes and perceptions — or misperceptions — toward electrification technologies.

Those technologies are usually described as “green,” but the issues they raise often cannot easily be described in black-and-white terms, but through many shades of gray, as electrification issues are indeed inherently complex and nuanced.

The public’s current viewpoints toward sustainability, EVs and electrification technologies, according to surveys, are similarly nuanced and, at times, seemingly inconsistent and even downright contradictory.

While ominous environmental threats may be inducing the environmentally conscious to purchase EVs, a sizable share of Americans apparently have other, shorter-term motivations. The former is concerned about

the planet lasting for their children and grandchildren; the latter may be more concerned about an EV battery lasting when they drive long distances. Green to some evokes trees; to others, it signifies dollars, especially those saved.

Survey data appears to support this apparent dichotomy — although surveys on clean energy, sustainability and EVs are themselves at times seemingly at odds.

A 2022 Pew Research Center survey found that 69% of U.S. adults “prioritize developing alternative energy sources, such as wind and solar, over expanding the production of oil, coal and natural gas, and the same share (69%) approve of the U.S. taking steps to become carbon neutral by 2050.” Yet a “relatively small share of Americans (31%) believe the U.S. should phase out the use of oil, coal and natural gas completely.”

EV sales have undeniably been surging, and a 2023 Cox Automotive study revealed that 51% of the 1,024 consumers surveyed said that they may purchase “either a new or used EV, up from 38% in 2021.”

In stark contrast, a July 2023 Pew Research survey reported that 50% of U.S. adults “say they are not too or not at all likely to consider purchasing an EV, while another 13% say they do not plan to purchase a vehicle.” And according to an April 2023 survey, from the Energy Policy Institute at the University of Chicago and the Associated Press-NORC Center for Public Affairs Research, just 19% of respondents indicated that it is “very” or “extremely” likely that they would purchase an EV as their next car.

50%



say they are not too or not at all likely to consider purchasing an EV,

An [April 2023 Gallup poll](#), meanwhile, found that over 60 percent of Americans believe that “electric vehicles (EVs) only help address climate change a little or not at all.” Additionally, a [June 2021 Pew Research report](#) found that while 47% of U.S. adults favored a phasing out of gasoline-powered cars and trucks, a majority, 51%, were in opposition.

EV costs, “range anxiety” and deficient public charging infrastructure, among other factors, may be constraining EV demand and fueling doubts about their inevitability.

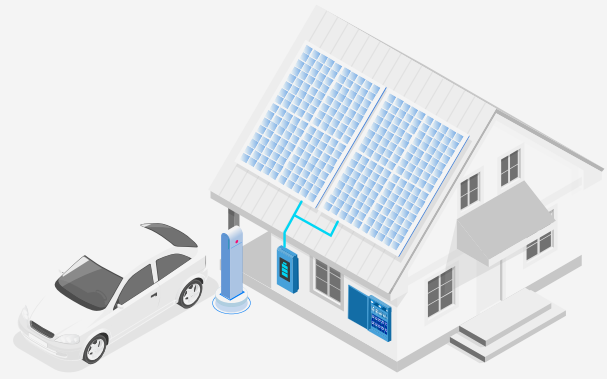
Too many EV owners specifically, and consumers generally, also appear severely information-challenged regarding purchasing and using EVs and even the charging capacities of their own homes. Though homeowners can usually charge any EV, albeit very slowly, through a standard 120-volt AC outlet, astonishingly, a [2022 Morning Consult survey](#) found that 78% of U.S. adults indicated that they lacked charging access at home. A [2022 Plug in America survey](#) discovered that only 40% said that they could obtain all needed information for buying an EV “without difficulty.”

And a [2023 J.D. Power study](#) reported that many EV owners are unaware of utility rebates and discount programs — finding “that just 51 percent of owners are aware of utility company programs in their area” that “could go a long way in reducing the pain of rising electricity rates.”

According to an [Ernst & Young international survey](#) of 18 markets, including that of the U.S., just “half (51%) say they understand the actions and investments they can make to be more [energy] sustainable.” The study deduced that:

Energy efficiency awareness campaigns by providers, governments and other stakeholders simply aren’t getting through.

Less than one-third of consumers have a good understanding of terms such as renewable energy, sustainability, carbon neutral and net zero. This level of understanding has not changed in the past year, despite media attention on the energy crisis and climate change.



Collaborations among banks and various original equipment manufacturers (OEMs), could lead to new solutions that encourage consumers and businesses to adopt whole home or building electrification.

Consumer education on EV battery usage should particularly focus on time-of-use (TOU) electricity rates, which local utilities are adopting in a growing number of states, such as California, Illinois, Texas, New York, New Jersey, Ohio, Pennsylvania, Massachusetts, Arizona, Florida, and soon, Missouri. With TOU rates, the amount consumers pay for electricity is based on the time of day when they use electricity.

