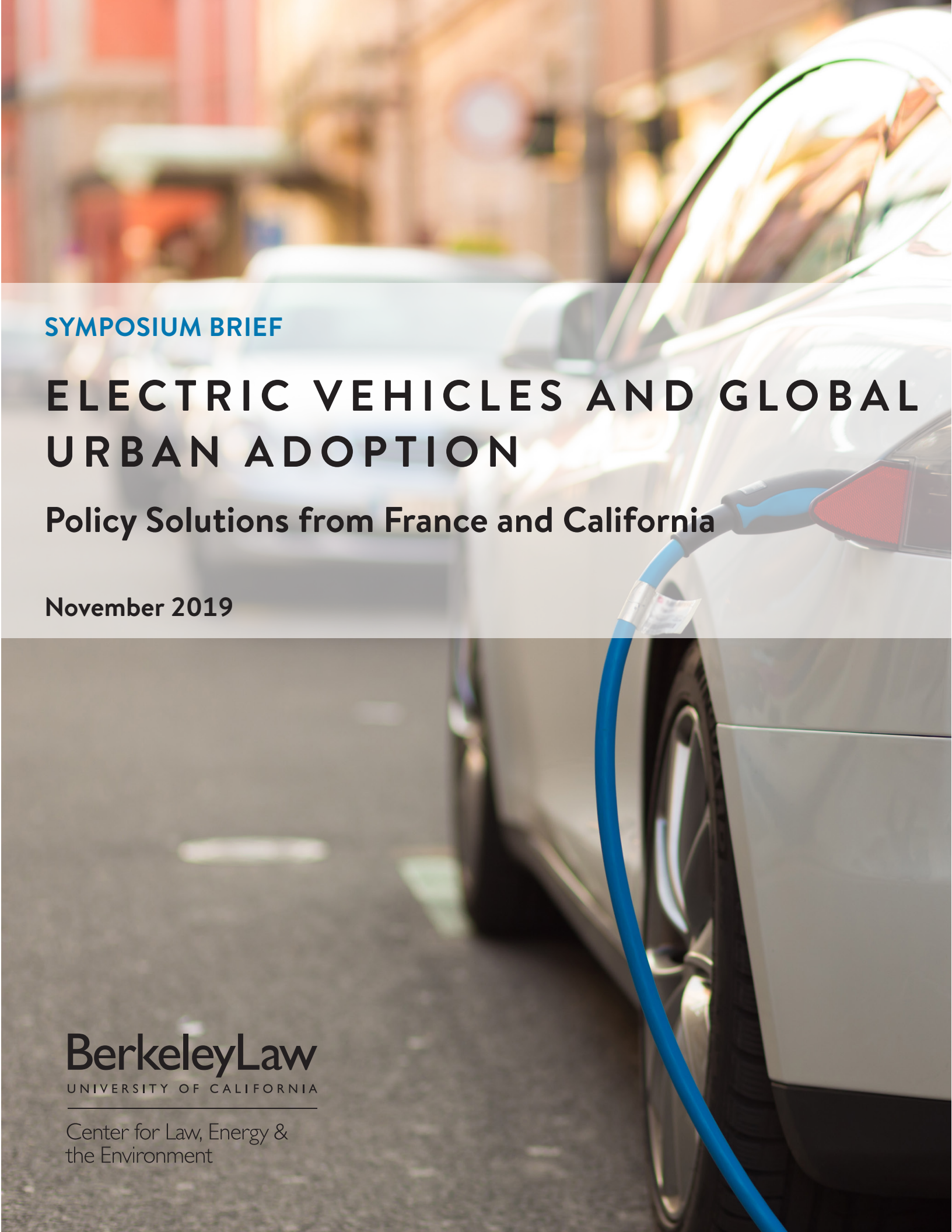

SYMPOSIUM BRIEF

ELECTRIC VEHICLES AND GLOBAL URBAN ADOPTION

Policy Solutions from France and California

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Center for Law, Energy & the Environment

This report was co-authored by Ethan Elkind and Ted Lamm, based on a conference at UC Berkeley School of Law in June 2019.

