



ZERO EMISSION TRANSPORTATION STRATEGY — 2021-2025 —

June 2021 | Environment Program

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Complementing this strategy is Hewlett's Zero Emission Road Freight Strategy 2020-2025 (April 2020, [link](#))



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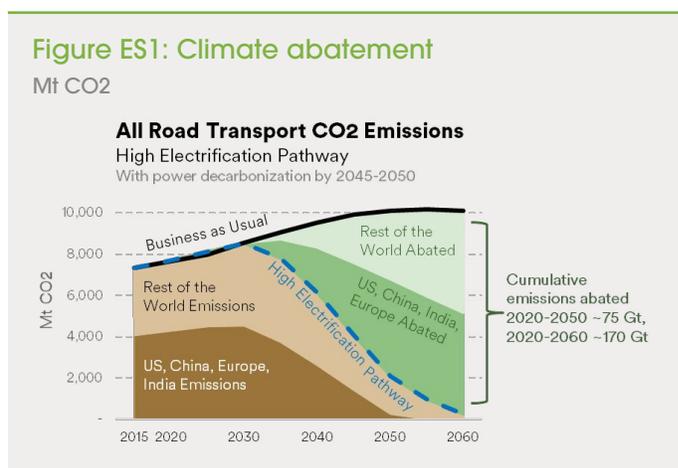
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Executive summary

Climate context: In 2017, the Hewlett Foundation’s Board renewed its third five-year commitment to our Climate Initiative¹ with an updated goal: To limit global warming emissions to keep global average temperature increase well below 2°C to protect the planet from the worst effects of human-induced climate change and help promote human prosperity and health around the world. The initiative focuses on the biggest emitting regions (China, Europe, India, and the United States) and includes six thematic areas: Transportation, Electricity, Industry, Finance, Strategic Communications, and Carbon Dioxide Removal. Hewlett’s transportation sub-strategy will soon be subsumed into a broader electrification strategy, to be developed later in 2021, that will cover power, buildings, and industry in addition to transport. Because we have had a long-standing focus on transportation, we are publishing this document to clearly articulate changes and provide clarity to our grantees and fellow funders. This document explains why we must (and can) electrify road transportation, our theory of change, what we plan to fund and where, the total philanthropic need, and how we plan to track progress. It is based on input from five regional climate foundation partners, 60 grantees and partners, and other funders. This report builds on our [Zero Emission Road Freight Strategy 2020-2025](#), released in 2020, which provides complementary strategy details on freight (see Appendix A for more details).

Why road transportation electrification? Our strategy will yield benefits to people and communities by mitigating against the worst effects of climate change and by generating a host of other benefits –improving air quality and health, creating jobs, and increasing business efficiency and consumer savings, while incorporating the voices of a diverse constituencies for enduring change. Hewlett focuses solely on road transportation (including passenger and freight movement) because it represents nearly 80% of transportation emissions and presents the greatest opportunity for success using philanthropic funds.

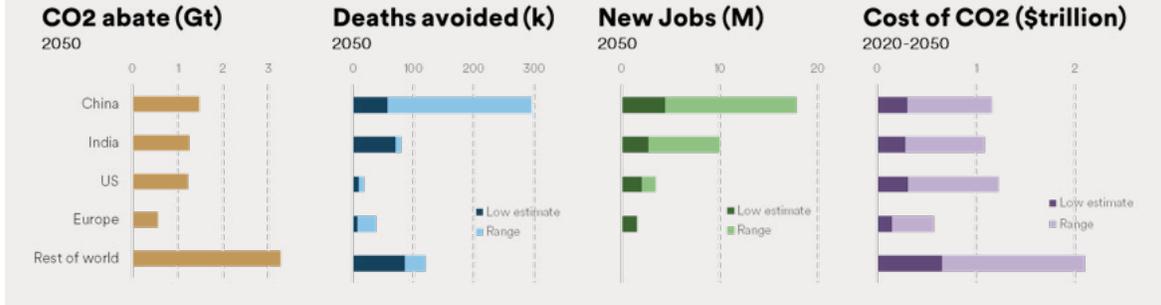
Goal: By 2050, this strategy aims to reduce road CO₂ emissions by 95+% (near net-zero) in China, Europe, India, and the United States by aggressively advancing Zero Emission Vehicles for passenger and freight travel – though as described below, the philanthropic funding needs extend beyond Hewlett. To increase funding, we will build strong partnerships with other funders. Consistent with key partners, our vision is for leaders to reach 100% electric vehicle sales by 2030 for city and school buses, 2035 for cars and light commercial vehicles, and 2040 for trucks and coach buses (for variation by region, see Table 1). With ambitious action, the world can abate 4.7 Gt CO₂ annually in 2050 (roughly equal from freight and passenger) in the four key regions and 8 Gt annually worldwide (assuming significant global uptake following our key regions, Figure ES1). Cumulatively, this adds up to ~75 Gt abated between 2020 and 2050. These actions position the world to have near net-zero road transportation emissions globally by 2060 (98% reduction in road transportation emissions).²



Where and what long-term benefits? Our strategy prioritizes China, Europe, India, and the U.S., complemented by cross-regional efforts. Beyond mitigating climate change, electrification will improve air quality, health, equitable mobility, business efficiency, and sustainability. Figure ES2 shows the range of benefits by region, including avoiding 230-550,000 deaths per year, creating 10-35+ million new jobs in key regions, and creating \$1.7-6.7 trillion in societal savings (2020-2050) from avoided climate change damages such as changes in agricultural productivity, human health, flood damages, and ecosystem services.

Figure ES2: Benefits by region

Health & job values are rough estimates using multiple sources and input. See Chapter 1 & Appendix C for details.



What obstacles must be overcome? Barriers to electric vehicles include a lack of supply of vehicle models, insufficient charging infrastructure, higher purchase costs, low consumer awareness, the need for shifts in the auto supply chain (e.g., from engine-based parts to batteries), and a lack of used vehicle markets. Opposition to actions, especially to the most transformational policies, comes from the oil and natural gas industry, laggard vehicle manufacturers, dealers, and politicians. Policymakers can lack the will or funding to move as decisively as necessary to make meaningful change. Finally, barriers, opposition, and low ambition can overlap, such as when the opposition exploits barriers and propagates misinformation.

How does the world get to our goal? Our strategy supports grantees to achieve three specific, five-year outcomes (A-C) complemented by three philanthropy levers (i-iii) to achieve them (see also Figure ES3):

- A. Ambitious electric vehicle regulatory policy:** Strong vehicle regulations at state, national, or cross-national levels are the foundation for rapid transformation of the electric vehicle market. Engaging government policymakers to adopt and implement regulations can increase the supply of cost-effective Zero-Emission Vehicle (ZEV) models. Key levers include ZEV regulations, strict vehicle-level CO₂/km standards, and criteria pollutant emissions standards (including PM, NOx) stringent enough to force the transition to electrification and establishing clean air areas (zero-emission areas).
- B. Ubiquitous, affordable charging:** A move from universal gas stations to ubiquitous EV charging stations, well-designed charging rollout plans and rates, and low-cost electricity overcomes barriers shared by consumers, fleet owners, freight companies, and utilities. Key levers include large-scale public financing; the expansion of public, workplace, and multi-family dwelling charging; smart or time-of-use charging and integrating EVs with clean power; charger incentives; sustainable source fuel regulations; innovative ways to finance charging; and integrating charging with buildings.
- C. Increased demand that complements strong regulations:** Governments, cities, and businesses demonstrate demand through fleet commitments, and individual buyers commit to purchasing electric vehicles. Key levers include subsidies and other government spending; high-level commitments from national, state, and city governments; emission pricing policies; electrified transit; zero-emission ports; fleet commitments; and purchaser incentives.
 - i. Foster a strong ecosystem for a rapid transition:** More diverse and stronger support with new allies (including environmental justice groups, businesses, utilities, labor, health advocates, and investors) builds broad support and pressure for effective action. Key interventions include building diverse coalitions, garnering corporate allies, strategic communications, and investor support, complemented by research and sharing knowledge and best practices across regions.
 - ii. Strengthen grantee capacity, including justice, equity, diversity, and inclusion:** Enhanced grantee capacity including advances in justice, equity, diversity, and inclusion (JEDI). Provide long-term, general operating support where possible. Support grantees to advance JEDI within their organizations and in their strategic work, including through internal dialogues, commitments, intentional programmatic work, and continuous improvement.
 - iii. Support fundraising:** Funding for zero emission transport reaches \$200+ million per year. Work with partner philanthropies to meet the full needs to transition all transportation to be zero emission.

Figure ES3: Theory of change



2050 GOAL

By 2050, **reduce CO₂ emissions by 95+%** in China, Europe, India & the U.S. by aggressively advancing Zero Emission Vehicles for passenger and freight travel

Benefits: 8 Gt Co₂ abated worldwide (80% reduction), 230-550,00 deaths per year eliminated

2050 OUTCOMES

Zero Emissions Sales by 2025

	 China & other leaders	 Europe & U.S.	 India
Buses (city & school) & 2/3-wheelers	100%	50%	50%
Cars	20%	15%	6%
Trucks & coach buses	8%	8%	4%

Ubiquitous, affordable charging

Ubiquitous EV charging stations, well-designed charging rollout and rates, and low-cost electricity overcomes barriers seen by consumers, fleet owners, freight companies, and utilities

Increased demand that complements strong regulations

Governments, cities, and businesses demonstrate demand through fleet commitments, and individual buyers commit to purchasing electric vehicles.

Ambitious electric vehicle regulatory policy

Strong vehicle regulations at state, national, or cross-national levels are the foundation for rapid transformation of the electric vehicle market

PHILANTHROPY LEVERS

Strong ecosystem for a rapid transition

More diverse and stronger with new allies (including environmental justice groups, businesses, utilities, labor, health advocates, and investors) builds broad political will and pressure for strong action.

Strengthened grantee capacity

Including advances in justice, equity, diversity, and inclusion

Funding for zero emission transport

reaches \$200+ million per year

Key Assumptions: Key regions influence global EV market & uptake elsewhere. Battery prices will reach <\$100/kWh in the coming few years. Fully decarbonized clean power by 2045. Regulatory policy has the strongest influence to overcome barriers.

How much funding is needed? To rapidly transform transportation electrification so that electric vehicles outcompete combustion vehicles and reach mass markets, the sector needs at least \$210 million per year globally for the next five years (~60% for passenger electrification and ~40% for goods). Hewlett's spending on transportation is roughly \$21 million per year (10% of the total need). Shifts in our funding will elevate freight efforts, continue to prioritize EV regulations, and increase funding for charging (outcome B) and fostering a strong ecosystem (approach i).

What does Hewlett exclude? We will concentrate our resources in electrification of road transport, in contrast to earlier transportation work that included aviation, shipping, and broader aspects related to transportation. Additionally, within road transportation we will focus on ZEVs, electrification, and associated infrastructure.

A five-year focused effort could dramatically transform road transportation to permanently tip the balance in favor of electric drive for all road transport. At the moment, this is an ambitious goal; although EV sales shares are growing in all regions, they remain less than 3% of the global market.

1. Why the world must (and can) electrify road transport now

Climate benefits

Transportation electrification is one of the most important ways to slash greenhouse gas emissions, reduce oil use, improve air quality and health, and heighten business efficiency and sustainability. Transportation currently represents around one-quarter of global energy-related emissions and is on a path to increase 50-60% by 2050. Freight accounts for roughly 40% of road transportation energy, and its emissions are projected to increase at least 80% by 2050.

Hewlett's goal is to support organizations that can help reduce road CO₂ emissions by 95+% in China, India, Europe, & the United States by aggressively advancing Zero Emission Vehicles for passenger and freight travel by 2050. Coupled with full power-sector decarbonization by 2045-2050, the world can reduce emissions in key regions by 95+% by 2050, and across the world nearly 100% by 2060 (Figure 1). To attain this goal, the world must electrify passenger transportation (personal vehicles and transit) and freight. High ambition could abate up to 4.4 Gt CO₂ in 2050 in the four key regions (China, India, the U.S., and Europe, 5 Gt by 2060) and 7.8-9.8 Gt worldwide (assuming significant global uptake following our key regions, 2050-2060).

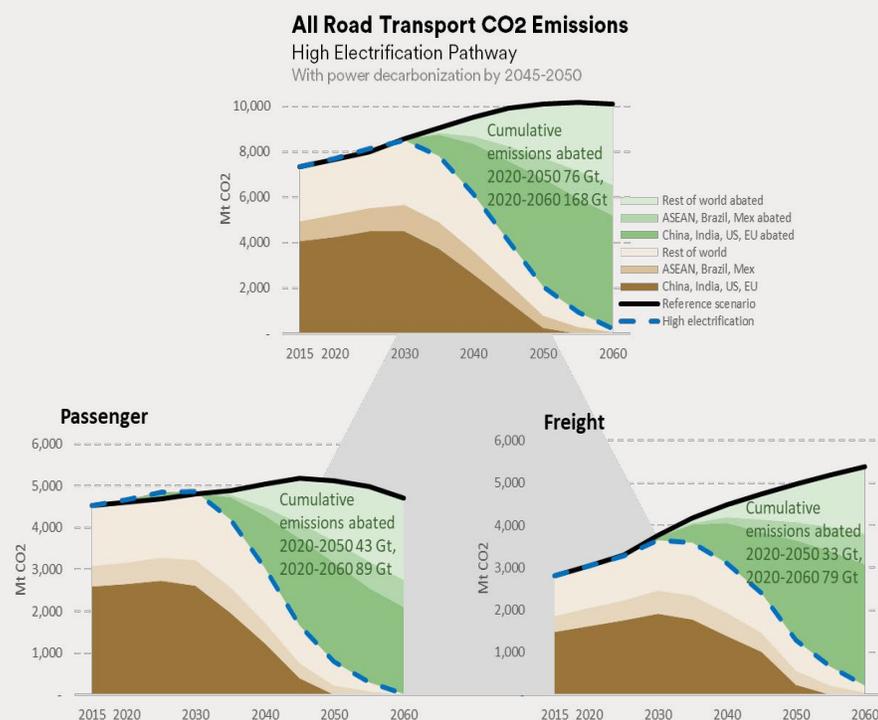
The impact of the coronavirus pandemic

The coronavirus pandemic has affected many aspects of everyday life, including how people move (increasing personal vehicle travel and reducing public transportation use, though the long-term effects are to be determined) and altering how individuals shop for food, other necessities, and other goods (online versus in-person). The economic impacts and stimulus programs offer opportunities for advancing zero emission vehicles and deploying charging infrastructure.

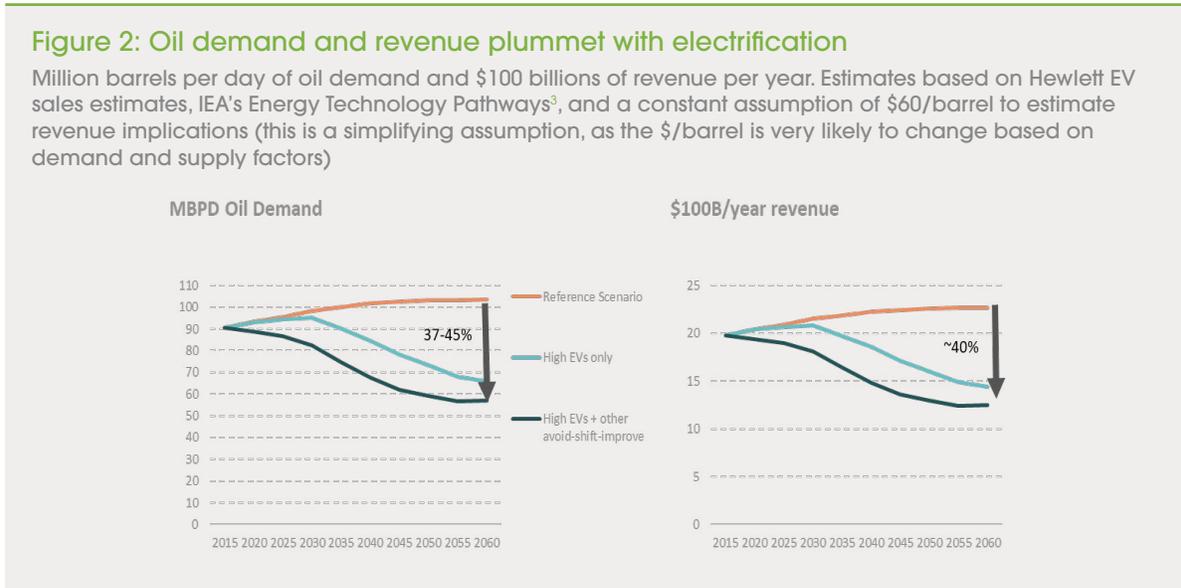
Positively, the world has adapted and continued to move forward on zero emission vehicles during the pandemic. California's Air Resources Board adopted its Advanced Clean Trucks rule and Europe implemented stricter CO₂ standards for passenger vehicles. Moving forward, we will remain flexible in our approach to advance ZEVs.

Figure 1: Climate trajectories – Overall, Passenger, and Freight

Mt CO₂. See Figure 11 for EV sales by region and Figure C5 for the associated power grid decarbonization associated with the full CO₂ benefits of electrifying transport.



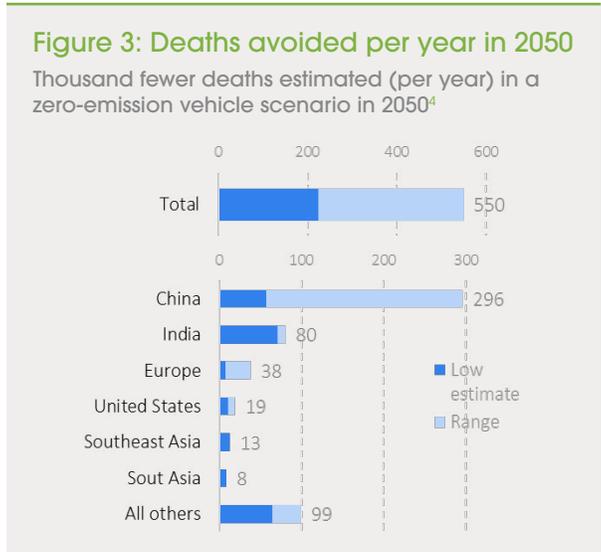
Addressing transportation is critical to reducing oil use; 65-70% of global oil goes to transport. By 2050-2060, electric vehicles could eliminate at least 40% of global revenue to oil (reducing revenues from ~\$2.3 trillion to ~\$1.4 trillion) and ~30-40% of oil use (~40 million fewer barrels per day) under the high electrification scenario. Additional climate mitigation in other oil and gas-dependent sectors (including industry, electricity, and residential uses) could reduce more demand. Consequently, the oil and gas industry represents significant potential opposition.



Air quality & health improvements

Eliminating road transportation emissions will **improve air quality and health. Transportation is responsible for ~13-32% (today to 2040) of all PM2.5, ~55% of all NOx emissions, and ~10% of all SO2 emissions.**⁵ PM2.5 is estimated to be responsible for about 95% of the global public health impacts from air pollution.⁶

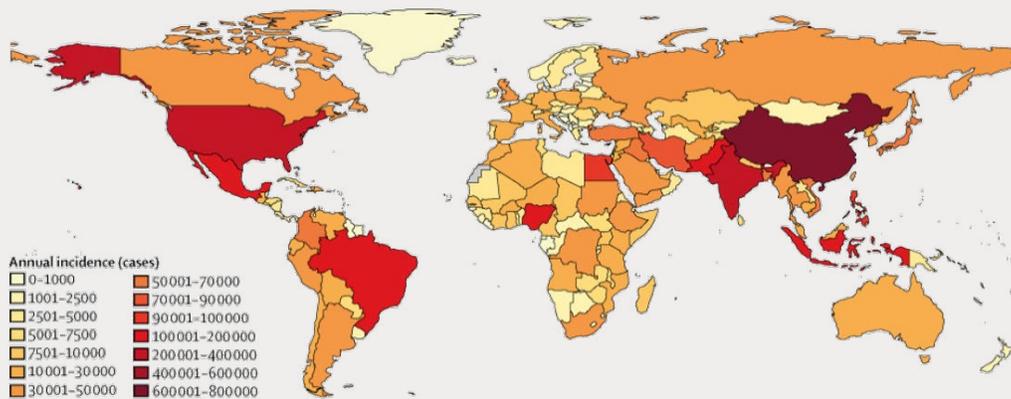
Air pollution leads to adverse health impacts. Negative health outcomes include premature deaths, heart disease, stroke, lung cancer, asthma attacks, and lost work days. Air pollution also affects systems outside of cardiovascular health, including chronic kidney disease, preterm birth and other negative birth outcomes, and cognitive decline. Global road transportation emissions cause **>230,000 PM2.5 and ozone-attributable premature deaths per year today.** Achieving the global goal of making ZEVs the predominant vehicles in use by 2050, could eliminate 230-550,000 deaths per year (see Figure 3) and also **eliminate 4+ million cases of child asthma per year** (Figure 4).



People of color (POC, including Black, Indigenous, Asian, and other races) and communities with low income contribute the least amount of pollution but suffer the greatest consequences of dirty transportation. Port facilities, major trucking corridors, warehouse distribution centers, and other diesel hot spots are often near POC or low-income neighborhoods, where freight trucks circulate and contribute to unhealthy air.⁷ This is a result of past and current inequities. See Chapter 2 A) Strong ecosystem for a rapid transition and i) Grantee capacity for more details on prioritizing justice, equity, diversity, and inclusion.

Figure 4: Asthma cases (from NOx exposure)

Number of new cases in 2019. These could be avoided in a zero-emission vehicle scenario.
 Source: Global, national, and urban burdens of pediatric asthma incidence attributable to ambient NO₂ pollution: estimates from global datasets. Milken Institute School of Public Health (2019)⁸



Societal savings, green economy, & jobs

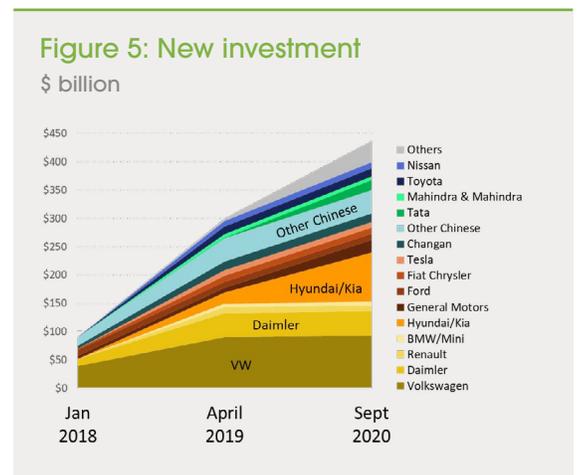
Fully electrifying road transportation creates dramatic societal savings and also benefits the economy through job creation. However, there will be a transition to new, clean energy jobs, and we expect the opposition to use job concerns as an argument against electrification. **It is therefore essential for advocates and proponents to understand the transition and its implications on the green economy** and jobs, garner support from labor groups, and ensure a just transition.

