



Building an EV Economy

Introduction

Transportation in America generates the largest share of greenhouse gas (GHG) emissions—29% of the country's GHGs in 2019, according to the US Environmental Protection Agency. Within the transportation sector, passenger vehicles and trucks—the pickups, minivans, SUVs, tractor-trailers, and other vehicles we see every day—emit the greatest share of GHGs into our environment.¹ Even a typical passenger vehicle emits about 4.6 metric tons of carbon dioxide per year, which is the equivalent of more than 5,000 pounds of coal burned.² Changing our vehicles to reduce emissions will be one of the most important levers for reducing GHG, improving our air quality, and combating climate change. A holistic approach that contextualizes the environmental, business, and economic cases will be critical to reduce transportation emissions and increase the use of EVs.

Guidehouse forecasts electric vehicle³ (EV) sales in North America are likely to grow at compound annual growth rate of over 30% to 2030 due to several coalescing factors, including state policy and regulatory action, automobile manufacturing companies looking for new markets, electricity grid operators valuing low-carbon energy, and changing consumer needs.⁴ The American Jobs Plan proposed by the Biden administration highlights growing the value chain for EVs, semiconductors, and batteries. It also suggests that economic development, supporting the environment, and developing high-paying, middle-class jobs can be mutually reinforcing goals. State and local governments, utilities, original equipment manufacturers (OEMs), and commercial fleet owners should take note.

As governments set sustainability targets and net-zero policy goals that include converting the transportation sector to EVs, an incredible opportunity unfolds to create a comprehensive ecosystem strategy that builds the foundation of an electric economy. Guidehouse recommends focusing on three strategic themes that encompass EV adoption, job creation, and stakeholder engagement:

- Anticipate EV adoption challenges
- Build the EV ecosystem
- Grow overarching EV economy

Adoption requires overcoming obstacles and meeting stakeholder needs—from tackling EV-charging needs to meeting GHG emissions reduction targets. Because this effort includes many stakeholders across the public and private sectors, building an EV ecosystem that spans regulatory and policy stakeholders, community organizations, commercial fleets, and individual EV owners is necessary when developing policy goals and programs that activate the electrification strategy. Finally, maximizing impact of the ecosystem includes creating an economic development strategy.

¹ EPA.gov, "Sources of Greenhouse Gas Emissions," <https://www.epa.gov/ghgemissions/sources-greenhouse-gas-emissions>

² EPA.gov, "Greenhouse Gas Equivalencies Calculator," March 2021, <https://www.epa.gov/energy/greenhouse-gas-equivalencies-calculator>

³ The types of electric vehicles discussed in this paper include passenger cars, trucks, vans, and buses. They also include hybrid vehicles that can be plugged in.

⁴ <https://guidehouseinsights.com/reports/market-data-light-duty-evs>

The complementarity of these strategies underscores the insight that building an EV economy is not only about EV adoption, but about how to use EVs as part of an economic strategy to build industries within electrification and to strengthen environmental justice. Congested, historically underserved neighborhoods, or those next to highways, should no longer suffer the externalities of traffic pollution and poor air quality, nor be isolated from economic opportunities. Supporting these communities by focusing efforts to electrify transportation methods and vehicles in high-traffic areas and creating workforce development programs that result in clean technology jobs for these community members is paramount for a successful electrification transition.