This report and its recommendations are solely a product of Berkeley Law's Center for Law, Energy & the Environment (CLEE) and do not necessarily reflect the views of all individual symposium participants.

Introduction

As nations and states around the world establish aggressive goals to reduce greenhouse gas emissions—California law, for example, mandates a cut to 40 percent below 1990 levels by 2030—transitioning to zero-emission vehicles like battery electric vehicles (EVs) is an essential need in the effort to slow climate change. Transportation is responsible for approximately 15 percent of global emissions, and a much higher rate among the most advanced economies: approximately 20 percent in Europe, 30 percent in the United States, and 40 percent in California, and even more when factoring in emissions from oil refineries. Yet even as many jurisdictions have begun to reduce emissions in their energy sectors, transportation emissions have remained flat or continued to rise, with the vast majority of these emissions coming from burning petroleum-based fuels. Transitioning to electric vehicles, particularly as electricity generation becomes less reliant on fossil fuels, will be key to achieving near- and long-term emission reduction goals.

Industry and government leaders have taken up the call, with automakers developing a wide range of plug-in electric vehicles and policymakers offering purchase incentives and developing infrastructure. Over three million electric vehicles are in service worldwide, with an annual growth rate over 50 percent. But electric vehicles still represent a small share of the overall vehicle market worldwide, at under 10 percent of new car sales in California and under two percent in France—two jurisdictions that have adopted aggressive targets to increase penetration. Among the greatest challenges facing these and other jurisdictions is adoption by urban residents who have limited access to vehicles and charging infrastructure. In California and France, approximately 40 percent of residents live in multi-unit dwellings, such as apartments, townhouses, and condominiums, many of which are in urban areas with little or no access to charging.

> "I'm tired of just fighting climate change. I want to win. And with the current wildfire crisis, we can see the urgency. Transportation is the highest emitting sector of the economy, one we need to focus on more and more to achieve our climate goals."
>
> Carla Peterman
> Former California Public Utilities Commissioner

To address these barriers, in June 2019 UC Berkeley School of Law's Center for Law, Energy & the Environment (CLEE), Paris' CentraleSupélec, and the Florence School of Regulation convened a symposium featuring French and California experts in electric vehicles and charging networks, electricity and utility regulation, and energy and environmental policy. Over two days in Berkeley, participants discussed their ideal vision for urban adoption of electric vehicles, the key challenges to achieving that vision, and the top legal, technological, and financial solutions needed to overcome those challenges. This symposium brief summarizes those findings.

> "California has seventeen manufacturers connected to EVs. Manufacturers see a big market for EVs in California because we have strong policies in place to promote zero-emission transportation."
>
> David Hochschild
> Chair, California Energy Commission

Vision for urban adoption of electric vehicles:

Participants described a vision for urban electric vehicle deployment to facilitate a phase-out of gasoline-powered vehicles, increase air quality, and reduce greenhouse gas emissions based on:

- **Affordable, convenient access to electric vehicles** for urban residents through cheaper vehicles, increased purchase incentives, a robust secondary market, and car-sharing and autonomous options.
- **Ubiquitous access to charging** including mandatory charging infrastructure in new multifamily buildings, eased permitting and reduced costs to install charging in existing buildings, and publicly accessible fast-charge hubs for city residents and fleets.
- **Complementary interaction between charging and grid needs** through optimal electricity rate design, incentives for infrastructure upgrades, and advanced communication technologies.
- **Reduced overall driving miles** through ride-sharing, public transit, and other mobility solutions, measures to cut "dead-head" ride-share miles, and incentives to focus driving on first- and last-mile transportation.

Key Barriers to Greater Urban Adoption of Electric Vehicles

- Lack of access to affordable, convenient private electric vehicles.
- Complexity and cost of installing charging in urban settings and existing multifamily buildings.
- Declining federal incentives and insufficient vehicle demand.
- Electricity rate design decreases the financial viability of charging stations.
- Difficulty of adopting optimal charging practices that could benefit users and electric utilities.
- Difficulty of adopting optimal charging practices that could benefit users and electric utilities.
- Need for grid infrastructure upgrades to avoid high costs on first-movers.