Roughly \$6.7 (range 1.7-6.7) trillion can be saved from the avoided social cost of carbon between now and 2050 (~16, range 4.3-16 2020 to 2060).⁹ This represents avoided damages associated with climate change, such as changes in agricultural productivity, human health impacts, property damages from increased flood risk, and the drop in value of ecosystem services due to climate change.

Economy-wide benefits: ZEVs are more efficient than combustion vehicles, saving businesses and consumers money on fuel.

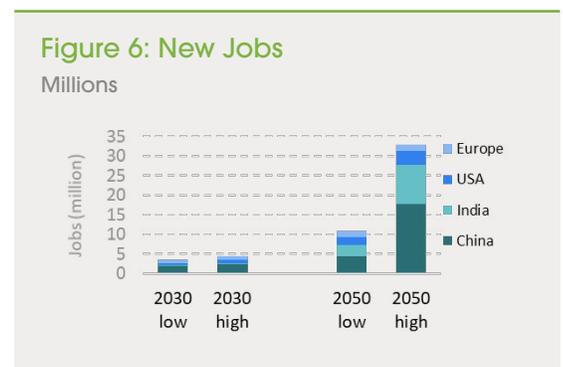
- **Individuals save** because electricity (fuel) and maintenance costs are significantly lower than combustion vehicles (Figure C1). In the U.S., over an electric vehicle’s lifetime owners can expect to save \$4,500-5,000 on fuel and ~\$4,500 on maintenance, cumulatively saving ~\$9,000.¹⁰ On a macroeconomic level, as spending on transportation drops, this liberates money for spending in other parts of the economy including purchase of other goods/services.
- **Businesses save**, improving efficiency and sustainability, which could also translate into lower consumer costs for goods (e.g., as transportation costs are lowered). Many truck segments already have savings on a total cost of ownership basis (walk-in step vans, delivery vans, even long-haul trucks have a payback of less than three years with economical charging), and almost all segments will achieve this parity within five years. Over the lifetime of a long-haul truck, by 2030 (with economical battery prices) a business owner could save net \$100-200,000 over using a diesel truck.¹¹

Catalyze \$50-100 trillion in private sector investments (vehicles + charging, *rough estimate*). Through September 2020, automakers committed \$435 billion to electrification, up from \$90 billion in 2018 (Figure 5). Note: this is a low estimate; roughly \$150 billion was invested in 2020 alone.¹²



ZEVs lead to millions of more jobs – 3-4 million in 2030, 10-35 million in 2050 (*rough estimates, Figure 6*). Job increases are direct (ZEV & battery manufacturing), indirect (charging operations, electricity), and induced (services via money saved on fuels).

- **Direct jobs in battery and ZEV manufacturing.** Some early studies predicted that there might be a lower complexity and potential job losses with electric vehicle manufacturing.¹³ However, recent European studies show that the labor intensity of making an EV is similar to combustion vehicles, thereby having similar employment needs. For instance, battery electric vehicles – BEVs – present new processes such as manufacturing high-voltage wiring converters and inverters, installing motor-charging units, and connecting battery cooling tubes; BEVs have three thermal systems; Internal Combustion Engine (ICE) vehicles have two.¹⁴ Battery manufacturing—cell production and module and battery pack assembly—is time-intensive and will make BEV labor hours similar to ICE vehicle manufacturing.



- A focus on a **just transition and retraining** can ensure that the shift from combustion vehicles to ZEVs ensures training and employment in new green jobs. Fossil-fuel-related expertise that focused on vehicle manufacturing (e.g., combustion engines) and ICE-related support (gas stations, mechanics, parts) will be replaced with a need for expertise in battery chemistry and thermal management, electric power electronics, sensors, and software.
- **Indirect jobs include quality jobs to install and maintain ZEV infrastructure for charging, and power sector jobs (grid upgrades, new plants).** A recent study in Europe showed 0.5 million new jobs in 2030 from e-mobility, with the biggest increase (~60%) from operation and maintenance of electric vehicle supply equipment.¹⁵ Power sector jobs will increase as renewable power suppliers build new supply plants to meet the additional needs to power EVs. Oil infrastructure has a very low job-intensity (4-6 jobs/€million); by contrast electricity/electric infrastructure has higher job-intensity and is typically domestically produced. See Figure C10 for details.
- **Induced jobs:** Funds saved from fuel will be spent on purchase of other goods/services, increasing jobs economy-wide. For example, services employ 24 people/€million, vs. 4-6/€million in oil and gas. One European study showed the indirect effect of jobs related to both manufacturing of other goods and services was significantly higher in the high-EV case.¹⁶

Green recovery funds can support the transition to electric vehicles. This can take many forms, including charging infrastructure spending, incentives for ZEV and battery manufacturing (e.g., re-tooling, expanding or new facilities, re-training), battery recycling, green debt instruments (e.g., reduced rates for meeting climate-friendly criteria), funds for a just transition, and prioritizing equitable transportation.

Why now?

The technology is here. Passenger and freight vehicle models are proliferating at great rates – there are roughly 150 passenger models available and that is expected to increase to over 500 by 2022 and over 700 by 2030 (Figure C2). For freight, over 115 truck manufacturers are making almost 200 ZEV truck models across all categories. **Battery pack prices continue to fall dramatically** and are on track for \$100/kWh by 2023. This provides the opportunity for transportation to decouple from oil for the first time in over a century (Figure 7). **Total cost of ownership is already attractive for many applications** because of lower fuel (electricity) and maintenance costs. Finally, purchase price parity continues to come closer; passenger EVs will start to reach price parity in the next few years. Figure C4 offers more details.

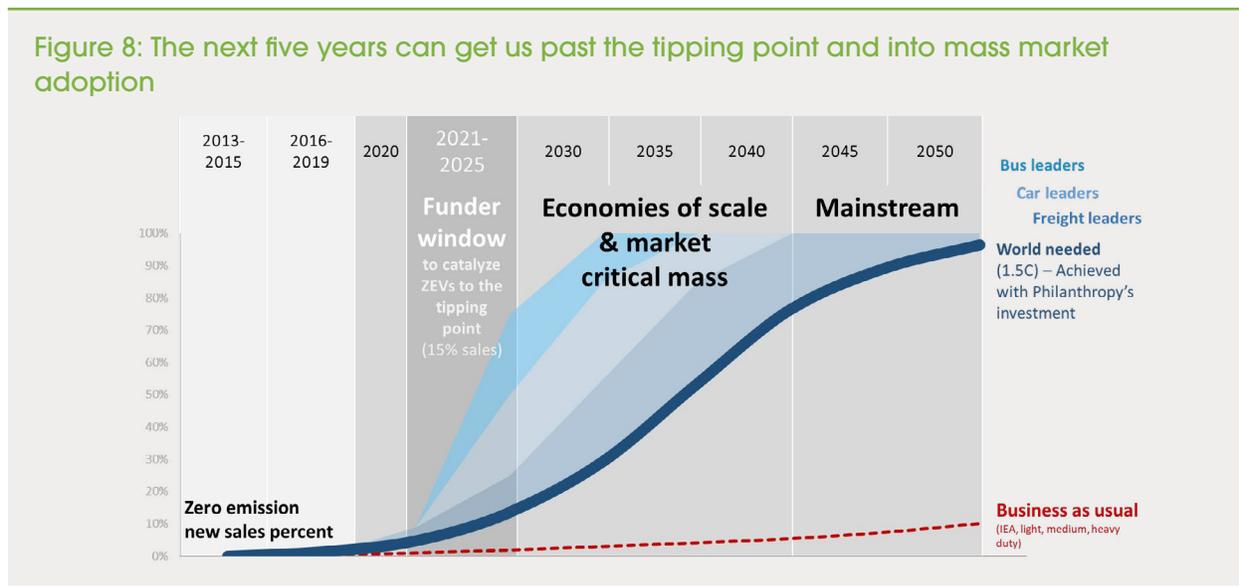
Figure 7: Battery prices continue to fall

See also Figure C2. Source: Lawrence Berkeley National Laboratory, <https://eta.lbl.gov/publications/why-regional-long-haul-trucks-are>



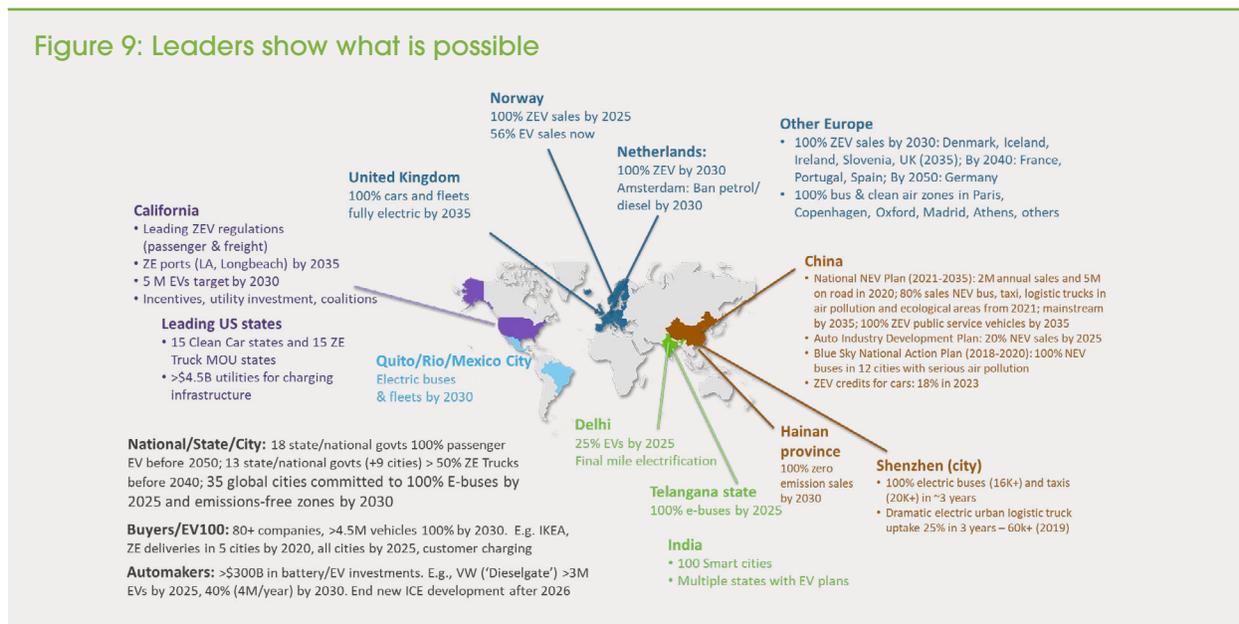
Philanthropy has a 5-year window of opportunity. EV sales continue to grow (Figure C3) but still only comprise 3-5% of sales in most markets and represent less than 1% of the global fleet. Concerted philanthropic focus can help mitigate climate change by creating conditions where EV sales get past the tipping point (~15% of sales), where the momentum will be unstoppable and there is a clear path to achieving 100% ZEVs. It takes roughly 10-15 years for vehicles to leave the market, which means that the world needs to aggressively get to 100% sales zero emission as soon as possible (see Figure 11 and Table 1) to substantially decarbonize by 2050. The number of vehicles globally is also projected to grow significantly (especially in China, India, and other emerging economies), offering a unique opportunity to ensure that new manufacturing capacity is electric. Positively, leading countries and states demonstrate that sales can increase with strong policy support and with widespread recognition of the importance of taking aggressive action. The philanthropic window (the next five years) will galvanize zero emission transformation – getting to the tipping point & critical mass (15% sales, see Figure 8). Governments, businesses, and people across the world, catalyzed by philanthropy and civil society, must act now and ambitiously in the next five years to avoid catastrophic climate change.

Figure 8: The next five years can get us past the tipping point and into mass market adoption

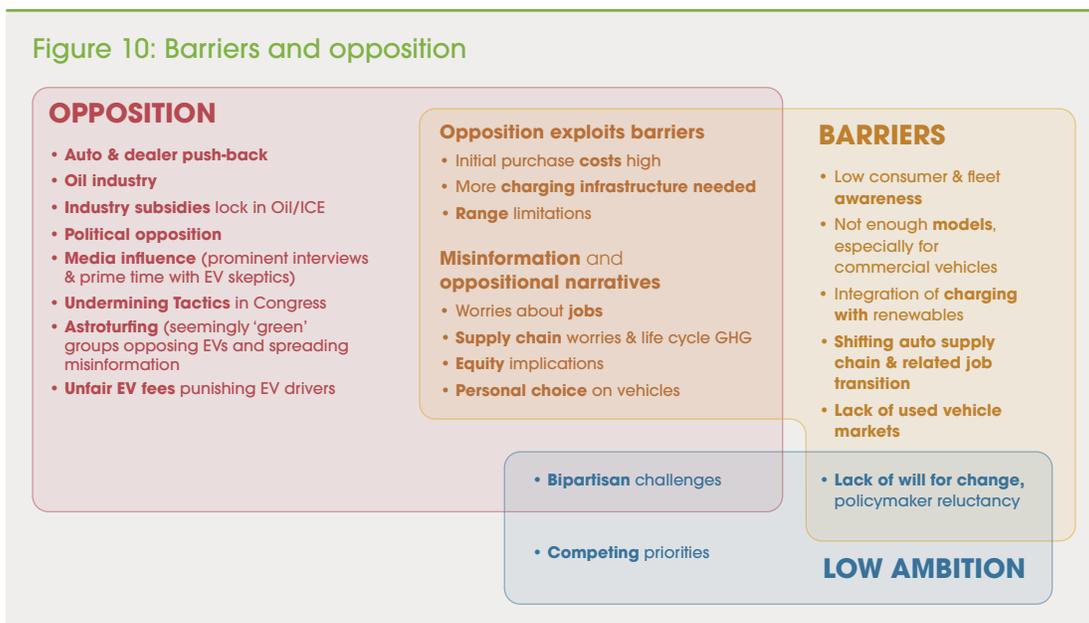


Momentum and action is growing from policymakers worldwide and in key markets, including Europe, China, California and elsewhere in the U.S., and India. See Figure 9.

Figure 9: Leaders show what is possible



Philanthropy and civil society know that the barriers and opposition can be overcome. Across every region, barriers to electric vehicles include lack of supply of vehicle models, insufficient charging infrastructure, higher purchase costs, low consumer awareness, the need for shifts in the auto supply chain (and related job transitions), and lack of used vehicle markets. Opposition comes primarily from the fossil fuel industry threatened by the financial impacts of widespread ZEV adoption, laggard vehicle manufacturers, dealers, and politicians. Policymakers also do not necessarily have the will, attention, or funding needed to move as fast as is needed for the climate. Finally, there is an overlap where the opposition exploits barriers and propagates misinformation (see Figure 10). However, past successes demonstrate that these barriers can be surmounted as support from the public and leadership to address climate is increasing; by working together, funders, civil society, and partners can achieve our goal.



Charging infrastructure, buildings, and power: Electrifying transportation has significant implications for charging infrastructure (new jobs, as described earlier), buildings (siting of and wiring for charging), and the electric power sector (increased electricity needs to charge EVs). This transition will require significant investment in infrastructure for charging stations within cities, along highways, at workplaces, and across major freight transportation routes. Charging installations and readiness can be integrated into buildings. As transportation electrifies, the power sector and utilities will be key players that can champion electrification. Electric vehicles represent a “quadruple win” by optimizing existing grid assets through smart charging, serving customers electricity to run vehicles, cutting costs with lowered rates, and reducing environmental impact through clean power production.¹⁷ Additionally, batteries in EVs can be integrated with the electrical grid to offer energy storage and support greater deployment of renewable power. Examples of cross-sector strategies include pursuing zero-carbon buildings prewired for EV charging, strategic coalitions that advocate for EVs along with 100% clean power, charging infrastructure deployed with smart charging to facilitate renewable power integration, and power grid planning that considers current electrical loads, plus electrified heating/cooling and electric vehicles. See Chapter 2 Section B on charging infrastructure for more details; as mentioned above, in late 2021 Hewlett will develop a broad electrification strategy that will incorporate transportation, power, buildings, and industry.

2. Theory of change

Overall theory of change and goal

Goal statement: By 2050, reduce road CO₂ emissions by 95+% in China, India, Europe, & the United States by aggressively advancing Zero Emission Vehicles for passenger and freight travel.

To achieve this goal, philanthropy, civil society, and partners must aim for the share of passenger and freight **ZEV sales to dramatically increase, starting now**. Our vision is for leaders (e.g., leading countries, states, provinces, and companies) to reach 100% electric vehicle sales or procurement by 2030 (city and school buses), 2035 (cars, light commercial vehicles such as vans), and 2040 (trucks, coach buses). Current geographic leaders include China, Europe, and the United States, followed closely by India and then the rest of the world. Leading companies include Tesla, VW, Volvo, and others.¹⁸ See Table 1 for 5-year outcomes and Figure 11 for EV sales outcomes by region over time.

Table 1: 5-year outcomes (end of 2025).

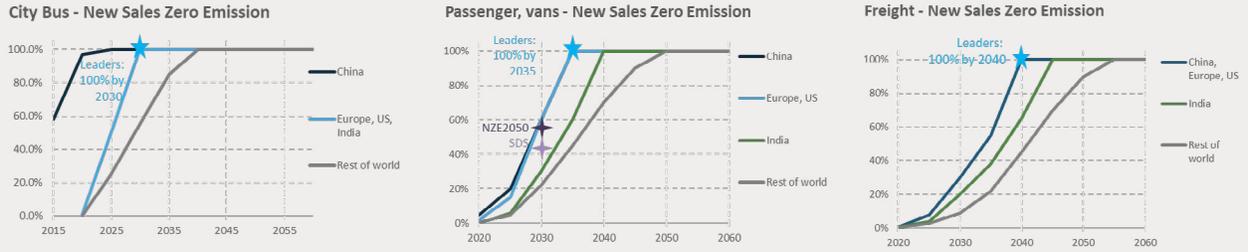
See also Figure 11.

Category	Metric	Geography Leaders are leading governments	2025 sales (achieve sales)	2030 sales (set goals by 2025)
Zero Emission Vehicle Sales % of new sales that are zero emission	Buses (city & school) & 2/3-wheelers	Leaders	100%	100%
		China	100%	100%
		Europe, U.S., India	50%	100%
		Rest of world	25%	55%
	Cars	Leaders	20%	60%
		China	20%	60%
		Europe, U.S.	15%	60%
		India	6%	30%
		Rest of world	5%	22%
	Trucks & coach buses	Leaders	8+%	30+%
		China, Europe, U.S.	8%	30%
		India	4%	20%
Rest of world		3%	9%	

Theory of change: In each region and across regions, we know what it takes to win. Our strategy supports grantees who seek to achieve three specific, five-year outcomes: A) Ambitious electric vehicle regulatory policy; B) Ubiquitous, affordable charging; and C) Increased demand that complements strong regulations. These are complemented by three philanthropy levers (i-iii) to achieve them: i) Foster a strong ecosystem for a rapid transition; ii) Build capacity, justice, equity, diversity, and inclusion, and iii) Support fundraising from partner philanthropies to attract more to meet the needs to transition all transportation to be zero emission. See Figure 12. Below are more details on each of these.

Figure 11: Electric vehicle sales outcomes: Leaders and key regions

See Table 1 for specific 5-year outcomes for sales in 2025 and for commitments for sales in 2030. The higher end of the EV sales outcomes in China, Europe, and the U.S. exceeds the ambition from IEA's Sustainable Development (SDS) and Net Zero Emissions in 2050 (NZE2050) scenarios.



Long-term outcomes (CH: China, US: United States, EU: Europe, IN: India)

Category	Metric / region	2030	2035	2040	2050	
Zero Emission vehicle sales	City buses & 2/3-wheelers: % of new sales that are ZE (region)	100% (CH, US, EU, IN)				
	Cars: % of new sales	60% (CH, EU, US) 30% (IN)	100% (CH, US, EU) 60% (IN)	100% (CH, US, EU, IN)		
	Trucks & non-city buses: % of new sales that are ZE (region)	30% (CH, US, EU) 20% (IN)	55% (CH, US, EU) 38% (IN)	100% (CH, US, EU) 65% (IN)	100% (CH, US, EU, IN)	
Tons abated	Mt CO ₂ abated worldwide per year		1,200 Mt	3,400 Mt	8,000 Mt	

Figure ES3: Theory of change

2050 GOAL

By 2050, **reduce CO₂ emissions by 95+%** in China, Europe, India & the United States by aggressively advancing Zero Emission Vehicles for passenger and freight travel

Benefits: 8 Gt CO₂ abated worldwide (80% reduction), 230-550,00 deaths per year eliminated

2050 OUTCOMES	Zero Emissions Sales by 2025	China & other leaders	Europe & U.S.	India
	Buses (city & school) & 2/3-wheelers	100%	50%	50%
	Cars	20%	15%	6%
	Trucks & coach buses	8%	8%	4%

<p>Ubiquitous, affordable charging</p> <p>Ubiquitous EV charging stations, well-designed charging rollout and rates, and low-cost electricity overcomes barriers seen by consumers, fleet owners, freight companies, and utilities</p>	<p>Increased demand that complements strong regulations</p> <p>Governments, cities, and businesses demonstrate demand through fleet commitments, and individual buyers commit to purchasing electric vehicles.</p>	<p>Ambitious electric vehicle regulatory policy</p> <p>Strong vehicle regulations at state, national, or cross-national levels are the foundation for rapid transformation of the electric vehicle market</p>
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PHILANTHROPY LEVERS	Strong ecosystem for a rapid transition	
	More diverse and stronger with new allies (including environmental justice groups, businesses, utilities, labor, health advocates, and investors) builds broad political will and pressure for strong action.	
	<table border="1"> <tbody> <tr> <td> <p>Strengthened grantee capacity</p> <p>Including advances in justice, equity, diversity, and inclusion</p> </td> <td> <p>Funding for zero emission transport</p> <p>reaches \$200+ million per year</p> </td> </tr> </tbody> </table>	<p>Strengthened grantee capacity</p> <p>Including advances in justice, equity, diversity, and inclusion</p>
<p>Strengthened grantee capacity</p> <p>Including advances in justice, equity, diversity, and inclusion</p>	<p>Funding for zero emission transport</p> <p>reaches \$200+ million per year</p>	

Key Assumptions: Key regions influence global EV market & uptake elsewhere. Battery prices will reach <\$100/kWh in the coming few years. Fully decarbonized clean power by 2045. Regulatory policy has the strongest influence to overcome barriers.

