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DRIVING THE TRANSITION TO ZERO-EMISSION TRUCKS

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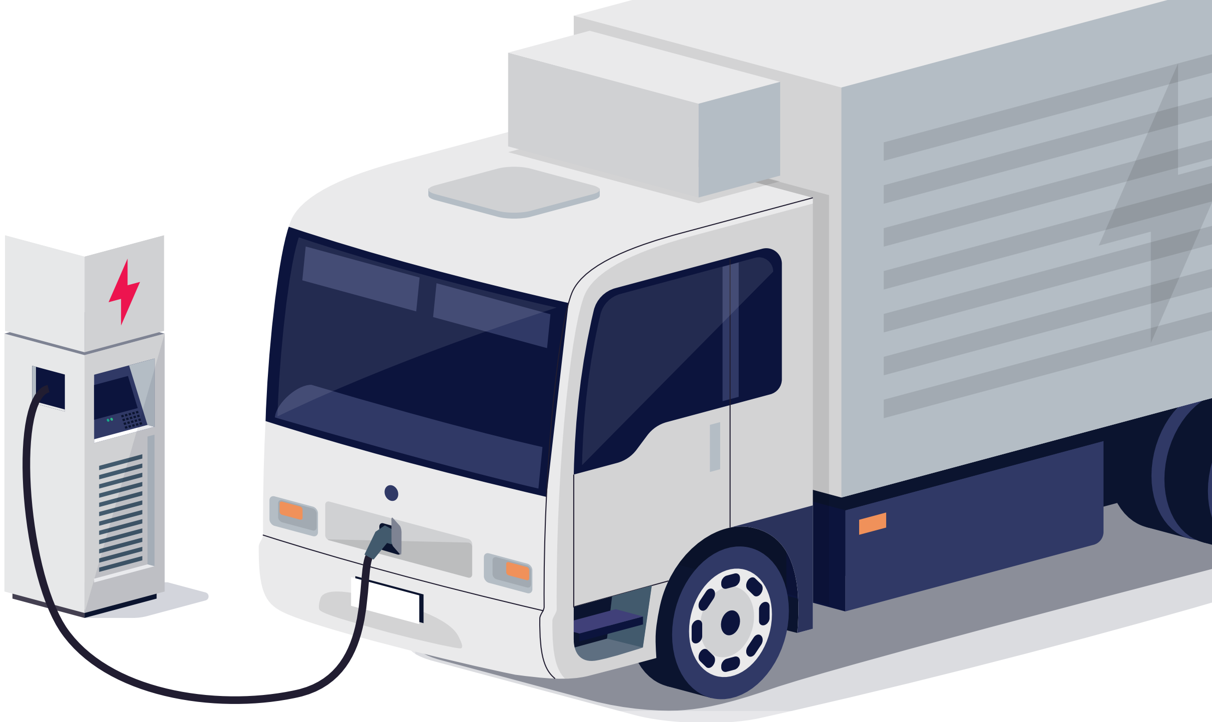

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Key policy messages

Total cost of ownership (TCO) parity between diesel and battery electric commercial vehicles (EVs) is approaching. In some regions and vehicle categories—such as heavy- and medium-duty trucks in China, and vans in India and China—electric vehicles are already cheaper over their lifetimes than their diesel counterparts. In other regions, cost parity is expected before 2033. This presents an opportunity for lower-cost road freight, along with cleaner air and reduced carbon emissions.

Regulatory policies, particularly zero-emission vehicle mandates, but also fleet-wide emissions reduction standards, are generally the most effective way to get electric trucks on the road, and are likely to achieve the fastest reduction in zero-emission vehicle costs.

Price instruments such as purchase subsidies and taxes are less effective on their own, but subsidies can help grow the market for zero-emission vehicles (ZEVs) particularly in the period before cost parity is reached.

Policies can work well in combination. Early deployment policies, such as city-wide zero-emission zones or ZEV mandates, can be highly effective in creating a growing electric truck market, and can increase the future effectiveness of carbon pricing.

International coordination on regulatory policies (such as ZEV mandates) in the leading markets of Europe, China, India, Canada, California and other US states could bring forward the cost-parity tipping point by up to two and a half years, making the transition to EVs cheaper for other countries all over the world. This is because of learning-by-doing and economies of scale.

Context: the opportunity of a transition in trucking

Around two thirds of land freight globally is carried by road,[1] making this form of transport central to the functioning of most countries' economies. The costs of trucking affect the prices of goods carried to consumers and businesses, influencing industrial competitiveness and economic productivity.

With its current technologies of petrol and diesel vehicles, road freight is responsible for around 6% of global CO_2 emissions.[2] It is also a significant source of air pollution that is damaging to public health: transport-related tailpipe pollution is responsible for almost 400,000 deaths each year.[3]

A technology transition in the sector is already under way. Its forerunner is the transition in passenger vehicles. Electric vehicles (EVs) now account for around 20% of global car sales[4], a share that is rising rapidly, outpacing most analysts' predictions.

Global sales of full-electric trucks are much lower, at only 0.9% globally in 2023, but growing rapidly. Sales grew by 35% in 2023 compared to 2022, with China leading the way and Europe catching up. Data from 2024 again showed an impressive growth, with medium-duty electric trucks reaching a 22% market share in China in December 2024, a tripling compared to January 2024.[5] In the US, sales increased nearly 44% in January to November 2024, compared to 2023.[6] There are signs that truck manufacturers are investing substantially in the development of electric vehicle technology, with 750 electric truck models now available in China, Europe and North America.[7] Sales of electric buses—which, like electric trucks, require large batteries—are well ahead, already at 3% market share globally in 2023.[8]

The new technology offers the opportunity of lower cost road freight, as well as reduced carbon emissions and air pollution.

For many countries, the transition to clean trucking can help cut back expensive oil imports, with positive effects for economic growth and employment.[9] And with global sales of trucks worth over $200bn per year, there will be additional benefits for countries whose manufacturers increase their market share over the course of the transition.

Policy challenge

The challenge for governments is to identify the right policies to advance this transition. Many countries have started designing policies to support electric vans (light-duty vehicles - LDVs) and trucks (medium-duty vehicles – MDVs, and heavy-duty vehicles – HDVs), or to reduce emissions from fossil-fuelled vehicles. Fuel efficiency standards have a long history of use, and in the EU these are now targeted at a 90% reduction in emissions by 2040. Zero-emission vehicle mandates have proven effective for driving the transition in cars, but have not yet been tested for trucks. Carbon prices are often recommended by economists, but high taxes on fuel have been in place for many years in some countries (for example, in the UK, equivalent to a carbon price of £210–240 per ton CO_2[10]) without driving a transition. Electric vehicle purchase subsidies have been widely used for cars and are being introduced for trucks by countries such as India,[11] and various European countries,[12] but are often seen by governments as too costly. What are the best policy options, or combinations?

In this policy brief we begin by comparing the cost trajectories of diesel, petrol, compressed natural gas (CNG), and battery electric vehicle (BEV) transport technologies. We then compare the policy options for advancing the transition, individually and in combination, using a model that simulates the process of technology diffusion. Finally, we take a more in-depth look at the options for India, and assess the opportunity for coordinated international action.

1 DHL Freight (27 April 2023). Global Freight Transport Statistics: International, Europe, and Germany
2 Ritchie, H. (2020). Cars, planes, trains: where do CO_2 emissions from transport come from? Our World in Data.
3 ICCT (2021). A Global Snapshot of The Air Pollution-Related Health Impacts of Transportation Sector Emissions In 2010 And 2015.
4 IEA (2024). Global EV Outlook 2024. International Energy Agency
5 Mao et al. (2025). Zero-emission medium- and heavy-duty vehicle market in China, 2024
6 Environmental Defence League (2024). 2024 was another record year for electric truck deployments, proving that the shift to zero-emission is not slowing down
7 BloombergNEF (2024). Zero-Emission Commercial Vehicles: The Time Is Now
8 IEA (2024). Global EV Outlook 2024. International Energy Agency
9 Lynch et al. (2024) Hidden Disparities On The Road To Net-Zero. EEIST consortium
10 UK Gov (2025). Extension to the cut in fuel duty rates to March 2026
11 The Government of India is introducing subsidies as part of its PM E-DRIVE programme. (Press Information Bureau, 2024).
12 ICCT (2024). European Heavy-Duty Vehicle Market Development Quarterly (January–March 2024)