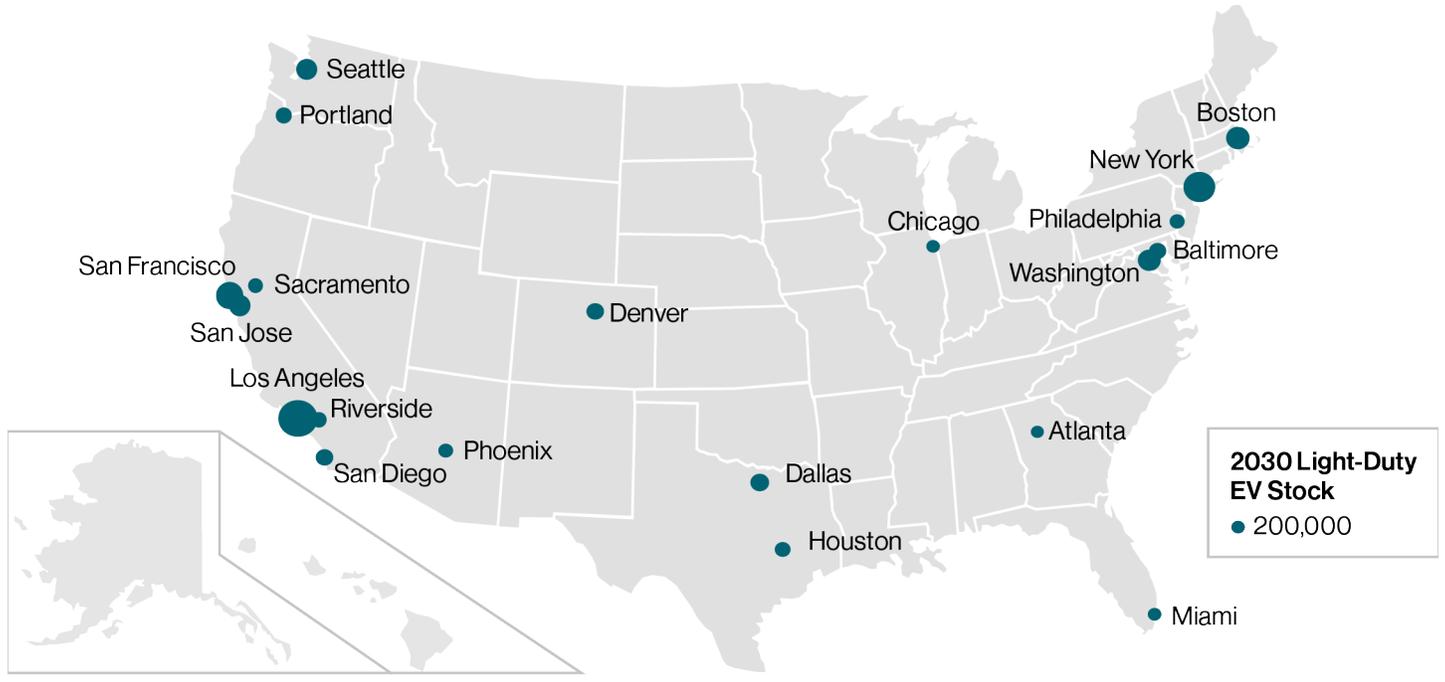


Figure 1: Top 20 Largest Metro Areas for Light-Duty EVs (EV Stock, 2030, Guidehouse Insights' Aggressive Scenario)⁵

Anticipate EV Adoption Challenges

When anticipating EV adoption and associated charging needs, governments should focus on factors that they can influence the most. First, as public entities representing their respective constituents, governments have a role in influencing customer behavior associated with purchasing an EV. Second, governments have a responsibility in ensuring equitable access to EV-charging infrastructure, more particularly in underserved and disadvantaged communities. Third, governments can influence technical factors such as designing EV programs where EV adoption and charging infrastructure is deployed in an equitable manner. Lastly, governments can set policies and regulations that support and accelerate EV adoption. The following paragraphs provide further detail on each of these four factors of influence.

⁵ Guidehouseinsights.com, "Market Data: EV Geographic Forecast—North America," 4Q 2020, <https://guidehouseinsights.com/reports/market-data-ev-geographic-forecast-north-america>

Customer Behavior.

Governments can play a prominent role in influencing some of the behavioral components that impact the EV purchasing decision-making, which remains the most significant barrier to adoption. Socio-economic factors such as education level and income level are positively correlated with EV adoption, specifically in the early stages of the market. Governments can bridge the knowledge gap by providing better access to information on the benefits of EVs to communities that are socially and economically underserved. Doing so will help them fulfil their responsibility to address any equity gap within their jurisdiction.

Governments also have a central role to play in increasing consumer awareness and acceptance associated with EVs. For an increasing number of use cases, an electric option is already more attractive than a combustion engine option from a total cost of ownership standpoint. This is the case today for passenger cars, delivery vans, and transit and school buses that: (i) operate within an optimal distance from their charging depot such that charging downtime doesn't impact operations significantly; and (ii) travel a sufficiently large amount of miles such that the lower operation and maintenance costs of an EV offset the higher purchase cost.