Consumers will pay higher rates during times of the day when power consumption in their local areas is greater. Consumers are thus incentivized to use the energy stored in their EV batteries during those higher-rate times — saving themselves money, possibly enough to cover the cost of purchasing batteries, while they can harness their stored energy to potentially power their homes’ essential loads for several days. Not only is this good for consumers, but it can also help reduce strain on the grid as more consumers will use less energy when local area power consumption is highest.

As clean-energy stakeholders attempt to expand and enhance their work at building public support for speedier mass adoption of EVs and electrification technologies, they should not lose sight of the unprecedentedly daunting environment in which they operate. When they urge the public to buy EVs, solar panels and other related technologies, they are not merely advocating the purchases of new consumer products and technology but, effectively, a wholesale change in lifestyles and societal behavior. Such far-reaching changes may seem to

some people to be unsettling, overly disruptive, or even threatening.

The last time human society undertook such a seismic shift in personal transportation usage was during the transition from the horse and buggy to automobiles over a century ago. That evolution took decades to play out, but unlike then, today, arguably, we do not have the luxury to transition at such a relatively leisurely pace — as unparalleled environmental threats now catalyze our transition.

We must move as expeditiously as possible in our engagement and education of the public on the urgent need for electrification.

We are certainly aided by the fact that, in stark contrast to the primitive communications technology that characterized the horse-and-buggy era, today we can harness the potent power of ubiquitous digital communications

technology to facilitate public outreach. However, that same digital technology has rapidly evolved since the 1990s to engender a vast spectrum of distinct communications media, networks and channels.

Therefore, because today's media landscape is so highly fragmented, a proverbial digital Tower of Babel, it is perhaps easier now than in the pre-internet era for mass communications of any kind to get lost in the noise. We thus have to work all the harder to ensure that public education messages are heard and understood.

"Human history becomes more and more a race between education and catastrophe," warned the great science fiction writer and futurist H.G. Wells.

The key takeaway here is that all key stakeholders need to level up their work, as concertedly as possible, to educate the general public on the rationale for mass adoption of EVs and electrification technologies. The stakes are high precisely because, ultimately, we are all stakeholders.

Recommended Guiding Principles for Public Education on Electrification

Leverage Trusted Parties

History suggests that education campaigns on public issues — especially those that generate diverging viewpoints — can be more successful when utilizing parties seen as trustworthy by the public. A [Rocky Mountain Institute survey](#) of homeowners found that consumers will most likely trust contractors to inform them of the need for energy upgrades. Friends and family and the local utility company were also ranked high. RMI notes that "when seeking information, consumers first look to someone who they believe will give them an honest opinion and then value expertise."

Energy providers, according to the previously cited Ernst & Young survey, need to do more to address consumer needs for information on electrification and sustainability issues: "More than half (59%) of consumers surveyed would like to turn to their energy providers for advice and support on sustainability, but most providers are falling short."

Focus on Consumers' Immediate Needs/Concerns

It has long been a truism in national political campaigns that voters prioritize "pocketbook issues" — as most citizens, by necessity, must focus on their pocketbooks every day. Consumers are more likely, similarly, to be motivated by industry education campaigns that focus on consumers' immediate needs and concerns: highlighting the practical, day-to-day benefits of sus-

tainability and electrification rather than dimensions that may be seen as theoretical in nature and distant in impact.

Some obvious examples of such benefits include reductions in utility bills and other consumer savings; job creation generated through new electrification products and services, grid modernization and other green-focused activity; and health benefits from diminished air pollution.

Expand Marketplace Pool of Clean-Energy Advocates

Over 90% of S&P 500 and 70% of Russell 1000 companies are now publishing environmental, social and governance (ESG) reports. Many of these companies will proudly promote their environmental and sustainability activity to their employees, on their websites and on social media.

However, just a relative few — except those companies that define and shape the energy and transportation ecosystems — will initiate efforts to enlighten their customers on the rationale for greater adoption of electrical and clean-energy technologies. We should thus encourage the expansion of the pool of consumer-facing businesses, regardless of their industry type, that can create and support consumer education initiatives advocating for sustainability through electrification in the workplace and home alike.

(continued)

Adopt Long Time Horizons

Even under the most optimistic scenario, fully transitioning to a clean-energy grid could take a generation. Shifting the needle on public attitudes on such a matter will thus absolutely demand public education and engagement strategies with similarly long time horizons.

Viralize Corporate Sustainability Communications

Some larger companies in recent years have created sustainability education initiatives for their employees. Such initiatives have the potential to viralize messaging on the need for all citizens to do their part to support sustainability to clean up the air in our cities – as employees can be urged to spread that messaging to their respective social circles.

The professional services firm Deloitte is a model: In 2020 it launched a [program to educate all of its employees](#) (over 300,000) on sustainability and to help them “become advocates of proactive” action.

Such an approach can serve as a template for other businesses with large employee bases that seek to help advance substantiality through greater electrification.

Identify & Share Successful Practices

Some assessments, as noted, of clean-energy education campaigns have judged them as lacking in impact. An apparent need therefore exists for organizations and businesses involved in such campaigns to expand the sharing of successful practices and results, if any, with other like-minded entities. Concerning environmental threats and sustainability, we are, indeed, all in this together. Qmerit’s newly established Electrification Institute aims to identify and publicly disseminate information on successful clean-energy education activity.