Reaching cost parity

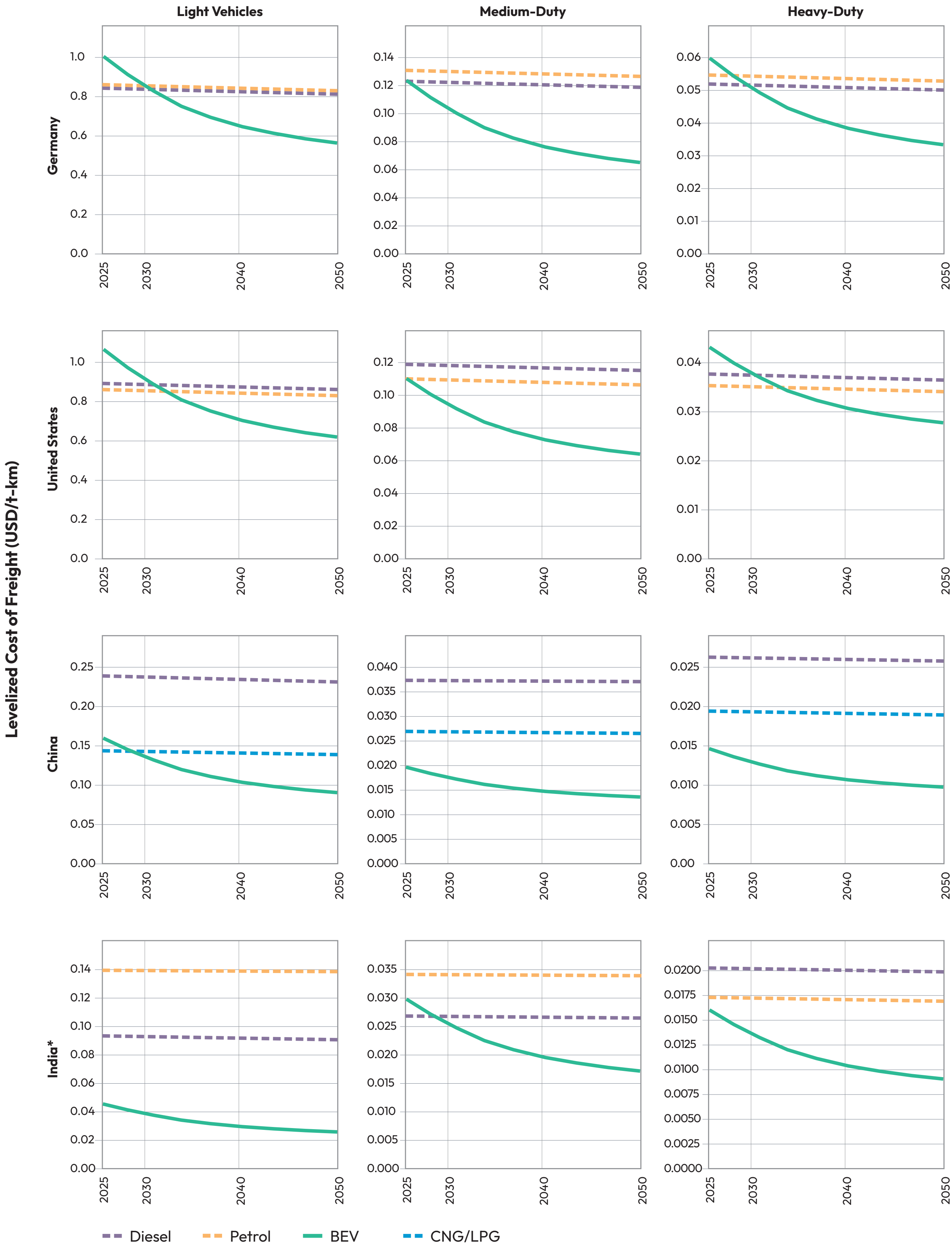
The large battery packs required for electric medium- and heavy-duty vehicles make electric trucks expensive at the point of purchase, compared to petrol and diesel trucks. Battery trucks are roughly 1.5x to 2x as expensive compared to diesel trucks globally. In India, the price is 2x to 3x for heavy-duty vehicles—the highest of the four countries that we take as examples in this study.[13] However, the operating costs of electric trucks are significantly lower, and because these vehicles tend to be used intensively, this contributes substantially to lowering their overall lifetime costs.

The latest data, a combination of real-world data and modelling from the International Council for Clean Transportation (ICCT), suggest that in the medium-duty segment, the lifetime costs (including purchase and use) of battery electric vehicles (BEVs) are already lower than those of petrol and diesel trucks in China, roughly equal in the USA and Germany, and only slightly higher than diesel trucks in India.

In the heavy-duty segment, lifetime costs of BEVs are slightly higher than those of petrol and diesel trucks in the USA and Germany, and already lower in China and India.

In all cases, the cost difference is expected to widen in favour of BEVs, as battery costs fall. The cost of lithium iron phosphate (LFP) batteries, the main choice for electric truck batteries, already fell by 86% between 2013 and 2024.[14] The extent of the cost advantage depends on oil prices, which are hard to predict. In our modelling, we assume oil prices stay constant at 2023 levels, which were close to the middle of the range experienced over the last 30 years. We use electricity price trends computed by the FTT:Power model,[15] and these typically decrease slightly over the modelled period. Infrastructure costs (such as EV charging infrastructure) are included in our estimates of fuel and electricity costs.

13 Global: ICCT (2024), Zero-Emission Commercial Vehicles: The Time Is Now (1.5-2x),
India: ICCT (2024), Total cost of ownership parity between battery-electric trucks and diesel trucks in India (2-3x)
14 BloombergNEF (2024) Lithium-Ion Battery Pack Prices See Largest Drop Since 2017, Falling to $115 per Kilowatt-Hour: BloombergNEF
15 Nijsse et al. (2023). The momentum of the solar energy transition. Nature Communications



* No data is available for long-haul HDV in India; cheaper short-haul HDVs are shown

Figure 1: Total cost of ownership (levelised costs) of battery electric vehicles, compared to petrol and diesel. In some regions, including China and India, the total cost of ownership (TCO) of electric trucking is already lower than that of petrol and diesel vehicles for most vehicle categories. Initial cost data are from ICCT; future costs are based on modelling.

Policy to reduce costs and increase uptake

The existing and expected cost advantage of battery electric trucks is not on its own sufficient to drive a rapid transition. Barriers include low availability of and familiarity with electric trucks, high purchase prices, charging times, lower payloads in some regions, and lack of supporting infrastructure.

We compare the effectiveness of different policy options in driving the transition to zero-emission vehicles using the Future Technology Transformations (FTT) model. The model simulates the choices of diverse vehicle buyers, the changing costs of technologies from learning-by-doing, and the progress of the transition—with new technologies increasing their market share at the expense of old technologies, following a characteristic S-curve pattern. Sales depend on the price difference and are limited by the current shares of a technology. That is, a new industry has a maximum growth rate.[16] The model does not explicitly include charging infrastructure.

The policy options we test are:

- **Subsidy + tax (feebate):** A purchase subsidy for BEVs set to achieve parity in total cost of ownership between BEVs and CNG/diesel trucks in 2025 (applied in any market segment where BEVs initially cost more). This subsidy is paid for by a tax on CNG, petrol and diesel trucks. Initially, this tax is low but increases as the sales of internal combustion engine (ICE) vehicles drop.
- A fixed **carbon price** on fuel, of €100 per ton of CO_2, which is around the level that the World Bank has suggested is roughly consistent with keeping the rise in global temperatures to well below 2 °C.[17]
- A **kickstart policy,** which imposes a mandate requiring the EV share of sales to rise to 20% by 2027, as a way of starting the transition.
- **Emissions standards:** a regulation that limits the carbon intensity of new vehicles, starting at current averages of 1200 gCO_2/km for HDVs, 800 gCO_2/km for MDVs and 300 gCO_2/km for LDVs, linearly decreasing to zero by 2040.
- **Zero-Emission Vehicle Mandate:** a regulation that requires the minimum share of ZEVs in vehicle sales to increase linearly from zero in 2025 to 100% in 2040. This is in line with the target set by many countries in the Global MOU on Zero-Emission Medium- and Heavy-Duty Vehicles.[18]

We include the 'feebate' (a combination of tax and subsidy) to show that subsidies can be fiscally neutral. A small tax on internal combustion engine vehicles (ICEVs) can offset subsidies without straining government budgets. Table 1 shows the ZEV subsidies required to achieve cost parity, and the related tax on ICEVs, as a percentage of purchase price.[19]

16 For details on the modelling framework, see Mercure (2012). FTT:Power : A global model of the power sector with induced technological change and natural resource depletion. Energy Policy
17 World Bank (2024). State and Trends of Carbon Pricing
18 Global Drive to Zero (2025). Global Memorandum of Understanding on Zero-Emission Medium- and Heavy-Duty Vehicles.
19 In the US, current laws require fuel taxes to be allocated to transport and transit infrastructure, notably the Highway Trust Fund. Such regulations may have to be changed to allow a revenue-neutral feebate policy to be implemented.

a. Subsidy needed to break TCO cost-parity (%)	India	China	US	Germany
Light-duty vehicles	0	22	21	15
Medium-duty vehicles	14	0	0	0
Heavy-duty vehicles	0	0	20	12

b. Revenue-neutral tax (%)	India	China	US	Germany
Light-duty vehicles	0	5	1	1.5
Medium-duty vehicles	1.3	0	0	0
Heavy-duty vehicles	0	0	1.4	0.5

Table 1: Budget-neutral approach to ZEV subsidies. Table 1a shows the subsidy required to reach cost parity for three weight categories of electric vans and trucks. Table 1b shows the related tax on ICEVs, as a percentage of purchase price.