Marketing and outreach influence consumer familiarity with EVs, which is a prerequisite for EV adoption. Outreach and education programs targeted at both individual and business consumers help accelerate EV adoption. Hosting drive and ride events allows prospective customers to experience an EV firsthand, whether for personal or commercial purposes. Stakeholder and community engagement through focus groups gives end customers a chance to voice their concerns and feedback directly to other stakeholders within the EV ecosystem, whether they are automakers, EV-charging providers, financing companies, vehicle leasing companies, fleet operators, or government entities.

Changing Needs.

According to Guidehouse Insights analysis, the current rate of EV adoption in North America in 2020 is outpacing the rate of public charging infrastructure deployment by a factor of 17 to 1.⁶ The relative lack of charging infrastructure in a given area can negatively impact the willingness to purchase an EV—a phenomenon commonly referred to as “range anxiety.” Because of the emerging nature of the EV market and because private actors are expected to prioritize infrastructure deployment in areas with highest traffic (and therefore highest expected charger utilization), the public sector has a role to play in ensuring that all communities are served in an equitable manner.

Governments can allocate additional funds to areas that are currently underserved by the private market in terms of charging infrastructure. Doing so is expected to increase EV adoption in these areas, thereby providing additional economic and environmental benefits to these communities. For instance, deploying Level 2 chargers at school bus depots in disadvantaged communities can accelerate a school district's electrification efforts, giving children the opportunity to ride a bus that improves local air quality and is less noisy. Likewise, deploying DC fast chargers at logistical hubs such as ports and airports will increase the number of routes that can be served by electric trucks, which will positively impact communities that trucks drive through.

When focusing charging infrastructure deployment efforts, Guidehouse recommends that government entities work closely with electric utilities to optimize infrastructure deployment in areas that the electric grid can best accommodate. Since electric utilities typically plan grid investments five to 10 years ahead, engaging with them early ensures that charging infrastructure deployment is future-proofed.

⁶ <https://guidehouseinsights.com/reports/market-data-ev-charging-equipment>

Technical Factors.

Governments should also be aware of the following areas that make the EV market unique and complex:

- **VEHICLE CHARACTERISTICS.** The existing vehicle stock provides insights on the current EV adoption curve. Breaking down the market into vehicle segments (e.g., passenger cars, medium-duty trucks, transit buses), powertrains (battery EVs vs. plug-in hybrid EVs vs. combustion engine vehicles), and ownership (individual vs. business-owned) draws a more detailed picture of the local dynamics likely to drive EV adoption. For instance, a logistical hub on the verge of electrification may be better qualified by estimating the number of delivery vans registered in the area and assessing the ownership concentration by businesses. Traffic patterns come into consideration when assessing the technical and commercial feasibility of electrifying a vehicle fleet: they will add constraints on the battery range and vehicle characteristics required, thereby impacting the speed of EV adoption. Figure 2 lists example vehicles for each segment.
- **BATTERY AND FUEL PRICES.** Battery costs and fuel prices impact the relative cost-effectiveness of an EV vs. a conventional vehicle. Battery pack costs are a major driver behind EV purchase costs, and will bring the purchase cost of an EV closer to that of a conventional vehicle as they keep decreasing with economies of scale and technology improvements. Gasoline, diesel, and electricity prices impact the operational costs associated with filling up a vehicle's tank and charging up an EV. This in turn impacts the total cost of ownership of an EV vs. a conventional vehicle.
- **SPATIOTEMPORAL GRANULARITY.** Governments should run different scenarios that each present a possible pathway of EV adoption, from business-as-usual to additional incentives accelerating EV adoption. Because EV-charging infrastructure requirements can have a significant localized impact on the electric grid, depending on where and when charging is expected to occur, governments need to develop a granular understanding of EV adoption and EV-charging needs. Guidehouse recommends forecasting needs at the census tract level. Census tracts are defined by the US Census Bureau and typically cover approximately 4,000 people, spanning a few blocks. This level of granularity enables governments to design programs that are focused on underserved populations within their jurisdiction.

- **GREENHOUSE GAS EMISSIONS.** On the one hand, converting a conventional vehicle to an EV results in tailpipe emissions reductions, since an EV doesn't emit any tailpipe emissions. Conventional vehicle tailpipe emissions are tied to make and model year. Regulators can reduce tailpipe emissions by enforcing more stringent standards on automakers. On the other hand, charging an EV results in additional GHG emissions associated with the power generated upstream on the grid. Grid emissions can be reduced by replacing high-carbon power-generating sources with low- to zero-carbon power-generating sources.

