1500 K Street NW
Suite 650
Washington DC 20005
+1 202.798.3986

www.theicct.org

Testimony of Rachel Muncrief
Deputy Directory
The International Council on Clean Transportation (ICCT)
Before the
Senate Democrats' Special Committee on the Climate Crisis July 22, 2020

1. Who is the International Council on Clean Transportation

The ICCT was established in 2001 as an independent source of technical and policy expertise on clean transportation with the core mission of *improving the environmental performance and energy efficiency of road, marine, and air transportation, in order to benefit public health and mitigate climate change*. In the last five years alone, we have worked successfully with regulators and lawmakers around the world and have played a significant role in 48 distinct regulations and policies, which are together projected to result in billions of tons of carbon dioxide reductions and prevent thousands of premature deaths over the next decade and beyond.

Today, the ICCT has an annual operating budget of $13 million, a staff of more than 60, offices in Washington, San Francisco, Berlin, and Beijing, with new offices planned in Brazil and India. Our core work focuses on the key transportation segments—passenger vehicles, heavy-duty vehicles, marine, aviation—as well as the fuels that power them. Our geographic focus is on the major automotive markets—China, US/Canada/Mexico, Europe, India, and Brazil—as well as other growing markets in the Middle East, Latin America, Southeast Asia, and Africa. In addition, we work at the sub-national level with major provinces, states, and cities. More information can be found on our website at www.theicct.org.

2. Sources of transport emissions and future projections

The transportation sector accounts for approximately 21% of global energy-related CO_2 emissions. In 2015, greenhouse gas emissions in the global transportation sector were equivalent to 10.9 billion metric tons (Gt) of carbon dioxide-equivalent emissions (CO2e). We project that in 2020 CO_2e emissions from transportation globally will rise to 11.9 Gt[1]. The four largest vehicle markets, in terms of new vehicle sales—United States, China, the European Union, and India — account for 46% of global CO_2 emissions from transportation. If treated as individual vehicle markets, maritime shipping (11%) and aviation (10%) would be the third and fourth largest emitters, after the U.S. and China. Put differently, two-thirds of transportation CO_2 emissions in 2020 are from the four largest vehicle markets and the marine and aviation sectors.

Looking at the contribution of different modes of transportation (Figure 1), on-road vehicles dominate, accounting for roughly 77% of global transportation CO_2 emissions in 2020 (43% from

[1] These results were modeled "pre COVID-19". We know that, to date, global carbon emissions dropped by approximately 17% compared to 2019 levels due to COVID-19. While this is the largest drop in carbon emissions since WWII, it is also temporary, and it is still unclear how (or if) COVID-19 will impact long term trends.

light-duty vehicles including 2 and 3 wheelers and 34% from heavy-duty vehicles including buses).

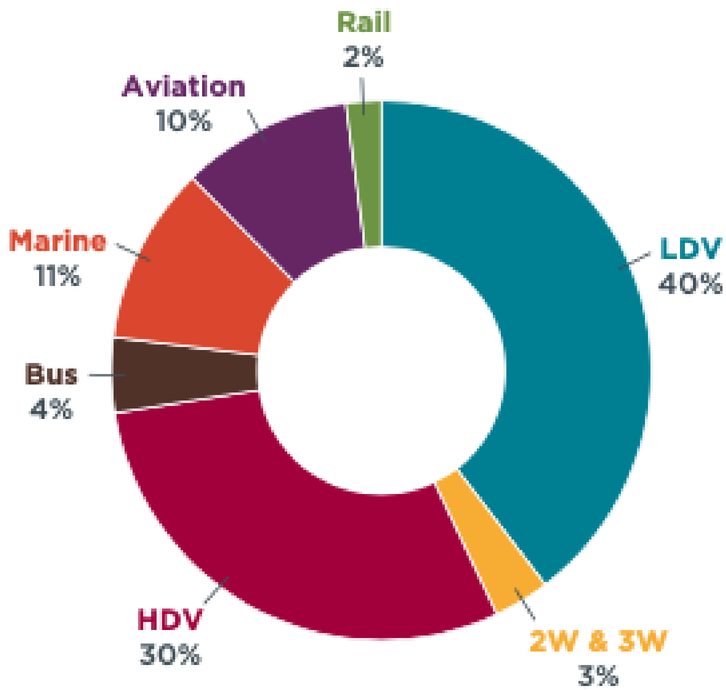

Figure 1. Share of global 2020 well-to-wheel CO_2 emissions from transportation, by mode.

