



Sparking EV America:
Turning President Biden's EV Charging Agenda into a Generational
Transformation of American Transportation

August 2021

pecanstreet.org



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Electric Vehicles are Having Their Moment

Ford's new all-electric Mustang Mach-E and F150 Lightning are the most talked about car models in America. GM, Volvo, Ford and Jaguar have pledged to go all-electric or zero-carbon by 2050 or sooner. Every major car maker sells or is developing at least one all-electric model. In the work truck and bus industry, more than 125 electric models are available or in rapid development. Uber and FedEx say their fleets will be zero-emission or carbon neutral by 2040, and scores of companies are preparing for their electric shift.

Despite all this momentum, the electric future is still in the "future." Only [2% of new cars](#) sold in the United States in 2020 were electric. All-electric models made up three quarters of that portion. Passenger EVs are just now beginning to extend beyond early adopter customers and onto the edges of a mass market.

When that market takes off, our charging infrastructure needs to be ready. If every vehicle in the United States were magically electrified overnight, where would drivers plug in? Who would they pay for charging, and how much would they pay? Homeowners can install Level 2 chargers, but what about apartment renters? Or city-dwellers who rely on on-street parking or private parking

facilities? If a large chunk of a region's transportation goes electric, could the grid even handle the load?

President Biden's focus on EV charging is a historic confluence of environmental, climate, economic and infrastructure policy. The funding that could come with it could not only speed up customer adoption of electric vehicles, but provide a more strategic, efficient, and equitable investment in charging infrastructure than private companies have provided so far.

But for all its size and promise, Biden's charging plan is short on details that will determine whether the billions of dollars pledged to install EV chargers across the country will be spent wisely and effectively, and, therefore, whether the investment will truly spark EV adoption faster than industry analysts have forecast or merely reduce the private cost of a gradual transition that is coming anyway.

This paper discusses the strategies that could turn President Biden's EV charging agenda into a generational transformation of American transportation.



A trendsetter and industry leader for nearly two decades, Tesla (first from left) is now sharing the EV spotlight with startups like Rivian (second). Legacy automakers are going electric, too. Ford's all-electric Mustang Mach-E (third) was recently named Car and Driver's EV of the Year and the 2021 SUV of the Year. The all-electric Ford F-150 Lightning (fourth) is the company's first all-electric pickup. Photos courtesy of Tesla, Rivian and Ford Motor Company.

Sparking Demand – A Plan to Make Charging Simple, Convenient and Frictionless

Replacing millions of gasoline cars with all-electric models requires a thoughtful, long-term strategy that extends far beyond a target number of chargers with a target budget.

There's a decade's worth of analyses, including [McKinsey's 2018 Charging Ahead](#) report, that consider the Level 1, Level 2, and Level 3 infrastructure that will be necessary to support the transition to electric vehicles. Despite its thoroughness, however, the implication of McKinsey's assessment is that charging infrastructure will be necessary to support a presumed EV adoption rate.

Biden's various plans, however, portray EV infrastructure differently – as a lever that could accelerate that adoption rate. Given the importance of clean, electric transportation to the country's broader climate and air pollution goals, federal spending could be a powerful spark. But this possibility requires more than money. It requires a strategy that will improve the country's charging capacity, not just increase it.

Today's charging environment is confusing, inefficient, incomplete and unreliable. It's run largely by individual companies that have little incentive to help anyone except their own customers. And it's not built for a future where millions of EV drivers will want a quick, simple charge. In short, it's full of friction that can make EV ownership a burden rather than a relief. Without a deliberate strategy, pouring hundreds of billions of federal dollars into the existing system could be a massive boondoggle that simultaneously muddles Biden's EV legacy and does little to increase EV adoption.

Consider the important difference between Level 1 or 2 AC charging and Level 3 DC charging. The hardware and infrastructure costs of Level 1 or 2 AC chargers are significantly more affordable. In many locations, existing utility infrastructure can handle the increased load that AC

chargers will bring, and existing buildings can be upgraded to service multiple Level 2 chargers without overhauling the utility infrastructure that leads to them.