A. Ambitious electric vehicle regulatory policy

Regulations \$70M/year



Outcome: Strong vehicle regulations at state, national, or cross-national levels are the foundation for rapid transformation of the electric vehicle market.

The world needs more EV options. Automakers are increasingly making stronger commitments to go electric (electric-only makers like Tesla are rapidly growing and Volkswagen, Daimler, Nissan, Volvo, and others have announced aggressive plans to electrify vehicles in the next 10 years). This commitment comes, in part, from the philanthropic-supported discovery of the Dieselgate scandal and is also in response to investments in regions with strong regulatory policies. Yet sales are still small compared to sales

of ICE vehicles. ZEV sales were 3.2 million in 2020 (~4.5% of global sales), with approximately 10 million EVs on the road, accounting for less than 1% of the global fleet. Given the goal is to have ~250 million by 2030¹⁹, the world needs 1+ billion ZEVs on the road by 2060.

Market demand alone is not enough to spur the increase in supply of EVs. To overcome barriers of ‘convenience’ and make purchase decisions, consumers need a diversity of available and affordable electric vehicle options (as well as other incentives, detailed under Strategy C/demand). Government policy has proven to be one of the most powerful tools to drive change, primarily through strong vehicle regulations. Even the most ambitious vehicle makers and buyers benefit from government policy that expands choice and drives the market toward zero emission options. Increasing and ensuring the supply and sale of electric vehicles provides greater market confidence to suppliers of EV components (e.g., batteries) and infrastructure, and accelerates the electrification of as many modes as possible. These modes include two- and three-wheelers, cars, vans, buses, short/medium-distance/delivery trucks, and long-haul trucks. Further, because regulations such as the California ZEV mandate and China’s NEV policy require vehicle manufacturers to meet certain sales requirements each year, the vehicle manufacturers have to find the price that the market will accept, providing assurance of affordability for those products.

Global implications: Many aspects of transportation, especially the auto, bus, truck, and machine makers are global players that respond to global trends. Pressure from single regions is important, but global market changes (or those in the largest markets pursued by this strategy) have the greatest potential to impact evolution within OEMs and technology companies to provide new solutions. Policies that target a supply increase, such as requiring manufacturers to meet specific thresholds of EVs or creating new financing through market mechanisms, are crucial to dramatically accelerate the transition to electric vehicles. Additionally, attention can be placed on areas of high impact – such as electrifying people’s main vehicles and electrifying first vehicles that drive the most.

European CO₂/km standards success story

In late 2017, the European Commission proposed a new CO₂/km standard for vehicles produced in the period of 2021 and 2030 that reduces emissions by 30% (increased to 37.5% through successful advocacy) for passenger cars, 30% for trucks, and 31% from vans (light commercial vehicles). This incentivized manufacturers to consider electrification as a lower-cost path to meet these requirements.

The market response was dramatic: EV share rose from 3% in 2019 to 11% in 2020 (growing to 23% by December 2020).²⁰ The highest sales shares of EVs in EU were Daimler (21%), BMW (17%), and Kia (17%). Daimler electric vehicles accounted for almost half (46%) of new registrations in Europe in December (33% plug-in hybrid, 13% battery electric vehicles). Average new car CO₂ emission levels went from 122 g/km in 2019 to an estimated level of 107 g/km in 2020.

Strategic opportunities across passenger and freight

- **Combustion vehicle or diesel engine bans and Zero Emission / City Clean Air Areas** (e.g., green and healthy streets initiative or European Clean Cities Campaign)
- **Strong fleet regulations/rules for ZEVs**
- **Strong enforcement** of vehicle and mission standards/watchdogs on performance
- **Research that demonstrates advantages**—environmental, economic, and more—of electric vehicles to build support for ZEV-positive regulations

Passenger

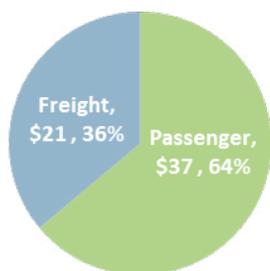
- **State or national ZEV regulations** or requirements. These are essential, and can include ZEV credits for shared vehicles to accelerate mobility systems efficiency and electrification.
- **Strict national (or cross-national) GHG vehicle (or efficiency) standards** stringent enough to force electrification, complemented by **criteria pollutant (PM_{2.5}, NO_x, etc.) standards**

Freight

- **Zero emission truck regulations**
- **Strict GHG medium- & heavy-duty vehicle standards** tight enough to drive electrification, complemented by **criteria pollutant (PM_{2.5}, NO_x, etc.) standards**

B. Ubiquitous, affordable charging

Charging \$60M/year



Outcome: Ubiquitous EV charging stations, well-designed charging rollout plans and rates, and low-cost electricity overcomes barriers seen by consumers, fleet owners, freight companies, and utilities.

Widespread electric vehicle uptake will rely on ubiquitous and affordable charging. Throughout all regions, there is a significant dearth of fast, public charging. Utilities and public funds must be directed to charging infrastructure.

Charging must address the needs of consumers (including addressing equitable charging), business, and fleet owners. Consumers expect convenience and the ability to charge a vehicle when at home, work, at dinner, or on a road trip. Fleet operators (such as bus transit agencies or shared mobility companies) and freight companies need to plan and account for charging in operations.

Simultaneously, policies must ensure that the fuel (electricity) is sustainable (zero emissions). Such policies are crucial to avoid risks about using natural gas or plug-in vehicles (see Chapter 5 for more details).

Finally, ZEVs can enable increased supply of renewable power through smart charging – a bonus for a decarbonized society, though not required for success. Smart charging (e.g., charging vehicles more during the day if a grid is reliant on solar when power is more abundant, and charging more at night if power comes from wind) can help avoid expensive upgrades to the power network or additional peak-capacity supply and optimize the system (see the example in the appendix on European smart charging).

Strategic opportunities across passenger and freight

Most interventions apply to moving both people and goods since electric vehicles are charged from the same power grid, which means that investments in grid integration benefit many outcomes. These interventions include creating public, workplace, and multi-family dwelling charging; grid considerations (timing, storage); and financing options.

- **Large-scale public financing for and utility investment in charging infrastructure** (e.g., green bonds, Europe’s Alternative Fuels Infrastructure Directive, multilaterals prioritize zero-carbon mobility). Engage electrical utilities as powerful allies
- **Fast (Level 2 and 3) charging infrastructure** (home, workplace, public spaces, hubs) by owners, companies, cities, states & utilities
- **Charging deployment planning**, including cost effective deployment strategies and accessibility (e.g., information on location, availability and suitability of charge points for consumers)
- **Integrated/optimized approach to power and transportation management**, such as smart charging (timing), EV-grid integration with renewables (storage), EV-ready power grids (capacity), and rate design
- **Financial charging infrastructure (Electric Vehicle Supply Equipment, EVSE) incentives**
- **New rates and regulations regarding EV-ready grids/new utilities business models** [U.S.: Rate-base charging to pay for infrastructure]
- **Battery life cycle research and related policies**, such as battery recycling requirements and second uses
- **Sustainable source fuel regulations** (e.g., low carbon fuel standards, Fuel Quality Directive), which can include supportive financial mechanisms such as reverse auctions to provide certainty for investments in EV charging
- **EV-ready buildings** (especially multi-family buildings) and other **supportive infrastructure rules** and friendly siting rules

Passenger

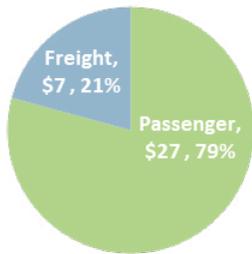
- **Equitable charging infrastructure** plans, including charging in communities with lower incomes and those of drivers (e.g., mobility service companies)
- **Bus charging infrastructure** (transit hubs, other) by local governments, transit operators. Buses are medium-duty vehicles that are ready to fully electrify now. To do so will require establishing more charging infrastructure and rollout plans (e.g., locations, types, uses).

Freight

- **Freight hubs** include charging/re-fueling. Integrating charging into freight hubs will have immediate and measurable impacts.

C. Increased demand that complements strong regulations

Demand \$35M/year



Outcome: Governments, cities, and businesses demonstrate demand through fleet commitments, and individual buyers commit to purchasing electric vehicles.

Ultimately, businesses, governments, civil-society advocates, and people must demand electric-drive vehicles and make the decision to buy them. Currently, EVs cost more to produce than ICEs, leading to higher purchase prices. However, as the market expands through strong policies, battery costs will fall and mass production and dedicated EV manufacturing platforms will reduce prices. Soon EVs will be less expensive (within the next 5 years) and more profitable (soon after) than combustion vehicles. Government policies can drive down costs through supply-side regulations like ZEV (or New Energy Vehicle) mandates, rules on Advanced Clean Trucks, and strong CO₂ regulations (as described in Section A). Beyond regulations, other policies can help improve affordability and increase demand for EDVs and generate a positive feedback cycle to manufacturers, as signs of demand encourage more supply.

Venues include businesses, national, subnational (e.g., state), and cities. Through setting ambitious decarbonization goals, leaders can drive the adoption of aggressive policies. Cities and businesses can increase pressure at higher levels (state, national, other cities and international city platforms).

Regions: Cities in Europe and China are likely to be the most aggressive on policies (e.g., clean air zones or banning diesels or combustion engines in city centers), U.S. and European cities are likely to engage on public procurement of EVs or zero emission ports/transit nodes, and emerging economy cities can have the potential for strong fiscal policies or regulations (low emission zones or controls on new vehicle sales).

Strategic opportunities across passenger and freight

- **Encourage green recovery incentives for ZEV manufacturing (vehicles and batteries)**
- **Garner government and fleet commitments to fully electrify** light-duty vehicles, buses, freight trucks, and other (all) vehicles. High-level commitments and coordinated global or multi-regional efforts, such as the International ZEV Alliance, Global Fuel Economy Initiative, or clean bus declarations, are particularly powerful. Pricing policies also can spur change for people and goods movement.
- **Cultivate multinational companies as allies to set aggressive ZE transportation (ZET) goals**, transparently report on emissions, commit to fully electrifying their fleets, roll out ZE cars and trucks, and support aggressive ZE policies
- **Engage with vehicle manufacturers to set science-based and zero emission targets – and engage investors/shareholders to demand such targets** (for more on investors, see *i. Foster a strong ecosystem for a rapid transition*)
- **Support pricing policies** (CO₂-based registration fees and road tolls, taxation, VKT fees, mobility or GHG pricing or congestion charges, parking policies, elimination of fossil fuel subsidies and fuel tax exemptions, fuel taxes, EV road access, license-plate control, feebates). Cities can be test beds for strong financial policies to encourage low emission choices and discourage unnecessary or high CO₂ trips. Road CO₂, vehicle-travel charges, and fuel taxes can help businesses make low-carbon decisions, and revenues from these can support clean transportation incentives or public transit.
- **Facilitate financing and new business models** on total cost of ownership

Passenger

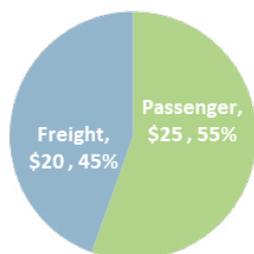
- **Support industry policies** (subsidies or tax credits for clean vehicles production, batteries)
- **Purchaser incentives or subsidies** (EV car, small truck, and bus rebates; tax incentives; registration; buyback of old ICEs) by cities, states, and national governments (“carrots”)
- **Public and private fleet EV car, small truck, and bus procurement commitments** (Climate Group EV100, C40 EV city-bus fleets declarations). *Note that fleet regulations were covered in (A).*
- **Expand consumer awareness** beyond early adopters through smart communications campaigns and activities like ride-and-drives that provide experiential learning
- **Electrified transit systems** (bus, BRT, metro, rail) and financing solutions. City design can consider future transportation needs such as public EV charging stations and plan for logistics centers, transit hubs, and large capacity inter-city and urban electrified public transit.
- **Electrify shared-use mobility** vehicles incentives and practices by companies and public fleets to buy/use EVs
- **China/India:** 2- and 3-wheeler electrification (policies, incentives)
- **EV-only parking**

Freight

- **Garner powerful multinational company allies**, including parcel companies, shippers, and fleets (e.g., Walmart, Lowes, NIKE, Best Buy, DHL, Hewlett-Packard, or IKEA) to set fleet procurement commitments and scale fleet of ZE trucks
- **Cultivate ZE truck manufacturer as allies** to show support, demonstrate viability and OEM commitment
- **Truck purchase incentive**, tax rebate, or subsidy
- **ZEV ports** (sea ports, multimodal facilities, railyards, and warehouses), model pilots, and emission control areas (trucks, note these also affect ships). Creating clean, zero-emission ports (where goods movement vehicles and machines are electric or zero-emission, and which can also extend to ships) helps reduce concentrated emissions from cargo equipment, trucks, and ships, and see improvements in air quality and health. Emission control areas reduce port emissions.
- **Highway tolls** can encourage freight efficiency and be designed to favor cleaner trucks.
- **Develop supportive policies** (e.g., weight exemptions)

D. Foster a strong ecosystem for a rapid transition

Ecosystem \$45M/year



Outcome: More diverse and stronger support with new allies (including environmental justice groups, businesses, utilities, labor, health advocates, and investors) builds broad support and pressure for strong action.

New and diverse audiences – including frontline communities in polluted cities, environmental advocates, health advocates, workers, businesses, investors, utilities, voters, and the public – are essential to develop broad and deep support for enduring change that can withstand shifts in environments or will. These new alliances and coalitions are needed at all levels—local, city, state, national, international, public—and the support must extend beyond the first movers and include unlikely places.

Justice, equity, diversity, and inclusion: Prioritizing justice, equity, diversity, and inclusion (JEDI) is essential if the world is to achieve lasting change and accelerate the speed and ambition of that change. Elevating JEDI builds strong coalitions, improves interactions between partners, and leads to durable policies. Prioritizing JEDI means that all organizations are

inclusive in their work, and communities have representation in decisions and relief from pollution. While good examples exist of engaging local communities, there are still significant gaps when it comes to collaborating with local communities, many of whom bear the brunt of pollution. Depending on the geography and issue, these communities can be Black, Indigenous, Asian, and other races (40% of the U.S. population), low-income or at risk of social exclusion (20% Europe, 12-29% U.S.), rural communities, and workers (e.g., manufacturing, charging, and truck, bus, and shared mobility drivers) (see Figure C12 for demographics). Frontline communities are deeply invested in safeguarding health; providing connectivity to jobs, services, and education; seeing affordability EVs with cost savings; equitable charging access; and transport-related jobs (see Figure C14). Prioritizing JEDI in transportation can lead to better solutions and more ambitious actions, including equitable charging infrastructure investments, creating green jobs (and just transition training) in local communities, expanding incentive programs, and more. *Note that in addition to the strategic focus on JEDI described here, Hewlett prioritizes expanded capacity to improve justice, equity, diversity, and inclusion within all of our grantee organizations, including groups focusing on environmental justice, but also within groups focused on policy, research, outreach, etc. (see the next Section i. Strengthen grantee capacity, justice, equity, diversity, & inclusion).*

Jobs, economy, and labor: The transition to EVs can generate new jobs and savings for individuals and society, advantages that must be highlighted. New technologies can cause worry about changes in employment, as electrification affects vehicle and supply chain manufacturing; port workers; truck, taxi, and mobility service drivers; even gas station employees. Positively, as introduced above, transportation electrification can produce new jobs—directly through ZEV and battery manufacturing, indirectly through charging infrastructure, and through increased spending on other manufactured goods and services. These green jobs can activate new labor allies, including electrical workers for charging infrastructure, as well as auto worker unions. To recruit the support of workers and unions, it is critical to emphasize new opportunities and retraining, if needed.

Finance and investors: Philanthropy can support partners and coalitions to engage financial institutions and also encourage more public-private-civil society collaboration. More collaboration can galvanize the innovation of private sector solutions to meet public sector needs. Institutional investors can shift their portfolios away from fossil fuels and companies invested in combustion and bring shareholder pressure on incumbent vehicle manufacturers to accelerate their EV investments and align their actions on policy accordingly. As an example, in the U.S., [28 investors signed a letter](#) aimed at the Biden Administration to double climate ambition, paired with 300 business leaders.

Communications: Strategic communications are essential to establish the narrative, put out positive communications, fight opposition, reach important audiences, find key messengers, help overcome opposition from incumbent interests, raise awareness about the economic and health benefits of EVs, and educate consumers and drive enthusiasm about zero emission vehicles.

Complementing this work is **research, sharing knowledge, and strategic and compelling communications** to push back against opposition.

Strategic opportunities across passenger and freight

- **Create and expand diverse coalitions** with environmental justice, local communities, health (doctors), jobs and labor (unions, drivers, electrical workers), air quality, economics, and equity. Support coalitions (and diverse stakeholders) to set long-term zero emission road transportation policy targets for both passenger and freight.
- **Prioritize JEDI within coalitions.** Looking at strategic work, groups can focus on five themes to integrate justice, equity, diversity, and inclusion: A) Define and listen to key partners & audiences, B) Become trusted partners, C) Support community groups over the long term, D) Collaborate to set priorities, and E) Jointly advocate for change. Complementing these themes, groups devote time to forging relationships, use internal diversity to engage others, develop outreach materials for communities, and use the right language and messages with the right audiences; seek input to understand where engagement is most relevant; and directly engage communities. See Figures C14 (details on stages) and C16 for more details.
- **Mobilize communities, amplify the voices of those affected by pollution, and encourage public pressure and engagement to demand policies** that improve their health and the planet
- **Build investor and finance support of ZEVs and charging infrastructure.** Engagement can be directly with financial institutions to set policies, or indirectly through pressure to incorporate climate into financial lending decisions. For instance, indirect pressure on bond rating organizations could ask for the incorporation of climate risk into debt and equity of manufacturers.
- **Fund strategic communications** at regional and global communications firms, as well as within grantee organizations
- **Share knowledge** through platforms and networks, including best practices (e.g., from demonstration and pilots) to facilitate faster scaling, and policy approaches from leading governments that have proposed or enacted strong electric vehicle standards
- **Encourage public-private cooperation** (Transportation Network Companies)
- **Engage consumer groups to put pressure on supply chains**

E. Hewlett: Strengthen grantee capacity, including justice, equity, diversity, & inclusion

Hewlett approaches grantmaking with an eye toward building long-term capacity. We prioritize justice, equity, diversity, and inclusion within all of our grantee organizations. This includes groups focusing on environmental justice and also grantees core to our strategy that focus on policy design, research, business outreach, and policymaker engagement.

Hewlett-specific grantmaking focuses on the national and international levels while continuing to rely on regional partners (including multiple potential re-granters by region) for detailed and sub-regional work.

Approach

- To strengthen capacity, Hewlett's grantmaking **prioritizes providing general operating support and multi-year grants**, where possible.
- We support all grantees **to advance justice, equity, diversity, and inclusion within their organizations**, including the following types of actions: 1) Start a dialogue and facilitate introspection, 2) Institutionalize commitments, 3) Be intentional with programmatic work, and 4) Continually improve and track progress (see Appendix C for more on these steps). This support can be incorporated into regular grants and also be applied through designated organizational effectiveness grants focused on DEI. *Note that we also prioritize JEDI in strategic work, as described under Ecosystem (Approach i).*
- In addition to specific support, Hewlett also supports JEDI through **improved relationships between grantees**, increasing technical skills and knowledge (e.g., among environmental justice focused groups), and removing other barriers.

F. Hewlett: Support fundraising from partner philanthropies

Hewlett's spending on transportation is roughly \$21 million per year; over the past few years, total annual funding for transportation has been ~\$70 million per year from known philanthropic funders. There is a significant overall funding gap. Working with partner funders to scale philanthropic investment in zero emission transportation is a key part of this strategy. Our goal is to catalyze at least \$200 million per year to advance zero emission transport. In the next few years, we aim to recruit at least 5 new or existing funders that increase their support for zero emission transportation by \$5M+ per year.

Fundraising approach

In 2020, we created and shared common resources for fundraising, including a summary presentation. Further activities to scale philanthropic funding include:

- **Fundraise by working with the Climate Leadership Initiative (CLI)** to present the opportunities and turn excitement into committed funds for zero emission transport. This involves reaching out to foundations and high net worth individuals through multiple channels.
- In the longer term, **collaborate with funders** to 1) Track the funding landscape and gaps by topic, region, and grantee, 2) Support multi-regional platforms and regional climate foundations, 3) Share information on grantees, and 4) Consider funding through existing intermediaries or pooled funds.

Funders already funding transportation electrification,

beyond Hewlett, include Tempest Advisors, Heising Simons Foundation, IKEA Foundation, Children's Investment Fund Foundation, Oak Foundation, Climate Imperative Initiative, Bezos Earth Fund, Sequoia Climate Fund, and others.

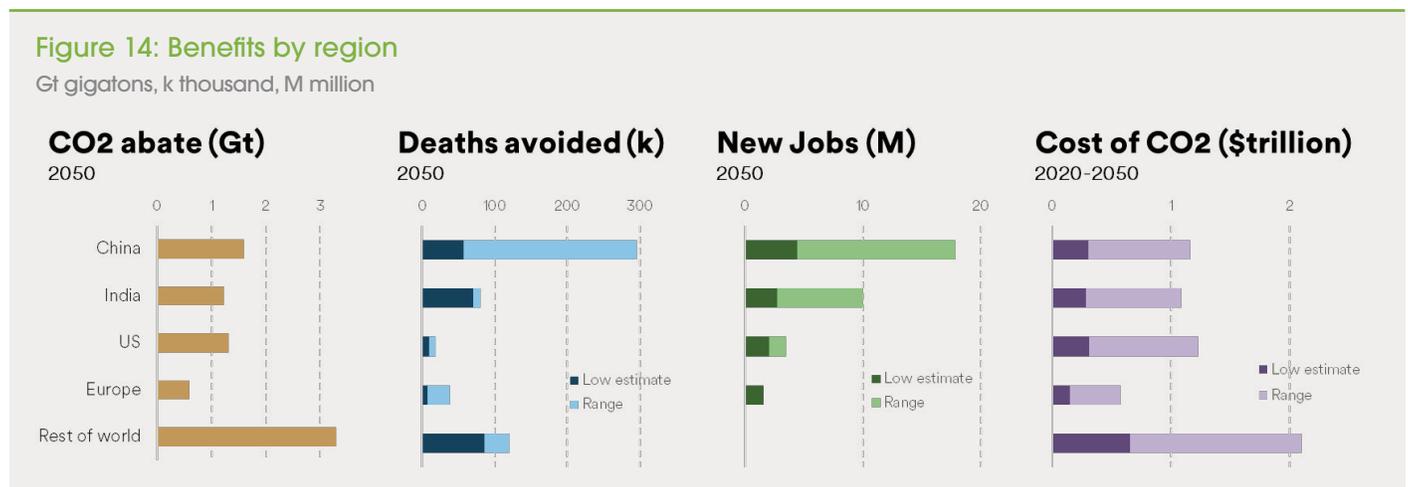
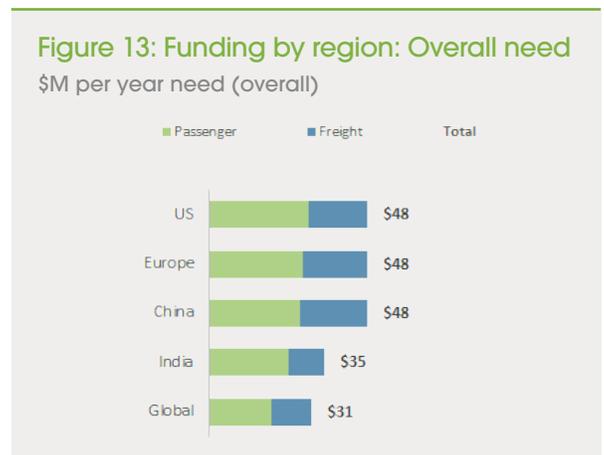
Additionally, regranteeing funders include ClimateWorks Foundation, Energy Foundation (U.S.), Energy Foundation China, European Climate Foundation, Shakti Sustainable Energy Foundation, and the Electric Mobility Initiative, and these regional re-granters also have access to more local funders.