"More EVs means more fixed costs but increased revenues for utilities, while more solar PV means more variable costs and decreased revenues."

Yannick Perez
Professor of Economics, Florence School of Regulation and CentraleSupélec

"When ratepayer funds are used to subsidize charging station construction, the quid pro quo is that there has to be some sort of plan to provide price responsiveness. But ultimately the PUC can't set rates directly."

Nancy Ryan
Partner, E3

Priority Solutions

National, state and local leaders could:

- Ease permitting requirements and encourage expanded deployment for charging infrastructure, including public charging stations, for urban residents.
- Require owners of existing multifamily buildings to install charging stations.
- Increase the availability of incentives like free charging and purchase rebates for electric vehicle purchasers.
- Commit to phasing out gasoline- and diesel-powered vehicles, at least through all-electric fleet vehicle purchasing as a start.
- Help TNCs encourage electric vehicle adoption among their drivers through support for the deployment of fast-charging hubs, driver education programs, and new pilot projects.
- Require or encourage standardization of communication protocols for smart charging.
- Make Level 1 (120 volt household outlet) charging more ubiquitous in urban areas.
- Require all autonomous vehicles and transportation network company (TNC) vehicles to be zero-emission

Electric utility leaders could:

- Develop new rate designs to incentivize charging while optimizing grid efficiency.
- Develop more app-based methods to seamlessly manage charging, along with charging companies.
- Target infrastructure upgrades to locations identified as most cost-efficient based on regional planning and collaboration.
- Explore energy storage options for second-life batteries and grid benefits of vehicle-to-grid services.
- Conduct more research on the best use of ratepayer funds for ratepayer benefits.

Barrier: Lack of access to affordable, convenient private electric vehicles.

Many urban residents lack access to electric vehicles, in part because private ownership of these vehicles is difficult if residents do not have dedicated, private parking spaces to install vehicle charging equipment. Since many urban residents lack such dedicated parking, they are limited in their ability to rely on an electric vehicle as their primary car. Many urban residents are also tenants, who may not have the ability to install a charger on their landlord's property even if they do have a parking space. And many landlords lack incentives to install new chargers, if they are responsible for upfront costs but do not fully benefit from savings. Transportation network companies (TNCs) and autonomous vehicle (AV) technology could offer a solution to the challenge of electric vehicle ownership, with fleets of non-driver-owned electric vehicles replacing personal vehicle trips and giving urban residents affordable and convenient access to an electric vehicle. Yet if not managed properly, these new vehicles risk adding ever more automobiles to city streets.

Solutions:

National and state leaders could require all TNC vehicles to be zero-emission.
TNCs like Uber and Lyft are changing the way many urban residents use automobiles with increased access across city landscapes at relatively low costs. These companies are creating a significant shift in the transportation landscape, offering a new on-demand transportation alternative and the potential to share rides efficiently across multiple passengers. They also offer an ideal opportunity for greater integration of electric vehicles: TNC vehicles are typically compact cars and sedans, TNC trips are typically short, and urban environments offer a high potential for frequent vehicle re-charging. In addition, TNC services present an opportunity to expose riders to electric vehicle models without requiring them to purchase, lease, or even test drive. Leaders at the state level could consider new legislation or regulation requiring all TNC vehicles to be zero-emission vehicles like electric vehicles, with potential exceptions for vehicles that need to haul more than four passengers or exceed a certain number of chargers in a day. (The California Air Resources Board is currently developing minimum EV requirements for TNCs pursuant to Senate Bill 1014 [Skinner, 2018]). Such a measure could both reduce the emissions generated by TNC trips and increase public exposure to vehicle options.