Level 3 DC fast chargers, which can quickly replenish car batteries in a very short period of time, are different. The chargers themselves are not only more expensive, but the building and utility infrastructure required to serve them is virtually non-existent. Building it will be expensive and complicated, but critically necessary, to provide the quick charging that will make electric vehicles convenient to millions of new drivers.

This AC/DC issue is just one of many that should drive the administration's plan. How do we revamp existing rebate and incentive programs to appeal to new buyers, particularly lower income buyers? How do we spark enthusiasm of landlords who would have to approve or fund upgrades to their properties? How do we incentivize car manufacturers, charger manufacturers and app developers to make their products interoperable and their data accessible to other companies' customers? And how do we move utilities from interested bystanders of the EV revolution to transformational agents of change?

Many organizations are working on this issue, and we're confident the Biden administration is, too. But publicly-available information about the administration's charging plan is scarce on details. For example, the [White House website](#) (April 22, 2021) proposes \$15 billion to fund 500,000 charging stations and support the "deployment of a mix of chargers in apartment buildings, in public parking, throughout communities, and a robust fast charging [network] along our nation's roadways." But

there are no details about what that mix will look like, how it will be divided, and what “robust” means.

Moreover, it's still unclear just how much of the administration's \$15 billion goal will be funded. Early negotiations suggest the total could be half that amount or less.

This is not a criticism of the administration's plan or announcements. Rather, it's a plea for more details. Lessons from the last decade have taught us that quick and convenient charging is the linchpin of the EV transformation, and this level of federal support to build charging infrastructure is a once-in-a-lifetime opportunity. Moreover, combining a large federal investment with a clearly defined strategy can attract private follow-on investment and innovation. As we saw with the rise of wind power in Texas following its Renewable Portfolio Standard in the early 2000s, markets rise to meet long-term policies.

We need to get this right. And getting it right starts with a detailed plan.

#1 – Build Equity and Emission Reduction in to Every Funding Decision

Unless they are hardwired into the administration's overall charging strategy, efforts to reduce emissions and increase equity will be muted.

The Biden administration has made it clear that sparking EV adoption is a key component of its climate, jobs and equity philosophy. We're confident that jobs will flow, given the amount of money the administration has pledged to build out the charging network.

Less clear or certain is whether this investment will accomplish its greatest potential on the climate and equity

fronts. If these two issues are not hardwired into the administration's planning, it's quite possible that increased EV adoption could have a muted impact on climate and local air pollution and the economic benefits of building a national charging network could bypass underserved and overburdened communities.

For example, a buildout strategy that relies on a state's existing electricity fuel mix would undoubtedly reduce local air pollution via reduced tailpipe emissions. But if the strategy does not also require a commensurate increase in the utility's renewable energy supply, the climate benefit of increasing EV ownership will be undercut. If communities that, for generations, have been overburdened by traffic pollution do not have adequate charging infrastructure for area residents and are not aggressively incentivized with new rebate approaches, EV adoption in those areas will lag. In both cases, the environmental, economic and justice impact of this large investment would be muted.

An infrastructure investment of this size is a generational opportunity to create local jobs during the construction of local charging capacity and beyond. Just as the federal highway system defined a century of domestic travel and culture, a national charging network could do so for the next 100 years. Creative incentives with existing highway mainstays (from national brands to local favorites like Buc-ees here in Texas) and new commercial entities should be examined. But this is an opportunity to create a new category of highway retail and service small businesses. Small business loans to minority-owned businesses or in disadvantaged communities that would benefit economically from highway travelers would be a powerful way to merge the president's climate, economic and equity agendas.

#2 – Prioritize Road-Trip Charging

Road-trip charging is one of the biggest impediments to broad EV adoption and one of the most expensive to resolve.

If the goal of infrastructure spending is to spark, rather than support, EV adoption, expanding the country's DC fast charging infrastructure should be a priority. The Biden plan hints at this, but it lacks the clarity and priority it deserves.