Policy and Regulation.

Governments have the ability and responsibility to set innovative policies that provide the most benefit to stakeholders. As sustainability goals are increasingly becoming a major focus point, transportation electrification policies are one of the levers that governments can pull to meet their goals.

Federal, state, and local regulations include fuel-efficiency standards, zero-emission vehicle sales penalties, and any other rules targeting higher-polluting vehicles. Recently, the Biden administration has sought to further accelerate the electrification effort and create more stringent standards at the federal level. California has pioneered state-level efforts for this transition, including developing a suite of rules (Advanced Clean Trucks, Advanced Clean Trucks Fleet, Transport Refrigeration Units, Heavy-Duty Diesel Vehicles) that are aimed at supporting adoption of cleaner vehicles.

Governments can also provide incentives making purchasing an EV over a combustion engine vehicle more attractive. Financial incentives include EV purchase tax credits and rebates, as well as EV charger installation rebates. Non-financial incentives include high-occupancy vehicle lane priority access and reserved parking access. When designing incentive programs, governments are in a unique position to shape what an electric mobility future looks like.

These factors, particularly policy and regulation, will be mutually reinforcing if an EV ecosystem is built.

ROAD USAGE	VEHICLE DUTY	VEHICLE SEGMENT	EXAMPLES VEHICLE
On-Road	Light Duty	 Class 1 Vehicles	• Sedan, small sport utility vehicle, small crossover, small pickup truck
		 Class 2a-2b Vehicles	• Sport utility vehicle, pickup truck, small delivery van
	Medium & Heavy Duty	 Class 3 Trucks	• Walk-in van, city delivery van
		 Class 4-5 Trucks	• Box truck, city delivery van, step van
		 Class 6 Trucks	• Beverage truck, rack truck
		 Class 7-8 Trucks	• Short-haul tractor truck, long-haul tractor truck
		 School Buses	• School bus
		 Transit Buses	• Transit bus
		 On-Road Specialty Vehicles	• Fire truck, ambulance, recreational vehicle, refuse truck, drayage truck
		 Transport Refrigeration Units	• Refrigeration unit (excluding tractor trailer) for warehouses, distribution centers, grocery stores
Off-Road	 Airport Ground Support Equipment	• Aircraft refueler, aircraft pushback tractor	
	 Seaport Cargo Handling Equipment	• Hostler truck, rubber-tired gantry crane, container handler	
	 Other Forklifts	• Counterbalance/telescopic handler forklift for warehouses, lumberyards, and construction sites	

Figure 2:
Vehicle Segmentation

Build the EV Ecosystem

While governments have considerable impact over various factors that accelerate EV adoption, they cannot work in a vacuum. Many stakeholders across the spectrum either have power to influence the marketplace, such as commercial fleets through their buying power, or advocacy groups raising awareness about particular issues. Therefore, the ecosystem must be inclusive and purposeful.

Purpose of Ecosystem.

Governments should work to design programs and policies that are accessible and impactful to the largest number of individuals as possible. Success of these programs will be largely dependent on the cooperation and participation of many internal and external stakeholders. Therefore, input from stakeholders is necessary to understand barriers to adoption and how to address challenges with implementing programs. The idea of an ecosystem suggests a dynamic environment in which issues are constantly surfaced and understood, while programs are continuously refined and expanded as needed. The process needs to be open, transparent, and as inclusive as possible to promote broad engagement and representation.

Identification of Stakeholders.

Federal, state, and local jurisdictions and agencies should actively participate within the ecosystem. Because different units of government have different levels of control, coordination to reinforce programs and avoid duplication of effort is useful. Ideally, regional or national consortiums will emerge to promote uniform policies and disseminate best practices, similar to the Regional Greenhouse Gas Initiative, which is a cooperative effort among states to cap and reduce CO2 emissions. While the coordination between environmental, utility, and transportation agencies seems obvious, other agencies should be brought into the ecosystem. For instance, programs focused on retraining workers and developing new green jobs would require—at a minimum—coordination with labor or workforce commissions or agencies.

Because transportation touches the lives of individuals across different communities, a robust network of community organizations and local community members should be included in the ecosystem. The significant amount of capital expenditures to electrify transportation will require involvement a variety of stakeholders, from supply chain OEMs for EVs and charging infrastructure and corporate and private fleets to individual drivers.