Approximately 43% of global transport CO_2 emissions come from freight transport, whereas 57% are attributed to passenger transport. **Trucks and ships combined are responsible for more than 95% of global freight transport CO_2 emissions, trucks alone being responsible for over 70%**. Given the rapidly growing demand for freight services and international trade coupled with improving passenger vehicle efficiency and electric vehicle uptake, freight is projected to overtake passenger transport as the number one source of transport CO_2 emissions within 30 years, or less.

Diesel engines are also much more prevalent in the freight sector – powering the vast majority of trucks and ships. Freight transportation is responsible for well over 50% of the health impacts from transportation - with diesel trucks in urban conditions being especially high contributors.

Without substantial policy action, the ICCT projects that global CO_2e emissions from transportation will grow significantly over the next 30 years, from approximately 12 Gt[2] in 2020 to 21 Gt annually in 2050. But within that overall trend, the regional distribution of global transport emissions will shift substantially. We expect nearly 90% of projected growth in transportation CO_2 emissions to take place in China, Asia-Pacific, India, Africa, and in the global aviation and marine sectors. In the US, the market currently responsible for the world's highest

[2] These results were modeled "pre COVID-19". We know that, to date, global carbon emissions dropped by approximately 17% compared to 2019 levels due to COVID-19. While this is the largest drop in carbon emissions since WWII, it is also temporary, and it is still unclear how (or if) COVID-19 will impact long term trends.

levels of transportation emissions, without further policy action, we project transportation emissions to remain nearly constant over the next 30 years without further policy action.

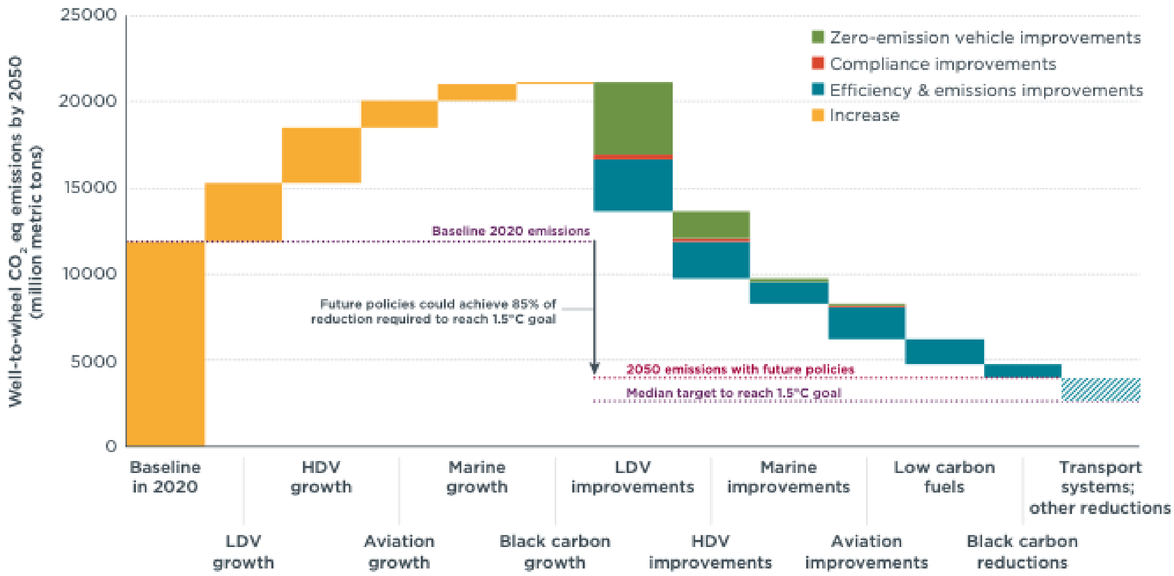

Figure 2. Baseline CO_2 equivalent emissions and mitigation potential in 2050 by major transportation segment.