Most EV adoption projections presume that most EV drivers will primarily charge at or near home or work. Short term, that's sure to be true. Long term, that presumption is worthy of debate. For the purposes of this paper, however, we'll accept it (we discuss how home/office charging can be improved in following sections).

But road-trip charging – where drivers will need a large and quick charge – is one of the biggest impediments to broad EV adoption and one of the most expensive to resolve.

How many of the administration's 500,000 chargers will be DC (fast), and how many will be Level 2 AC home chargers?

If thinking about running out of charge – so called "range anxiety" – makes a daily city commuter nervous, just wait until you have 50 miles of charge left and are 75 miles away from a public charging station. And even if you can make it to a public charger during a road-trip, a Level 2 AC charger that will deliver a maximum of 30 miles of range per hour of charge is nearly useless. Filling up Mustang Mach-E would take 10 hours. This might make sense for roadside motels and other road-trip destinations,

but it's no replacement for mega-gas stations that can refill a 400-mile range gas tank in five minutes.

The infrastructure needs and costs for DC fast charging are significantly different than for Level 2 AC charging. Further, DC fast charging is indeed faster than Level 2, but it's not as quick as filling up a gas tank. The national network of fast chargers is an opportunity for economic activity beyond what we expect from today's transportation network. For example, it makes as much sense to add DC charging capabilities to shopping centers and restaurants along the interstate highway system, where customers will have something to do for 30-45 minutes, as it does to add electric charging to today's network of gas stations.

It's here where a federal strategy and commitment to design and fund a strategic and equitable fast charging network along the nation's highways could have the biggest and longest-lasting impact.

#3 – Revamp Customer Incentives

Maximizing and revamping home charging incentives must be a priority.

Expanding the EV market beyond upper-income customers requires new thinking about rebates, incentive programs and some of the home improvements that will be needed as EV sales extend beyond early adopters.

Though some EV owners may be satisfied using the 120-volt chargers that come with all EV models, the vast majority will not. A [recent analysis of California EV](#) owners who returned to a gasoline powered car cited charging hassles as the primary source of their switch. An overwhelming majority of them relied solely on slow 120-volt

charging; they never invested in a 240-volt Level 2 charger, despite existing incentives. If we want home charging to be successful, it's going to be Level 2 or better. And the current system of tax breaks and after-the-fact rebates needs to be revised.

There are two primary categories of financial incentives for EV buyers. First, the federal government provides a tax credit of up to \$7,500 for qualifying vehicles to buyers who have an equal or greater tax liability that year. Some states, cities and utilities offer additional tax credits or rebates that help offset the purchase price of the vehicle.

Second, a mixture of federal tax credits and local rebates reimburse customers for a portion of the purchase prices of a Level 2 charger and the cost of hiring an electrician to install a 240-volt outlet.

Together, these incentives can add up. In Austin, Texas, the total incentive package from federal, state and utility incentives can exceed \$11,000. But all of these are after-the-fact credits or rebates that favor wealthier customers who can front the expense and wait weeks or months to recoup their costs.

Imagine, instead, an incentive approach where all these incentives are delivered at the dealership. The \$7,500 federal tax credit could be converted to a point-of-purchase discount, reimbursed by the federal government to the dealer. Dealers could provide vouchers – again, backed by the federal government – for a percentage discount from various charger manufacturers. Better yet, dealers could carry chargers from various manufacturers. Further, a federally-backed voucher for a specific cost of parts and labor from an approved and licensed electrician would simplify the process for customers and even allow the federal government to support historically underutilized businesses (HUB) businesses.

Apart from the logistical ease of this approach, it would allow customers to finance the true cost of the purchase (price + EV charger + electrician – all rebates and discounts) rather than committing to a larger monthly payment and receiving rebate checks over the next 12-18 months.

#4 – Look Beyond Single-Family Homeowners

Level 2 charging isn't effortless for single-family homeowners, but it's certainly easier for them than for those who own or rent condos or rent single-family homes or apartments.