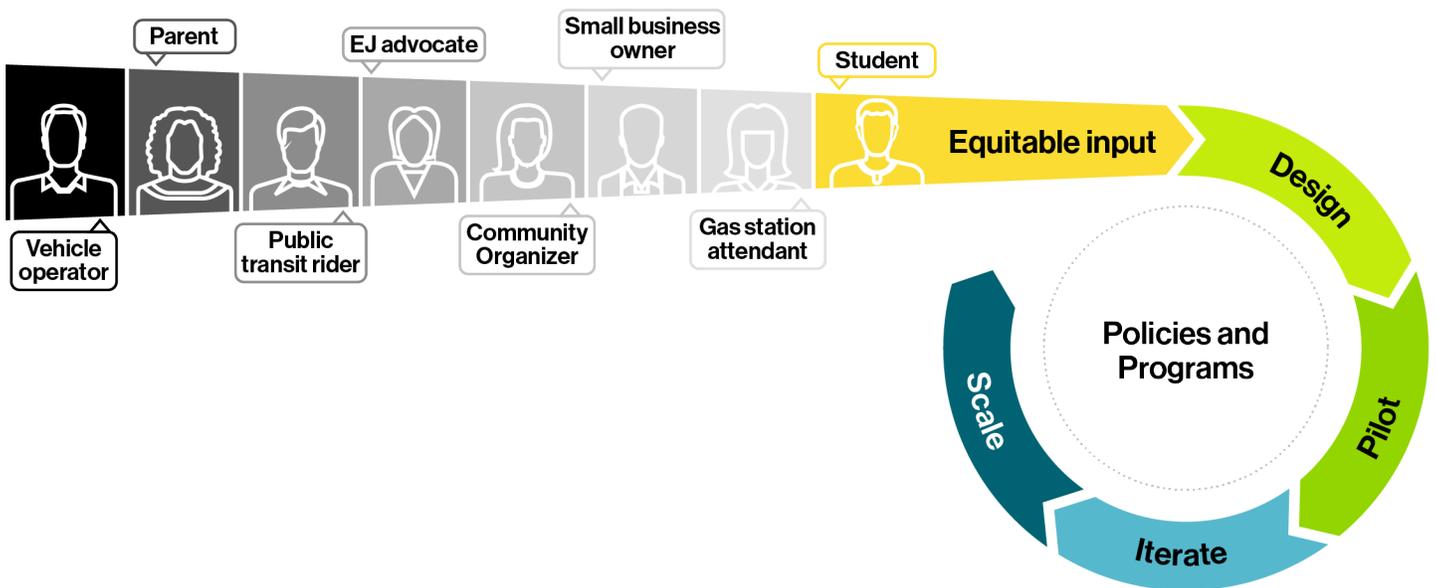


Figure 3:
Community Stakeholders

Technical Factors.

While broad engagement of many stakeholders is the first step to ensuring social and economic equity and environmental justice, it will not guarantee inclusion and a just transition. Local community members, individual vehicle operators, and local employees who will be directly impacted by a transition to EVs need to be engaged early in the process so they can provide input to and understand your goals and objectives, and provide feedback on the design of programs and policies intended to improve their air quality and health. Many nonprofits and advocacy groups will play an important role in ensuring the final environmental and health impacts are robust and equitable. Program and policy design should always involve the voice of individual constituents to ensure their perspectives are understood and considered. After significant input is received, programs must be purposefully developed with equity as the defining metric, so that they have a net positive impact on disadvantaged communities through metrics such as improved local air quality and job creation. Furthermore, programs can be designed to specifically target disadvantaged communities, such as using a funding allocation carve-out.

After developing an inclusive, dynamic ecosystem, stakeholders can consider how to capture as much economic value within a jurisdiction as possible by creating an economic development strategy.

Grow Overarching EV Economy

The shift from internal combustion engines to electric engines is more than a substitution of fuel. Entire fleets of vehicles need to be replaced and a new infrastructure that supports charging and increased electricity generation and delivery will be built. As a result, governments and private stakeholders will invest significantly and increase economic activity, a lot of which could be captured domestically.

As a result, electrification of transportation should be viewed as an economic development strategy tool. With different stakeholders spending billions on new vehicles and charging infrastructure, state and local governments should consider how to capture value along the electrification process where possible. From raw materials and OEM, to downstream stakeholders who build the charging infrastructure or manage fleets, the value chain holds many opportunities to extract value.