3. Priority geographies

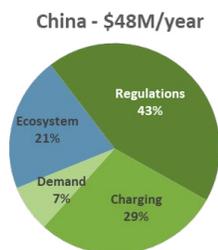


Per the Climate Strategy refresh in late 2017, going forward, Hewlett will focus on the U.S., Europe, China, and India, complemented by global (cross-national and multilateral) efforts that can support other regions. These four key regions represent over 70% of market demand for new vehicles, over 70% of the world's production of vehicles, and 60% of the CO₂ abatement potential in 2050. Additionally, fuel and vehicle standards developed in these key regions have historically been adopted in other regions, and world-leading examples such as Europe's strict criteria pollutant standards, China's New Energy Vehicle policy, and California's Advanced Clean Trucks rule show that leading ambition can inspire others to act. Consequently, these regions can also play an important pioneering role in policy. Therefore, by catalyzing change in these four major markets, philanthropy, civil society, and partners can have a global impact.

Figure 13 shows the estimated annual funding need and Figure 14 shows the climate, health, and economic benefits of the climate action.



China



China is an essential region because of its high and growing emissions, the potential to reduce emissions, spillover benefits to the world in terms of reduced ZEV costs, health/air quality concerns, economic development interests for manufacturing ZEVs, proven actions to spur ZEVs, and recent announced ambition to reach carbon neutrality before 2060. The Chinese market comprised 32% of vehicle sales in 2020, the largest vehicle market in the world. China is poised to grow its market share significantly, having grown from having ~ 13% of total vehicles registered worldwide in 2015.

Climate: China has the opportunity to leapfrog combustion vehicles (its rapidly urbanizing car density could increase five-fold by 2050²¹). Incentives for achieving zero emission transportation include reducing harmful emissions (very high emissions abatement potential of up to 1.6 Gt CO₂/year in 2050, ~20% of global abatement), improving air quality and reducing current health problems, and achieving status as a world leader on technology. Today, passenger travel contributes ~60% of emissions, but because of a dramatic rise in freight emissions (nearly triple today), the share of passenger travel will be 30% in 2060; without actions, total road transport CO₂ emissions are on a pathway to increase 35% by 2050.²²

Health: In China, transportation is currently responsible for ~6% of all PM_{2.5} emissions and ~33% of NO_x emissions.²³ There are ~760,000 cases of asthma per year. China has very poor air quality – with PM_{2.5} reaching four times guidelines established by the World Health Organization. A widespread transition to ZEVs could nearly eliminate transportation emissions, thereby saving 55,000-300,000 lives annually in 2050.²⁴

Industrial policy, jobs and economics: China has an extremely strong desire to increase economic competitiveness and has succeeded in becoming a leader in battery and EV manufacturing to date, in part through the use of **industrial policy** created to ensure that China provides the clean technology of the future. China has the largest market for electric two/three wheelers, cars, buses, light-duty delivery trucks, rail, and bikes, and the market is increasing dramatically. The country has been the global leader with the greatest growth in electric vehicle sales for several years – 47% of world’s electric cars and 90% of electric buses and trucks are in China. Over ten years ago, China prioritized developing electric vehicles to become a global technological leader. Officials refined industry policy through pilot programs. China’s most rapid industry and market growth (2013-2017) were driven by aims to revitalize the auto industry, as well as to improve air quality and oil security. In 2001 and 2006, policies identified “New Energy Vehicles” in Five Year Plans (for economic and social development), demonstrating foresight and desire to succeed in ZEV markets. In 2009, China created an Auto Industry Adjustment & Revitalization Plan. More plans followed: NEV Development Plan (2012-2020), Accelerating the Promotion & Application of NEVs (2014), a “Made in China 2025” policy (2015), and a Medium- & Long-Term Development Plan for the Automotive Industry (2017). Throughout, China passed regulations and standards, provided fiscal incentives, and piloted programs to advance ZEVs, especially in government and public fleets. China has produced the largest number of EVs over the past decade, though Chinese brands are not widely embraced by the global market (exports are lower than EVs made in the U.S. or Europe). A future transition to 100% ZEVs could create lead to significant additional jobs in local manufacturing (ZEVs and charging), providing electricity/fuels, and also deliver an induced benefit in increased services totaling 2-2.5 million new jobs by 2030, and 4-18 million new jobs by 2050 (*rough estimates*²⁵). Cumulatively between 2020-2050, China could save up to \$1.2 trillion in avoided climate damages.

Policy momentum and drivers: China is committed to aggressive action as evidenced by its stated ambition to reach carbon neutrality before 2060 and carbon peaking before 2030. China’s Blue-Sky National Action Plan, world-leading New Energy Vehicle (NEV) policy (which requires up to 5 million cumulative EVs by 2020 and 20% sales by 2025), charging infrastructure policies (more than 4.8 million charging poles as the target), and NEV industry development plan exemplify the country’s commitment. It also has fiscal policies including national and local subsidies and national tax exemptions, and non-fiscal measures like a national ZEV mandate for cars, local low-emission zones, license-plate restrictions for traffic, and the control of annual incremental license plates, all of which can rapidly advance EV markets. In addition, growing congestion and air quality concerns have elevated public transit to a national priority and galvanized initiatives to consider traffic demand management policies (congestion charging, parking management) and control of vehicle sales.

Geographies

China’s strong national policy potential (historical successes) mean that there is a stronger focus at the highest levels of government. Specific regions in China can also demonstrate very fast action, such as megacities like Beijing and Shanghai, which have led on preferential licensing for EVs, and Shenzhen’s quick electrification of buses, taxis, and urban logistic vehicles, or Hainan Province’s ban of fossil fuel vehicles by 2030.

Map shows Clean Diesel Action Plan regions



Challenges: China is reluctant to join international agreements that commit to an increasing share of EVs. China can have low-quality EV supply (both the vehicles and the batteries) leading to concerns about durability and safety. Different ministries have responsibility over different types of regulations or incentives and can send inconsistent messages. China lacks detailed carbon inventories. There is a lack of confidence and alignment regarding heavy duty vehicles and goals between policymakers, different ministries, and advocates. Finally, China's electric vehicle transition faces barriers common across regions.

Strategic opportunities.

Working with our key grantee the Energy Foundation China (EFC), below are examples of zero emission road transportation strategic opportunities that grantees are interested in pursuing in China.

Passenger

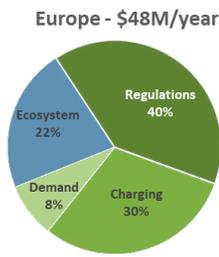
- **Regulations:** Continue to enhance the New Energy Vehicle (NEV) regulation requiring electric passenger vehicles to make up 50% of new vehicle sales by 2030 and all public service vehicles being electric by 2035. Promote national and local environmental policies including air pollution control and carbon mitigation, and adopt ambitious electrification fleet regulations for ride hailing and public vehicles. Strengthen compliance. Support cities to expand green logistics zones (or zero-emission zones).
- **Charging:** Expand infrastructure planning, funding, siting, and implementation, and pilot electrified highway corridors. Increase grid capacity to support fast and large-scale EV penetration. Update tax policy and price of fuel and electricity. Work closely with ministries and stakeholders to advance renewable energy to cleanly power electric vehicles. Mobilize and direct government recovery funding toward charging infrastructure.
- **Demand:** Change the license plate control policies to favor ZEVs, and implement strict pricing policies (e.g., congestion charging, parking fees) and other controls. Support the government to create a diesel and gasoline reduction target. Influence consumer behavior and demand for EVs in cities.
- **Ecosystem:** Engage policymakers in the key national ministries of industry, environment, transport, development, energy, finance, and urban development. Use arguments around air quality, health, climate change, oil security, auto industry competitiveness, and dirty diesel, to encourage effective enforcement of polluting vehicles. Share information with and build capacity of key stakeholders, engage and educate the public, and increase strategic communications.

Freight

EFC began addressing freight and goods movement 3-4 years ago focusing on mode shift to rail (aiming to increase the share by 10%) and reducing empty miles (by 25%). In 2019, EFC significantly ramped up efforts on zero-emission freight. *Please see the full freight strategy for more details.*

- **Regulations:** Support the government to create a New Energy Vehicle (NEV) mandate for zero emission trucks (e.g., 5-40% new sales BEV by 2030 by segment) and pursue fleet regulations for logistics operators. Promote national and local environmental policies including air pollution control and carbon mitigation, and adopt ambitious electrification demand targets for bus, post-office truck, and sanitary truck etc. Support the Hainan Province government to create truck regulations. Support cities to expand green logistics zones (or zero emission zones).
- **Charging:** Expand infrastructure planning, funding, siting, and implementation and pilot electrified highway corridors
- **Demand:** Support the government to create a diesel reduction target. Support the government to sustain the fiscal incentives longer considering the technology maturity.
- **Ecosystem:** Cultivate corporate allies and ZE truck fleets, encourage ambitious truck manufacturers to influence policies, create a zero-emission freight coalition. Share information with and build capacity of key stakeholders, engage and educate the public, and increase strategic communications.

Europe



Europe is a key region because of its climate leadership, proven action on transport, and unique cross-national political structure. The region has a commanding role to play to advance the world toward a tipping point of Zero Emission Vehicle sales. The European market represented 18% of all vehicle sales worldwide and produced 22% of the world’s vehicles in 2020; as manufacturers make EVs in their home market they are likely to want to scale and export EVs worldwide.

Climate: Europe has a moderate emissions abatement potential of up to 0.6 Gt CO₂/year in 2050 (~7% of global abatement). Today, passenger travel is ~60% of emissions, but will drop to 45% in 2060 as freight expands.

Health: In Europe, transportation is currently responsible for ~9% of all PM_{2.5} emissions and ~50% of NO_x emissions.²⁶ A widespread transition to ZEVs could nearly eliminate transportation emissions, thereby saving 38,000 lives annually in 2050.²⁷

Industrial policy, jobs and economics: ZEVs can create 0.5-1 million new jobs in 2030, with large increases from operation and maintenance of electric vehicle supply equipment and induced benefits via increased services, and 1.5 or more million new jobs by 2050.²⁸ Germany is especially impacted by the transition because of the importance of the car and truck industry for the country, and France follows. Additionally, Spain, Italy and some Eastern European countries are dependent on the decisions that are being made by the big vehicle manufacturers in Germany and France and don’t have their own manufacturers. Vehicle manufacturers across Europe are declaring interest in and vision toward 100% zero emissions. Cumulatively, between 2020-2050, Europe could save up to \$600 billion in avoided climate damages.

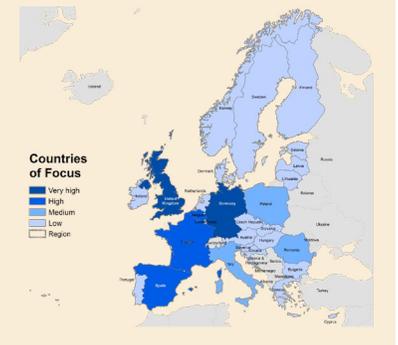
Equity, inclusion, diversity, and justice: Traditionally, Europeans have been much more focused on equity through an anti-poverty lens, and efforts to address JEDI broadly are just beginning. From a low-income lens, communities tend to split along eastern and western Europe, or rural and urban areas. Currently, ~21% of the population (112 million people) experiences social exclusion.²⁹ The public is increasingly aware of existing and rising racism, and there is a growing need to include race to serve disadvantaged communities.

Policy momentum and drivers: In Europe, great support for climate action already exists across many levels—regionally, at the country level, cities, with the public, and in businesses. The EU Commission’s “Climate Law” has proposed a 55% emission reduction by 2030 (from 1990 levels), and the European Green Deal aims for a 90% transport emissions reduction by 2050. Success will rely on completely eliminating reductions in road transportation emissions (the remaining few emissions being aviation and shipping). Europe has set the world’s strongest CO₂/km standards for cars (~62 g/km in 2030) that are forcing zero emission (mostly electric) vehicles into mainstream. By July 2021, the Commission will revisit and strengthen the 2030 CO₂ standards for cars and vans; by 2022, the Commission will revisit the CO₂ standards for trucks (the expected timing is a proposal in summer 2022 and negotiations lasting through 2023). The Commission “will also assess what would be required in practice for [transport] to contribute to achieving climate neutrality by 2050 and at what point in time internal combustion engines (ICE) in cars should stop coming to the market.” Europe has a growing mandate to address air quality and prioritize health in cities as illustrated by low emission zones in many cities and commitments to establish zero emission areas. There are strong actions in Germany (where the green party is set to join the government in autumn 2021), Belgium, France, the United Kingdom, and the Netherlands. Other actions include high taxes on fossil fuels, rapid power sector decarbonization (with world-leading targets of 80% zero emission by 2030), a conducive environment to push low-carbon fuels (e.g., renewable energy directive), and cities with high ambitions. Europeans are also not afraid to litigate to see results, such as the Volkswagen Dieselgate scandal, and courts have upheld up the rights of cities to create zero emission areas. The vehicle industry is increasingly interested in ZEVs, and many have made a ‘fossil-free’ pledge by 2035-2040 (including Volvo, Daimler, and Volkswagen).

Geographies

Action across Europe has a high potential in the European Commission, which can set ambitious vehicle policies.

Crucial venues are the European Union and the United Kingdom. Key member states include those calling for the phase-out of the combustion engine: Germany, Denmark, Netherlands, Austria, Belgium, Greece, Ireland, Lithuania, Luxembourg, and Malta. Scandinavia, especially Norway, are important leaders. Other key states include France and Poland. Progressive cities are also important, including Berlin (Germany); London (UK); Paris (France); Amsterdam and Rotterdam (Netherlands); Barcelona and Madrid (Spain); Rome and Milan (Italy); Oslo (Norway); and Warsaw (Poland).



Challenges: In addition to the barriers and opposition common across the world, Europe has a strong fossil fuel lobby (oil and natural gas) and has mixed experience with automakers and their related jobs and economic impact—they can be significant opposition, but some are becoming more reliable allies (such as Volkswagen, Scania, Renault, and others). Opponents to ZE transportation in Europe worry about job losses in the transition to zero emission vehicles (public and union opposition) and include right-wing and conservative parties, and concerns about costs and equity impacts (especially for communities with lower incomes). Another risk is that industry players (especially some suppliers and the oil and gas industry) are pushing for plug-in hybrids to be counted towards meeting the CO₂-standards (for cars and trucks), which would keep the door open for ICE technology. Finally, higher ambition is required to meet European climate targets.

Strategic opportunities.

Working with our key grantee the European Climate Foundation and close partners of ICCT and Transport and Environment (T&E), below are examples of ZE road transportation strategic opportunities that grantees are interested in pursuing in Europe. Across both passenger and freight opportunities are:

- **Green recovery:** Advance EVs through the Green New Deal
- **Combustion vehicle or diesel engine bans and Zero Emission / City Clean Air Areas** (e.g., C40's Green and Healthy Streets Initiative or European Clean Cities Campaign)

Passenger

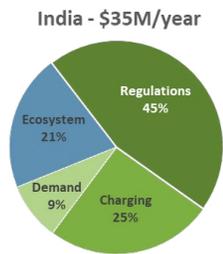
- **Regulations:** Defend, improve, and enforce CO₂ standards. Hold governments, automakers, or cities accountable when they fall short of emission standards (i.e. Dieselgate), air quality protection, or climate plan agreements. Support cities to implement Clean Air (zero-emission) areas, garner mayoral buy-in, and support implementation of ambitious actions.
- **Charging:** Explore public-private financing for electric vehicle charging equipment. Spur infrastructure development in workplaces and to serve multi-unit dwellings (in cities). Equitable charging infrastructure development, including expanding charging in communities with lower incomes and those of drivers (e.g., mobility service companies). Use smart charging to maximize renewable energy.
- **Demand:** Build a corporate fleet campaign, taking advantage of the fact that ~60% of all new car sales go to corporate fleets and that fleet managers care about total cost of ownership in ways most consumers do not. Strengthen demand-side policy, especially in fleets, taxis, shared vehicles, and delivery vehicles. Improve Total Cost of Ownership (TCO) of EVs by introducing higher taxes, feebates and fuel costs for gas-guzzlers. Phase out internal combustion vehicles in some member states. Mobilize EV owners in policy debate, such as in Norway where the EV Drivers Associations helped break down prejudices against EVs and improved EV policies.
- **Ecosystem:** Support diverse passenger vehicle coalitions including consumer groups, health groups, business groups, and labor, and improve communications to highlight benefits to consumers, the environment, the economy, and industry (emphasizing jobs and European automaker competitiveness); an example platform is the Platform for Electromobility.³⁰ Expand communications and myth busting, and highlight oil's negative impact on climate, health, and regional energy security. Make the economic case for shifting away from oil by eliminating oil imports, which make up 90% of Europe's oil needs. Promote labor and equity benefits, supported by research.

Freight

Please see the full freight strategy for more details.

- **Regulations:** Support the European Commission (EC) to strengthen the CO₂ targets in the mid-term review for trucks CO₂ standards in 2022, with the potential for a ZE truck mandate or credit. Increase criteria pollutant standards with Euro VII. Support cities to implement Clean Air (Zero Emission) areas.
- **Charging:** Support the EC to incorporate ZE truck infrastructure in the Alternative Fuels Infrastructure Directive³¹ and explore public-private EVSE financing.
- **Demand:** Support the EC to incorporate ZE trucks into the Clean Vehicles Directive, a public purchasing program. Expand cross-national and domestic highway tolling based on CO₂.
- **Ecosystem:** Build the European Clean Trucking Alliance, including ~25 leading companies (expected ~30 by the end of 2021) focused on creating demand and advancing ZE freight. Foster early corporate adopters and build relationships with truck makers. Roll out National Truck Platforms in Germany, Denmark, Spain, Italy, France, Poland, and the UK; these platforms include representatives from government, truck makers, charging companies, fleets, advocates and others and will dive into truck models, infrastructure requirements, and cost of ownership.³² Expand communications and myth-busting.

India



India has the ability to leapfrog vehicle ownership (and production) into ZEVs and is the key region with the largest combination of projected population and vehicle growth (it is undergoing rapid urbanization and motorization). India is concerned with economic competitiveness (and industrial policy), air quality, health, emissions, and energy security.

Climate: India has a very high emissions abatement potential of up to 1.2 Gt CO₂/year in 2050 (~15% of global abatement). Vehicle

ownership rates will dramatically increase. Today, passenger travel is ~55% of emissions, and will drop to 50% in 2060 as freight and passenger travel expand.

Health: In India, transportation is currently responsible for ~8% of all PM_{2.5} emissions and ~45% of NO_x emissions.³³ India has extremely poor air quality—over eight times the World Health Organization guidelines for PM_{2.5}. There are ~350,000 cases of asthma per year. A widespread transition to ZEVs could nearly eliminate transportation emissions, thereby saving 70,000-80,000 lives annually in 2050.³⁴

Industrial policy, jobs and economics: Policies aimed at ensuring India can manufacture the batteries and electric vehicles of the future are critical. In 2014, India established a “Make-In-India” initiative encouraging manufacturing of products in India with the goals of job creation and economic competitiveness. The government has a blueprint to create a specialized workforce to support the electric mobility mission. Local vehicle manufacturing is expected to double by 2040, and it is essential to ensure this new capacity is for electric vehicles. One essential area is the country’s battery manufacturing; under the National Energy Storage Mission, manufacturing EV batteries could be worth **\$300 billion over the next twenty years**, providing 25-40% of global EV battery demand by 2030. A transition to ZEVs can lead to significant jobs in manufacturing (ZEVs and charging), providing electricity, and an induced benefit in increased services, totaling up to 0.3-1 million new jobs by 2030, and 3-10 million (or more) new jobs by 2050 (*estimates*³⁵). Cumulatively between 2020-2050, India could save up to \$1.1 trillion in avoided climate damages.

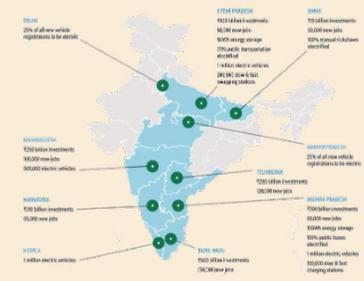
Policy momentum and drivers: The government has strong high-level support for electrification and is prioritizing domestic manufacturing of EVs and components (e.g., batteries) for India’s use and for export, and supports mobility for all. Existing efforts focus on maximizing public benefits, such as expanding electric buses, electric taxis, electric two-/three-wheelers, and electric urban logistic vehicles.

Challenges: In addition to the barriers and opposition common across the world, India has also seen mixed messages on ambition at the highest levels —national leadership lacks a central roadmap to vehicle electrification, provides inconsistent policy signals, and is encouraging multiple fuels pathways (including fossil fuels). With the exception of electric 3-wheelers, India has limited EV model availability, especially among cars and trucks. The availability of few critical raw materials and the slow pace of Tier-1/component manufacturers in India often limit the number of current models available. Opposition to zero emission vehicles in India comes primarily from the incumbent domestic auto industry (e.g., through the Society of Indian Automotive Manufacturers), a significant concern given its large manufacturing presence (generating 50% of manufacturing GDP).