Harness Simplified Messaging

The energy grid, sustainability and electrification are, as noted, inherently complex, often arcane matters. Public education about them thus necessitates messaging that can be assessable, understandable and persuasive to the mass public. That is obviously not an easy task, especially when confronting a public that may not only be fully uninformed about vital aspects of these issues but too often, and more vexing, misinformed. Put simply, low public understanding of electrification technologies puts a high premium on messaging sufficiently simplified to reliably raise understanding.

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Accelerating EV Adoption – A Holistic Approach

By Wade Sheffer, Vice President of GM Energy



An Ecosystem Approach

The transportation industry is in the midst of one of the most significant technological transformations in more than a century.

The innovations in electric propulsion technology, paired with rapid advancements in software, vehicle development and manufacturing, are leading to more advanced and seamlessly connected vehicles for both residential and commercial applications. For customers who are accustomed to driving vehicles powered by internal combustion engines (ICE), an electric vehicle (EV) offers a number of inherent benefits to ownership, in addition to a completely different driving experience.

Electric motors typically require less maintenance and associated operating costs over time, while also featuring no tailpipe emissions. Additionally, EVs typically have smoother and faster acceleration, as well as better handling and performance and a quieter ride, making them fun vehicles to drive. The ability for certain customers to charge their EVs at home, at work or throughout the community can also lead to added convenience and potential cost-savings throughout the lifespan of the vehicle when compared to their ICE-powered equivalents.

As EV technology continues to progress, advancements in hardware and software are also allowing applications of transportation electrification to be used in new ways, even beyond automobiles.

It is in this newly defined space in which the true value of EVs can be unlocked – allowing them to serve as part of a broader ecosystem of energy solutions which can provide additional value to automakers, increased energy independence for customers, and more flexibility and resiliency for utilities and the grid.

However, in order for EV adoption to truly be successful, it requires a combination of ongoing education, the continual development of new technologies which can be accessed and deployed at scale, and cross-industry collaboration.

Broadening EV Education

For mass adoption of EVs to be truly successful, customers will need to be confident in their choice to transition to all-electric, which is often easier said than done.

Purchasing a new vehicle is already a significant decision. Making the switch from a traditional internal combustion engine to an EV however, is one that represents a lifestyle change. When customers consider making the switch to an EV, there is an inherent list of questions, myths and misconceptions about swapping the gas pump for a plug.

From inquiries about range and charging access, to topics which are much more technical in nature, relating to charging speeds and Kilowatt-Hours – the lack of

As EV technology continues to progress, advancements in hardware and software are also allowing applications of transportation electrification to be used in new ways, even beyond automobiles.

accessible and reliable EV educational resources often represents a direct barrier to greater EV adoption.

This is why a concentrated effort to broaden access to EV education and dispel myths about EVs plays a critical role in helping customers along their journey and making an all-electric future a reality.

By showcasing the inherent benefits, technologies and overall value-add of EVs, the switch to an EV lifestyle becomes more compelling, and customers can begin envisioning themselves as participants in the greater energy ecosystem.

Charging Infrastructure

A primary concern for customers contemplating making the switch to an EV is access to reliable, convenient charging.

For mass EV adoption to be achieved, customers must feel confident in their ability to charge wherever they are – whether that be at home, at work, in the community or while traveling long distances.

In addition to educating customers about ways to charge an EV, levels of charging, charging best practices, and home installation among other topics, it is paramount that the actual public charging infrastructure itself is widespread enough that concerns relating to range anxiety begin to dissipate over time.

The transition of public sentiment from the convenience of a gas station on every corner to having to specifically seek out charging stations will take time – but can be accelerated by continuing to invest in building out infrastructure so that it is accessible to all EV drivers, regardless of where they charge. This is especially true for customers who do not have the ability to install charging infrastructure in their primary residence.

Ensuring that these customers can have readily available access to charging while at work or throughout their communities at parks, convenience stores, shopping centers and additional metropolitan areas will help contribute to the mitigation of range anxiety and represents another key enabler for greater overall EV adoption.

Energy Management Solutions

As EV adoption begins to scale, the expanded capabilities they provide create a new potential white space for customers across all segments to take greater control over energy management, helping to mitigate the potential impact of weather-related events, and even, in some instances, helping to contribute to greater grid resiliency.

The introduction of smart grid technology helps electric utilities identify potential issues with the grid and provide information to the utility and its customers, while also allowing customers to monitor their own usage.

Smart meters, used by certain utilities, allow customers to view energy use by month, by day, or by the hour, and some customers can even receive alerts when power consumption is moving toward a higher-cost tier.

At home, there will be opportunities to work with local utilities to both inform and incentivize customers to take advantage of time-of-use rates, if available, whereby EV charging can be scheduled during off-peak hours. This provides not only a customer benefit in terms of the potential for reduced charging costs, but also helps to reduce the stress on the grid during peak times.



A primary concern for customers contemplating making the switch to an EV is access to reliable, convenient charging.