When we model what is feasible, utilizing assumptions based on ICCT's judgment of technology potential, estimated costs, policy opportunities, and regulatory compliance, there is enormous potential for CO_2 emissions reductions from Light Duty Vehicles, Heavy Duty Vehicles, Ships, Aircraft, and Fuels as shown in Figure 2. The yellow bars on the left- hand side of the chart quantify the impact of factors that are expected to drive up GHG emissions (including CO_2, N_2O, methane, and black carbon) by 2050. These reflect policies adopted as of February 2019, and assume no further policy action. Added to baseline emissions for 2020 they result in a 77% increase of current emissions by 2050. The blue, green, and red bars on the right side of the figure show the estimated potential impact of efficiency improvements, zero-emission vehicle growth, and improved compliance from each segment of the transport sector. These estimates attempt to account for technology constraints, limits on policy ambition, and realistic assumptions about policy effectiveness, based on past experience. The hatched bar at the right of the figure shows the gap that remains, after accounting for these constraints, between the sum total of the mitigation potential we have identified and the 2.6 Gt transport-sector emissions target which is consistent with the goal of limiting global warming to 1.5° C this century.

As Figure 2 shows, the largest single mitigation opportunity in our assessment is energy-efficiency improvements across all modes. Next is electrification of light-duty and heavy-duty vehicles. This finding underscores the importance of continuing support for efficiency measures while simultaneously targeting measures to accelerate electric vehicle adoption.

The results presented in Figure 2 represent global opportunities to decarbonize. We also looked specifically at what targets the U.S. would need to meet in order to contribute proportionally to these CO_2 reductions. These targets are summarized in Table 1 below.

Table 1. Targets for U.S. on-road market to align with a global target of limiting global warming to 1.5₀C this century

	LDV			HDV		
	2W & 3W	Passenger Cars	Light Commercial Vehicles	Buses	Rigid Trucks	Tractor Trailers
2030 EV sales targets	72%	34%	34%	37%	21%	10%
Fraction of total 2050 vehicle kilometers traveled by electric vehicles	100%	70%	65%	80%	55%	35%
Cumulative real-world fuel consumption reduction for ICE vehicles (2020 vs 2050)	37%	44%	47%	35%	37%	34%

In summary, the US would need to reduce its on-road transport CO_2 emissions by 79% from 2020 to 2050, from approximately 1.9 GT/year to 0.4 GT/year in order to align with a global target of limiting global warming to 1.5_0C this century.

3. Barriers and Opportunities for reducing emissions in the freight sector

Significant benefits can be obtained from improving the efficiency of heavy-duty vehicles, improving compliance with efficiency standards, and increasing the proportion of zero-tailpipe-emissions vehicles in the global fleet.

Improving efficiency of conventional trucks. There is a significant amount of known and commercialized (or demonstrated) cost effective technology that can significantly improve the efficiency of heavy-duty vehicles. This includes improvements in engine efficiency, reductions in aerodynamic drag, reductions in tire rolling resistance, and hybridization. The rate of advance in ICE technology may slow as manufacturers increasingly direct R&D efforts to electric technologies in order to meet increasingly stringent efficiency targets. In our modeling, when we look at what is feasible, we assume that the real-world CO_2 emissions of new ICE heavy-duty vehicles decline at an annual rate of 2%. This represents a global average. Markets with the most advanced efficiency regulations (the United States, the European Union, and Japan, for example) will likely come close to reaching the cost-effective limits of ICE efficiency sooner. We believe it is feasible for U.S. ICE tractor-trailers to have a cumulative real-world fuel consumption reduction of 34% from 2020 to 2050. This also includes the assumption that improved compliance with HDV efficiency standards, brought about by improved enforcement as needed, could boost efficiency gains for new ICE (including non plug-in hybrid vehicles) by an additional 0.5% per year in 2020–2030 and 0.25% per year in 2030–2050.