Geographies

National efforts are important to consider the highest level supply policies and to support domestic manufacturing. In addition to the national initiatives, efforts in India are increasingly at the state level. Delhi has ambitious ZEV policies (including light commercial vehicle electrification), and there is increasing action in most states to create and implement EV plans. Examples include progress in Gujarat, Kerala, Tamil Nadu, Andhra Pradesh, Karnataka, Uttar Pradesh, Telangana, and others.

Map shows state EV policy targets



Map source:

https://www.wricitiesindia.org/sites/default/files/Full_report_EV_State_Policy.pdf

Strategic opportunities.

Working with our key grantee the Shakti Sustainable Energy Foundation, the related Electric Mobility Initiative (EMI), and other grantees, below are examples of zero emission road transportation strategic opportunities for India. Across both passenger and freight opportunities are:

- **Promote and push for new vehicle manufacturing (OEM and direct Tier 1 suppliers) to be electric vehicles** through national and state policies and incentives
- **Ecosystem: Build, demonstrate, and communicate the strong link between people, health, and air quality**, and use this to drive policies and faster adoption of electric vehicles at all stakeholders/levels

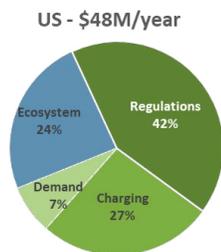
Passenger

- **Regulations:** Implement ZEV policies and regulations for passenger cars to increase model availability. Establish state manufacturing requirements and policy incentives (regulatory, fiscal and non-fiscal) to spur greater investment by manufacturers. Support key cities to create urban access restrictions.
- **Charging:** Electricity tariff/rate design, guidelines and planning frameworks to deploy EV charging infrastructure, guidelines for installation of charging infrastructure to expand deployment, encourage renewable power integration (e.g., smart or time of use charging, batteries as energy storage systems).
- **Demand:** Provide input on incentives such as FAME2 (national fiscal incentive), state-level incentives, and innovative business model policies. Support key cities to implement pilots, such as low-carbon zones and pricing policies (parking).
- **Ecosystem:** Support Electric Mobility Forum convenings to increase technical expertise among key stakeholders and integrate communications strategy (better engaging media and stakeholders, counter myths, raise awareness). Convene key NGOs and partners to clarify roadmaps and milestones, deploy strategic communications, and share knowledge (e.g., vehicles, infrastructure).

Freight

- **Regulations:** Develop fuel economy standards for heavy-duty trucks by 2024 that drive electrification or a possible stand-alone ZET regulation. Explore state-based approaches to promote ZE trucks through air pollution control areas, ZEV quotas in state-level fleet procurement rules, and preferential ZEV permitting of commercial vehicles. Support state & city fleet requirements (e.g., for garbage trucks). Support cities to create urban access restrictions.
- **Charging:** Improve utility readiness for infrastructure, establish public investment in infrastructure, and support siting of infrastructure. Demonstrate an inter-city freight corridor between two major cities.
- **Demand:** Implement and learn from Deliver Electric Delhi and share lessons. Support governments to waive registration fees and road taxes for zero emission trucks. Encourage large freight mover commitments.
- **Ecosystem:** Cultivate corporate allies (ecommerce, shippers, logistics) and ZE Truck fleets, encourage local truck manufacturers to make ZE trucks. Convene key NGOs and partners to clarify roadmaps and milestones, Deploy strategic communications. Share knowledge (e.g., vehicles, infrastructure).

United States



The U.S. is a key region because of its high emissions, abatement potential, vehicle purchases, and world leadership from state to federal levels, especially elevated by the Biden Administration's attention to address climate and advance electric vehicles.

Climate: The U.S. has a high emissions abatement potential of up to 1.3 Gt CO₂/year in 2050 (~16% of global abatement). Today, passenger travel is ~65% of emissions, but will drop to 45% in 2060 as freight expands. The U.S. market represented 19% of all vehicle sales worldwide in 2020.

Health: In the U.S., transportation is currently responsible for ~30% of all PM_{2.5} emissions and ~50% of NO_x emissions.³⁶ Many places do not meet air quality standards. Up to 45% of the urban population in North America may be within close enough proximity to major roadways to increase immediate health risks. At least 50 million people live in areas of air quality non-attainment. A widespread transition to ZEVs could nearly eliminate transportation emissions in 2050, thereby saving at least 6,000-10,000 lives, avoiding 93,000-300,000 asthma attacks and 400,000-1,000,000 lost workdays.³⁷

Industrial policy, jobs & economics: Much attention is being put on American supply chains, factories, and related jobs for electric vehicles and charging infrastructure, with a renewed focus on global competitiveness and world leadership (as the Chinese EV market is currently higher than that of the U.S.). The American Jobs Plan includes a \$174 billion investment to “win the EV market,” spur domestic supply chains, re-tool factories, and make batteries and EVs; an ambitious goal of 500,000 EV chargers by 2030 supported by grants and incentives; supported by labor and training to operate and maintain “21st century infrastructure.” Additionally, the Department of Energy is incentivizing [Advanced Technology Vehicles Manufacturing](#) through loans and innovation funds, with a focus on batteries and other EV technologies. A transition to ZEVs can lead to significant jobs in manufacturing (charging especially), providing electricity/fuels, and an induced benefit in increased services (through lower spending on fuels) totaling up to at least 0.3-1 million new jobs by 2030, and 2-3 million new jobs by 2050 (*estimates*³⁸). Cumulatively between 2020-2050, the U.S. could save up to \$1.2 trillion in avoided climate damages.

Policy momentum and drivers: Ambitious actions at the federal level are again a reality in the U.S., coupled with leadership from states. This momentum builds on a track record where the U.S. and key states such as California have led the world in policies driving ZEVs. California passed the first zero-emission vehicle (ZEV) regulations for passenger cars in 1990 and the world's first ZEV regulation for trucks (2020). Fifteen U.S. states signed a medium/heavy duty memorandum of understanding (2020) and a similar number adopted light duty ZEV standards. The federal government passed leading truck efficiency standards (2011) and is now reemerging as a leader on climate and electric vehicles at the federal level. The [American Jobs Plan](#) (March 2021) and related executive orders ([Tackling the Climate Crisis](#) and [Buy America](#)) specify a multi-tiered approach to advancing electric vehicles: By 2030, electrify 645,000 government fleet vehicles, electrify 50,000 transit vehicles (replacing diesel), electrify 20% of school buses, provide point of sale rebates and tax incentives to buy American-made EVs, and invest \$174 billion in the supply chain, chargers, and jobs and training noted earlier. Finally, the U.S. also has significant EV supply and innovation, with Tesla and other EV-only makers based in the U.S., and traditional vehicle manufacturers such as GM and Ford ramping up electrification models.

Justice, equity, diversity, & inclusion: Prioritizing JEDI in the U.S. is essential, and the approach is multi-layered. There is a strong awareness of JEDI issues, with a primary focus on communities of color (especially Black and Latino, ~40% of the population) and low-income communities (12-29% in poverty or up to 185% of the poverty line). Many local groups exist (over 115 active organizations), and capacity continues to build. Diverse coalitions are essential and should include environmental justice, equity, local community groups, consumers, labor, and business, in addition to environmental groups. JEDI efforts in the U.S. are focused on ensuring that marginalized populations are supported in ways that ensure equitable access to EV transitions and its benefits

Challenges: Vehicle manufacturers, typically represented through the Auto Alliance and Engine Manufacturers Association, and ICE-based vehicle suppliers are usually in opposition, especially to ZEV regulations. Oil companies and the American Fuel & Petrochemical Manufacturers trade association oppose ZEVs and are more engaged than ever before, as are natural gas suppliers and fleets that use natural gas. Labor representatives can be moved from potential opposition to allies, as described in the just transition details earlier. An additional challenge is the lack of a used vehicle market.

Geographies

Work in the U.S. includes federal, state, and city action. Important states include California, other states that follow CA's stricter vehicle rules, states that signed onto the Transportation Climate Initiative, states that have signed the medium & heavy duty Memorandum of Understanding, regions such as the auto states in the Midwest, conservative states, and potentially Texas.

Map shows number of primary grantees (“main”) plus local organizations



Strategic opportunities.

Working with our key grantee the Energy Foundation and others, below are examples of zero emission road transportation strategic opportunities that grantees are interested in pursuing in the U.S. The Energy Foundation theory of change is to reach tipping points (when EVs outcompete conventional vehicles) in key states and cities through broad support, regulations, fiscal incentives, clean fuel standards, and preferential access, building toward aggressive national actions and policies. Across both passenger and freight opportunities are:

- **Increase large-scale public investment in infrastructure** and for zero-emission corridors (e.g., Green New Deal, Transport Climate Initiative, Congestion Mitigation and Air Quality Improvement Funds, others).
- **Cultivate utilities as ZEV champions**, investors in charging infrastructure, and advocates for policy among the nation's leading utilities and ZEV-related businesses by demonstrating how ZEVs support their business models and allow for increased renewable energy load management. Support relevant cases with utility commissions.
- **Support clean fuel regulations** like the low-carbon fuel standard to create financing mechanisms for ZEV infrastructure.

Passenger

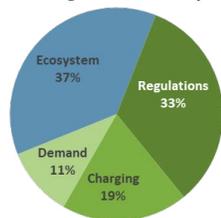
- **Regulations:** Define strong national post-2025 emission standards (miles per gallon and/or criteria pollutant standards) that drive electrification for light-duty vehicles. Support California's leadership to implement 100% zero-emission vehicles, and encourage other states to follow. CA's aims are to achieve 100% ZEV by 2035, per the governor's September 2020 executive order. New Jersey and Massachusetts announced similar ambition following CA. Expand, implement, and defend the light-duty ZEV program, together with supporting utility, fiscal, consumer, and infrastructure policy in ZEV states, including newer states or those in the process of adopting or exploring ZEV regulations (CO, WA, NV, MN, NM, PA, VA). Share knowledge and leadership from California with other states and countries.
- **Charging:** To be ready for charging infrastructure, require multi-family housing and new buildings to be prewired for future charger installation.
- **Demand:** Support mobility service companies as they electrify, building on 2020 commitments from Lyft and Uber to electrify their fleets. Expand business leadership and commitment to ZEVs by building knowledge, connecting with other like-minded businesses, leveraging investors and through select corporate engagement and pressure campaigns. Expand domestic investment in ZEV manufacturing and supply chain.
- **Ecosystem:** Build broad, local coalitions that include frontline communities, technical support/research groups, health, businesses, labor, electric utilities, and select vehicle makers. Cultivate broad, bipartisan support for ZEVs, highlighting messaging (e.g., cost savings, national security, air quality, public health) and local messengers that resonate. Focus on diverse and important states (e.g., based on market size, market influence, and other factors), including beyond coastal states. Counter opposition with local support, strong communications, clear research, and demonstration of demand by showing that the industry is not a monolith (engaging some vehicle makers as allies), and revealing the self-interest of ZEV opponents. Utilize clear, compelling communications in the campaign to build support among policymakers, business leaders, customers, and the public, and to counter opposition.

Freight

- **Regulations:** Expand the Advanced Clean Trucks Rule to multiple other states. Support a strong fleet rule in CA and other states. At the federal level, increase GHG standard stringencies, stricter NOx/criteria pollutant limits, and pass a national Advanced Clean Trucks rule. Support California reaching 100% ZE medium- and heavy-duty vehicles by 2045.³⁹ Establish Clean Air Zones and electrified delivery in cities, ports, and hubs, with the support of local coalitions.
- **Charging:** Reform retail electricity rates to enable economically competitive charging rates for truck fleets and favorable charging curves throughout the day, such as through time-of-use rates and limited demand charges.
- **Demand:** Encourage attractive ZE truck financing, new business models, tax benefits, feebates.
- **Ecosystem:** Build alliances with shipping companies, big fleets, and zero-emission truck manufacturers, use the relationships to encourage strong policy for supply (Make ZEV), and drive commitments to transition their fleets to demonstrate demand. Develop strong, diverse, local coalitions with frontline communities, technical support, environmental justice, labor, health, and communications groups. Significantly expand strategic communications. Pursue select corporate pressure campaigns. Share knowledge, lessons from demonstrations, and build capacity of fleets, policymakers, utilities. Research on infrastructure roadmap and incentive planning.

Cross-regional & businesses

Cross-regional: \$31M/year



Because of the global nature of the vehicle market, by working within, across, and beyond key regions, philanthropy, civil society, and partners can send global signals on EV supply and EV demand (from nations and cities), support learning across boundaries, and lead to global benefits even when focusing on specific high-priority regions.

Cross-regional (including multilateral) efforts are a good way to support learning and sharing across regions and to support the global expansion of EVs. This includes national government-focused efforts such as the ZEV Transition Council⁴⁰ and work at the IEA, UNEP, iZEVA, UNFCCC, G2Z, and G7; company-focused efforts like EV100, CEVA, or the Smart Freight Center; and non-state party actions (like the Global Climate Action Summit).

Strategic opportunities.

Working with our key grantee the ClimateWorks Foundation and other grantees, below are examples of zero emission road transportation strategic opportunities that grantees are interested in pursuing globally. Opportunities across both passenger and freight opportunities include:

- **Governments:** Provide platforms for multilateral government ambition, learning, and joint action like the [ZEV Transition Council](#), [International ZEV Alliance](#), [ZEV Community](#), and [Global Commercial Drive to Zero](#). Communicate the economic, jobs, and industrial policy benefits of strong regulations and other ZEV policies through reports like ICCT's Power Play.⁴¹
- **Business:** Promote corporate commitments from multinational companies through programs like EV100 and CEVA.
- **OEMs:** Encourage investment in electric vehicles and commitments for 100% zero emission vehicles
- **Cities:** Work with cities to secure commitments for and implement access constraints globally, such as zero emission zones/areas or diesel bans (e.g., C40's Green and Healthy Streets commitments).
- **Investors:** Encourage institutional investors to shift portfolios away from companies invested in combustion vehicles, and bring shareholder pressure on incumbent vehicle manufacturers to accelerate their EV investments and align their lobbying on policy accordingly.
- **Charging:** Roadmap for EVSE deployment, standardized infrastructure

Passenger

- **Regulations:** Encourage a race to the top regarding regulatory policies including zero-emission vehicle requirements for automakers, multipliers for GHG and fuel-economy standards.
- **Charging:** Increase access to infrastructure, implement low-carbon fuel requirements for fuel providers.
- **Demand:** Launch public awareness campaigns. Provide incentives including financial (rebated, tax credit), non-financial (lane access, parking).
- **Ecosystem:** Support multi-jurisdictional initiatives and agreements focused on light duty vehicles, such as the International ZEV Alliance, ZEV Community, the Clean Energy Ministerial Electric Vehicle Initiative, and more. Convene market leaders globally to share insights, increase ambition, and pursue coordinated actions. Support coordination among NGOs and advocacy coalitions across regions. Build new allies including utilities, conservatives, communities, and businesses. Provide credible and accessible information for consumers, businesses, and policymakers to raise awareness and educate key stakeholders.

Freight

- **Regulations:** Encourage global vehicle manufacturers to dramatically ramp up ZE Truck production & support aggressive ZE truck policies. Encourage national governments to set aggressive goals such as through the Global Memorandum of Understanding aiming for 30% of new medium- and heavy-duty vehicles to be zero emission by 2030, 100% by 2040-2050
- **Demand:** Encourage multinational companies (including parcel companies, shippers) to set aggressive ZE freight goals, transparently report on emissions, deploy ZE Trucks in their operations, and support aggressive ZE truck policies. Beachhead deployments.
- **Ecosystem:** Support global coalitions and knowledge sharing platforms, such as CALSTART's Drive to Zero Program, TDA's Zero-Emission Freight Vehicles ACTION Group. Other grantees working across regions include ICCT, Smart Freight Centre, RMI, EDF, NRDC, Global Strategic Communications Council, and others.⁴² Share knowledge across countries/regions on truck mandates, financial incentives/disincentives and timing, new business models on total cost of ownership, results of demonstrations, challenges, successes, models, applied research. Create global resources for strategic communications with positive frames, myth busting from a global perspective, and increase public awareness.

Please see the full freight strategy for more details.

4. Funding

\$210 million/year needed

It will cost ~\$210 million per year in philanthropic funding to electrify road transportation at the rate necessary to meet the climate challenge. Figure 15 shows that this is roughly 62% for passenger electrification and 38% for goods. Figure 15 also shows the breakdown across strategies and regions.

Hewlett funding

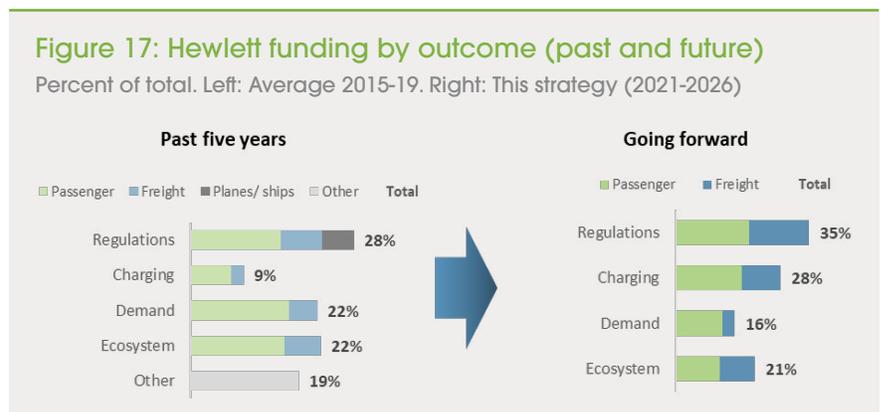
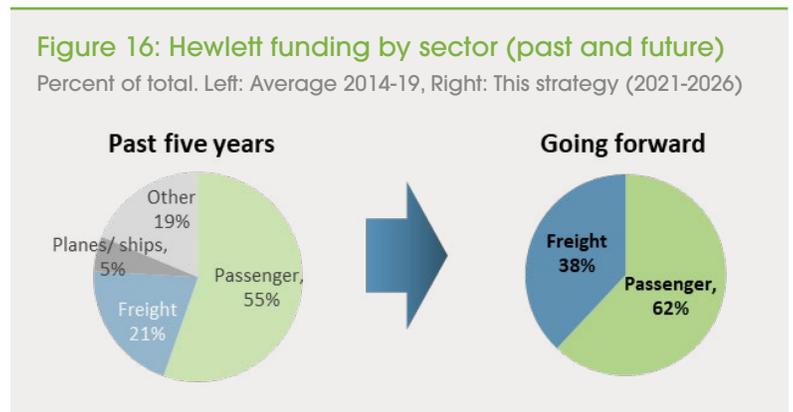
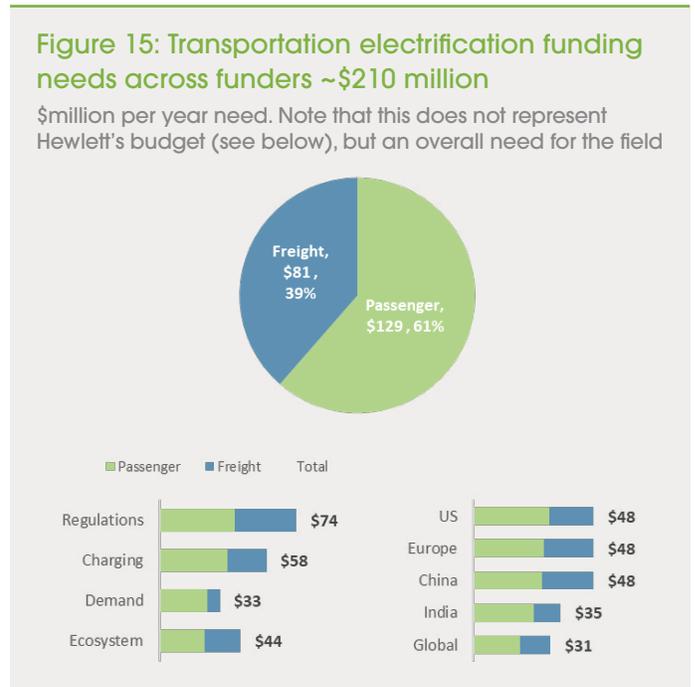
Hewlett’s spending on transportation is roughly \$21 million per year, roughly half of which is direct transportation grants; the remaining funding goes through general operating support (GOS) to organizations (such as regional climate foundations) that work on transportation and other sectors; because GOS is directed by the grantees, the spending figures broken out by type are therefore estimates.

Below are Hewlett’s funding shifts for passenger/freight, strategy elements, regions, and grantmaking/ JEDI/ fundraising.

Passenger and freight (Figure 16): Hewlett will significantly increase support for goods movement (zero emission trucks). We will focus on road transportation for the coming few years and will not emphasize marine and aviation.

Outcomes and Philanthropy Levers (Figure 17): We will continue to emphasize regulations while elevating (and increasing funding for) charging and broad-based support. Support for action and the local environment will impact what is pursued most aggressively within these parts.

Regions: Prioritize regional spending roughly in line with the overall funding need (Figure 15), meaning increases to Europe, India, and China through cuts to Latin America (per decisions in the Climate-wide strategy refresh) and moderate reductions to the U.S.



Grantmaking and JEDI: As described in Chapter 2, our grantmaking will focus on the national and international levels and continue to rely on regional partners for detailed and sub-regional work. We encourage all of our grantees to approach work with a focus on justice, equity, diversity, and inclusion both in their organizations and in their strategic work.

Fundraising: Finally, Hewlett will continue to collaborate with the Climate Leadership Initiative (CLI) and other funders (current and prospective) to raise more money to seize the opportunity to advance zero emission road transportation.

5. Monitoring

Implementation markers

Our 5-year outcomes for measuring progress were provided in Table 1 (Chapter 2, Figure 11) covering ZEV sales in 2025 and strong policies in place for sales in 2030: Leaders reach 100% ZEV sales for buses by 2025, 20-60% for cars by 2025-2030, and 8-30% for trucks in 2025-2030.

Table 2 shows 3-year implementation markers. We will track progress against these markers annually.