For years, proponents of on-site distributed energy, energy efficiency improvements and cleaner fuel retrofits have wrestled with the "split incentives" and policy restrictions that rental property and condominiums present. The person who pays the monthly energy bills – often the tenant – reaps the benefit of energy efficiency improvements, but the owner or landlord must fund or approve the improvement. Many condo HOAs prohibit improvements, such as solar panels, that affect the outside appearance of a community or involve shared infrastructure. Beyond purchase-oriented incentives, the Biden administration should focus a portion of its EV charging efforts on removing existing barriers and incentivizing property owners to install more chargers and charger-ready infrastructure to their on-site parking facilities.

It's also important to remember that millions of Americans rely on street parking and private parking facilities. Providing equitable access to charging infrastructure is more complicated for these Americans than for owners or renters of single-family homes or multi-family residences that have parking facilities. But these drivers deserve a federal strategy to reduce the barriers they will face as the rest of the country goes electric.

#5 – Look Beyond the Charger and Into the Circuit Panel

Not all 240-volt chargers are equal, and not all homes are equipped to add new, dedicated, high-amp circuits.

To install a home Level 2 charger, newer homes and those built in states with aggressive code requirements may only require simple improvements by an electrician, including connecting new wiring to a circuit panel and adding a new high amp circuit. Owners of smaller and older homes, however, face a bigger question that few EV customers will even think about: does my circuit panel have enough amps?

Not all Level 2 chargers are equal. Though they all deliver 240 volts, amperage varies by model; some allow customers (or the car) to select an amperage of 48 amps or more. A 16-amp 240-volt charger can add 3.8 kWh per hour of charge. A 48-amp 240-volt charger can add more than 11 kWh per hour. Depending on the size of a car's battery, that gap can be the difference between hassle-free home charging and daily charging anxiety.

When an electrician installs a 240-volt circuit, the cost between a 20-amp circuit and 50-amp circuit is negligible if there's "room" for a dedicated 50-amp circuit. But millions of homes in the United States simply don't have enough amps for an additional dedicated 50-amp circuit.

In places where homes receive natural gas for heating, water heating and cooking, homes are not required to have "enough" amps to service all potential electric appliances. Adding a high-amp EV charger compounds the problem.

Pecan Street examined how a portion of homes that participate in our energy research would be impacted by increased electrification (EVs, electric heat, electric water heating, for example). The homes in our network skew



ChargePoint's Flex home charger allows the user or car to select variable amperage, which can significantly speed up charging but which requires dedicated circuits with a higher amperage.

newer and more expensive than the average American house, and we found that 38% of the homes in our sample have a 200-amp panel. Nearly half (46%) had a total panel size of 125 or 100 amps. Adding an EV charger to a 100-amp home or a charger and one or two large electric appliances to a 125-amp home would require upgrading to a new 200-amp service panel. That would not only be a huge expense for the homeowner (upwards of \$4,000, parts and labor), it could be a new expense for the local utility, who may have to upgrade equipment that serves clusters of homes.

The federal government's commitment to EV charging is a great opportunity to head off this issue before it becomes

a hindrance to EV ownership or local electrification efforts or an expensive cost for customers and utilities. The administration could act by pushing for national building standards that require larger capacity circuit panels in new homes, reserving some “EV charging” funding for retrofits of existing homes, and developing incentives for utilities to make the necessary infrastructure upgrades. All of this the federal government can do more simply and quickly than individual states or cities.

#6 – Look Beyond Hardware and Concrete to Data and Other “Invisible Infrastructure”

A modern EV charging infrastructure involves critical elements that most customers will never think about.

President Biden’s infrastructure plan received a lot of attention not only for its size, but for expanding what we think about as infrastructure. New York Times columnist [Binyamin Applebaum wrote](#): “Infrastructure makes other things possible. It is the stuff we take for granted, that we notice only when it breaks down.” It’s not just roads and bridges, but healthcare and education. That same breadth should be applied to our thinking about EV charging infrastructure. To be successful for generations, the EV charging infrastructure we build must encompass more than the wires that feed charging stations and the charging hardware we install on American highways. This “invisible” infrastructure will not only determine how successful EVs become, but it encompasses many issues that the federal government is well suited to address.