Electrifying trucks. In the HDV segment, we assume that EV market uptake will move from the easiest vehicle segments to electrify to larger, more challenging segments. Specifically, we estimate that by 2050 it is feasible for electric buses to be 81% of the global bus stock (93% of new bus sales); electric light heavy-duty trucks (such as those used for local delivery) to make up 69% of the global stock (87% of new LHDT sales); electric medium heavy- duty trucks (such as those used for regional delivery) to be 42% of the global stock (60% of new MHDT sales);

and electric heavy heavy-duty trucks (such as those used for long haul trucking) to be 29% of the global stock (44% of new HHDT sales). Our modeling does not differentiate between battery electric vehicles, which are more likely to play an outsized role in the smaller truck segments, and fuel cell vehicles, which will likely be more important in decarbonizing large-truck segments.

Availability of zero emissions trucks. The transition to zero-emission commercial trucks holds great promise. Although heavy-duty electrification is in the early stages, the pace of development could progress quickly. Innovation in battery technologies, cost reductions from potential economies of scale, and development of high-power charging stations can provide a foundation for commercial trucks to follow the path of electric passenger cars. Incremental growth is made further feasible by the ability of commercial fleets to incorporate fuel savings in purchasing decisions, as well as to precisely plan infrastructure for company-specific operations.

There are a number of manufacturers with current and planned offerings of zero emissions trucks in the U.S. Major U.S. truck OEMs such as Freightliner, Volvo, and Peterbilt are all offering (now or planned within the next year) battery electric versions of some of their best-selling models (targeted at the short and regional haul sectors). Whereas, U.S. based companies, Nikola Motors and Tesla are currently the main companies currently targeting the long-haul sector.

More information on the upcoming availability of zero emissions trucks can be found at

- https://theicct.org/blog/staff/benchmarking-growth-zero-emissions-trucking
- https://www.iea.org/reports/trucks-and-buses
- https://globaldrivetozero.org/tools/zero-emission-technology-inventory/

Costs of zero emissions trucks. Declining technology costs are making zero-emission trucks increasingly cost- competitive with conventional diesel vehicles. Although zero-emission trucks are more expensive in the near-term than their diesel equivalents, our analysis predicts that electric trucks will be less expensive than diesel (from a total cost of ownership perspective) in the 2025–2030 time frame, due to declining costs of batteries and electric motors as well as increasing diesel truck costs due to emission standards compliance. Of course, there are obstacles, such as charging time and reduced cargo capacity, which could also add costs for fleets; however, electric trucks are expected to be cost-competitive even with these costs. We predict fuel cell trucks will also become less expensive in upfront vehicle cost and total cost of ownership by 2030.

Infrastructure for zero emissions trucks. Infrastructure costs for zero emissions trucking are significant, but do not fundamentally impede the viability of zero-emission trucks. Whether constructed by fleets, third parties, or public agencies, charging and hydrogen infrastructure for zero-emission trucks pose significant costs. As fleets deploy the technologies at greater scale, infrastructure costs add more than $70,000 per battery electric long-haul tractor-trailer and more than $25,000 per drayage truck or delivery truck, amounting to 7% to 9% of the lifetime operating cost in each application. If these infrastructure costs are excluded, electric fleets could see vehicle ownership cost parity with diesel in the early 2020s; including these infrastructure costs pushes parity five to 10 years later.

Initial infrastructure buildouts will be costly without careful planning and coordination. In the early zero-emission truck deployments, it will be essential to plan infrastructure for specific routes, applications, and duty cycles to minimize costs.