Figure 2 presents the global results of the policy comparison, assuming all countries implement each policy simultaneously. While this aggregate view obscures country-specific trends, it highlights typical results. Across all weight categories, the carbon price and feebate policies achieve only a modest increase in the market share of zero-emission vehicles. The kickstart policy has a substantial impact, while the two long-term regulatory measures are most effective by a considerable margin. In this global analysis, the effectiveness of the feebate is understated compared to that of the carbon price because in market segments where BEVs are already lower cost than diesel trucks, no subsidy is applied; even so, the feebate outperforms the carbon price in the light-duty segment. The carbon intensity regulation and the zero-emission vehicle mandate perform similarly to each other, with the mandate being slightly more effective.

Hydrogen fuel cell vehicles (FCEV) do not gain traction in any of the modelled scenarios. Because they are more expensive than battery electric vehicles, they lose out to battery electric vehicles if a carbon tax or emissions regulation is introduced. These results suggest that an FCEV-specific subsidy would be needed to promote the diffusion of this technology. The level of these subsidies would need to be high. For instance, in India FCEV prices are four times as high as BEV prices. Despite this, there may be niche applications where their faster refuelling and payload advantages outweigh their higher costs.

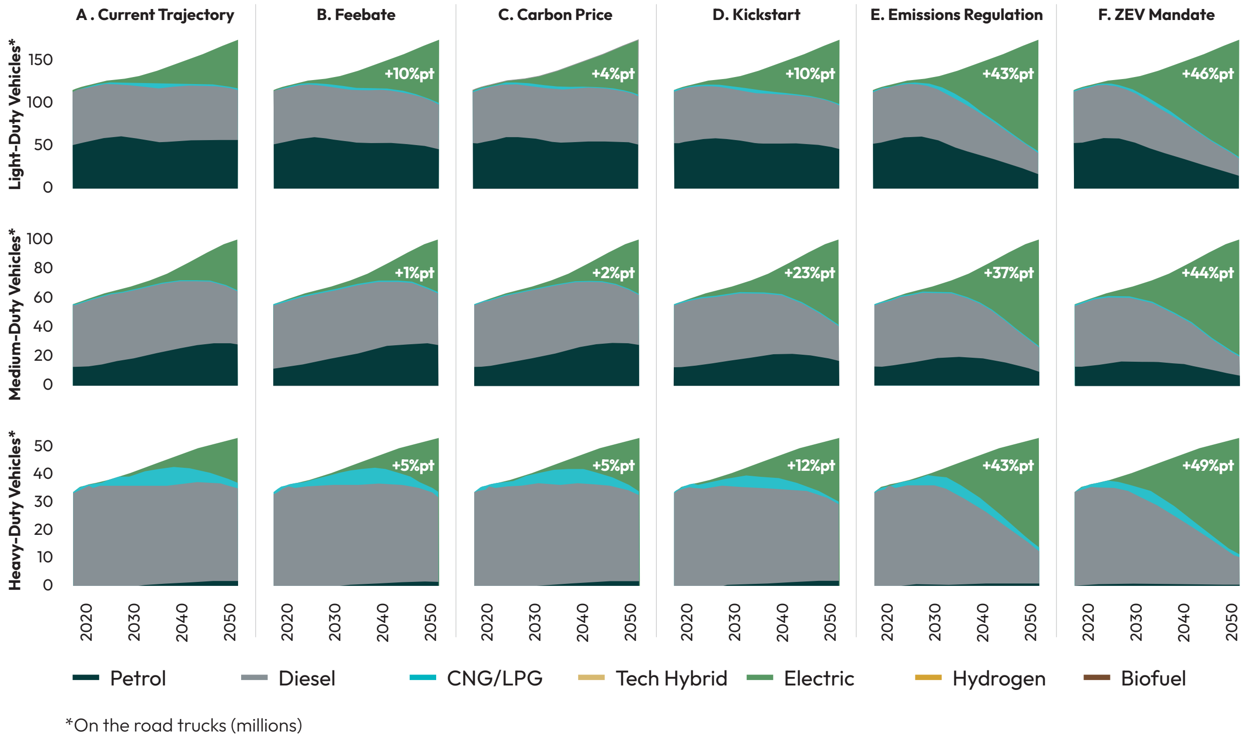


Figure 2: Policy effectiveness at the global level. The bolded number is the percentage point (%pt) increase of zero-emission vehicles compared to a scenario without policy support.

The results for China are shown in figure 3. Price instruments here are less effective than is typical globally, as the total cost of ownership of BEVs is already (much) lower than that of petrol or diesel trucks. Regulatory policies, especially the ZEV mandate, can still accelerate the transition.

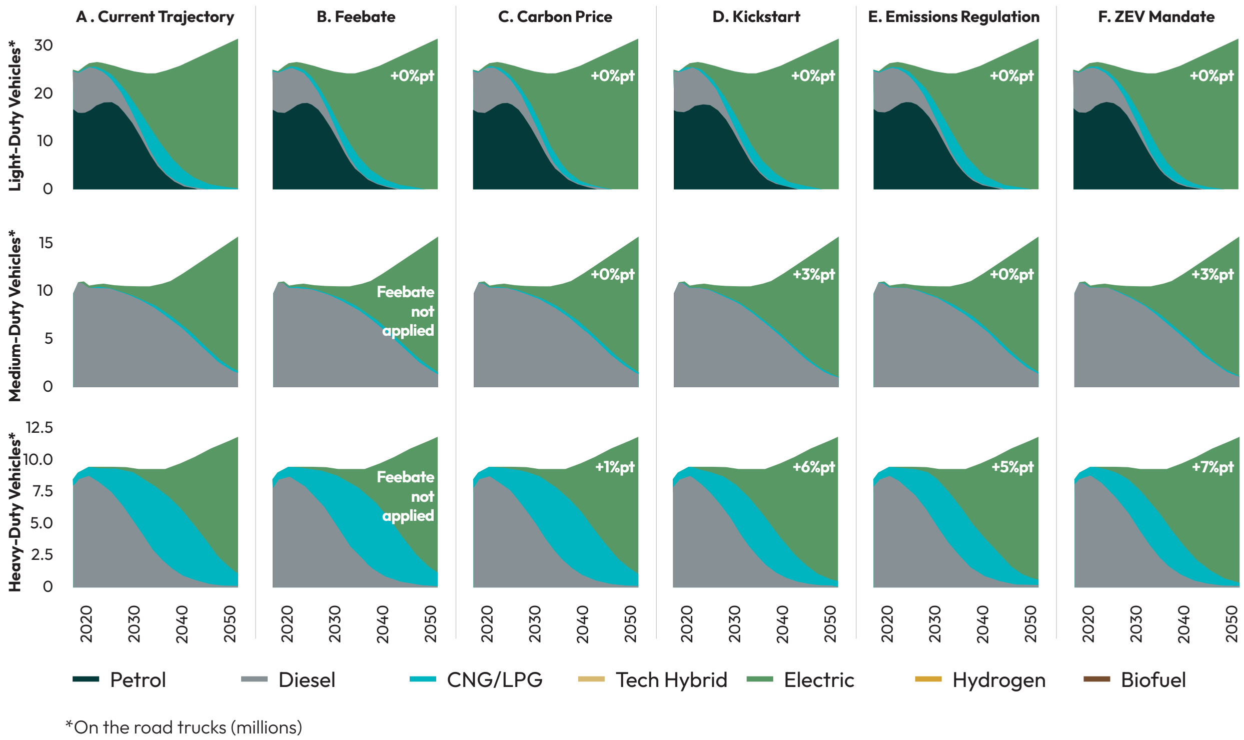


Figure 3: Policy effectiveness in China

In Germany, price instruments, especially the BEV purchase subsidy (paid for with the tax), can be highly effective in stimulating uptake of zero-emission vehicles, as shown in figure 4.

This reflects the higher cost differential experienced by Germany at present. Regulatory policies, however, are by far the most effective, particularly the ZEV mandate.