Table 2: 3-year (by end of 2023) implementation markers
(type of marker)

Group	Implementation markers
Regulations	<ul style="list-style-type: none"> At least 20 state, national, cross-national, or fleet regulations that put us on a pathway to meet our goals (10+ light-duty, 10+ trucks) <i>(short-term outcome)</i> 5+ implemented examples of zero emission areas, diesel bans, or other significant access constraints for ICE vehicles <i>(short-term outcome)</i>
Charging	<ul style="list-style-type: none"> Public funding and utilities in all key regions increase investment in charging by a factor of three, with utilities acting as powerful allies <i>(short-term outcome, tripwire if we don't see this increase)</i>.
Demand	<ul style="list-style-type: none"> 200+ government (123 as of 2020) and 500 corporate (339 as of 2020) commitments to fully electrifying their fleets <i>(short-term outcome, tripwire if we don't see this increase)</i>.
Ecosystem	<ul style="list-style-type: none"> All coalitions in key regions are diverse, such as including representatives from environmental justice groups, labor, health, environmental groups, communications capacity, and businesses. Coalitions (and diverse stakeholders) set long-term zero emission road transportation policy targets for both passenger and freight <i>(grantee activity)</i> 5 or more large investors commit to including climate risk in lending policies and include corporate lobbying as part of their assessment, or similar actions. <i>(short-term outcome)</i>
Capacity & grantee JEDI	<ul style="list-style-type: none"> Coalition capacity stays intact to move from campaign/policy to the next one <i>(grantee capacity)</i> Hewlett report on Advancing Justice, Equity, Diversity, and Inclusion in Support of Zero-Emission Transportation published to promote knowledge sharing among grantees <i>(staff activity)</i>
Fundraising	<ul style="list-style-type: none"> At least 5 funders that are new or have increased their support for zero emission transportation at \$5M+ per year, reaching \$200+ million per year <i>(context & staff activity)</i>

Key assumptions

Key assumptions the strategy is based on are:

- Action in key regions will result in electric vehicles propagating globally.
- Battery prices will continue to fall to reach \$100/kWh pack price or lower in the next few years.
- The full benefits of decarbonized road transportation assume the power sector will also act ambitiously and be decarbonized with clean power by 2045 (see Figure C5).
- Regulatory policy is the most important driver of electric vehicle uptake.

Risks

Potential risks include:

- **Moving too slowly** because of competing policymaker priorities.
- **Pursuing partial solutions** that don't get to zero emission or don't eliminate local air pollution, such as improved vehicle efficiency, natural gas vehicles, producing hydrogen from natural gas, pursuing plug-in hybrids, or in other ways counting low-carbon (versus zero carbon) fuels (such as in regulations).
- **Freight risks** include using biofuels for trucks; using less efficient solutions such as using renewable power to create liquids; and implementing more costly solutions such as fixed catenary lines, hydrogen fuel cells, or battery swaps that require significant investments.
- **Conflating electrification with “job-killing” automation**, increasing the potential opposition by labor groups.
- **Opposition using** misinformation, imposing new barriers (EV fees), and similar actions.
- **Perceived inevitability** causing funders to exit early (or not enter at all).
- **Pursuing full (Level 4) automation before or concurrently with electrification.** Automation would add extra cost, increasing the purchase price and thus delaying price parity. Additionally, ensuring electric comes before automation avoids any potential increase in emissions with automation

Evaluation

Within the next two years, we will formulate an evaluation plan to answer key questions, share lessons, and inform potential strategy refinements. Example evaluation questions are below:

- **Process and lessons:** What are lessons from successful policies and actions? What unexpected opportunities arose (to better predict in future philanthropic strategies)? How have partners overcome barriers, opposition, and ramped up ambition? Who have been unexpected allies? How have partners gotten groups such as labor and OEMs to be allies? Who was unexpected opposition? Are there more effective ways to address opposition?
- **JEDI:** Are justice, equity, diversity, and inclusion being prioritized in the work and coalitions? What are successes? What are barriers? What lessons can be learned?
- **Pace:** Is the market for freight trucks accelerating quickly enough? Is charging infrastructure rolling out fast enough? What are the barriers preventing quick action?
- **Funding:** Has philanthropy committed the funding needed for rapid change?

Planning for success and potential exit strategy

As described in the *Why now?* section of Chapter 1, with concerted action, as well as funding the full needs beyond what Hewlett can do on its own (Chapter 4), the next five years can get the world past the tipping point and into mass market adoption of electric vehicles for all types – buses, 2-3 wheelers, cars, and freight trucks. If advocates are fully funded and the strategy succeeds, philanthropy can catalyze a world where EV sales are significant in 2026 and significant regulations, policies, and commitments are in place for future years. This would deliver a clear vision and timeframe for getting to 100% electric road transportation. If the expected tipping points are reached, philanthropy could ramp down funding, with some ongoing funding expected for implementation, enforcement, and tracking.

Appendix A: Process

The process to create Hewlett's Zero Emission Transportation Electrification Strategy included the following aspects.

- **Incorporate high-level guidance from Hewlett's updated climate initiative:** *Climate Initiative Strategy 2018-2023* (Hewlett Foundation, 2017). <https://hewlett.org/wp-content/uploads/2018/01/Hewlett-Foundation-Climate-Initiative-Strategy-2018-2023.pdf>
- **Build off our freight-specific strategy:** *Zero Emission Road Freight Strategy 2020-2025* (Hewlett, April 2020). <https://hewlett.org/library/zero-emissions-road-freight-strategy/>, complemented by a freight regulation convening in early 2021.
- **Expand focus on justice, equity, diversity, and inclusion** (based on interviews and surveys, the full details of which are in a separate report, available publicly in summer 2021), health/air quality (research, modeling), and economics/jobs (research, modeling)
- **Incorporated work with the Climate Leadership Initiative** (CLI) over 2020
- **Incorporated regional strategies, reviews, and input from regional partners:** ClimateWorks Foundation, Energy Foundation, Energy Foundation China, European Climate Foundation, and Shakti Sustainable Energy Foundation

Thanks to the many groups who contributed to the strategy development. In addition to CLI, and the regional partners listed above, this includes:

Consultant: Hovland Consulting LLC, <http://www.hovlandconsulting.com/>

NGOs and Experts: American Lung Association, BEUC, C40 Cities Climate Leadership Group, CALSTART, Center for Applied Environmental Law and Policy, Center for Community Action and Environmental Justice, Chicane Labs, Clean Energy Works, Clean Vehicles Campaign (Partnership Project), Clean Water Action & Clean Water Fund, CLEER (Clean Energy Economy for the Region), Climate Nexus, Climate Plan, Coalition for Clean Air, Coltura, Communities for a Better Environment, Conservation Colorado, Earthjustice, East Yard Communities for Environmental Justice, Electrification Coalition, Energy Media, Environment New Jersey, Environmental Advocates NY, Environmental Defense Fund, EPHA, Eurocities, EV Hybrid Noire, EV100/The Climate Group, Forth, Green for All, Green Latinos, Institute for Transportation and Development Policy, International Council on Clean Transportation, Labor Network for Sustainability, Lawrence Berkeley National Laboratory, Link Houston, Los Angeles Cleantech Incubator, Moving Forward Network, Natural Resources Defense Council, NESCAUM (Clean Air Association of the Northeast States), New Jersey Work Environment Council, North American Council for Freight Efficiency, Rocky Mountain Institute, Securing America's Future Energy, Sierra Club California, Sierra Club Foundation, Smart Freight Centre, The Climate Group, The Greenlining Institute, Transport & Environment, UC Davis, Union of Concerned Scientists.

Appendix B: Examples and supporting regional details

This appendix provides examples by strategy and by region to provide more context and real-world examples. Hewlett supports many, but not all of these examples.

Regulations

Below are details on California's Advanced Clean Trucks Rule and China's New Energy Vehicle regulation.

California Advanced Clean Trucks Rule

The California Air Resources Board's 2020 Advanced Clean Trucks (ACT) Rule was a watershed moment for freight electrification and decarbonization. The rule sets the world's first zero-emission vehicle sales requirement for commercial truck manufacturers (requiring 40-75% of sales by 2035 to be zero emission, depending on the class of truck, yielding zero-emission trucks to be 15% of trucks on the road by 2030).

Building on past successes and coalition support over time, modest and nimble philanthropic funding enabled a doubling of ambition. The ACT rule, with further support, can become a model zero-emission policy for the world.

California, a leader on zero emission vehicles worldwide, starting decades ago, had the technical expertise and broad support to implement this ambitious rule. In 1990, the state passed their first passenger Zero Emission Vehicle (ZEV) regulations. Leveraging that success and subsequent ambitious policy actions on sustainable freight, zero emission ports, and a focus on environmental justice, coupled with advancements in the market on battery electric and fuel cell medium- and heavy-duty trucks, regulators from the California Air Resources Board (CARB) turned their attention to trucks and created a similar ZEV regulation, named the California Advanced Clean Trucks (ACT) Rule.

Hewlett and other philanthropic organizations supported a diverse coalition (including environmental justice, research, equity, labor, businesses, communications, and others) to engage in the ACT rulemaking process. The partners demonstrated business and public support and feasibility, and were able to roughly double rule, which was adopted in June 2020.

The ACT rule is a model rule that can be transferred and scaled to other states and countries, dramatically increasing the benefits globally.

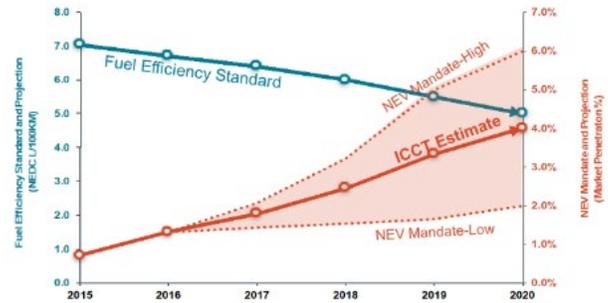
More information: "Spurring Zero Emission Trucks: Lessons from California's Advanced Clean Trucks Rule, Hovland Consulting, October 2020, [link](#)). Images from [Electric Trucks Now](#)



WHY
Electric trucks will help families living in "diesel death zones."
[LEARN MORE](#)

China New Energy Vehicles

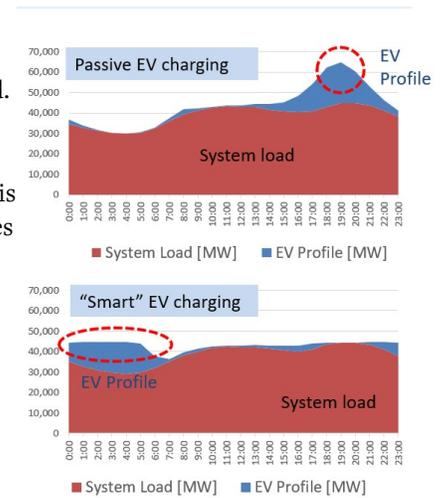
China became the world's first country to have a national ZEV regulation in 2017 when the Ministry of Industry and Information Technology issued a "New Energy Vehicle (NEV)" Policy, which required NEV credit targets of 10% in 2019 and 12% in 2020 – this translated to 2-6% EV market in 2020 and required 2-4.2 million cumulative EVs in 2016-2020. Bloomberg New Energy Finance called the NEV policy the "single most important piece of legislation for EVs globally." In 2019, China increased NEV targets to 18% by 2023, and in 2020, and China announced intent to increase NEV ambition to 25% of new sales by 2025.



The policy was modeled on California's ZEV regulation and was supported by cross-regional collaboration between China and California through workshops, information papers, support and guidance to key government officials, and surveys in Chinese cities to provide information to policymakers, advisors, and scholars. More details: [Overview](#), [paper](#), chart from ICCT.

Charging

Smart charging (Europe case studies): EV-grid synergies can be positive or negative. Passive charging, where vehicles are charged at will when they are plugged in (often at the end of the day), will likely incur high cost (monetary and CO₂) and should be avoided. Passive charging requires significant investments (distribution grid, peaking plant capacity, additional fuel use in peaking plant). In Germany alone, the costs for passive charging could exceed €2.5 billion in 2050. Smart charging, where the timing of charging is controlled (usually through variable costs of power over time), can avoid these downsides (the net cost may be close to zero) and has been proven effective in a range of locations. Where and when owners charge electric vehicles will be country- and power-source specific. For example, grids with high wind penetration would charge during the night. Grids with high solar use would charge mostly during the day. Chart source: Element Energy.



Demand (cities and businesses)

Cities

- Green and Healthy Streets Declaration:** After initial forays into banning diesel (begun in 2017 by Mayor Hidalgo in Paris with five other mayors of European cities following suit), C40 helped initially 13 cities (Mexico City, Quito, Cape Town, Paris, London, Copenhagen, Barcelona, Milan, Rome, Los Angeles, Seattle, Vancouver, Auckland) and now (January 2020) 36 cities commit to establish green and healthy streets. The declaration, which reflects practical steps and tangible actions, pledges to "1) Procure, with our partners, only zero-emission buses from 2025; and 2) Ensure a major area of our city is zero emission by 2030."
- Mayor's Purchase Collaborative (U.S.):** Thirty U.S. cities, including New York, Los Angeles, and Chicago, signaled their intent in March 2017 to invest a combined \$10 billion to procure 114,000 electric vehicles for municipal fleets. More recently, with the U.S. Climate Mayors group, mayors established a broader EV Purchasing Collaborative to both to leverage collective buying power and accelerate EV public fleets, as well as send a powerful signal to the global auto market. U.S. cities, counties, state governments, and public universities can all join the Collaborative. As of mid-2020, 38 states have purchased at least 2,200 vehicles. [Link](#)

Vehicle manufacturer commitments

- Vehicle manufacturer announcements** to fully electrify keep accelerating (though work still needs to be done to make sure the models come to fruition). Examples include: Volvo fully electric sales by 2030 ([link](#)). General Motors 100% ZEV sales by 2035, carbon neutral by 2040 ([link](#)). Daimler committed to a CO₂-neutral fleet of new cars worldwide by 2039 ([link](#)). Ford aims to be carbon-neutral by 2050 ([link](#)). Those with the largest announced financial investments include Volkswagen, Hyundai/Kia, Daimler, GM, Ford.
- Dieselgate and Volkswagen’s carbon-neutral pledge by 2050:** Dieselgate forever changed the trajectory of passenger vehicles by spurring improved emissions testing, enforcement, and standards around the world as well as broad industry adoption of electric vehicles. Subsequent investigations supported by Transport and Environment (T&E) in Germany and by ICCT in Europe revealed multiple manufacturers exceeded emissions standards, yielding significant additional actions taken on enforcement, monitoring, and financial settlements, all of which are accelerating the transition to EVs. Following the scandal and subsequent revelations on emissions cheating (that were uncovered with support from philanthropic organizations), Volkswagen committed to 25% new sales and 3 million EVs by 2025, 40% (4M/year) by 2030, and to end new ICE development after 2026, investing \$93 billion over the next five years ([link](#), [link](#), [link](#)).

Corporate commitments – EV100

EV100 is a corporate platform (led by The Climate Group) for major companies to work together and pledge to drive the transition to EVs in their own operations by 2030. To date, more than **over 90 companies** have made commitments for more than **4.3 million electric vehicles**. EV100 commitments are one or more of the following: 1) Transition their owned/leased fleet to EVs (100% up 3.5 tons, 50% 3.5 - 7.5t), 2) Require EVs for service contracts, 3) Install workplace charging at all relevant premises, and/or 4) Install customer charging at all relevant premises by 2030.

Leadership by global companies has direct effects (on the company, employees, service providers, and customers) and indirect effects (on automakers and governments) by showing commitment and signaling strong market demand for EVs by 2030 or before. As of the end of 2020, there were over 92 members.

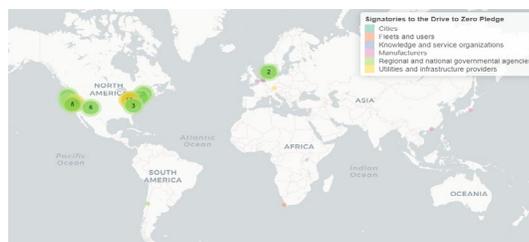


More recently, EV100 has engaged to increase policy ambition. In late 2019 and early 2020, EV100 shared 2030 phase out briefings with government officials, earned media coverage calling for 2030 phase out, and nine EV100 members wrote to the UK Chancellor calling for extension of EV funding. In 2020, the UK moved forward their combustion vehicle phase out from 2040 to 2035, and extended its plug-in car and van consumer incentives with £532 million through to 2023. [2021 Annual Report](#)

A key member of EV100, IKEA (Ingka Group) committed to **100% ZE last-mile deliveries** in Shanghai, Paris, Los Angeles, New York and Amsterdam by 2020, other cities globally **by 2025**, and to be climate positive by 2030 ([link](#)).

Commercial Drive to Zero

CALSTART’s Commercial Drive to Zero program, launched in 2018, aims to drive adoption of ZE commercial vehicles with full market penetration by 2040. CALSTART’s initial focus is on enabling ZE urban freight and leveraging that capability to build the capacity for long distance freight. As of the end of 2020, there were over 100 pledge supporters. CALSTART engages with fleets and corporations; pursues delivery, medium, and heavy regional applications in key first-mover regions (see map); builds aligned policies; and shares lessons across regions, such as through its Policy Toolkit (a live matrix of policies and actions with examples), vehicle availability guide, and total cost of ownership calculator. CALSTART is also involved with the Transportation Decarbonization Alliance ZEFV ACTion Group aiming for cost parity of urban and regional trips by 2025, 80% of such trips ZE by 2040, and full ZE freight by 2050.



Strong ecosystem

The International Zero Emission Vehicle Alliance (IZEVA)

IZEVA is a platform for government commitment and collaboration on ZEVs to make all passenger vehicle sales in our jurisdictions ZEVs as fast as possible, and no later than 2050” and “to take actions to overcome any barriers, achieve our targets, and continue to increase ZEV adoption to meet climate change goals.” Eighteen members are Baden-Württemberg, British Columbia, California, Connecticut, Germany, Maryland, Massachusetts, The Netherlands, New York, Norway, Oregon, Québec, Rhode Island, The United Kingdom, Vermont, and Washington. Members coordinate on setting deployment targets, acting together, and promoting momentum. <http://www.zevalliance.org/>

EVHybridNoire

EVHybridNoire is the largest network of diverse EV drivers & enthusiasts. The group was created to inform, educate, and increase awareness of the changing automotive landscape, as well as to increase access to new auto technology to a wider, more diverse audience. EVHybridNoire seeks to address the gap in access/adaptation of diverse audiences and electric, hybrid, and alternative fuel vehicles. Areas of focus include climate justice and public health, beneficial policy, increased multimodal EV adoption, education and outreach, workforce economic development, innovative EV financing, research/data analysis and monitoring, and TNC electrification.

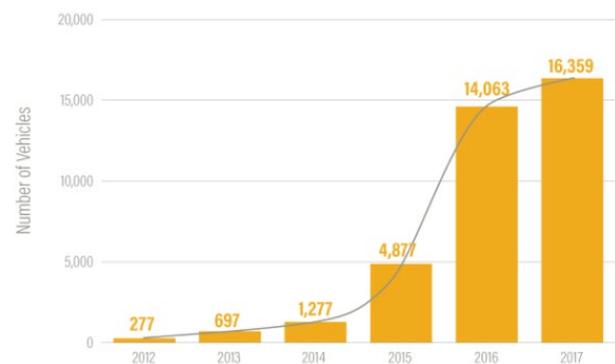


Regions

China: Shenzhen Bus and urban logistics electrification

Shenzhen built the largest and the world’s first 100% electrified bus fleet in roughly three years ([Lu, Zue, Zhou](#)). Buses have a 250 km range, five-hour charge time, charge along most routes, and time their charging with operations (charging the batteries fully overnight).

Shenzhen’s action on urban logistic vehicles is equally dramatic. In three years, the city electrified 35% (61,800 of 350,000) of its commercial trucks (focusing on logistic vans). The expansion benefited from significant (45+) models available, purchase subsidies, preferential city access, innovative business models (leasing), preferential electricity rates, and EV charger incentives. <https://rmi.org/insight/a-new-ev-horizon>



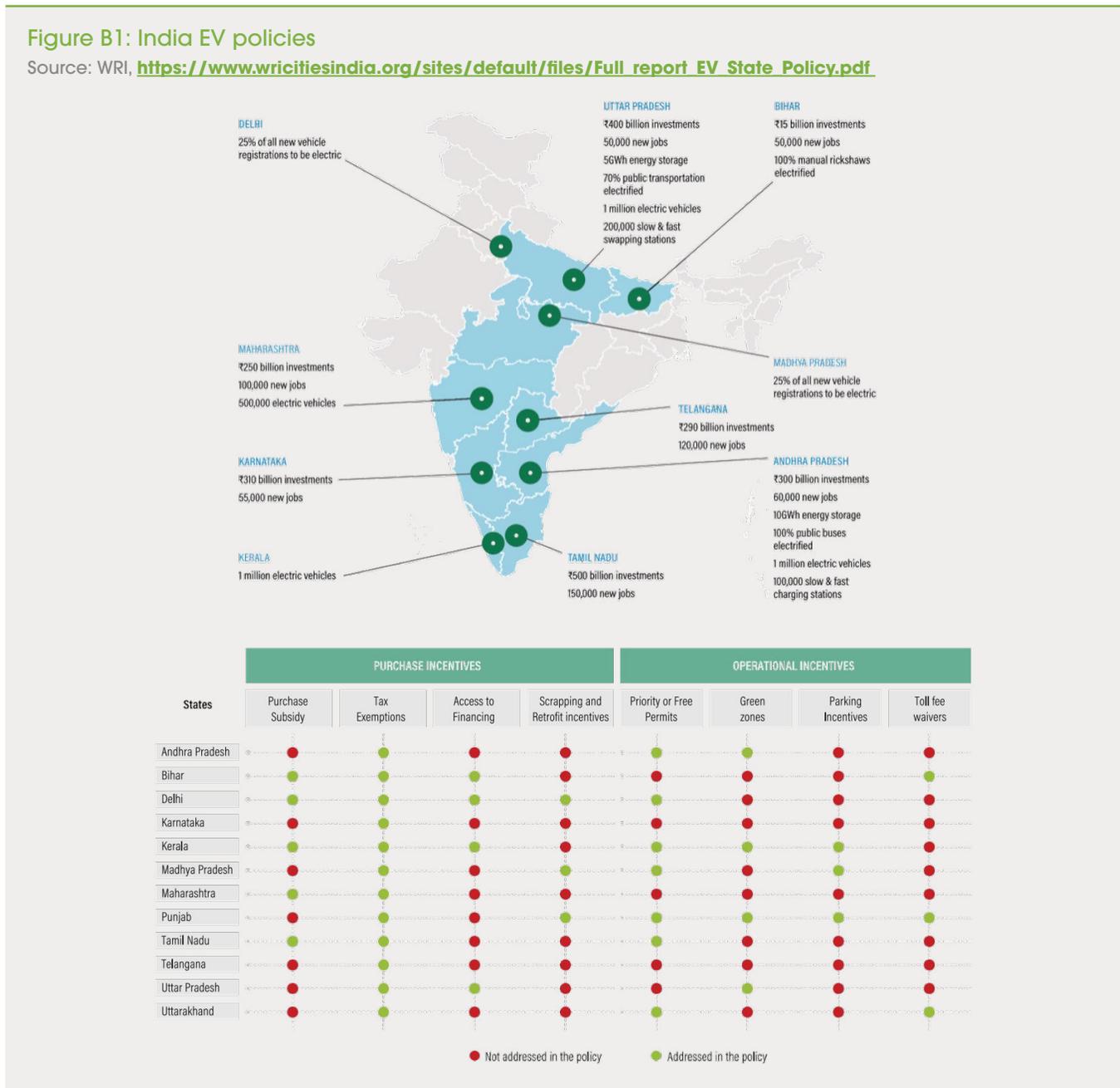
Source: Shenzhen Urban Transport Planning & Design Institute Co, Ltd

WRI CHINA

India EV policies

India has had varying signals of ambition levels. “Making India’s passenger mobility shared, electric, and connected can cut its energy demand by 64% and cut carbon emissions by 37%” (NITI Aayog/RMI report, [link](#)). The report calls for a whole system approach to mobility transformation with potential pathways for government, the private sector, and civil society with opportunity areas of mobility as a service, interoperable transportation data, mobility-oriented development, vehicle-grid integration, product manufacturing, and electric vehicle deployment.