The future of the global market for EVs. As detailed in a recent ICCT report, a number of vehicle electrification targets have been announced by national governments (Table 2). Most goals currently focus on light-duty vehicles, especially passenger cars. More than a dozen countries, mostly in Europe, have proposed a timeline to phase out new sales of fossil fuel passenger cars or to only sell zero-emission models by 2050. Among them, Norway has the most ambitious target, aiming to achieve a 100% electric vehicle share of new passenger vehicle and light-duty van sales by 2025. The targets are meant to provide a clear signal to automakers, charging infrastructure providers, and vehicle fleet managers to make the transition to electric vehicles. However, further steps remain to turn the goals into enforceable policies to ensure they are achieved.

Table 2. Vehicle electrification goals announced by select national-level governments.

Government	Target vehicle type	Target year	Target on new sales	Source
Canada [a]	Vehicles	2040	100% electric vehicles	Government document
China [b]	Vehicles	2025	25% electric vehicles	Draft government document
Costa Rica [c]	Light-duty vehicles	2050	100% electric vehicles	Government document
Denmark [d]	Passenger cars	2030	No gasoline or diesel vehicles	Government document
		2035	No gasoline, diesel, or plug-in hybrid electric vehicles	
France [e]	Passenger cars and light-duty commercial vehicles	2040	No vehicles using fossil fuels	Law
Germany [f]	Passenger vehicles	2050	100% electric vehicles	ZEV Alliance commitment
Iceland [g]	Passenger cars	2030	No gasoline or diesel vehicles	Government document
India [h]	Passenger cars	2030	30% electric vehicles	Speech of Transport Minister
Ireland [i]	Passenger cars	2030	No fossil fuel vehicles	Government document
Israel [j]	Passenger cars	2030	No gasoline or diesel vehicles	Speech of Energy Minister
Japan [k]	Passenger vehicles	2030	23%-33% electric vehicles	Government document
Netherlands [l]	Passenger cars	2030	100% electric vehicles	Government document
Norway [m]	Passenger vehicles	2025	100% electric vehicles	Government document
	Light-duty vans	2025	100% electric vehicles	
	Long-distance coaches	2030	75% electric vehicles	
	Trucks	2030	50% electric vehicles	
Portugal [n]	Passenger cars	2040	No vehicles with internal combustion engines	Speech of First Secretary of State for Mobility
Scotland [o]	Passenger cars and vans	2032	No gasoline or diesel vehicles	Government document
Singapore [p]	Vehicles	2040	No internal combustion engine vehicles	Speech of Deputy Prime Minister
Siri Lanka [q]	Vehicles	2040	100% electric or hybrid vehicles	Speech of Finance Minister
Slovenia [r]	Passenger cars and light-duty commercial vehicles	2030	100% vehicles with CO_2 emissions up to 50 g/km	Government document
South Korea [s]	Passenger cars	2030	33% electric vehicles	Speech of President
Spain [t]	Passenger cars	2040	100% electric vehicles	Draft law
Sweden [u]	Passenger cars	2030	No gasoline or diesel vehicles	Government document
United Kingdom [v]	Passenger cars and vans	2035	No petrol, diesel, hybrid, or plug-in hybrid vehicles	Speech of Prime Minister

a. Department of Finance Canada, “Investing in the Middle Class. Budget 2019,” (2019), https://www.budget.gc.ca/2019/docs/plan/budget-2019-en.pdf

b. Chinese Ministry of Industry and Information Technology,”新能源汽车产业发展规划(2021-2035 年)(征求意见稿) [New Energy Vehicle Industry Development Plan (2021-2035), proposal for public comments)],” (2019), http://www.miit.gov.cn/n1146285/n1146352/n3054355/n3057585/n3057589/c7552776/content.html