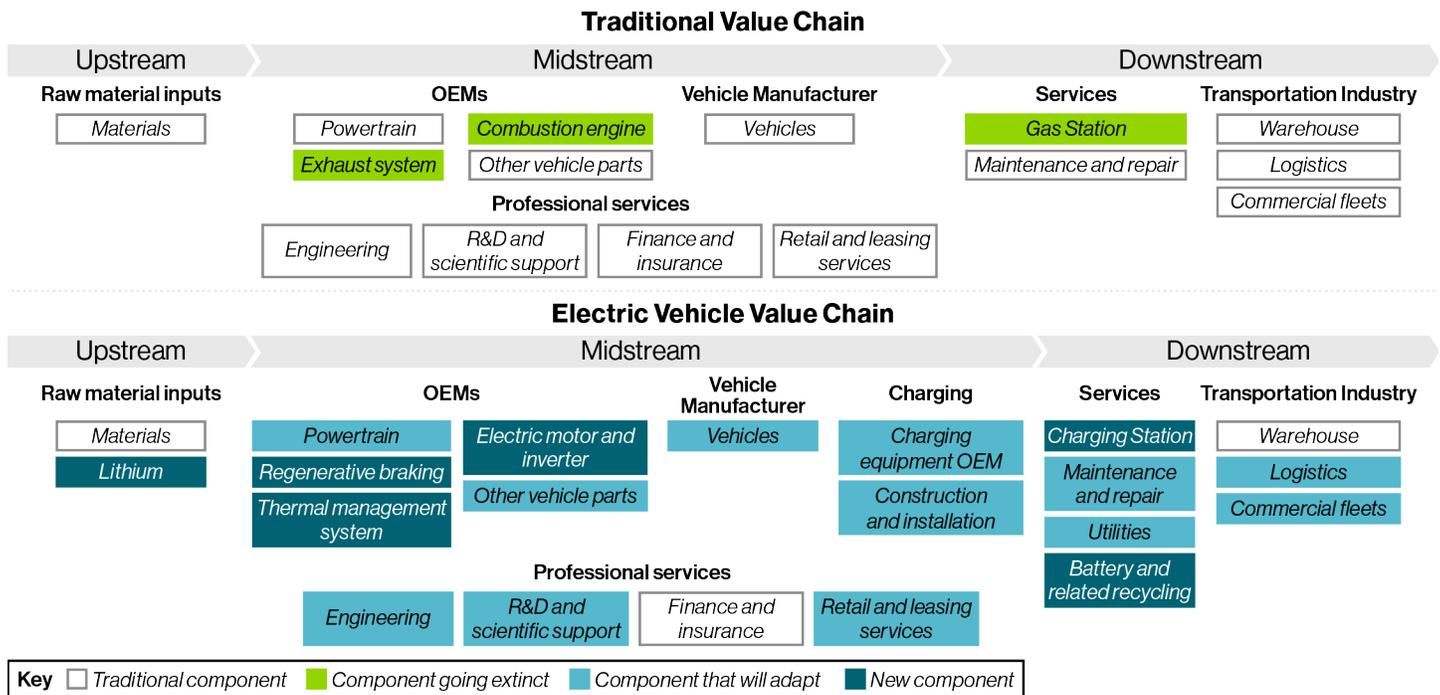


Figure 1:
Value Chain

Like all other technology transitions, the value chain will see significant disruption. Some new industries emerge, such as charging-equipment manufacturers and installation companies, while others decline. Workers in some fields will be displaced and others may need retraining. Governments can anticipate these disruptions and develop programs that support fledgling industries and support individuals whose jobs are lost or changing.

Tapping into Opportunity.

State and local governments need to understand the spectrum of opportunities and should consider the following.