> "Electrifying shared-use vehicles can provide tremendous benefits. Many shared vehicles are driven much more than personal vehicles, so the emissions benefits of electrification are multiplied. Ridesharing makes it easier for people to begin driving, as well as ride in, EVs."
>
> Jamie Hall
> Manager of Public Policy, General Motors

National and state leaders could require all autonomous vehicles to be zero-emission.
While TNC vehicles are changing how and where urban residents access automobiles, autonomous vehicle technology has the potential to deepen the distinctions among car ownership, driving, and riding. One possible automobile future centers on ride services provided by TNCs with autonomous electric vehicles, creating a new transit network consisting of individual passenger vehicles. In this scenario, charging infrastructure would not need to be located near rider destinations, as vehicles could communicate with each otherto optimize rider needs while charging at locations away from the urban core on an automated basis. At the same time, streamlining on-demand vehicle access even more will increase total vehicle miles traveled and thus congestion and emissions (relative to public transit, biking, and walking). As autonomous vehicle technology evolves, state leaders could consider legislation and/or regulatory action requiring all vehicles to be electric. Such a measure could take advantage of autonomous vehicles' unique potential to charge optimally while reducing the impact of more vehicles on the road.

> "The concern over transportation emissions is not just about adding more EVs. We also want to reduce trip length, coordinate with transit systems, etc. The goals are to enable electrification and congestion relief and to meet clean miles standards. A vast amount of companies looking at AVs will be in hailing, fleet and ride sharing services."
>
> Joshua Cunningham
> Advanced Clean Cars Branch, California Air Resources Board

National, state, and local leaders could help TNCs encourage electric vehicle adoption among their drivers through support for the deployment of fast-charging hubs, driver education programs, and new pilot projects.
Local government leaders could consider incentives specifically targeted to increase TNC adoption of electric vehicles. (Since TNCs typically do not own their drivers' vehicles, these incentives would likely function by leading the TNCs to increase driver use of electric vehicles.) For example, TNCs and local leaders could collaborate on fee-and-incentive models to raise funds for drivers to transition to electric, as Uber has begun to do in London (in which TNC riders pay a per-mile fee to subsidize Uber drivers who switch to electric vehicles). City governments could identify locations optimally suited to TNC use—such as airport parking lots and urban

perimeter sites on corridors that drivers use to enter cities—as targets for the earliest investments in fast-charging hubs. City leaders can also initiate outreach campaigns to drivers to educate them on how charging an electric vehicle can function in the context of daily TNC driving. National and state leaders at agencies with research and development funds could also consider pilot projects to help select groups of drivers acquire electric vehicles and report the challenges or successes of using them in TNC scenarios.

"Uber is looking at shared EVs and AVs. Electrification is a critical piece of sustainability in urban areas. How do we upscale, partner, and propel use of electric mobility?"

Ramona Prieto
California Public Affairs, Uber

Barrier: Complexity and cost of installing charging in urban settings and existing multifamily buildings.

Driving an electric vehicle requires access to a charger. For drivers who live in single-family homes with access to dedicated parking garage spaces, charging overnight can be simple and reliable. But for those who live in multifamily housing, lack dedicated parking spots, and/or park on the street—in short, urban residents—charging can present a daunting scenario. Curbside charging stations, fast-charger plazas, and mandatory charging ports in newly constructed buildings can all alleviate the problem, but public spaces and existing buildings present significant legal and financial barriers.

Solutions:

National, state and local leaders could require owners of existing multifamily buildings to install charging stations.
Approximately 40 percent of residents in California and France live in multifamily buildings, which typically lack dedicated garage spaces and whose owners may have no financial interest in installing charging infrastructure for tenant use. Requiring charging infrastructure in new construction, as California's most recent building codes and EU Directive 2018/844 do, affects an important but relatively small portion of the population due to the slow turnover of building stock. National, state and local governments could consider instituting mandatory installation in all existing multifamily buildings, a measure similar to California's mandatory earthquake- and fire-safety upgrades and many jurisdictions' energy efficiency requirements that take effect whenever a renovation occurs. Such requirements could prove costly, particularly for smaller owners, but as parallel policies enhance the market for electric vehicles, these installations will increase rental value.

"50 to 80% of residents in multifamily dwellings rely solely on public charging for their EV charging needs."