Certain EVs will also have capabilities which allow them to start and stop charging during certain time periods based on peak load, energy supply, and overall demand from the grid. This capability, known as managed charging (sometimes called “V1G”), can monitor and manage overall energy consumption to help create efficient EV charging programs for certain communities.

These types of smart technologies can enable utilities, homes and companies committed to energy management to leverage the integration (EVs) to help balance the electricity system, and even supply emergency backup power in times of peak demand.

Broadening access to these types of technologies will serve as another key driver for mass EV adoption, allowing customers to extend the use of EV technology beyond the vehicles themselves, and unlock potential cost-savings, while helping to strengthen their own energy independence and provide support for grid resiliency.

Collaborative Approach

While there are clear benefits to an all-electric future, mass EV adoption will not simply happen by chance. Rather, it will result from a strategic and holistic approach to addressing the current barriers to adoption head-on.

Continuing to pioneer new applications and offerings for EV technology, in combination with industry-wide education, and the expansion of widely available infrastructure, will help lower the barriers to adoption and allow more customers to experience the full benefits of electrification sooner, and on a broader scale, than ever before.



While there are clear benefits to an all-electric future, mass EV adoption will not simply happen by chance.

Fleets, EVs & Public Charging

by Steve Young, Vice President of Operations, Wheels, Inc.



Fleet owners constitute a very large part of the American economy, delivering everyday essential goods and services to consumers and businesses alike. Fleet companies account for over 2.5 million road vehicles and generate over \$1.1 trillion in annual revenue. Yet, arguably, despite this sector being a lifeblood for the economy, it has not received the attention entitled it in the ongoing public discussion on the transition to electric vehicles (EVs) and other related clean-transportation technologies.

The Ceres Corporate Electric Vehicle Alliance, a nonprofit organization composed of 31 top fleet operators and other businesses, in 2022 joined the NAFA Fleet Management Association to urge the Federal Highway Administration (FHA) to prioritize fleets and their specific EV charging needs.

The Alliance, in a letter to the FHA, noted that Alliance members intend to purchase over 330,000 zero-emission vehicles (ZEVs) during the next five years for the U.S. market. The Alliance also underscored the need for “strategically placed, cost-effective, and interoperable public EV charging infrastructure” — as it is “essential for trips that take commercial and other fleet operators substantial distances from their fleet depots or homes.”

Fleet operators had ample justification for this outreach to the FHA. The Alliance letter stressed that, while workplace and at-home EV charging “will accommodate much of the growing need” for EV charging capacity, “a substantial gap” will remain “unless more public, on-road charging stations are available.” An Alliance survey of fleet companies specifically determined that “26% of fleet EV charging is expected to take place at fleet depots and 42% at employee homes, leaving a gap of 32% to be filled.”

For the consumer, public support for electrified transportation appears rich in dollars and effective in design. The Inflation Reduction Act (IRA) provides a \$7,500 tax credit for EV purchases, a sizable benefit that most participating Americans will feel come tax time. Likewise, the Bipartisan Infrastructure Law (BIL) will channel billions to states to build out public charging to help make EV ownership more tenable.

However, for businesses and their fleets, governmental efforts, while admirable in the broad sense, may fall short when it comes to execution. Yes, the IRA provides up to \$40,000 for the purchase of a new, clean commercial vehicle and up to 30% off the cost of an on-site charging station, up to \$100,000 per station.

Sounds generous, but these are tax credits, meaning companies must have a tax liability to enjoy the benefits. Corporations often have the resources to mitigate their bill to Uncle Sam, to a point where even credits like these aren't much of a carrot.

And those BIL dollars for public charging represent another execution risk for businesses. Most of the focus is on how this can help streamline EV use for individual drivers. Rightly so, but keep in mind that fleets may become heavy users of public charging — their use of onsite charging may not suffice, as discovered by the aforementioned Ceres Corporate Electric Vehicle Alliance survey.

*For the consumer,
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State and federal EV-focused programs must become more business-relevant in their design and rollout. Incentives, for example, should come in the form of actual discounts or rebates at the time of purchase, versus appearing later in the game as possible tax credits.

Likewise, the Federal Highway Administration should work with states to ensure — as a matter of routine formal policy — that charging installations are tailored for the needs of both the consumer and professional driver.

This could result in higher voltage ports for medium and heavy-duty vehicles and separate areas within the same station for consumer versus commercial vehicles.

Such actions will not only serve commerce, which includes the small, middle-market and family-owned companies that anchor our economy, but represent a step toward a more holistic view of America's charging needs.

To achieve a more electrified transportation system by 2030, we need to promote the proliferation of private and home-based charging in parallel to the buildout of a public charging system that is consumer-friendly yet works for fleet businesses, too. What specifically works for fleet companies will ultimately be consumer-friendly as well.