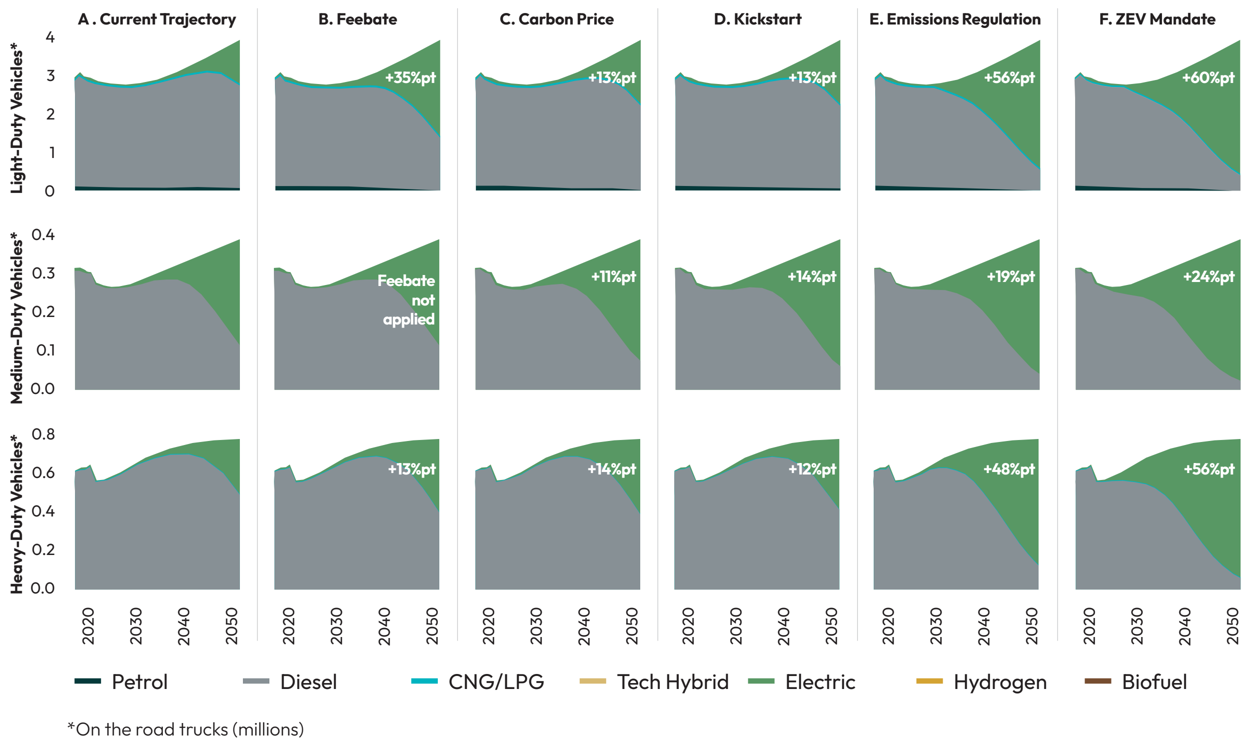


Figure 4: Policy effectiveness in Germany

In India, the transition to electric vans (in the light-duty segment) is already well underway. Price-based policies are more effective for medium-duty trucks, where the cost-parity point is furthest away, than for other weight categories. Regulatory policies are most effective overall, as they increase the availability of BEV models and accelerate their cost reduction.

The ZEV mandate has the greatest advantage over the carbon intensity regulation in the light-duty segment, whereas the effects are similar in the medium- and heavy-duty segments.

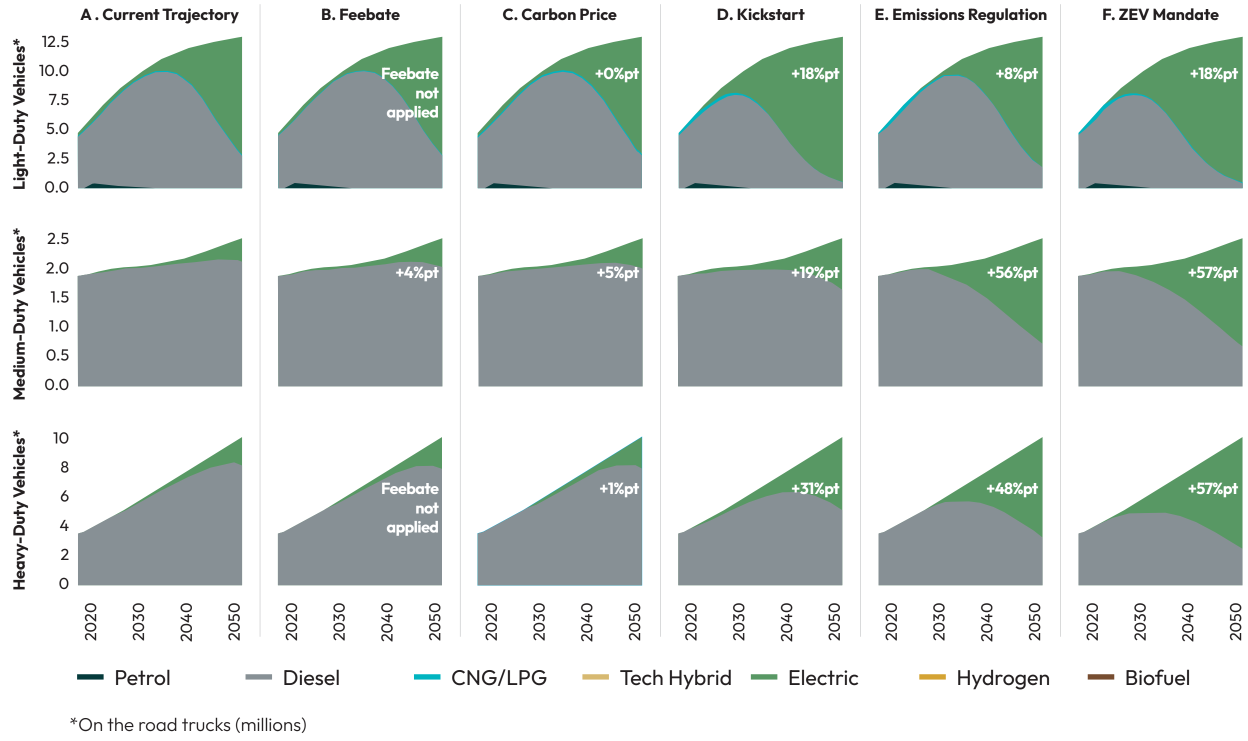


Figure 5: Policy effectiveness in India

In the US, the transition lags behind the other three countries, with all segments needing robust policy support. The feebate proves more effective than carbon pricing in the light- and heavy-duty segments where it is applied.

In the medium-duty segment, where the feebate is not applied because TCO parity has already been reached, carbon pricing shows mild effects. As observed in other countries, regulatory policies demonstrate the highest effectiveness overall.

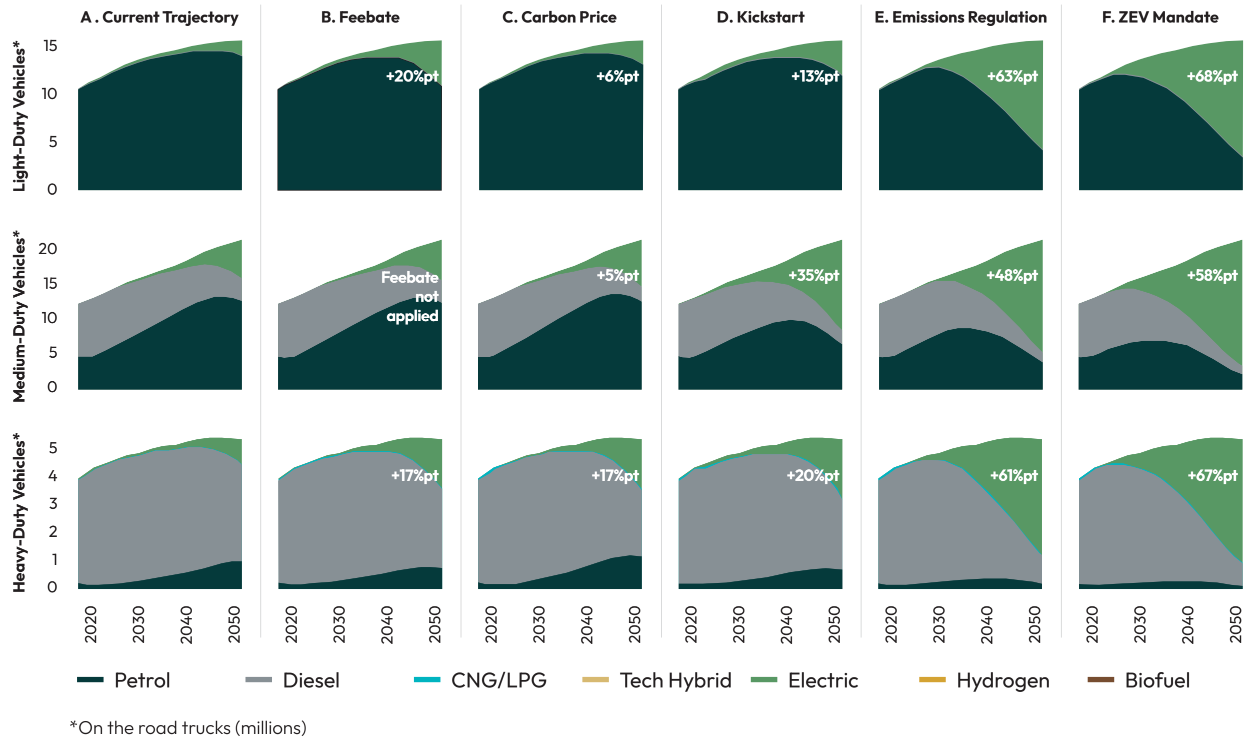


Figure 6: Policy effectiveness in the US

Relating the model results to real-world observations

The transition to zero-emission trucks has not progressed far enough for there to be much empirical evidence of which policies are effective in moving it forward. The findings presented above are broadly consistent with what has been observed in the transition to zero-emission cars, where purchase subsidies for electric vehicles have played an important role in many countries, and zero-emission vehicle mandates have proven to be an especially powerful lever.[20]