Sara Rafalson
Director of Market Development, EVgo

National and state leaders could encourage expanded deployment of public charging stations for urban residents.
Fast-charging "plazas" may be the most optimal deployment for residents of multifamily buildings, in order to replicate the gas-station model of fueling for quick electric vehicle re-charge sessions while shopping or en route to or from work. National and state regulators could allow utilities to recover costs of investing in the trenching and other electrical work required to site stations in the most optimal locations. National and state leaders could also require and provide funding for multifamily building owners to install chargers.

"Solving charging infrastructure for multifamily homes is much harder than for single-family homes with dedicated parking."

Alice Reynolds
Senior Advisor to the Governor for Energy, Office of Governor Gavin Newsom

Local leaders could ease permitting requirements for charging infrastructure.
Installing new charging in existing buildings and public spaces can be costly and time-consuming, in large part due to extensive permitting processes. Infrastructure needs such as extending and upgrading electrical connections and digging trenches for new lines require approvals from utilities, public works and building departments, fire

"There is curb space competition, challenges around transformer placement in sidewalk vaults on the public right of way, public works permitting, grid limitations, infrastructure costs, and fire safety codes. The big challenge is to muster the political will to overcome these challenges."

Debbie Raphael
Director of the Department of Environment, City of San Francisco

departments, and more. The complexity and cost of these processes can be prohibitive for owners of small multifamily buildings and can significantly delay projects in publicly accessible commercial parking lots. Local government leaders could consider reducing permit fees and accelerating review of applications for existing multifamily buildings in order to reduce this barrier. They could also prepare local permitting guidebooks to walk owners through the process.

> "One of the best predictors of success in permitting EV charging is whether the person on the other side of the phone drives an EV."
>
> Tyson Eckerle
> Deputy Director of Zero Emission Vehicle Infrastructure, Governor's Office of Business and Economic Development (GO-Biz)

Local leaders could make Level 1 (120 volt household outlet) charging more ubiquitous in urban areas.
While Level 2 (240 volt) chargers are generally preferable for their increased speed and convenience, Level 1 chargers can serve many drivers' needs when overnight charging is an option or a full charge is not needed. In situations where Level 2 infrastructure is too costly to install, property owners could more cheaply expand access to Level 1 outlets near parking spots. Local governments could provide incentives or requirements for that type of installation. In addition, as municipalities switch to efficient lighting through LED bulbs, they could potentially install outlets on light poles for Level 1 charging availability for those parking electric vehicles on the street.

Federal, state, and industry leaders could collaborate to resolve second-order legal and technological conflicts.
In addition to the permitting and construction costs of installing new charging infrastructure in urban settings, other regulatory and technical barriers can render projects problematic for private entities. For example, the Americans with Disabilities Act requires a minimum number of commercial parking lot spaces to be reserved for drivers with disabilities, and these spots cannot overlap with charging stations. As a result, the law can limit the number spaces an owner of a small lot can use to install chargers. Proposed California legislation contemplates requiring all publicly accessible chargers, including those provided by subscription services, to accept credit cards (rather than mobile payment), a measure that could potentially increase access but might also draw funds toward retrofits and away from new installations. And utilities may be reluctant or unable to install sidewalk-level transformers where needed to support curbside charging. Federal, state, and industry leaders could create task forces to identify and propose proactive solutions to these problems that may arise as the industry develops further and as more regulations and protocols apply.

> "Getting a public charging station in a multifamily building in Paris is a bit of a nightmare right now. New buildings require them, so that's not a problem. But it's a different framework for existing multifamily buildings."
>
> Guillaume Dezobry
> Attorney, Fidal & Lecturer in Public Law, University Picardie

Barrier: Declining federal incentives and insufficient vehicle demand.

Electric vehicle sales must accelerate significantly to achieve the reduction in petroleum consumption and phase-out of internal combustion engines needed to achieve climate and air quality goals. Global sales now exceed one million vehicles per year, but sales of gasoline-powered cars have hardly slowed. While the range of electric models available is steadily growing, drivers still seek well-known traditional options, particularly in the U.S. where drivers are continuing to buy larger SUVs and pickup trucks. At the same time, key purchase incentives that drove early market growth—such as the federal purchase tax credit for U.S. consumers—are expiring or shrinking. This decline in incentives and the still-narrow selection of vehicles will substantially curtail the ability of governments to meet even modest market penetration targets in the short term. Measures to increase these incentives and find other means to boost purchases will likely be necessary.