The Basic Economics of Job Matching and Productivity

By Haig R. Nalbantian

Haig R. Nalbantian

Labor/Organizational
Economist

The growth in the market for electric vehicles (EVs) is being hampered by substantial shortages in the supply of electricians qualified to do the work required to build the EV charging infrastructure. With demand far outpacing supply, the EV charging market is experiencing severe strain, exacerbating the fundamental challenges that make labor markets generally among the least efficient of all markets for goods and services. Efforts to quickly expand the supply of qualified labor and to improve “job matching” are essential to strengthen the ability of labor markets to support the transition to electric vehicles.

The essential function of labor markets is to match people to available jobs, price those jobs and motivate people to perform effectively in those jobs. Simultaneously achieving these outcomes efficiently is actually a difficult challenge due to incompleteness and asymmetries in information between the contracting parties. This is true even in the best of circumstances, let alone under the kind of conditions we’re observing in the market for EV electricians.

So, for instance, employers know most about the actual job or role, the associated rewards, the work environment, the organization’s culture and what it takes to be effective within it. Indeed, before they’re hired, prospective employees or contract workers have very limited knowledge of any of these factors, only what employers choose to represent to them. On the other hand, prospective employees or contract workers know far more than their potential employers about their own capabilities: what they really know, how they work, their diligence, character and integrity, their energy, and their penchant to cooperate, among other characteristics, that affect performance. Employers can only rely on proxies for the actual characteristics and behaviors on interest, indicators such as resumes, recommendations, test scores/results (if available), and interviewers’ impressions, among other things. These are, at best, imperfect signals of underlying realities and they do not reflect performance in the actual context of the work or organization.

Labor Markets (and labor market institutions such as agencies, search firms, job fairs, etc.) need to address and overcome these information gaps. Unfortunately, they are among the most inefficient and ineffective markets of all. All too often, experience after hire reveals poor match quality: either the employee has misread the actual requirements and conditions of the job and is ill-equipped to deliver on the specifications, or the employer has misread the suitability of their new hire for the role and his or her fit for the organization. Rapid terminations and “quick quits” – that is, turnover within the first one to two years of hire – are telling signals of inefficient matching observed among many employers.

The higher the volume of hiring, the greater the pace of growth – as in the EV market – the more likely it is that poor matches will result from the hiring process. Quick quits tend to rise under these conditions. These issues are compounded when considering the market for contract workers where there is often less opportunity to directly observe the workers in action and the mutual commitment to the match is weaker, often undermining investment in the relationship on both sides.

Haig R. Nalbantian is a labor/organizational economist. He is co-founder and co-leader of the Workforce Sciences Institute and a former Senior Partner at Mercer

The economic significance of this challenge is revealed in the surge in recent years of “predictive hiring” mechanisms. Employers are increasingly resorting to new methods and technologies to try and improve the quality of matches by expanding the level and quality of pertinent information available to employers and workers. These methods are designed to elicit more information about both the hard and soft skills that workers possess and to increase transparency about what the actual job is like. Some of these mechanisms involve empirical determinations of the profile of successful employees or contractors in their own organization and using such a profile to identify prospective workers with characteristics and experience that match that profile. By building the hiring profile on an empirical basis, the employer hires to specifications that are more likely to be associated with higher value.

Some predictive hiring mechanisms involve the use of gamification in the assessment process. Specifically, games are created in which prospective workers are presented with simulations of the actual job and asked to solve specific problems or complete specific tasks. The technology tracks how the candidate responds to the challenges presented, giving visibility to otherwise unobservable characteristics like sensory acuity, responses to unexpected events, decision processes, quality and pace. To the extent these games reasonably capture attributes and capabilities required to perform the job, this approach can make for better matches of employer and worker.

But match quality is only part of the economic equation determining labor productivity. Simply having the right workers, simply having access to the right mix of skills, knowledge, experience and capability doesn't ensure those workers will be productive. Labor productivity is also influenced by how those workers are deployed in the production process and how motivated they are to exert the effort and diligence required to perform well. The kind of predictive hiring mechanisms noted above do not address these operational challenges of actually executing the work.

This is what makes the Qmerit platform so unique. In effect, it is an “all-in-one” system of workforce management that simultaneously enhances match quality, the efficiency of labor market allocation of workers to job or work assignments and incentives for work performance and human capital development. It harnesses the power of technology to close the information gaps that make traditional labor markets inefficient. Improved matching arises from testing and certification of requisite skills and knowledge at different levels of proficiency.

Efficiency is enhanced as the smart market mechanism allocates – in real-time – qualified labor to specific jobs as they become available, permitting workers to opt for those assignments in which they have a comparative advantage and/or preference. Finally, performance incentives are strengthened using a system of continuous performance feedback from customers and assigning “credits” such that those who deliver to higher standards are more likely to gain access to the better jobs going forward. They advance in the queue of notification of available jobs for which they are qualified.

Moreover, by testing job proficiencies and providing the content and resources for self-directed training, the platform helps workers enhance their capabilities and make them eligible for higher-level, higher-paying jobs. This provides incentives for workers to grow their human capital which in turn expands the pool of available talent, a critical contribution in labor markets, like those for EV workers, that are plagued by severe and chronic labor shortages.

Haig R. Nalbantian

Labor/Organizational
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Simply having the right workers, simply having access to the right mix of skills, knowledge, experience and capability doesn't ensure those workers will be productive.