Following are some key examples.

Utility Rates and Smart Charging Policies

Some utilities have embraced EVs as a new source of revenue and a way to differentiate themselves from competitors. Generally, though, the industry isn’t ready to support rapid EV deployment with their existing fuel mix, much less one more reliant on renewable energy – a necessity if more EVs are to drastically reduce climate emissions. The federal government has various levers with which to move the industry forward, from new rules from the Federal Energy Regulatory Commission, like Rule 2222, to research grants to entice utilities to better serve future EV owners. This could include special rate plans for EV owners that offer time-of-use rates for their EV charger circuit, or additional incentives for customers with roof-top solar to charge when solar or wind generation is highest.

In addition, the federal government should pursue the potential of EVs’ vehicle-to-grid (V2G) capabilities. V2G allows EVs to charge during times of low grid demand or when renewable energy is plentiful and then discharge a portion of that energy back to the grid during times of peak demand. Pecan Street’s research, [conducted with the first V2G facility in Texas](#), demonstrated the technology is quick and reliable. But few car manufacturers allow it within their warranties, and standard EV chargers are not yet V2G capable.

Another Pecan Street analysis found that, depending on whether “smart charging” programs are deployed, high penetration of EVs could [either be a costly headache for utilities or a lucrative new revenue stream](#) that could help them manage peak demand. Rate plans that center around the high demand periods and unique capabilities of EVs – and that make EV ownership an even stronger money saver for customers – will add to the growing list of EV driver benefits.

Data and Hardware Compatibility

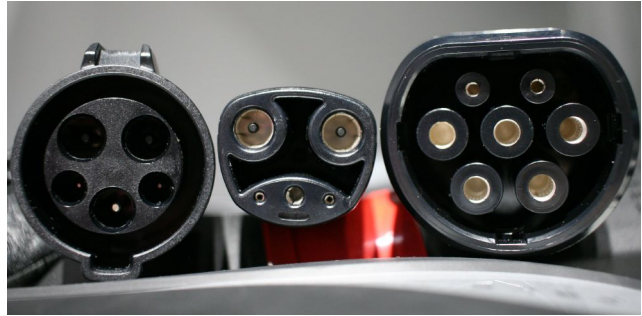
Imagine pulling your Ford into a gas station and being told “We only fill up Chevys.”

Every dollar of federal money spent to expand America’s EV charging infrastructure should aim to make all EVs, chargers and charging networks open and interoperable.

EVs are rolling computers, and the data they generate and rely on should be compatible and freely sharable. The electricity they need to run should be as hassle free as filling up a gas tank. Unfortunately, car makers and charging companies that constantly compete for market share are disincentivized to allow or promote cross-compatibility.

Tesla’s EVs use a proprietary charging outlet. That means a Nissan Leaf can’t use a Tesla charger without an adapter, and once plugged in, the Leaf won’t talk to Tesla’s data network. Beyond such technical limitations, non-Tesla owners are not even allowed to use Tesla’s charging network. Imagine pulling your Ford into a gas station and being told “We only fill up Chevys.” (At the time of this writing, there are reports that Tesla is considering opening its charging network to non-Tesla customers.)

Third-party charging networks are better; they are more open, allow customers from all car companies and even other charging networks to charge and use their data network. But they are not frictionless, either. It only takes a few minutes to Google “EV road trip” and find article after article that details the complexity of the charging network, at least partly because, like most technologies, none of these companies HAVE TO allow other customers or make the data that runs their networks accessible to whoever the customer wants to grant it to. Many



EV chargers use various hardware configurations, and private charger companies are not required to share data or functionality with customers from other networks or all EV models.

chargers are offline when their apps say they are available. Moreover, Level 2 and Level 3 charging have competing standards for the vehicle connection and communications protocols. And the mishmash of charging information available on most apps would be paralyzingly confusing to the average driver.

Charging should be like universal phone apps; it should work for every model, and customers should be able to use their data however they want with whomever they want, even if it’s with the competition.