China is the furthest ahead of all countries in the trucks transition. Its industrial policy of supporting the development of batteries and manufacturing of "new energy vehicles" helped make these technologies available, while subsidies, procurement requirements, and clean air zones at city levels have driven deployment and cost reduction. For example, the cities of Shenzhen and Chengdu implemented zero-emission zones, in addition to bans on diesel trucks downtown during certain times of the day.[21] China has also implemented clean transportation requirements in some heavily polluting industries.[22]

The European Union is coming second globally in the transition, thanks to its increasingly strict emission standards.[23] Early in the transition, emissions standards can force a shift towards higher efficiency petrol and diesel vehicles without achieving significant deployment of zero-emission vehicles, as has been the case for many years in the past. But as our analysis shows, once these standards become sufficiently stringent, they can increasingly drive a shift towards the new technology (although slightly more slowly than a more targeted ZEV mandate), and this now appears to be happening in Europe.

It is likely that our modelling somewhat understates the effectiveness of subsidies, because we do not represent constraints on the availability of finance often faced by the companies that purchase vans and trucks. Real world experience suggests that capital-constrained businesses may be unable to switch to electric vehicles even when their total operating cost is lower than that of diesel vehicles, and subsidies can help overcome these constraints.[24]

20 ICCT (2019). Overview of global zero-emission vehicle mandate programs
21 ICCT (2023). Zero-emission bus and truck market in China: A 2022 update.
22 ICCT (2024). The ultra-low emission campaign on heavy industries in China.
23 European Commission (2024). Reducing CO_2 emissions from heavy-duty vehicles.
24 Mission Possible Partnership (2022). Making Zero-Emissions Trucking Possible.

The effect of policies on the rate of cost reduction
Figure 7 shows how each policy affects induced innovation and concomitant cost declines, showing BEV costs in 2035 and 2050. The regulatory policies achieve the greatest cost reduction—significantly more than the price-based policies. By pushing manufacturers to supply BEVs in greater volumes, the regulatory policies drive innovation and economies of scale, accelerating the progress of new technologies along their learning curves, and bringing down costs. The ZEV mandate achieves slightly deeper cost reductions than the emissions intensity regulation because it can only be complied with by selling the new technology (BEVs), and not by selling more efficient versions of the old technology (diesel trucks).

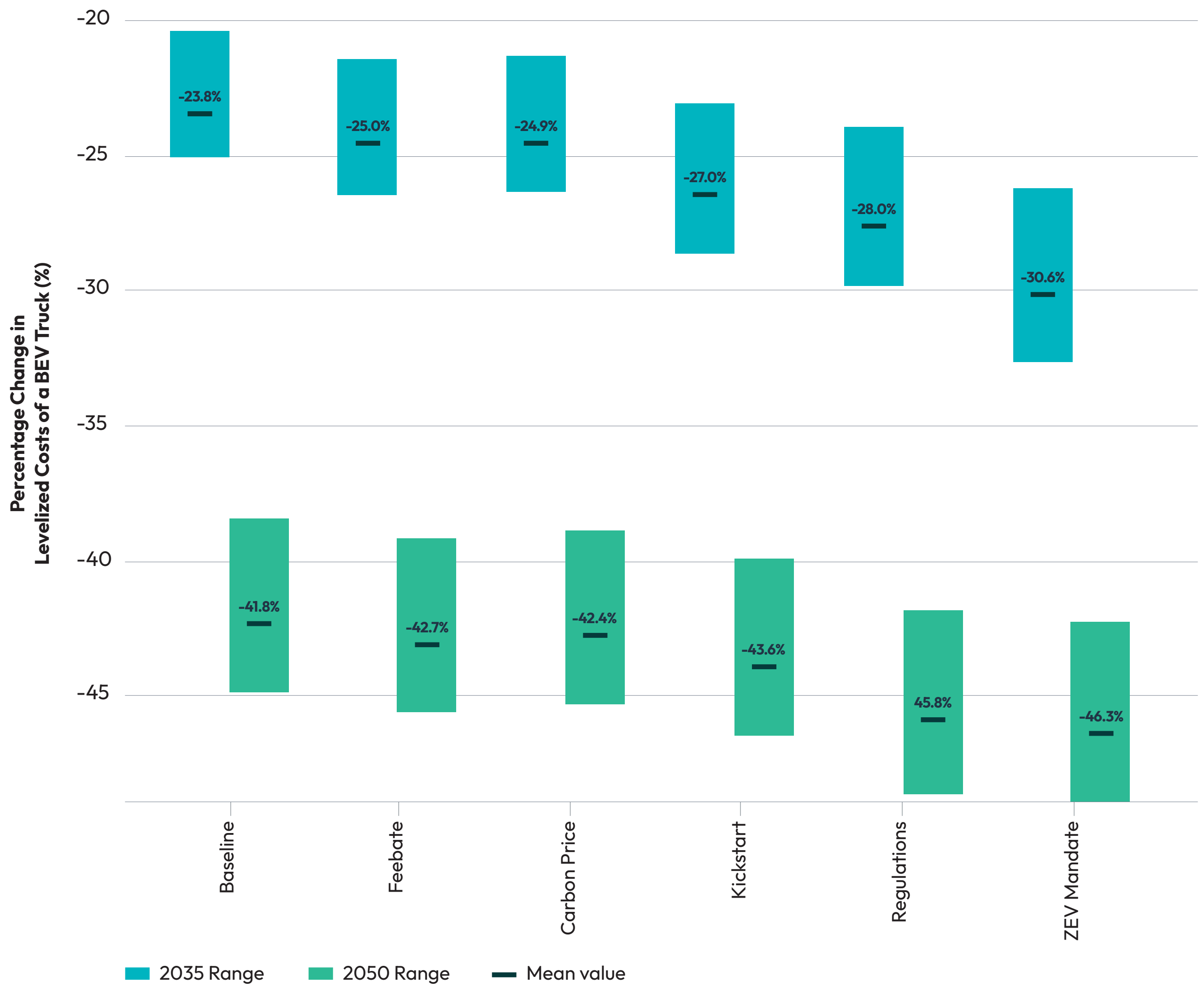


Figure 7: Effect of policies on the rate of cost reduction of BEVs. The figure shows the range of changes in the cost of a BEV truck from the start year to 2035 and 2050, for the four countries of interest (China, India, Germany, US). The direct effect of subsidies is not included; only their indirect effects via induced innovation are included.