Our Prosumer Future Should be Built on Open Systems



By Annette Clayton, CEO, Schneider Electric North America

Here's a problem we can all relate to. The cord doesn't fit. The Bluetooth speaker won't connect. The software isn't compatible with your operating system. Nothing extinguishes the excitement of a newly purchased product faster than having to comb through a user manual.

In the Internet of Things (IoT) era many, of our beloved smart speakers and health and fitness technologies operate as part of closed systems that don't allow for functionality with products from competing brands. And while this may be fine for cheaper consumer products, it has much bigger implications for consumers looking to take control of their energy use.

Extreme weather, high energy costs and the EV transition have consumers rethinking energy, particularly now that reliable and affordable electricity is no longer a given. More households and institutions are joining what's known as the "prosumer" ranks by producing and managing their energy through interconnected apps, rooftop solar, battery storage, bidirectional EVs and other innovations. In fact, 83% of Americans now cite energy efficiency and sustainability as the most important factors in home improvement.

Further driving consumer interest are new federal tax credits from the Inflation Reduction Act signed into law last year, which help homeowners afford technologies that enable energy autonomy such as smart electrical panels, EV chargers, battery storage and solar panels. Consumers will soon be able to take advantage of rebates provided by the same legislation which will be doled out by states under varying eligibility rules.

It's encouraging to see this initial consumer enthusiasm bolstered by federal incentives, because in order to meet our climate goals we need to electrify 336,000 homes every month for the next 25 years, according to Rewiring America. We're a very long way off this target. To stand any chance, the consumer experience needs to be significantly improved – and it's no mystery what consumers are looking for. We need a prosumer marketplace that prioritizes choice, affordability and ease of use. And for all three, we need consistent, exponential innovation. Thankfully, this is where open systems thrive.

Fundamental to open technology systems is the need for a common language for IoT devices to talk to each other. Not only does a common language create more connections between more technologies and increase compatibility, but it also significantly simplifies development for manufacturers, leading to new and improved products coming to market faster. It also leaves the door open for disruptive technologies that further accelerate competition and innovation.

Schneider Electric welcomes this competition and we're confident in our ability to stay ahead of the curve.

In fact, our company is building a complete ecosystem of partners that support the prosumer at every phase. EnergySage provides a comprehensive education to new prosumers so they know how to plan and budget for their home energy system. Qmerit

Fundamental to open technology systems is the need for a common language for IoT devices to talk to each other.

provides a nationwide workforce network connecting the consumer to local qualified contractors. EV Connect helps manage networks of chargers and delivers a seamless EV charging experience that empowers drivers. AutoGrid provides benefits to customers for enrolling in virtual power plants (VPPs) which are a coordinated network of decentralized energy resources that can operate in lieu of a physical, fossil generation power plant. Household enrollment in VPPs can significantly reduce costs through monthly payments and the VPPs themselves provide a public service by helping to rescue the grid during brownouts and blackouts.

At the core of this ecosystem is our Schneider Home product, the first open home energy management system controlled by a single, easy-to-use app that automates energy production, storage, measurement and control, making homes more efficient, resilient and sustainable. Now available to pre-order in California, this system allows the homeowner to plug in and connect the solar provider, battery storage or EV charging system of their choice. And because this is an open solution, cutting-edge new technologies can be easily added over time.

In the future, I believe a fully self-sufficient, net-zero home will be affordable for most homeowners. It's just a matter of how fast this future arrives. I'm confident that emerging digital energy technologies running on open systems are what will democratize and quicken this transition.

Energy digitization is already occurring across every sector of the economy. By making what has traditionally been invisible suddenly visible, it is empowering more consumers. Whether you're optimizing power usage at a factory in Kentucky or at a home in California, digitization enables you to maximize energy production and eliminate energy waste. Through energy digitization, knowledge is—quite literally—power.



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Wired for Change:

How Commercial Real Estate Must Adapt for the Electric Grid of the Future



By Greg Bolino, Head of Sustainability Consulting & Josephine Tucker, Head of Clean Energy and Infrastructure Advisory, JLL

Envision a future where 50% to 75% of vehicles that park at a building require charging. EVs could account for 81% of new car sales in the United States by 2040, according to BloombergNEF.

To power all those cars, the US must quadruple the number of EV chargers between 2022 and 2025, and grow more than eight-fold by 2030, estimates S&P Global. However, many predictions around charger demand overlook a fundamental need: infrastructure. A level 2 charger, the most common type used at commercial buildings, delivers 7-19 kilowatts (kW) per hour to a vehicle. When multiplied by dozens or hundreds of chargers, the electricity demand is simply too great for the existing supply to meet.

Commercial real estate owners have an opportunity to play a significant role in the electric grid of the future. Properties equipped to meet occupants' needs for reliable EV charging will stay competitive and command higher valuations.

Buildings at the confluence of an electrified future

Many tenants are already negotiating with building owners to get infrastructure to support their transition to electric fleets and enable employees to charge at work. JLL research shows 36% of corporate occupiers have leases that include EV charging today and an additional 42% would like to include it in their leases upon renewal.