Solutions:

National, state, and local governments could increase the availability of incentives like free charging and purchase rebates.
In the U.S., electric vehicle purchasers are eligible for federal tax rebates of up to $7,500 per vehicle, a measure that has significantly increased vehicle affordability and helped drive competition among Tesla, Chevrolet, Nissan, and other manufacturers. But these incentives decline after each manufacturer has sold 200,000 electric vehicles, despite the fact that they are still essential for cost-competitiveness (particularly among middle- and lower-income drivers). The French government offers rebates of up to €8,500 for buying an electric vehicle and scrapping a diesel or gasoline car, and California offers its own purchase credit of up to $5,000, depending on vehicle type

and income level. Even as electric vehicle costs continue to fall, maintaining, advertising, and even increasing these rebate and tax credit programs will be essential to boost purchase rates above the single digits and address transportation emissions in a timely manner. Federal and state governments can consider the climate, air quality, and electric grid benefits of electric vehicles in calculating these incentives. Local governments could consider taking on smaller-scale incentives, such as subsidized or free parking and charging, that purchasers can incorporate into their financial decision-making.

Federal and state legislatures could commit to phasing out gasoline- and diesel-powered vehicles.
No measure could bolster electric vehicle adoption more than a mandatory phase-out of fossil-fuel powered vehicles. Not only would such a phase out ensure that new vehicles purchased after a date certain are all zero-emission, but it would transmit a market signal to manufacturers drastically increasing the importance of developing competitive, affordable electric models. Faced with a future deadline, manufacturers would have no choice but to turn their tremendous technological and marketing capacities toward promoting electric vehicles as the future. Regulators in France and legislators in California have already proposed banning the sale of internal combustion engines by 2040. Committing to these phase-outs could significantly increase electric vehicle sales both before and after that date.

> "EV development in France is driven by European, state, and local communities targets, triggering the industry transformation. At the national level, the objective is to deploy five times the current number of EVs or hybrids in the next four years."
>
> Dominique Lagarde
> Director of Electro-Mobility, Enedis

National, state, and local governments could require all-electric fleet vehicle purchasing.
While a total phase-out of sales would be the most straightforward way to shift the purchasing behavior of millions of individuals, it may face substantial political barriers. National, state, and local governments seeking to make rapid advances in electric vehicle adoption can consider all-electric mandates for fleet vehicles, including both public service vehicles and private transportation company cars. Single organizational buyers with sophisticated budgeting practices (as opposed to millions of idiosyncratic consumers of individual personal vehicles) often control large numbers of these fleet purchases, and the fleets in turn can serve as high-profile examples of electric vehicles in action. These fleets may be better able to manage charging needs through coordinated action and vehicle swapping. State-level fleet requirements, which would affect thousands of regularly scheduled purchases, would also increase manufacturers' certainty in developing a range of models.

Barrier: Electricity rate design decreases the financial viability of charging stations.

Commercial electric vehicle charging in California typically occurs under electricity rates based on time of use: the amount the utility charges per kilowatt-hour depends on the time of day electricity is drawn from the grid, with rates highest when overall demand is highest. Many utilities also institute additional demand charges (also known as capacity charges) for particularly high peak-electricity usage, which are designed to encourage high-demand customers to reduce peak power usage and reduce overall stress on the grid. Commercial and other publicly accessible charging sites can face particularly high exposure to demand charges and time of use rates, since Level 2 and direct current (DC) fast chargers (480 volts) draw high levels of current and consumers may elect to charge irregularly or at peak times. This rate structure, which was designed for traditional commercial use that was predictable and centralized, can undercut the business case for installing charging infrastructure for large-scale public use. New rate structures may be necessary to support increased installations of commercial and public charging infrastructure.