c. Government of Costa Rica, “National Decarbonization Plan 2018-2050,” (2019), https://unfccc.int/sites/default/files/resource/NationalDecarbonizationPlan.pdf
d. Danish Ministry of Energy, Utilities and Climate, “Sammen om en grønnere fremtid. Klima- og lufudspil [Together about one greener future. Climate and Air Plan],” (2018), https://efkm.dk/media/12350/klimaministeriet_klimaogluftudspil_digital.pdf
e. French Republic, LOI n° 2019-1428 du 24 décembre 2019 d’orientation des mobilités [Law Number 2019-1428 of 24 December 2019 on Mobility Orientation], https://www.legifrance.gouv.fr/affichTexte.do?categorieLien=id&cidTexte=JORFTEXT000039666574&dateTexte=
f. International ZEV Alliance, International ZEV Alliance Announcement, (2015), http://www.zevalliance.org/international-zev-alliance-announcement/
g. Ministry for the Environment and Natural Resources, “Iceland’s Climate Action Plan for 2018-2030,” (2018), https://www.government.is/library/Files/ Icelands%20new%20Climate%20Action%20Plan%20for%202018%202030.pdf. This target is on new registrations instead of new sales of cars, and exemptions, such as for remote areas, will be considered.
h. “India turns to electric vehicles to beat pollution,” BBC News, (July 24, 2019), https://www.bbc.com/news/world-asia-india-48961525
i. Government of Ireland, “Climate Action Plan 2019. To Tackle Climate Breakdown. Annex of Actions.,” (2018), https://www.dccae.gov.ie/en-ie/climate-action/publications/Documents/16/Climate_%20Action_Plan_2019_Annex_of_Actions.pdf
j. Shoshanna Solomon, “Israel aims to eliminate use of coal, gasoline and diesel by 2030,” The Times of Israel, (February 27, 2018), https://www.timesofisrael.com/israel-aims-to-eliminate-use-of-coal-gasoline-and-diesel-by-2030/
k. Ministry of Economy, Trade and Industry, “次世代自動車戦略 2010 [Next-Generation Vehicle Strategy 2010],” (2010) https://www.a3ps.at/site/sites/default/files/conferences/2011_eco-mobility2011/2011_Eco-Mobility_01_04_Miura.pdf
l. Dutch Government, Klimaatakkoord [Climate Agreement], (2019), https://www.klimaatakkoord.nl/documenten/publicaties/2019/06/28/klimaatakkoord
m. Norwegian Ministry of Transport and Communications, “National Transport Plan 2018-2029,” (2017), https://www.regjeringen.no/contentassets/7c52fd2938ca42209e4286fe86bb28bd/en-gb/pdfs/stm201620170033000engpdfs.pdf
n. Filipa Almeida Mendes, “Governo aumenta apoios à compra de carros eléctricos [Government increases support for the purchase of electric cars],” Publico, (November 17, 2018), https://www.publico.pt/2018/11/17/sociedade/noticia/governo-quer-veiculos-electricos-circular-portugal-1851418?fbclid=Iw AR19alFsBAEOeA4j9gxGfKxvoPydN2wU7dKxemjDZWMqqL7d0R-CeFY7qYo
o. Scottish Government, “Climate Change Plan: third report on proposals and policies 2018-2032 (RPP3),” (February 6, 2018), https://www.gov.scot/publications/scottish-governments-climate-change-plan-third-report-proposals-policies-2018/pages/12/
p. Aradhana Aravindan and John Geddie, “Singapore aims to phase out petrol and diesel vehicles by 2040,” Reuters, (February 18, 2020), https://www. reuters.com/article/us-singapore-economy-budget-autos/singapore-aims-to-phase-out-petrol-and-diesel-vehicles-by-2040-idUSKBN20C15D
q. Target is for stock instead of new vehicle sales. “Sri Lanka to scrap state-owned fossil fuel vehicles by 2025,” The Straits Times, (November 10, 2017). https://www.straitstimes.com/asia/south-asia/sri-lanka-to-scrap-state-owned-fossil-fuel-vehicles-by-2025
r. Ministry of Infrastructure of the Republic of Slovenia, Strategija na področju razvoja trga za vzpostavitev ustrezne infrastrukture v zvezi z alternativnimi gorivi v prometnem sektorju v Republiki Sloveniji [Market Development Strategy for the Establishment of Adequate Alternative Fuel Infrastructure in the Transport Sector in the Republic of Slovenia], (2017), https://e-uprava.gov.si/.download/edemokracija/datotekaVsebina/298735?disposition=inline.
s. Cho Chung-un, “Korea aims to become world’s No.1 green car provider, first to commercialize autonomous driving,” Korea Herald, (October 15, 2019), http://www.koreaherald.com/view.php?ud=20191015000824
t. Congress of Deputies of Spain Proposición de Ley sobre Cambio Climático y Transición Energética [Proposed Law on Climate Change and Energy Transition], (2019), http://www.congreso.es/public_oficiales/L13/CONG/BOCG/B/BOCG-13-B-48-1.PDF. Spain’s Draft Law on Climate Change and Energy Transition, has been approved and is in its final administrative processing.
u. Government Offices of Sweden, “Klimatpolitiska handlingsplanen – Fakta-PM [Climate Policy Action Plan - Facts PM,” (2019), https://www.regeringen. se/4af76e/contentassets/fe520eab3a954eb39084aced9490b14c/klimatpolitiska-handlingsplanen-fakta-pm.pdf. Government analyzing conditions for a national ban on combustion vehicle sales, final report due 1 February 2021.
v. Prime Minister Johnson announced bringing forward its combustion vehicle phase out to 2035 (from original 2040 target) and including hybrids in the phase-out. The proposal is now in an open consultation process, with July 2020 deadline. Department for Transport, Open consultation: Consulting on ending the sale of new petrol, diesel and hybrid cars and vans, https://www.gov.uk/government/consultations/consulting-on-ending-the-sale-of-new- petrol-diesel-and-hybrid-cars-and-vans