Since most buildings don't have the proper infrastructure today to meet this surging demand, owners and occupiers must work together to achieve shared goals and outcomes. Some properties will require energy efficiency improvements to free up electricity capacity, and others may need major infrastructure upgrades. Consider the following:

- **Building infrastructure:** Most office towers, apartment buildings and industrial parks were not designed to be transportation fuel stations. Investing in advanced assets like microgrids with onsite renewables, battery storage, fuel cells or hydrogen stations can help expand electricity capacity and diversify the energy supply.
- **Utility coordination:** A building may need new transformers or substations to increase electricity capacity. If so, securing those infrastructure upgrades from the utility will take time and possibly a co-investment. Even if a building has sufficient capacity, early talks with a utility provide an opportunity to take advantage of incentives or pre-negotiate rates so that one is not hit with excess demand charges once there is expanded EV charging. In Illinois, for example, ComEd currently offers an EV charging delivery rate option for commercial customers to incentivize charging infrastructure development. Participating in a demand response program or adding onsite generation can help to manage utility challenges.

JLL research shows 36% of corporate occupiers have leases that include EV charging today and an additional 42% would like to include it in their leases upon renewal.

- **Financing capital improvements:** Expanding electrification infrastructure requires many complex financing decisions. Building owners may find opportunities to coordinate with utilities and tenants on co-investments for infrastructure upgrades. They must also determine how to revalue buildings to reflect the addition of desirable infrastructure.
- **Monetization opportunities:** JLL Research estimates that in 2021, the US logistics industry spent \$136.5 billion on fuel, and US consumers spent \$491.2 billion to power their passenger vehicles. As these expenditures shift from gasoline to electricity provided at home and workplaces, commercial real estate owners have an untapped opportunity to generate additional operating income. They must decide whether to monetize EV charging with an energy-as-a-service model or other arrangement.
- **Decarbonization:** Expanding EV charging is often part of a broader decarbonization strategy. If net zero emissions are the goal, you must determine how to source renewable energy to power chargers, whether through local assets, power purchase agreements (PPAs) or onsite installations such as rooftop solar panels.
- **Managing energy supply and demand:** Even if you collect and analyze energy data at your properties today, you will need to drastically scale those efforts to manage an expansive EV charging network on top of other energy consumption. This operational demand may require new investments in software, cloud infrastructure and talent to help optimize supply and demand.

Every building will require a unique strategy depending on its occupants' needs and the role its owners and tenants want to play in the energy ecosystem. Whether a logistics center powering a fleet of electric trucks, a shopping center, or an office tower, taking a holistic approach will allow you to achieve optimal balance.

Acting with urgency

Electrification upgrades can take several years to plan and implement. The average backlog for a typical utility upgrade, such as a new transformer or substation, hovers around 12-18 months across the US. Those who don't start now will find themselves behind the curve. Look for advisers that can explain what financing arrangements are working for other property owners, facilitate conversations with vendors and utilities, and help you understand the impact on property valuations. As the lines blur between real estate owners and energy providers, having a partner who bridges the divide can help develop a path forward to an EV-centric future.



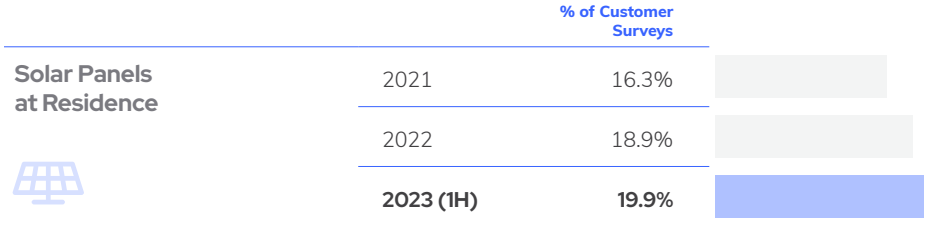
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Solar Panels & Battery at Residence

Data sourced from the Qmerit customer base of EV charging installations.
 The make-up of Qmerit customers with Solar grew by 6% between 2022 and 1st half of 2023

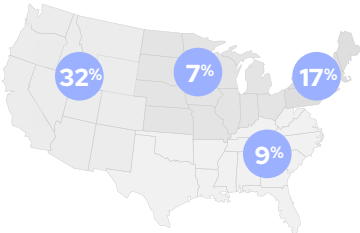


78,059 customers surveyed

Solar Panels at Residence by Region (for years 2021, 2022, 2023 H1)		
Midwest		7%
Northeast		17%
South		9%
West		32%



78,007 customers surveyed



40,070 customers surveyed

Solar Regional Highlights

Data sourced from the Qmerit customer base of EV charging installations.