Policy combinations and sequencing

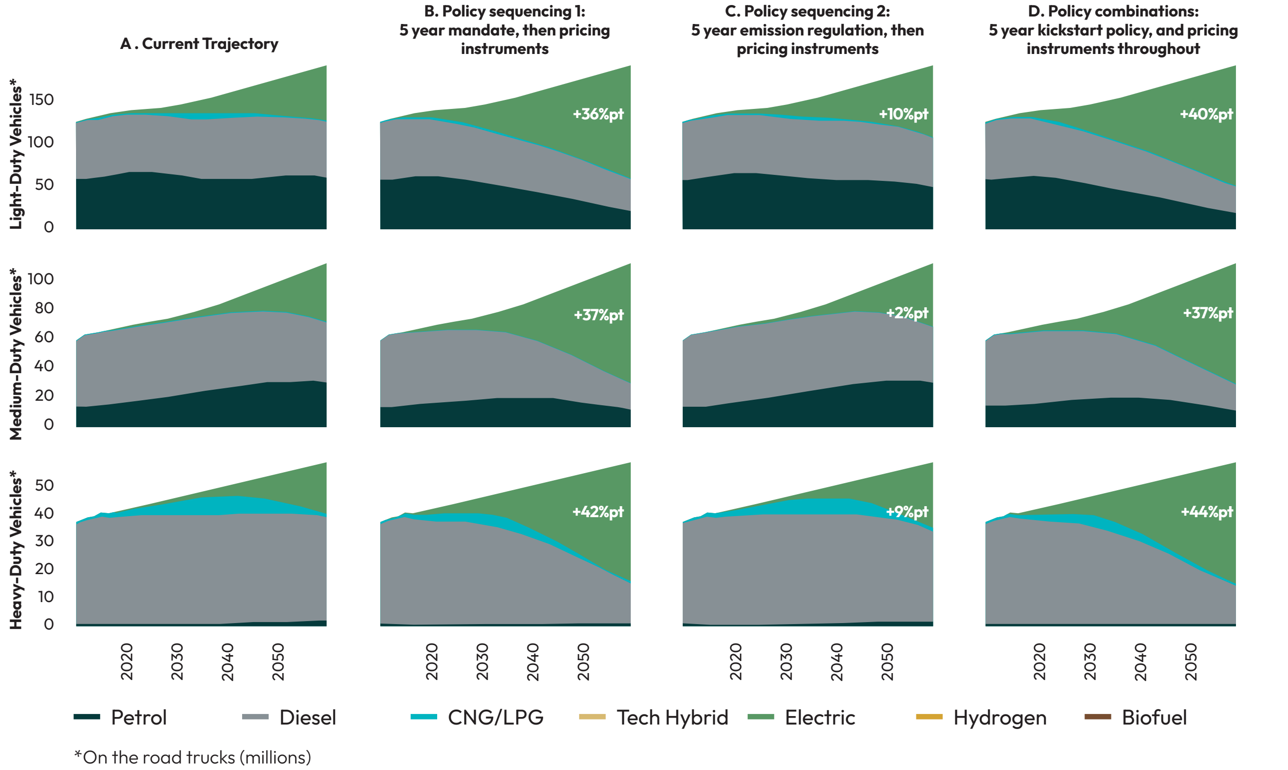


Figure 8: Policy combinations and sequencing. Global shares of vans and trucks by technology as a result of combining policies. The figure compares policy approaches across vehicle classes. The baseline (A) shows the current trajectory with limited electrification. (B) shows a 5-year kickstart policy followed by carbon pricing and feebates for the remainder of the period. (C) shows 5-year emissions regulations followed by the same pricing mechanisms for the remainder of the period. (D) shows 5-year kickstart mandate with carbon pricing and feebate used simultaneously throughout the period.

Governments often use policies in combination rather than individually, for the good reason that well-designed policy packages can be mutually reinforcing. In figure 8, we show the results of a comparison between three policy packages.

The sequencing of policy instruments significantly affects transition speed. A short-term ZEV mandate (the kickstart policy) accelerates progress more than early-stage emission regulations. Early emission standards are less effective as they can be met with increased efficiency of ICE vehicles.

Pricing mechanisms, here carbon pricing and feebates, become far more effective after regulatory policies have established the presence of electric vehicles. The most effective policy sequencing method involves the simultaneous use of both regulatory and pricing mechanisms early in the transition. The advantage of this approach is seen most strongly in the heavy-duty vehicles segment, which is at a particularly early stage of transition. This shows that whilst the individual policies can influence the speed of the transition, carefully designed policy combinations can create synergistic effects that rival the effectiveness of full-scale ZEV mandates or emissions intensity regulations over the course of the transition. This may be an important finding for governments that do not yet have the confidence to set a regulatory trajectory towards 100% zero-emission vehicles.

Other policies that can help advance the transition

Our modelling does not encompass the full spectrum of policies required to drive the transition to zero-emission trucks. Additional policies may be needed to support charging infrastructure, battery swapping and recycling, to enable cost-competitive domestic production or exports, and to navigate political economy challenges including job losses and job creation.

Most importantly, we do not model charging infrastructure, which is essential for all electric vehicles. Heavier segments of trucking require dedicated charging infrastructure, unlike vans which can make use of the charging infrastructure provided for cars. Government investment in charging infrastructure can be important to establish its early availability and can help to mobilise private investment. The establishment of battery swapping facilities, popular in China, can enable trucks to be used more intensively and charging to take place during times of low electricity prices. In the US and Europe, similar benefits can be derived from on-site battery storage.

We do not model industrial policies, such as tax breaks for manufacturers of zero-emission vehicles, and these may be helpful in countries with significant truck manufacturing sectors. We also do not model exemptions for road tolls, such as those stemming from the EU's Eurovignette Directive, which can lead to substantial cost savings for zero-emission truck operators.

Direct ZEV purchase mandates targeting specific polluting industries or regulated entities (e.g., shippers, logistics firms) are an additional policy tool, as demonstrated by California's Advanced Clean Fleets regulation, China's Ultra-Low Emissions campaign, and the planned EU legislation on Decarbonising Corporate Fleets. While our analysis has focused on supply-side regulations, these targeted demand-side mandates could play a powerful complementary role in accelerating the deployment and market maturation of zero-emission trucks.

Finally, it is worth considering the political economy of the transition, including the policy lobbying activities of the industry. To prevent opposition, it may be helpful to supplement regulatory policies that force the pace of the transition with subsidy policies that make the lower costs of BEV trucks accessible to firms at an earlier date.

International coordination can bring forward the tipping point

Globally, thirty-three countries are part of the Global Memorandum of Understanding on Zero-Emission Medium- and Heavy-Duty Vehicles (Global MOU), committed to reaching a 30% share of zero-emission vehicles in truck sales by 2030 and 100% in 2040[18].

If some of the countries with the largest markets were to coordinate their regulatory policies in line with this goal, this could substantially accelerate the fall in costs of BEV trucks, with benefits for all countries.

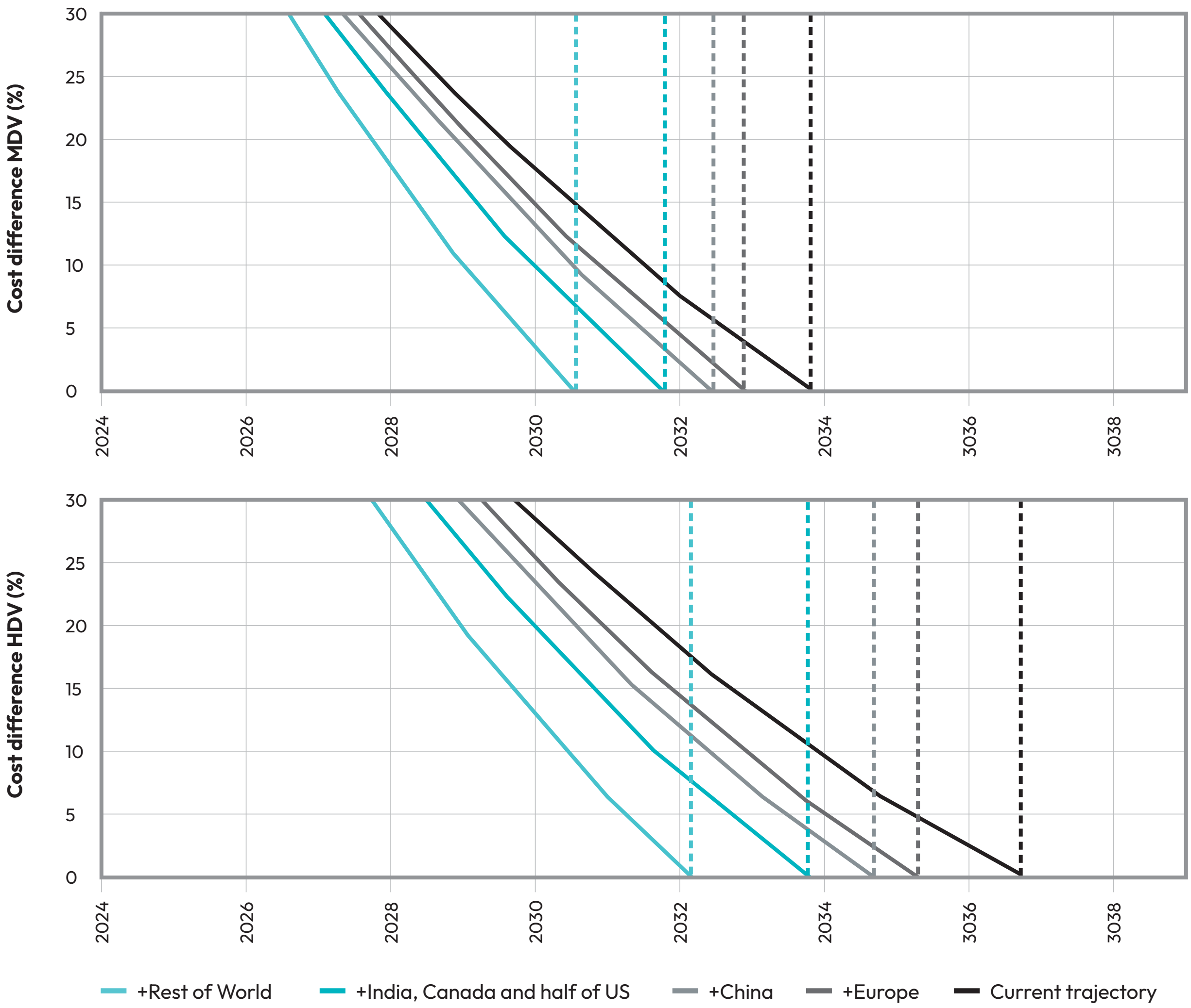


Figure 9: The effect of international coordination on the purchase price difference between BEVs and diesel vehicles in China. Only medium- and heavy-duty segments are shown, as in China the purchase price of electric vans (light-duty) is already below that of petrol/diesel vans.