- **ECONOMIC STRUCTURE.** At a high level, this requires each government to understand the strengths and weaknesses of its economy, such as cost of labor, cost of land, tax structure, and human capital or workforce.
- **CONNECT WITH LOCAL BUSINESSES.** Governments should also take inventory of the types of local businesses currently in operation. This outreach should be for different purposes. Governments should identify ways to support businesses that will be part of the electrification transition and consider how to support individuals who might lose jobs in industries, such as gas stations, that will suffer during the electrification transition.
- **WORKFORCE DEVELOPMENT.** Programs can target job functions that will be needed in larger quantities in the future. Developing the workforce will help attract various companies to locate in specific jurisdictions.
- **NEW TECHNOLOGY.** Rapid changes in technology, particularly with the rise of the digital age, force governments to adapt. Within the electrification transition, governments will need to understand the limits and the benefits of EVs and create the requisite infrastructure to enable the use of these vehicles.
- **MARKET DEVELOPMENT .** Private and public stakeholders should work together to create pilot projects that can expand into large programs, thereby creating a market for EVs.
- **COORDINATION.** With the development of the EV ecosystem, the coordination between counties, cities, utilities, and state agencies will be easier.

Two large opportunities within the value chain exist—manufacturing and charging infrastructure.

Charging Infrastructure

While EV manufacturing has locational specificity, charging infrastructure represents a universal opportunity for all jurisdictions. Every community will need an increase in charging stations as the population of on-road vehicles goes electric. The economic opportunity within charging infrastructure lies across three areas: charging equipment manufacturing; construction and installation; and ongoing servicing and maintenance. The charging equipment manufacturing opportunities face the same challenges as EV manufacturing. Certain geographies might be better suited for large-scale operations than others. However, construction and installation are very localized, and jurisdictions should plan how to maximize this economic opportunity. Governments can support this industry by having training sessions for existing electricians or workforce development programs that train electricians. Finally, firms that service the stations can exist locally.

In addition to capturing this economic activity locally, numerous stakeholders in the EV ecosystem will play a large role in ensuring the success of this transition. Coordination is necessary between utilities and the local governmental arms devoted to transportation. The location of public charging equipment or charging stations should be determined based on present and future traffic patterns. Utilities will have to plan to increase their capacity to support the additional strain charging puts on the grid and build substations or transformers in specific areas to support and provide charging. Local businesses can choose to install chargers as a way to increase traffic. Governments will have to work with stakeholders to create a streamlined, efficient permitting process as well..

EV Manufacturing.

An economic development strategy that includes manufacturing requires understanding manufacturing trends at large and within the EV industry. New advanced manufacturing processes will be largely automated, reducing the number of automotive plant laborers. Furthermore, not every geographic location can become the next Detroit of EVs. The high cost of labor and land and unfavorable tax structures might make mass production of automobiles too costly. Similarly, overcoming the lack of a developed workforce might make an area a poor choice for a manufacturing plant. However, local jurisdictions can consider whether advanced manufacturing or micromanufacturing makes sense.

EVs will be vastly different than traditional internal combustion engine vehicles for a variety of reasons: batteries will supplant internal combustion engines; motors and drivetrains will be more consolidated and built with fewer parts; and centralized computer architecture will become more prominent. As a result, the supply chains for EV manufacturers will shorten and require significantly fewer suppliers and OEMs.

For areas with legacy automobile OEMs, the governments can work with stakeholders to understand what components can be made in existing factories with minor modifications. In particular, governments can support these firms by considering workforce development programs that upskill workers or education programs that support electrical and software engineers.

Even without a strong manufacturing base, state and local governments can build components for an industry hub. State and local governments can attract microfactories to build EVs for local commercial or public fleets by being a first mover and signing procurement contracts. Furthermore, jurisdictions can create incubator programs or have robust business attraction and development teams to attract startup companies or companies looking to expand to areas that have high demand for EVs. Therefore, governments should also consider how policy requirements for EV quotas that create local demand can create an incentive to companies to locate in the area. Even if an area cannot compete within manufacturing, it still can consider having remote design labs or engineering studios, especially since the new vehicles are so dependent on software and computer programming.

About Guidehouse

Guidehouse is a leading global provider of consulting services to the public sector and commercial markets, with broad capabilities in management, technology, and risk consulting. By combining our public and private sector expertise, we help clients address their most complex challenges and navigate significant regulatory pressures focusing on transformational change, business resiliency, and technology-driven innovation. Across a range of advisory, consulting, outsourcing, and digital services, we create scalable, innovative solutions that help our clients outwit complexity and position them for future growth and success. The company has more than 12,000 professionals in over 50 locations globally. Guidehouse is a Veritas Capital portfolio company, led by seasoned professionals with proven and diverse expertise in traditional and emerging technologies, markets, and agenda-setting issues driving national and global economies. For more information, please visit www.guidehouse.com.