4. Policy recommendations

Technically sound policies, well-designed incentives, and targeted investments will be the key to ensuring that what is feasible, regarding decarbonization of the freight sector, becomes reality within the timeframe required to meet important climate targets.

New vehicle regulations are needed to drive efficiency improvements and increased electrification of the fleet.

Many governments are adopting regulations that require increased deployment of electric vehicles. The transition to electric vehicles requires that sufficient electric vehicle model offerings are available across vehicle classes and company brands on the market. The most effective policies to ensure sufficient availability of electric vehicles are direct electric vehicle regulations—often call Zero Emission Vehicle (ZEV) or New Energy Vehicle (NEV) regulations—which require each manufacturer to deploy increasing shares of electric vehicles over time.

By early 2020, California and ten other U.S. states, the Canadian province of Québec, and China, have adopted direct electric vehicle regulations for passenger vehicles. Analysis of expected manufacturer compliance indicates that the adopted ZEV regulation will lead to around 10%-15% electric vehicle sales in California by 2025. On June 21, 2020, China released a policy document to extend its NEV regulation from 2020 to 2023. Based on the newly-finalized NEV credit requirements, electric vehicle share in China is likely to at least double from 2019 to 2023. British Columbia has also adopted such legislation, but unlike other North America policies that are through 2025, British Columbia also requires 100% zero-emission vehicle sales by 2040.

California and China are each in the process of developing regulations to require increased uptake of zero-emission heavy-duty vehicles, which will be the first in the world. In June of 2020, California adopted a strengthened proposal to require increasing percentages of zero-emission new truck sales across three vehicle classes. The regulations set increasing requirements that reach 40% (heavy tractors), 55% (commercial vans and pickups), and 75% (medium-duty trucks) zero-emission vehicle shares by 2035.

Strong regulations on vehicle greenhouse gas emissions or vehicle fuel economy can also push increased electric vehicle availability. The key example of regulations which are strong enough to require electric vehicle sales are the 2020-2030 CO_2 emission standards for passenger cars and light-duty commercial vehicles in the European Union. In early 2020, the EU-level regulations are spurring EV sales share (7.8% January-April 2020) in Europe that is approximately double the 2019 EV share of 3.6%. Going forward, stronger ZEV, CO_2 or efficiency regulations will be critical to ensure sufficient volume of electric vehicles to reach economies of scale and become a mainstream technology.