> "The highest-cost period now occurs between 4pm and 9pm, when the sun decreases and demand increases. A whole-house residential rate applies a price signal to avoid charging in those hours. Customers are starting to become aware of these new rates, and they can save up to $50 per month if they follow the incentives."
>
> -Robert Thomas
> Principal Manager, Southern California Edison

Solution:

Electric utilities could develop new rate designs to incentivize charging while optimizing grid efficiency.
Demand charges and time-of-use rates can reduce profitability of commercial and public electric vehicle charging owners by increasing the operator's costs for DC fast charging at all times of day, as well as for all types of charging at times when multiple users overlap with peak grid-wide demand. These structures are intended to discourage use at peak times in order to reduce stress on the grid and to pay for the additional costs

of that stress when use cannot be avoided. Commercial and public charging operators, however, rely for revenue on unpredictable, high-voltage use by consumers who require convenient, immediate access. Electric utilities and regulators are currently developing alternative rate designs and mechanisms that can serve grid needs without penalizing electric vehicle charging, such as:

- Energy-only rates that eliminate demand charges for charging facilities;
- Dynamic rates that offer incentives for operators to encourage customers to charge at the peak midday and overnight oversupply periods; and
- Sub-meters that allow individual vehicle owners to pay separate rates for vehicle charging and other home electricity use.

Increasing pilot programs to roll out these innovations will help utilities, regulators, and charging operators identify the rate design that can best support electric vehicle expansion and grid strength while maximizing energy savings, utility cost recovery, charging optimization, and customer understanding.

Barrier: Difficulty of adopting optimal charging practices that could benefit users and electric utilities.

While electric vehicle adoption decreases use of gasoline and diesel, thereby reducing greenhouse gas emissions, it increases use of the electrical grid, potentially increasing the overall need for generation capacity if charging occurs at peak demand times, which could lead to a counterproductive result. The ability of electric vehicles to charge on flexible time frames offers a significant opportunity to "soak up" excess electric capacity during peak oversupply times, but behavioral and logistical challenges can prevent even the most dedicated drivers from charging during optimal times. This dynamic is particularly true for urban drivers who cannot charge on demand in a dedicated parking spot but instead rely on shared infrastructure that may not be available at all hours and may be located far from the home or office. These limitations can subject drivers and charging operators to higher electricity costs and place greater stress on existing electrical infrastructure to meet increased demand. Technological innovations will be essential to the ability of urban drivers to optimize their charging and ensure that the transition to electric vehicles generates the greatest possible environmental benefit at the lowest possible cost.

Solutions:

Electric utilities and charging companies could develop more app-based methods to seamlessly manage charging.
Optimizing charging to reduce electricity costs and system stress can be as simple as waiting to plug in a vehicle until the moment system-wide demand is lowest. However, utilities lack simple methods to communicate real-time price signals to users, and most users are unable to leave the workplace in the middle of the day (or the house in the middle of the night) to plug or unplug a vehicle. Digital innovations can overcome these structural and behavioral challenges by allowing customers to cede control of charging decisions to technology that automatically balances grid and customer need criteria. San Diego Gas & Electric, for example, offers a phone app that allows customers to set a maximum hourly price for charging and automatically shuts off the charger if prices exceed the pre-set level. This affords a level of responsiveness to grid and affordability needs and is particularly valuable to urban users who are more likely charge during daytime hours at workplace stations. Future iterations could incorporate additional parameters, such as taking full advantage of a customer's charging window (allowing the app to charge the vehicle at optimal intervals within variable timelines) or offering real-time discounts for delayed charging. As usage of these technologies expands, utilities and charging companies will be able to build greater geographical and time-of-day flexibility into their networks, improving grid resiliency and efficiency.