In figure 9, we show the effect of international coordination from the point of view of China. In China, the total cost of ownership of electric vehicles is already lower than that of diesel vehicles. A second tipping point, where the purchase price of electric trucks becomes cheaper than that of their diesel equivalents, can be brought forward by 1-2 years to be in reach within the decade if China and the EU coordinate strong regulatory policies. This could be a key threshold for more cash-constrained firms, which may not be able to get a loan for an electric van or truck even if it is cheaper than a diesel or CNG vehicle over its lifetime.

If India, Canada, and US states that support the transition join China and the EU in this coordinated action, the purchase price-parity tipping point can be brought forward by another year. In the absence of national-level policies in the US, California and the 10 states that follow its clean truck regulations,[25] together with Canada, can still make a large difference.

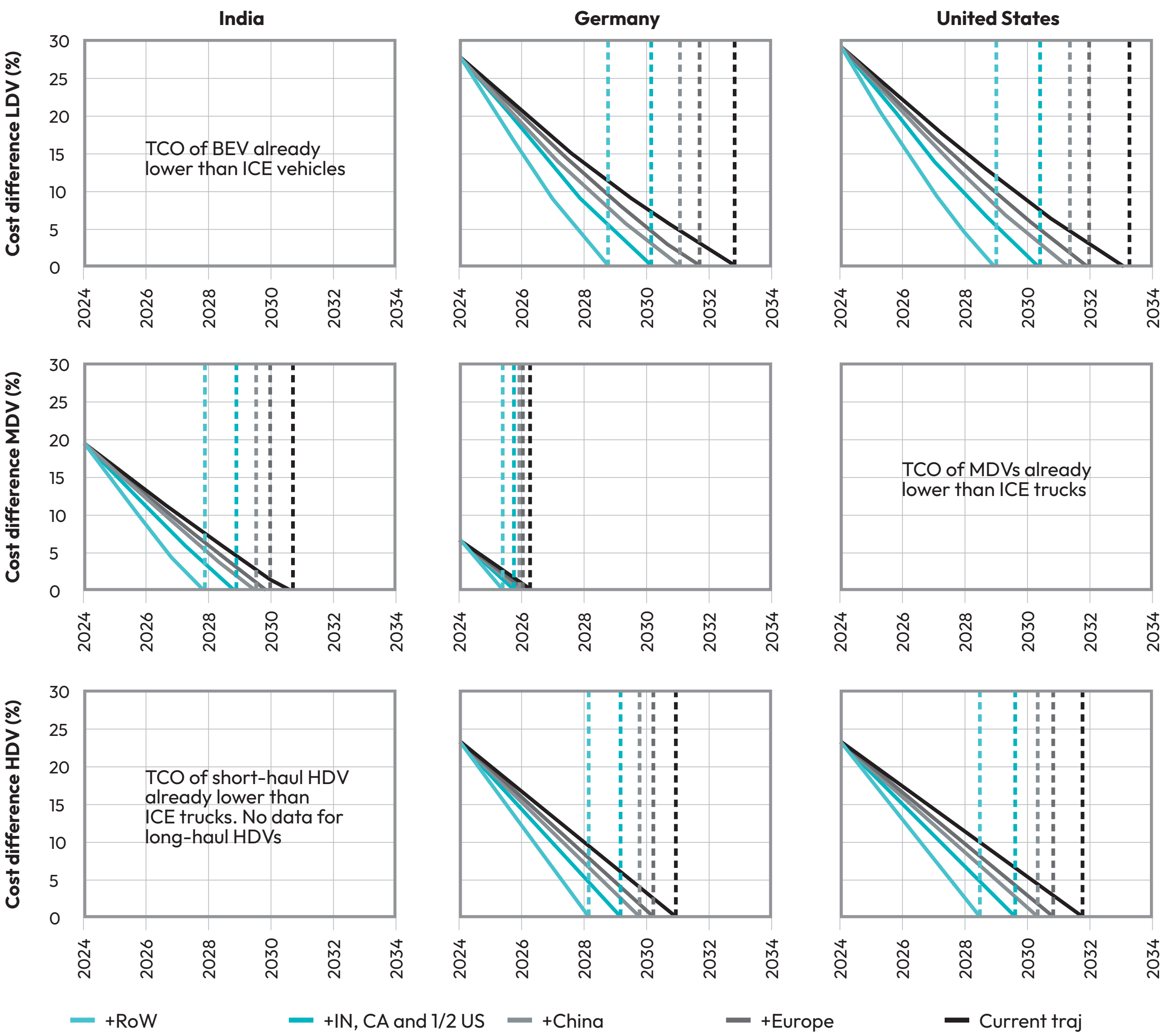


Figure 10: International coordination and TCO difference between electric and diesel vans and trucks. In India, TCO parity has already been reached for vans and large trucks before the start of the simulation, so no data is shown for these categories. The same applies for medium-duty vehicles in the USA. In all modelled countries and all categories, cost parity is reached before 2033.

25 US DOE (2025). Adoption of California's Clean Vehicle Standard by State.

In most countries other than China, the first tipping point—parity in total cost of ownership between electric and diesel vehicles—is still to be reached in most segments of the market. Figure 10 shows that internationally coordinated or aligned regulatory action between the EU, China, India, Canada, and certain US states could bring this threshold forward in time by up to two and a half years. Since trucks and their component technologies are traded internationally, this accelerated cost reduction could benefit any country involved in the transition.

The value of automotive manufacturing to economic growth, jobs and exports makes the sector a focus for competition not only between companies but also between countries, as evidenced by policies such as local content requirements and domestic subsidy conditions in markets such as the US, EU, India and China, and occasional trade disputes between them. Supporting domestic manufacturing tends to be a strong priority. Nevertheless, competition and cooperation are not mutually exclusive. Within the European Union, governments have cooperated to shape the market and drive the transition to zero-emission vehicles while their industries have continued to compete for market share. The broader set of countries currently supporting the Global MOU on Zero-Emission Medium- and Heavy-Duty Vehicles are engaged in a similar form of cooperation.

The transition in India

India is the third largest importer of oil globally, as its domestic production falls far short of meeting its growing fuel demand.[26] Road transport uses almost half of this oil,[27] and the transition in the sector therefore offers an opportunity to reduce import dependence and enhance energy security.

India's logistics sector plays a pivotal role in the nation's economy, contributing over 14% to its GDP.[28] Road transport accounts for approximately 70%[29] of freight movement, and sales of medium-duty and heavy trucks in India make up 7–8% of the global total[7]. With freight demand projected to nearly quadruple by 2050[2] due to rapid economic growth, urbanization, and rising consumption, challenges loom large. The sector faces inefficiencies in freight movement and high logistics costs, significantly higher than the 8–10% of GDP observed in developed economies,[30] leading to substantial environmental impacts. Despite trucks constituting only 3%[2] of the total vehicle fleet, freight transport contributes nearly 40%[31] of the transport sector's greenhouse gas emissions, driven largely by the extensive use of diesel-powered medium- and heavy-duty vehicles.

India has introduced various policies to decarbonise road freight. Launched in 2022, the e-FAST program facilitates collaboration between government stakeholders and private sector partners, driving large-scale road freight electrification by shaping policy and action.[32] Additionally, in November 2024 the PM E-DRIVE scheme was announced, with a 5 bn INR (€53 million)[33] allocation by the Ministry of Heavy Industries (MHI) offering purchase incentives to support the adoption of electric trucks. This funding encourages manufacturers and fleet operators to invest in electric freight vehicles, accelerating the shift to cleaner logistics.

In alignment with India's net-zero commitment by 2070, the Bureau of Energy Efficiency (BEE) has proposed[34] new declining emissions standards for cars.[35] Similar emissions standards for light-duty commercial vehicles are under consideration. Continued tightening will eventually make ICEVs non-viable, effectively allowing only zero-emission vehicles to be sold.

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34 Bureau of Energy Efficiency. (2024, June). OM on Inviting comments on the proposal of Future Fuel Efficiency Norms i.e, CAFE-III & CAFE-IV norms.
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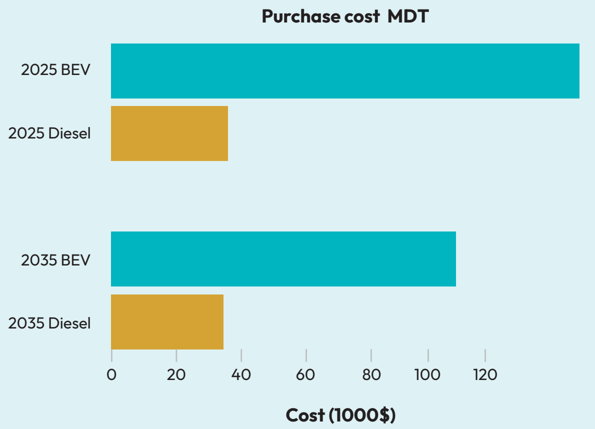
The transition in India. Cont.