Specific states are significantly advancing the adoption of EV transport. Twelve states have draft or final EV policies (Figure B1). Examples include: Andhra Pradesh aims for 1 million EVs on the road by 2024. Himachal Pradesh aims for a 100% transition to EVs by 2030. Karnataka aims for 100% e-mobility in auto-rickshaws, cab aggregators, corporate fleets, and school buses/vans by 2030. Gujarat aims for 100,000 EVs on the road by 2022, including 2-wheelers, 3-wheelers, cars, and buses. Telangana aims for EV sales in 2025 to be 80% 2- and 3-wheelers, 70% commercial cars, 40% buses, 30% private cars, and 15% electrification of all vehicles. Delhi aims for 25% of new vehicles registered be EVs by 2024.⁴³



Appendix C: Supporting modeling details

Electric vehicles and climate

Figure C1: CO2/mile and monthly costs and combustion vehicles

Source: Carbon counter & NYT⁴⁴

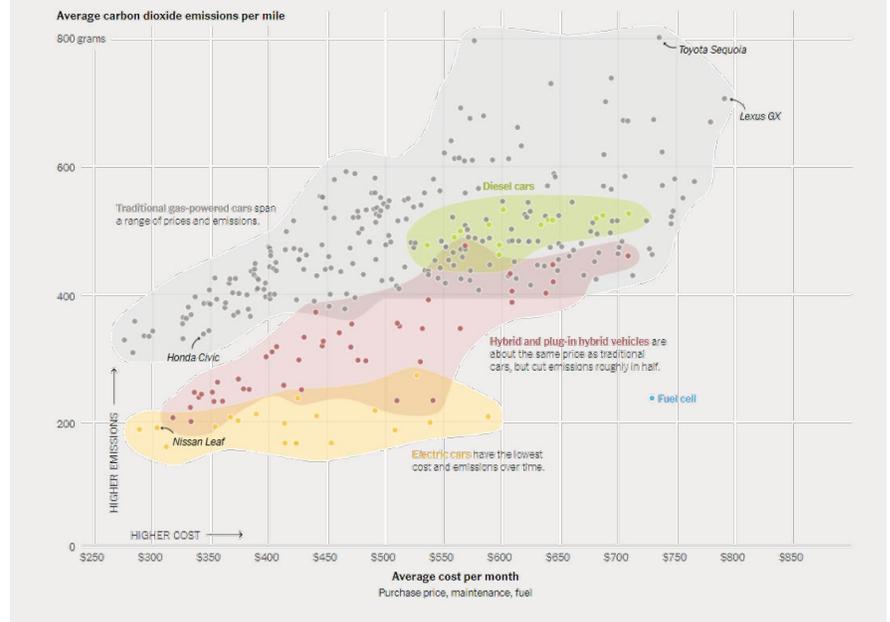
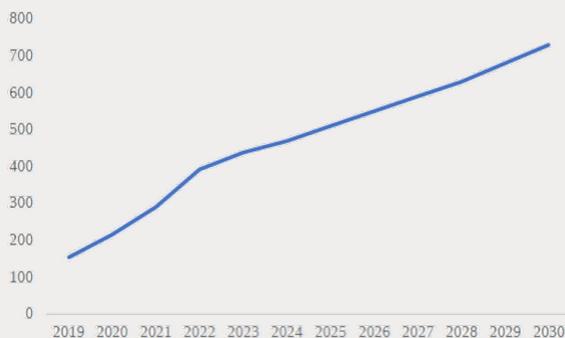


Figure C2: Electric models are taking off and battery prices continue to fall

Source: "Electric Vehicle Market Status Manufacturer Commitments to Future Electric Mobility in the U.S. and Worldwide," MJ Bradley, May 2019. <https://www.mjbradley.com/sites/default/files/ElectricVehicleMarketStatus05072019.pdf>

Number of models considered include Audi, BMW, Daimler, FCA, Ford, Cadillac, Hyundai, Mercedes, Toyota, and VW.

BNEF estimates 500 EV models by 2022 (EV Outlook 2020, <https://about.bnef.com/electric-vehicle-outlook/>)



Lithium-ion pack price (volume-weighted), real 2018 \$/kWh

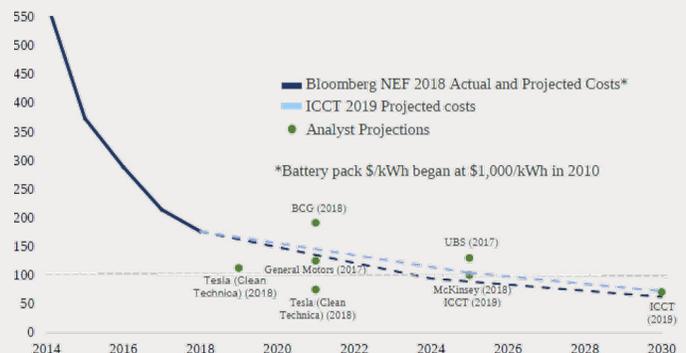


Figure C3: Electric vehicle sales

Percent of new sales (source: IEA Global EV Outlook 2020)

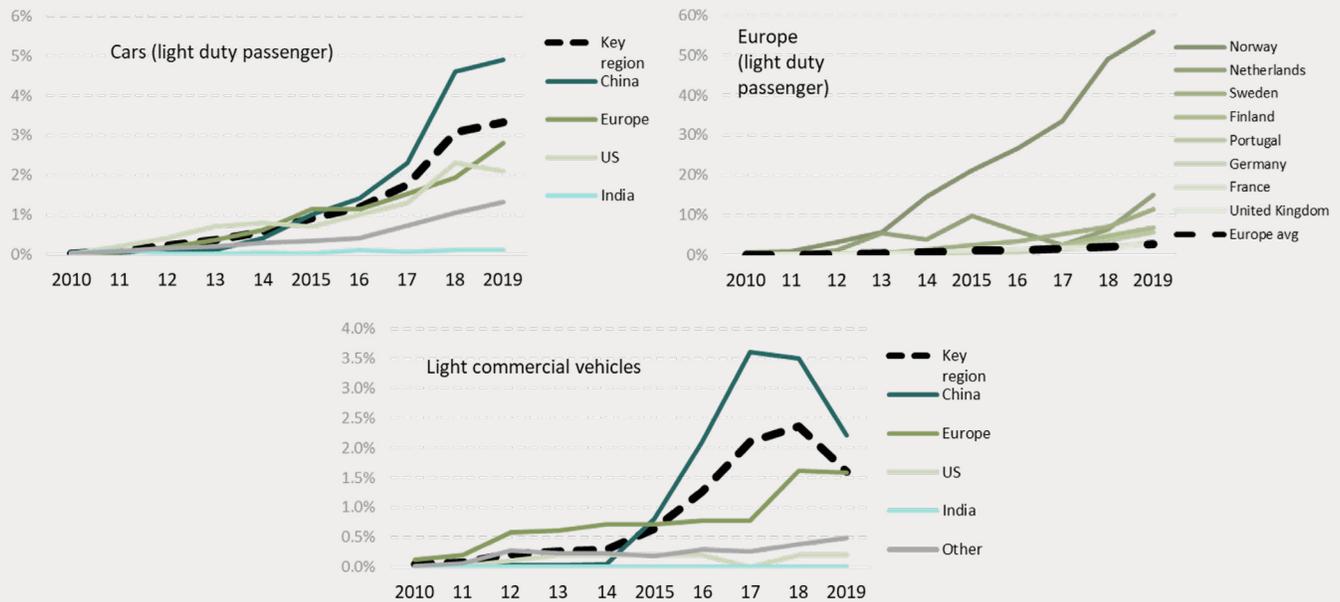


Figure C4: Total cost of ownership is attractive and price parity continues to come closer

Passenger sources: Air Quality Control Commission hearing documents (cost-benefit analysis and Environmental Coalition presentation)⁴⁵ and Bloomberg New Energy Finance 2019 Electric Vehicle Outlook⁴⁶

Freight sources: ICCT 2019 (2 sources), BNEF Long-term EV Outlook 2019, North American Council on Freight Efficiency (May 2018), Transport & Environment (2019), LBNL (2019), CA Air Resources Board (Feb 2019, not that this analysis includes benefit of Low Carbon Fuel Standard fuel credits).

Passenger

The total cost of ownership is already more attractive for electric vehicles (fuel and maintenance gains offsetting higher purchase price over the lifetime). In the U.S. with fuel savings and lower maintenance, an EV owner would have lifetime savings of \$3,800 for vehicles bought in 2023 and \$10,000 for vehicles bought in 2027.

In the U.S., the average BEV is \$6,300 more expensive than its combustion counterparts. **Purchase price parity will likely occur between 2020 and 2027.**

Passenger vehicle segment (BNEF)	US	EU	China
Small (320 km range)	2024	2027	2026
Medium (400 km range)	2024	2023	2022
Large (480 km range)	2023	2022	2030
Sport Utility Vehicle (480 km range)	2023	2024	2033*

Freight

For battery electric trucks, some usage segments have total cost parity now (urban uses, walk-in step vans, deliveries) and many will see parity by 2025 (drayage, regional cabs, heavy goods). Long-haul tractor-trailers can achieve parity by 2030 (some models show price parity now). For all use cases, battery electric trucks have much lower Total Cost of Ownership (TCO) than hydrogen fuel cells.

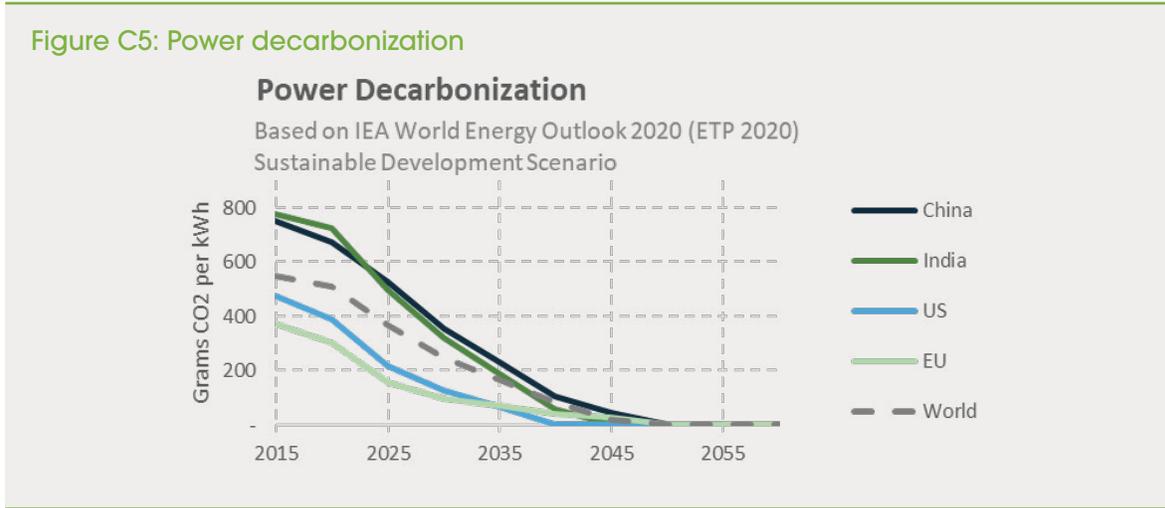
Battery Electric Truck Total Cost of Ownership

% vs. Diesel truck

■ 2020 ■ 2025 ■ 2030



Figure C5: Power decarbonization



Health

Figure C6: U.S. health benefits (low estimates)

k: thousand of people with specified health benefit (e.g., avoided deaths, avoided heart attacks, etc.)

Source: U.S. Energy Policy Simulator, Scenarios focusing on 100% EVs in line with Hewlett goals, using policy settings as close as possible (e.g., EV sales mandates, fleet makeup, subsidies, feebates, low carbon fuel standards). Three scenarios modeled: Zero Emission Transport, ZE transport with renewable/clean power, and renewable clean power only. Bar charts below show ZE transport, plus transportation part of additional benefit of seeing renewable power (ZE transport with renewable/clean power minus renewable clean power only). Note that the business-as-usual case for the U.S. included ~25% ZEV cars, ~45% ZE bus, and ~55% ZE light duty trucks; as such, the results are low estimates if one were to compare to a BAU with very low ZEVs).

Scenarios modeled in November 2020. <https://us.energypolicy.solutions/scenarios/home>.

See Figure ES2 for estimate range including ICCT estimates.

Health benefits (per year in 2050)

US

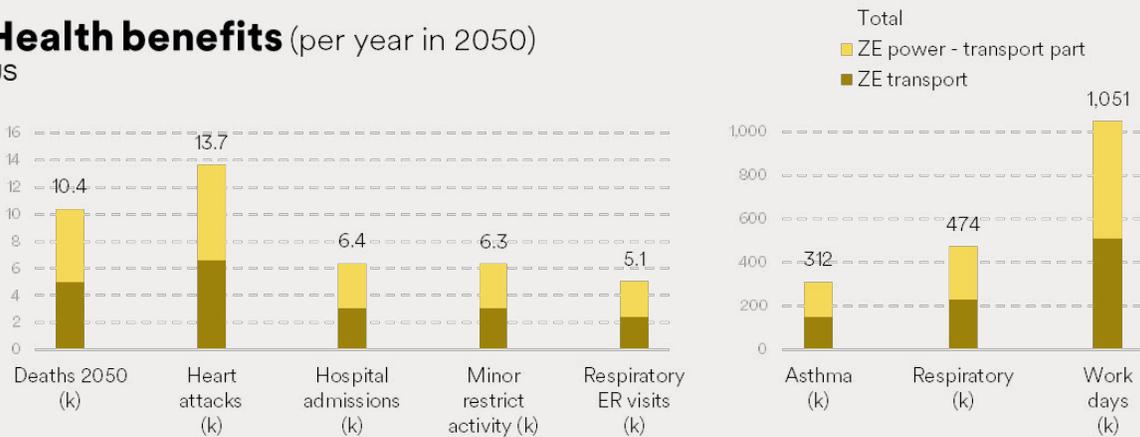
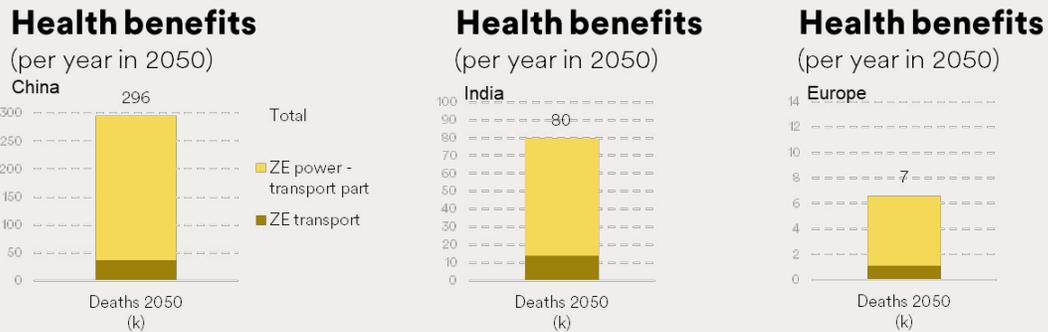


Figure C7: China, India, and Europe health benefits

Source: Energy Policy Simulators (<https://energypolicy.solutions/>). See Figure ES2 for estimate range including ICCT estimates.



Jobs, economics, & societal savings

Figure C8: Social cost of carbon inputs

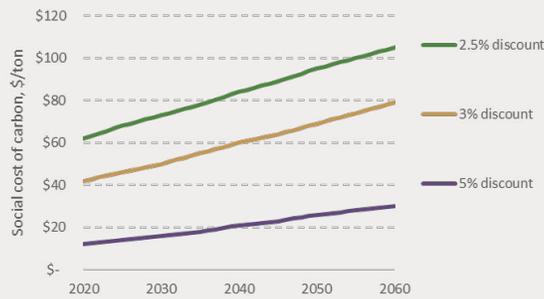


Figure C9: Millions of electric vehicles over time growing as the global fleet electrifies

Millions, based on Hewlett ZEV sales rates, see Figure 11. Note USA truck only includes medium- and heavy-duty trucks. Other regions include commercial vehicles (including light trucks)

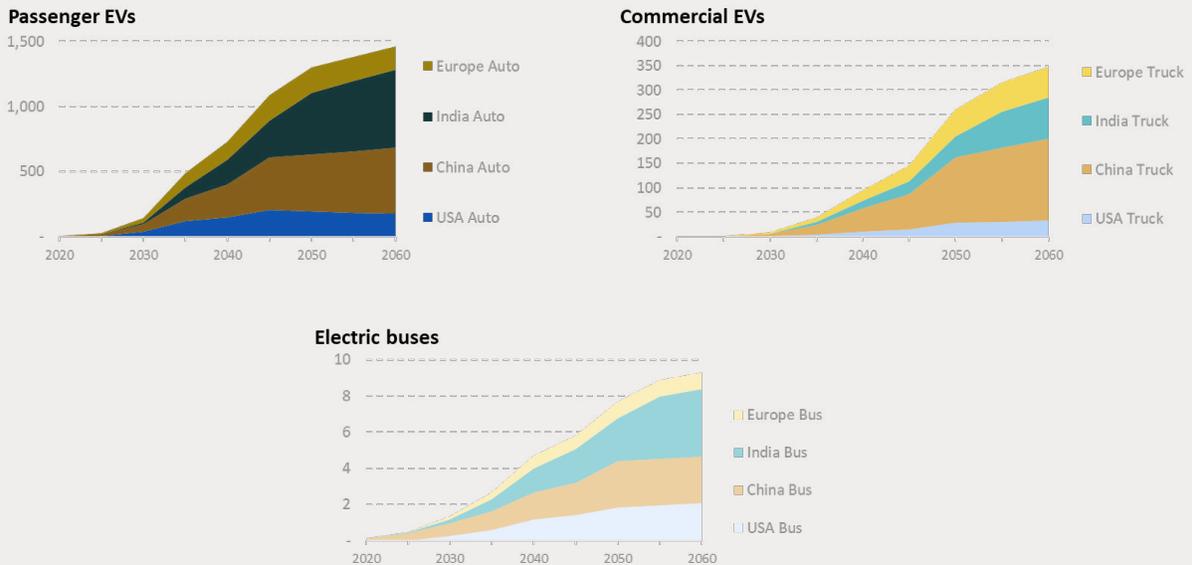
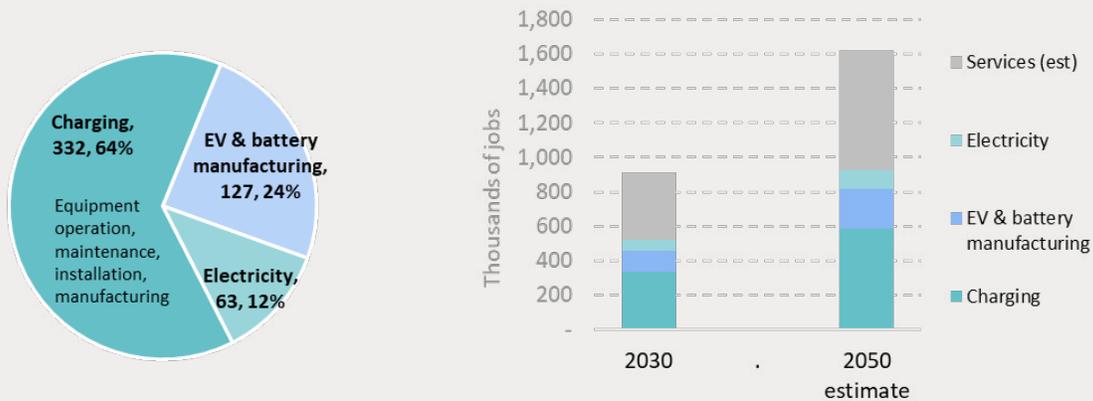


Figure C10: Europe job studies

Thousands of jobs. https://www.platformelectromobility.eu/wp-content/uploads/2018/02/European-Platform-for-electromobility%E2%80%99s-position-on-Green-Deal_FINAL-2.pdf. Estimates of services from next study.

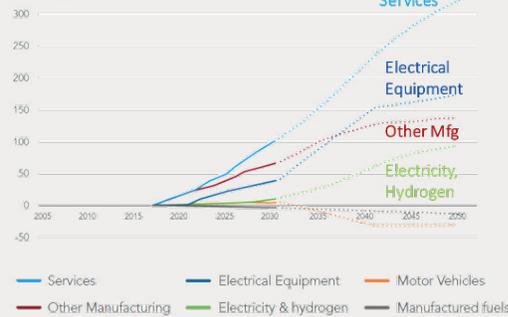


New Jobs, and Number of jobs per million Euros

<https://www.camecon.com/what/our-work/fuelling-europes-future//>

Additional jobs (thousands)

Fuelling Europe's Future



Jobs/€million



Figure C11: U.S. job studies

Table 3 from Energy and Environmental Research Associates (2017), <https://caletc.aodesignsolutions.com/assets/files/EERA-PEV-Economic-Impacts-and-Employment-Growth.pdf>.

An Assessment of Macroeconomic Impacts of Medium- and Heavy-duty Electric Transportation Technologies in the United States (2018), <https://www.caletc.com/assets/files/EERA-MHDV-Macroeconomic-Impacts-of-Electrification.pdf>

National Economic Value Assessment of Plug-In Electric Vehicles, NREL (2016), https://afdc.energy.gov/files/u/publication/value_assessment_pev_v1.pdf

Electric Vehicle Adoption in California Could Increase GSP By More Than \$140 Billion, Create Half a Million Jobs In Just 10 Years (Next 10, 2020), <https://www.next10.org/press-releases/ev-benefits>

Table 3. Summary of analyses estimating the macroeconomic impacts of PEV use in U.S. light duty vehicle sector.