2023 (H1)

Top Metropolitan Statistical Areas with Solar



San Diego-Chula Vista-Carlsbad	64.6%
Riverside-San Bernardino-Ontario	55.8%
Sacramento-Roseville-Folsom	42.1%
Oxnard-Thousand Oaks-Ventura	41.1%
San Jose-Sunnyvale-Santa Clara	40.7%
San Francisco-Oakland-Berkeley	32.8%
Los Angeles-Long Beach-Anaheim	31.9%
Las Vegas-Henderson-Paradise	31.3%
Denver-Aurora-Lakewood	27.4%
Phoenix-Mesa-Chandler	23.2%



Top Metropolitan Statistical Areas with Battery



San Diego-Chula Vista-Carlsbad	12.8%
San Francisco-Oakland-Berkeley	11.6%
Riverside-San Bernardino-Ontario	9.1%
Los Angeles-Long Beach-Anaheim	6.9%
Tampa-St. Petersburg-Clearwater	3.9%
Houston-The Woodlands-Sugar Land	3.0%
Phoenix-Mesa-Chandler	2.7%
Denver-Aurora-Lakewood	2.5%

Solar by State

Data sourced from the Qmerit customer base of EV charging installations.

2022	2023 (H1)			2022	2023 (H1)		
4%	23%	AK		19%	35%	MT	
0%	1%	AL		8%	10%	NC	
13%	10%	AR		0%	0%	ND	
25%	26%	AZ		3%	9%	NE	
40%	41%	CA		17%	22%	NH	
25%	26%	CO		15%	17%	NJ	
20%	23%	CT		43%	48%	NM	
21%	28%	DC		30%	31%	NV	
15%	15%	DE		17%	18%	NY	
12%	12%	FL		5%	7%	OH	
3%	2%	GA		4%	9%	OK	
60%	72%	HI		12%	11%	OR	
8%	15%	IA		7%	7%	PA	
16%	12%	ID		18%	21%	RI	
9%	10%	IL		6%	7%	SC	
4%	6%	IN		7%	6%	SD	
4%	8%	KS		1%	2%	TN	
10%	7%	KY		11%	10%	TX	
12%	12%	LA		21%	29%	UT	
23%	24%	MA		9%	11%	VA	
12%	13%	MD		27%	33%	VT	
19%	29%	ME		6%	8%	WA	
3%	5%	MI		9%	12%	WI	
9%	11%	MN		7%	10%	WV	
8%	8%	MO		0%	0%	WY	
0%	0%	MS					

Age of Home by State

Data sourced from the Qmerit customer base of EV charging installations.
2023 (1H)

		Prior to 1940	1940 to 1959	1960 to 1979	1980 to 1999	2000 to present
Age of Home by State	AK	0%	13%	29%	17%	42%
	AL	4%	4%	11%	19%	63%
	AR	4%	3%	14%	16%	64%
	AZ	0%	4%	10%	24%	61%
	CA	7%	13%	21%	23%	35%
	CO	4%	4%	14%	24%	54%
	CT	12%	15%	23%	23%	28%
	DC	45%	13%	4%	8%	30%
	DE	2%	9%	15%	17%	57%
	FL	1%	5%	10%	24%	59%
	GA	2%	3%	9%	22%	64%
	HI	2%	9%	28%	9%	52%
	IA	9%	9%	20%	17%	45%
	ID	1%	2%	11%	25%	61%
	IL	10%	8%	15%	26%	41%
	IN	4%	7%	13%	22%	53%
	KS	3%	11%	12%	28%	46%
	KY	6%	8%	18%	20%	48%
	LA	9%	12%	11%	21%	47%
	MA	22%	10%	16%	22%	31%
MD	7%	9%	14%	29%	42%	
ME	20%	5%	12%	23%	40%	
MI	8%	13%	22%	26%	31%	
MN	12%	9%	13%	23%	43%	
MO	12%	7%	17%	27%	37%	

		Prior to 1940	1940 to 1959	1960 to 1979	1980 to 1999	2000 to present
Age of Home by State	MS	8%	4%	8%	19%	60%
	MT	0%	15%	30%	10%	45%
	NC	3%	3%	8%	21%	66%
	ND	0%	0%	15%	31%	54%
	NE	6%	7%	11%	23%	53%
	NH	13%	8%	12%	26%	40%
	NJ	11%	11%	20%	27%	31%
	NM	3%	8%	14%	38%	37%
	NV	0%	1%	6%	25%	69%
	NY	16%	17%	20%	20%	26%
	OH	11%	11%	16%	24%	38%
	OK	6%	8%	18%	18%	50%
	OR	10%	11%	17%	23%	39%
	PA	12%	10%	14%	23%	41%
	RI	22%	16%	15%	26%	22%
	SC	1%	3%	6%	18%	72%
	SD	15%	8%	15%	8%	54%
	TN	3%	5%	8%	21%	63%
	TX	1%	3%	7%	19%	69%
	UT	5%	6%	14%	20%	55%
	VA	3%	6%	14%	23%	54%
	VT	29%	8%	18%	28%	17%
	WA	9%	7%	14%	25%	46%
	WI	13%	10%	15%	23%	39%
	WV	3%	5%	17%	22%	53%
	WY	0%	0%	0%	100%	0%

Home Age

Data sourced from the Qmerit customer base of EV charging installations.