Fiscal incentives have played an integral role in spurring electric vehicle sales.

Almost all global electric vehicle sales to date occurred in markets with financial incentives to make electric vehicles more cost competitive with conventional vehicle alternatives. Specific policies include upfront purchase incentives (e.g., China, Japan, France, Germany, the United Kingdom), federal tax credits (e.g., the United States), and tax and registration fee exemption or discounts (e.g., Netherlands, Norway, Sweden). Financial incentives will remain important in the near future until electric vehicles reach cost parity with conventional vehicles.

Prematurely ending these policies can stifle electric vehicle sales, as happened in Denmark in 2016 and the U.S. state of Georgia in 2015. In April 2020, China announced it would extend its national subsidies and tax breaks for electric vehicles by two years until end of 2022, whereas the policies were originally scheduled to be terminated at the end of 2020.

With the continued decline of battery prices, several jurisdictions have modified their incentive schemes to reduce incentive values in recent years. For example, China has phased down its purchase subsidies for electric vehicles six times from 2014 to 2020. Starting from March 12, 2020, the United Kingdom's plug-in car grant was reduced from £3,500 to £3,000, the third time this grant has been cut since it launched in 2011. However, there are also markets that are proposing to increase incentives for electric vehicles. For example, Germany, as part of its COVID recover package, increased the maximum subsidies from €4,000 to €6,000 for battery electric cars and from €3,000 to €4,500 for plug-in hybrid electric cars registered after November 4, 2019.

The transition to electric vehicles requires a convenient and reliable charging infrastructure network.

Policies that have been adopted to support charging access include city charging strategies (e.g., New York, Oslo, Shenzhen), fiscal incentives for the construction and operation of charging infrastructure (e.g., Chinese national government, Beijing, Paris, Tokyo), streamlined permitting process for charging station development (e.g., Los Angeles, San Jose, Seattle), and EV-ready building and parking codes which mandate a percentage of new parking spaces be equipped with charging wiring and equipment (e.g., Beijing, London, San Francisco).

Governments in China also ensure a smooth and convenient charging experience through regulating charging pricing, standards, and payment mechanisms (e.g., Shanghai, Tianjin, Wuhan). Much more charging infrastructure will be needed as the electric vehicle market grows and as charging needs evolve with local conditions. Government and operator strategies are evolving from simply putting more charge points on the ground to catering to identified consumer needs with the strategic placement of public charge points. With diligent infrastructure planning, electric vehicle charging could ultimately be more convenient for many drivers than fueling conventional vehicles.

For electric trucks, overnight and loading area charging can greatly reduce charging costs, and coordination among fleets and public agencies could help distribute the initial costs. Government-led programs and public-private partnerships would help coordinate and share such investments.

International cooperation has played a unique role in accelerating the global transition to electric vehicles by facilitating faster learning from global market and policy developments.

One representative cooperation platform is the International ZEV Alliance, which is an intergovernmental organization founded in 2015 with an aim to reduce greenhouse gas emissions from the transport sector to mitigate climate change. Members of ZEV Alliance include five nations (Canada, Germany, Netherlands, Norway, United Kingdom), ten U.S. states, two Canadian provinces, and one German state.

Policy makers from these jurisdictions meet regularly to collaborate and share knowledge. In addition, ZEV Alliance conducts a series of technical studies on topics such as how to design incentive policies, how to electrify the heavy-duty sector, and how to meet the growing infrastructure needs for electric vehicles. The ZEV Alliance members commit to achieve 100% zero-emission passenger vehicle sales no later than 2050, providing a clear signal to industry and stimulating investments.

Other successful international cooperation platforms include C40 Cities, Electric Vehicle Initiative (EVI), Under2 Coalition, and the Transportation Decarbonization Alliance (TDA). The EVI's EV30@30 campaign goal, among 11 member countries and 29 supporting companies and organizations, is to reach a 30% electric vehicle sales share by 2030.