Region	Source	Main Assumptions	GDP Impacts (Range)	Jobs (Range)
United States	EPRI Winebrake and Green 2009	40% of light-duty vehicles PEVs 16-20% of miles driven electric	\$23B - \$94B	162,000 - 863,000
	Winebrake 2003	50% of vehicles PEVs	\$38B	440,000
	NREL Melaina et al. 2016	Several scenarios of PEV market penetration ranging between 12 million and 73 million PEVs by 2035 (see Table 4 for details)	\$2B - \$12B	100,000-150,000
	U.S. DOE 2002	1% of light-duty vehicles PEVs	\$1.5B	14,000
States				
California	Roland-Holst 2012	PEVs 15% of on-road fleet by 2025	Near \$5B	49,000
		PEVs 45% of on-road fleet by 2030	Near \$8B	97,000
Florida	Gaschel 2016	20k PEVs in 2016; 60k in 2020; 280,000k in 2025; 780,000 in 2030	\$31M - \$1.49B	230 - 8,400
Ohio	Maves and Brenner 2012	Add 1,000 PEVs in Ohio	\$1.3M	20
New York	NYSERDA 2011 Winebrake and Green	PEVs 40% of light duty vehicles 17-22% of miles driven electric in 2008	\$4.4B to \$10.7B	19,800 to 59,800
Arizona	Salisbury 2013 & 2014	PEVs 5% of on-road fleet by 2030	N/A	114 - 713
Nevada				430 - 1,930
New Mexico				54 - 315
Utah	SWEEP 2017	PEVs 8% of on-road fleet by 2035		n/a
Regional				
Cleveland	EPRI Winebrake and Green 2007	40% of light-duty vehicles PEVs 16-20% of miles driven electric by 2030	\$380 - \$590	3,670 - 3,730
Austin			\$110 - \$250	380 - 410
Birmingham			\$160 - \$270	1,290 - 1,320
Kansas City			\$330 - \$540	2,860 - 2,880
Newark			\$180 - \$430	1,370 - 1,590
Sacramento			\$110 - \$250	860 - 870

Equity, inclusion, diversity, & justice

Figure C12: Demographics in the U.S. and Europe at risk population

U.S. percent of population by race (2019) and Europe percent of population by risk of social exclusion⁴⁷

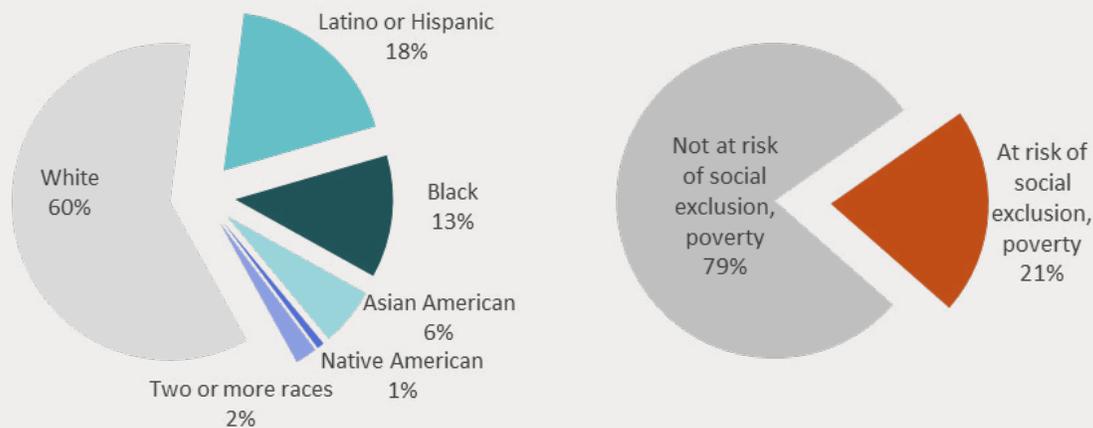


Figure C13: Internal and Strategic stages to improve justice, equity, diversity, and inclusion

Forthcoming Hewlett's resource: "Advancing Justice, Equity, Diversity, and Inclusion in Support of Zero-Emission Transportation" (2021) will have more details (forthcoming summer 2021).

Internal stage	Step	Strategic stage	Step
1: Start a dialogue and facilitate introspection	Begin dialogues internally on the importance of justice, equity, diversity, and inclusion.	A: Define and listen to partners	Determine key partners , including POC and low-income communities
	Create internal roles, liaisons, committees , or working groups that address JEDI issues.		Listen to community needs, hold workshops, gather information
	Reflect on current practices and understand organizational baselines and challenges	B: Support community groups over the long term	Provide direct funding and build capacity , such as fundraising, communications, and other needs as determined by partners
2: Institutionalize commitment	Establish organizational priorities for justice, equity, diversity, and inclusion	C: Become trusted partners	Build relationships and trust over time, involve local groups in coalitions early
	Train staff on JEDI issues, and consider hiring external experts		Dedicate staff time for JEDI-focused work
	Integrate JEDI into job roles, performance, and assess salaries for potential disparities	D: Collaborate to set priorities	Collectively define inclusive goals and priorities
	Improve recruitment to seek diverse candidates, and consider if a JEDI-focused position makes sense		Co-create communications with local communities that resonate, especially health, mobility access, infrastructure, cost savings, and potential jobs
	Develop mentorship programs		E: Jointly advocate for change
Set qualitative and quantitative metrics related to JEDI			
3: Be intentional with programmatic work	Establish JEDI goals for programmatic and strategic work (see strategic stages) and have written guidelines for effective partnerships		
4: Continually improve and track progress	Improve over time , including ongoing training		
	Track progress against goals		
	Learn from others		

Figure C14: Frontline community priorities

Question asked: How important are the following benefits to underserved communities (looking over the next 5 years)? Left chart: percent of responses by importance. Right chart: average importance and variation based on standard deviation

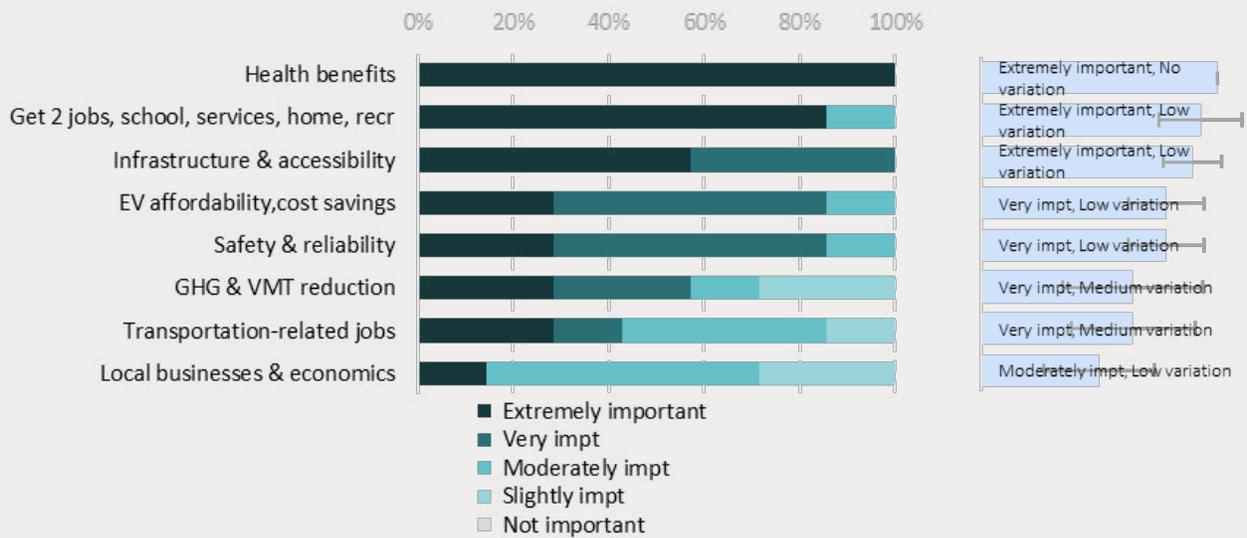
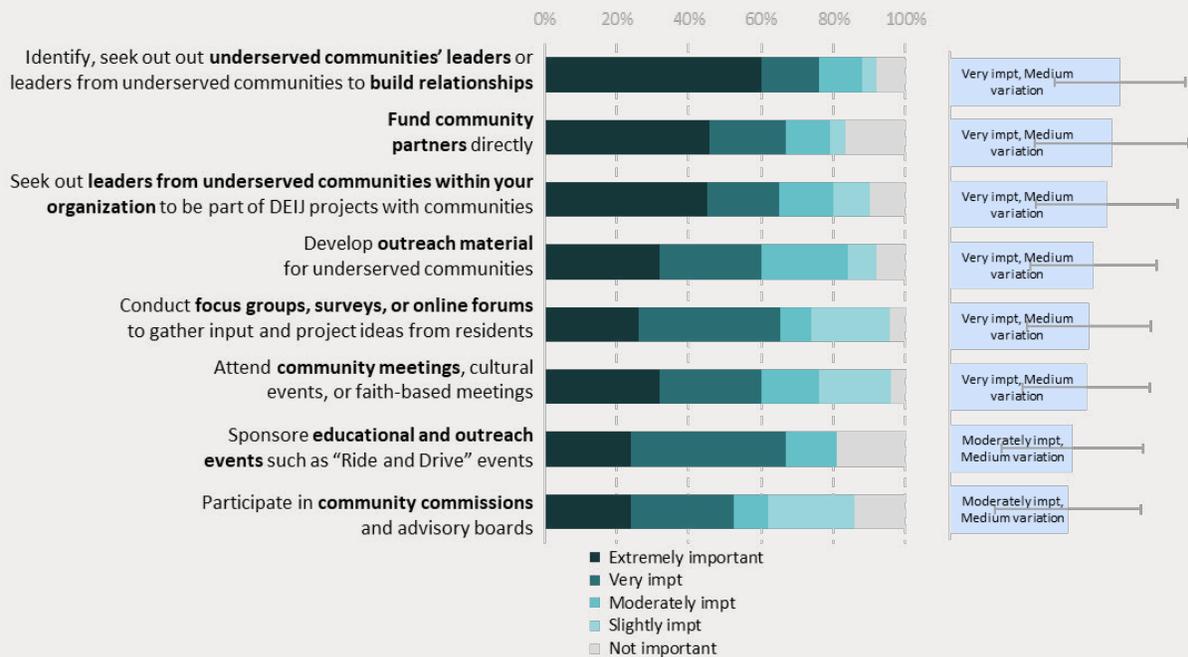


Figure C15: Strategies to engage frontline communities

Question asked: What types of strategies have you used to build networks within underserved communities, and how important do you think these were? Left chart: percent of responses by importance. Right chart: average importance and variation based on standard deviation.



Endnotes

1. “Climate Initiative Strategy 2018-2023,” Hewlett Foundation (2017). <https://hewlett.org/wp-content/uploads/2018/01/Hewlett-Foundation-Climate-Initiative-Strategy-2018-2023.pdf>
2. This strategy shows a higher ambition for transport than in the 2017 Climate Strategy, as technology, commitments, support, and policy momentum have been changing rapidly, allowing for greater levels of mitigation from transportation. This does not alter the goals of the overall climate strategy but does relieve the pressure on the amount of carbon dioxide removal we will need.
3. IEA Energy Technology Pathways (2017) data used for Reference Technology Scenario (RTS), final and primary energy demands and cost per barrel of oil (varying based on level of demand across different usage scenarios). Oil use also includes non-transport oils use .
4. Sources include: www.theicct.org/publications/health-impacts-transport-emissions-2010-2015 and Energy Policy Simulators (see Appendix C for details, <https://energypolicy.solutions/>). Ranges reflect increasing population growth and different scenarios.
5. IEA World Energy Outlook 2020. PM2.5 high range in 2040 represents the Sustainable Development Scenario
6. Union of Concerned Scientists: Inequitable Exposure to Air Pollution from Vehicles in the Northeast and Mid-Atlantic. <https://www.ucsusa.org/resources/inequitable-exposure-air-pollution-vehicles>
7. For example, in the US, Latino residents, residents of other races, and Asian American residents have 42, 42, and 40 percent higher exposure to PM2.5 concentrations, respectively, relative to the regional average. African American residents have 30 percent higher exposure. However, white residents have 19 percent lower exposure. *Source:* Union of Concerned Scientists: Inequitable Exposure to Air Pollution from Vehicles in the Northeast and Mid-Atlantic, <https://www.ucsusa.org/resources/inequitable-exposure-air-pollution-vehicles#:~:text=On%20average%2C%20communities%20of%20color,they%20are%20for%20white%20residents>. Similar results from a California study (<https://www.ucsusa.org/resources/inequitable-exposure-air-pollution-vehicles-california-2019>).
8. <https://publichealth.gwu.edu/content/new-study-finds-millions-children-worldwide-develop-asthma-each-year-due-traffic-related-air>, [https://www.thelancet.com/journals/lanpla/article/PIIS2542-5196\(19\)30046-4/fulltext](https://www.thelancet.com/journals/lanpla/article/PIIS2542-5196(19)30046-4/fulltext).
9. Ranges represent different discount rates applied to the social cost of carbon. At 2.5% discount rate, cost of carbon increases from ~\$60 to 100 per ton (2020-2050), ~\$4.2 trillion/year in 2050, ~\$4.7 trillion/year in 2060. US EPA (Table ES-1, https://www.epa.gov/sites/production/files/2016-12/documents/sc_co2_tsd_august_2016.pdf). Higher discount rates would have lower social cost of carbon savings (e.g., \$12-26/ton at 5% discount rate). See Appendix C (Figure C8 for details).
10. Colorado Air Pollution Control Division ZEV Regulatory Analysis (August 2019), <https://drive.google.com/drive/folders/1-Vp1cOFNX2NSw2gEurYgZTs9AiFyeKk> (File APCD - ZEV Regulatory Analysis.pdf, Table 13). Values show net present value, range is from 2023-2030.
11. Advanced Clean Trucks Total Cost of Ownership Discussion Document, CA Air Resources Board, February 2019. https://ww2.arb.ca.gov/sites/default/files/2019-02/190225tco_o.pdf. ICCT 2019: Estimating the Infrastructure Needs and Costs for the Launch of Zero Emission Trucks, <https://theicct.org/publications/zero-emission-truck-infrastructure/>. ICCT, CALSTART, and C40 Cities. Zero-Emission Freight - Vehicle Market & Policy Development Briefing for C40 Cities, September 2019. Why Regional and Long-Haul Trucks are Primed for Electrification Now (Lawrence Berkeley National Laboratory, Univ. of California Los Angeles, and Univ. of California Berkeley, March 2021. <https://eta.lbl.gov/publications/why-regional-long-haul-trucks-are>). North American Council on Freight Efficiency (May 2018), Electric Trucks: Where They Make Sense, <https://nacfe.org/future-technology/electric-trucks/>. See also Hewlett’s Zero Emission Road Freight Strategy 2020-2025 (April 2020).
12. Reuters (2018, 2019): <https://www.reuters.com/article/us-autoshow-detroit-electric/global-carmakers-to-invest-at-least-90-billion-in-electric-vehicles-idUSKBN1F42NW>, <https://graphics.reuters.com/AUTOS-INVESTMENT-ELECTRIC/010081ZB3HD/index.html>, Atlas Public Policy 2020, and Bloomberg New Energy Finance 2020

13. Taking the High Road: Strategies for a fair EV Future, UAW Research Department (2020), and Fueling Europe's Future (2018, Cambridge Econometrics)
14. BCG study Shifting Gears in Auto Manufacturing, September 2020, <https://www.bcg.com/publications/2020/transformative-impact-of-electric-vehicles-on-auto-manufacturing>) shows that battery electric vehicle total 'content per vehicle' (value of the vehicle's components to an OEM) are actually higher than internal combustion vehicles
15. Transport & Environment, June 2020, https://www.platformelectromobility.eu/wp-content/uploads/2018/02/European-Platform-for-electromobility%E2%80%99s-position-on-Green-Deal_FINAL-2.pdf. Assumes 40% BEV and 20% PHEV in 2030. Excluding rail expansion in these estimates.
16. Fueling Europe's Future, Cambridge Econometrics, 2018, <https://www.camecon.com/what/our-work/fuelling-europes-future/> See Figure C10 for more details.
17. *Transportation Electrification – Utility Fleets Leading the Charge*, Edison Electric Institute, 2014. https://www.eei.org/issuesandpolicy/electrictransportation/FleetVehicles/Documents/EEI_UtilityFleetsLeadingTheCharge.pdf and *Utilities Rev Up the Electric Vehicle Renaissance* (2019), <https://www.forbes.com/sites/anthonyeggert/2019/03/05/utilities-rev-up-the-electric-vehicle-renaissance/?sh=3c7331b6209e>
18. Example commitments include: GM 100% ZEV sales 2035, Volvo fossil free 2040, SAF fossil free 2040.
19. IEA Global EV Outlook 2020, <https://www.iea.org/reports/global-ev-outlook-2020>
20. <https://theicct.org/sites/default/files/publications/MarketMonitor-EU-jan2021.pdf>
21. China Automotive Technology and Research Center, as reported in <http://news.163.com/16/0125/20/BE707GND00014JB5.html>. CATARC finds that density could rise to 450-550 cars per thousand persons compared to the current density of roughly 100 cars per thousand
22. IEA World Energy Outlook 2020
23. IEA World Energy Outlook 2020
24. Ranges reflect ICCT (A global snapshot of the air pollution-related health impacts of transportation sector emissions in 2010 and 2015, www.theicct.org/publications/health-impacts-transport-emissions-2010-2015) and Energy Policy Simulator scenarios (see Figure C6, <https://energypolicy.solutions/>)
25. Estimates using multiple sources, including Energy Policy Simulators (<https://energypolicy.solutions/>), European & US job studies (Figures C10-11), Hewlett estimates of ZEVs over time (see Figure C9), and current vehicle production levels (OICA, <http://www.oica.net/category/production-statistics/2019-statistics/>)
26. IEA World Energy Outlook 2020
27. Ranges reflect ICCT (A global snapshot of the air pollution-related health impacts of transportation sector emissions in 2010 and 2015, www.theicct.org/publications/health-impacts-transport-emissions-2010-2015) and Energy Policy Simulator scenarios (see Figure C7, <https://energypolicy.solutions/>)
28. Estimates using a variety of sources, including Transport & Environment (June 2020, https://www.platformelectromobility.eu/wp-content/uploads/2018/02/European-Platform-for-electromobility%E2%80%99s-position-on-Green-Deal_FINAL-2.pdf. Assumes 40% BEV and 20% PHEV in 2030; Excluding rail expansion), Fueling Europe's Future (https://www.camecon.com/wp-content/uploads/2018/02/ECF-Fuelling-Europe_EN_web.pdf), estimates of ZEVs over time in line with Hewlett scenarios (see Figure C9), and current vehicle production levels (OICA, www.oica.net/category/production-statistics/2019-statistics/).
29. "The Europe 2020 strategy promotes social inclusion, in particular through the reduction of poverty, by aiming to lift at least 20 million people out of the risk of poverty and social exclusion." Those vulnerable to social exclusion are people who are: at risk of poverty, severely materially deprived, or living in households with very low work intensity. https://ec.europa.eu/eurostat/web/products-datasets/-/t2020_50
30. <https://www.platformelectromobility.eu/>
31. https://ec.europa.eu/transport/themes/urban/cpt_en

32. Building on positive economics shown in “Trucking into a greener future,” Gilbert-d’Halluin A; Harrison P, 2018. <https://europeanclimate.org/wp-content/uploads/2019/11/6-09-2019-trucking-into-a-greener-future-summary-report.pdf>
33. IEA World Energy Outlook 2020
34. Ranges reflect ICCT (www.theicct.org/publications/health-impacts-transport-emissions-2010-2015), population growth to 2050, and Energy Policy Simulator scenarios (see Appendix C, <https://energypolicy.solutions/>)
35. Estimates using multiple sources, including scenarios from Energy Policy Simulators (<https://energypolicy.solutions/>), European and US job studies (Figures C10-11), Government of India estimates via Rocky Mountain Institute, estimates of ZEVs over time in line with Hewlett scenarios (see Figure C9), and current vehicle production levels (OICA, <http://www.oica.net/category/production-statistics/2019-statistics/>)
36. IEA World Energy Outlook 2020
37. Ranges using input from American Lung Association: The Road to Clean Air (2020) <https://www.lung.org/clean-air/electric-vehicle-report> and US Energy Policy Simulator scenarios (see Figure C6, <https://us.energypolicy.solutions/scenarios/home>)
38. Estimates using a variety of sources, including scenarios from the US Energy Policy Simulator <https://us.energypolicy.solutions/scenarios/home>, US job studies (see Figure C11), and estimates of ZEVs over time in line with Hewlett scenarios (see Figure C9)
39. <https://www.gov.ca.gov/2020/09/23/governor-newsom-announces-california-will-phase-out-gasoline-powered-cars-drastically-reduce-demand-for-fossil-fuel-in-californias-fight-against-climate-change/>
40. <https://www.gov.uk/government/news/joint-statement-of-the-zero-emission-vehicle-transition-council>
41. <https://theicct.org/publications/global-electric-vehicle-industry>
42. Other cross-national initiatives that represent venues where zero emission freight could be advanced and elevated include the International ZEV Alliance, Global Green Freight Action Plan (SmartWay-based public-private partnerships and standardized emissions reporting via GLEC), UNEP’s Climate and Clean Air Coalition (CCAC), and programs currently focused more on passenger mobility. These include Clean Energy Ministerial Electric Vehicles Initiative (EVI) and Pilot City Program (PCP), Decarbonizing Transport Initiative, Under2 Coalition, and Global e-mobility Program (UNEP, IEA, ADB, others).
43. Review of State EV Plans Across India Amidst COVID-19, NRDC, September 2020. <https://www.nrdc.org/experts/anjali-jaiswal/review-state-ev-plans-across-india-amidst-covid-19>
44. Underlying source: <https://www.carboncounter.com/#!/explore-presented-in-https://www.nytimes.com/interactive/2021/01/15/climate/electric-car-cost.html>. Also <https://www.ucsusa.org/resources/going-pump-plug>
45. Colorado Air Quality Control Commission hearing materials: <https://drive.google.com/drive/folders/1sKF5uiVUroi59CHJyVLJUm3EGmjFhq8c> via <https://www.colorado.gov/pacific/cdphe/aqcc-meeting-materials-aug-13-16-2019>
46. <https://bnf.turtl.co/story/evo2019/>
47. https://ec.europa.eu/eurostat/web/products-datasets/-/t2020_50