National, state and local leaders could require or encourage standardization of communication protocols for smart charging.
In addition to consumer-facing charge management apps, leading grid and vehicle engineers are developing smart charging technologies that allow vehicle fleets to charge dynamically throughout the day, accounting for both system-wide demand trends and

> "Managed charging needs to be invisible to the user as much as possible. We need good communication among the EV, EV charging service, and utilities. We need to standardize communication."
>
> Doug Black
> Grid Integration Group Leader,
> Lawrence Berkeley National
> Laboratory

> "We want everyone to charge at night when the rest of demand is lowest and also during midday oversupply. It's a very complex rate design to communicate those signals; nighttime is relatively simple, but daytime is pretty complicated, seasonal, and shifts all the time."
>
> Yuliya Shmidt
> Advisor to Commissioner
> Rechtschaffen, California Public
> Utilities Commission

the use patterns of the host commercial building. These innovations, such as one developed in a pilot project between Alameda County and Lawrence Berkeley National Laboratory, have the potential to drive substantially smoother charging patterns for large numbers of vehicles controlled by a single entity. However, these systems will need standard communication protocols across vehicles, charging equipment, buildings, and the grid to reach maximum adoption and efficiency. As state and local leaders authorize more pilot programs or allocate more incentives for fleet charging, they could require these standard protocols to facilitate interoperability and increase the odds of success.

Barrier: Need for grid infrastructure upgrades to avoid high costs on first-movers.

Some first-movers deploying electric vehicle charging may experience high costs paying for associated grid upgrades to service increased demand in otherwise low-demand areas. For example, French law requires builders of new apartment buildings to install chargers, and the first builder in a particular grid area may be responsible for paying all of the grid upgrade costs. As a result, subsequent builders may not face these costs, if the utility or grid operator has already made the improvements. Similarly, some electric vehicle charging companies may experience high "demand charges" on their utility bills (essentially charges to cover the maximum grid infrastructure need for the moments of highest demand in a billing cycle), which can impose disproportionate costs for brief periods of especially high-power usage.

"EVs are a flexible resource: they can respond dynamically to signals. They may reduce the amount of solar PV that must be deployed."

Joshua Huneycutt
Energy Division Analyst, California Public Utilities Commission

"California will need 2.5 terawatt hours of energy storage to integrate variable generation. But 2.5 terawatt hours of storage is very expensive. Meanwhile there are 263 million vehicles in the U.S. If we assume full electrification of the fleet, we will have approximately 20 terawatt hours of portable storage."

Sachu Constantine
Managing Director of Regulatory Program, VoteSolar

"The preliminary results from our research are that EVs and stationary batteries are working together to support microgrids. Our conclusion is that capacity based tariffs will reduce the cost shift."

Icaro Freitas Gomez
Vedecom

Solutions:

Electric utilities could target infrastructure upgrades to locations identified as most cost-efficient based on regional planning and collaboration.
Such planning processes could forecast costs and ensure that these costs are distribute equitably among ratepayers in the region who may later take advantage of these upgrades to install electric vehicle infrastructure.

Electric utilities and industry leaders could explore energy storage options for second-life batteries and grid benefits of vehicle-to-grid services.
Energy storage, particularly from used electric vehicle batteries that are no longer sufficient for use in the vehicle, could provide inexpensive options to reduce peak demand at charging sites and therefore reduce or eliminate high demand charges. Policy makers could streamline this deployment through regulatory action to encourage siting. In addition, regulators, utilities and automakers could develop pilot projects to deploy sub-meters to allow vehicle owners to receive payments or bill credit for managed charging or vehicle-to-grid dispatch.

Electric utilities and regulators could conduct more research on the best use of ratepayer funds for ratepayer benefits.
Such an analysis could help determine the ideal rates and use of funds to ensure an equitable and robust deployment of electric vehicles, by reducing costs and potentially creating incentives for innovation and deployment of infrastructure, private ownership and fleet purchases.

Conclusion

With the global need to reduce greenhouse emissions dramatically over the coming decades, nations and states around the world have a strong incentive to collaborate on promising solutions and new technologies. France and California are just two examples of jurisdictions working toward similar goals of reducing transportation emissions through vehicle electrification. As this clean technology improves, more discussion, conferences, and formal collaborations will be necessary among like-minded nations and subnational entities to advance this transition in energy storage and transportation.

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For further information, including background research and presentations, visit
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