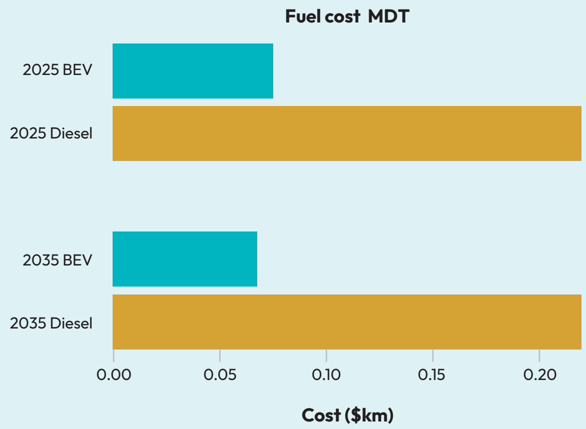
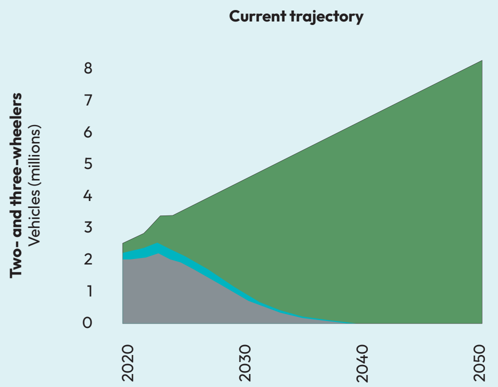


Figure 11: Purchase and fuel cost for medium-duty vehicles in India

The cost of zero-emission vehicles is a significant barrier. There is a stark difference in purchase costs between diesel and electric vehicles in 2025, and this is expected to remain high, despite some reduction, in 2035. Fuel costs show the opposite effect. The high upfront costs mean that even in cases where it makes economic sense to purchase an electric vehicle, firms may not be able to do so if they lack the capital.

In addition to the subsidies mentioned above, schemes to provide low-interest loans to businesses that wish to purchase zero-emission trucks could have an important positive effect. Another route to derisking is "trucks as a service", where Original Equipment Manufacturers (OEMs) retain ownership and lease out electric trucks.[36]



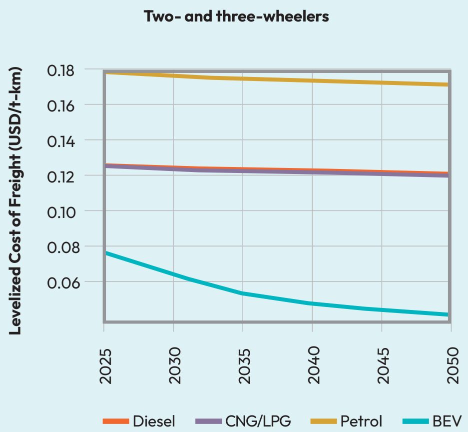


Figure 12: Two- and three-wheelers in India. Even without additional policies, the market share of electric three wheelers is expected to rapidly grow in the next decade as their total cost of ownership is much lower than that of their diesel alternatives.

India is making strong progress in electrifying small vehicles (two- and three-wheeled vehicles), which are often used for last-mile delivery. This is the segment where the cost of ZEVs is of least concern, as it is already substantially below that of petrol, diesel, and CNG alternatives.

In 2022, half of all sales of three-wheelers were electric,[37] and based on modelling, we expect this trend to continue, even without further policies. For motorbikes, the total cost of ownership of electric vehicles is already much lower than that of petrol equivalents, but growth in their deployment is slower due to more limited availability.

36 Smart Freight Centre (2023). Financing the transition to electric trucks - Framing paper for the start of a dialogue
37 International Energy Agency (2023). Transitioning India's Road Transport Sector

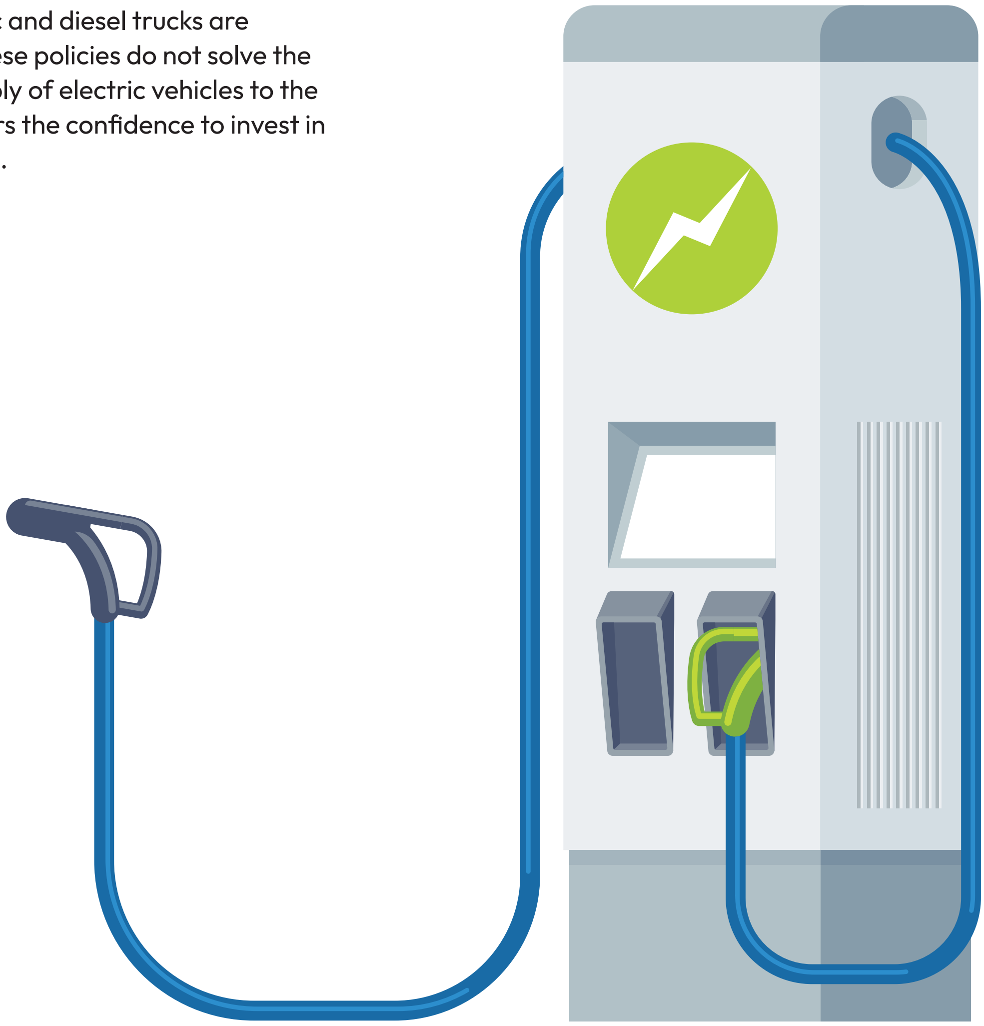
Conclusion

In many regions, the cost-parity tipping point (measured by total cost of ownership) between electric freight vehicles and their CNG or diesel equivalents has already been reached or is within reach thanks to the substantially lower running costs of EVs. This is particularly true for China. Upfront costs of EVs, however, are often still substantially higher, creating barriers for firms wanting to make the switch.

Regulatory policies, such as fleet-wide emissions standards or zero-emission vehicle mandates, are highly effective at lowering the costs of electric vehicles and increasing their market share. These regulatory policies have an outsized effect on adoption early in the transition, as they create a market for low-carbon trucks. Early kickstart mandates can be national policy, but city-wide zero-emission vehicle zones, successfully demonstrated in China, can have a similar effect. Price-based instruments such as subsidies or carbon prices are less effective on their own, as the total costs of ownership of electric and diesel trucks are already similar, and these policies do not solve the problem of lack of supply of electric vehicles to the market, or give investors the confidence to invest in charging infrastructure.

When combining policies, ZEV mandates used early in the transition are highly effective, as they increase the supply of EVs and create more choices for firms. Once the availability of EVs has increased, a carbon tax or an EV subsidy becomes more effective.

International coordination of policy in the leading markets of Europe, China, India, Canada and certain US states could bring forward the cost-parity tipping point by up to two and a half years, making the transition to EVs cheaper for other countries all over the world. European regulatory policy alone brings forward the tipping point by almost a year in many regions.



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Economics of Energy Innovation and System Transition

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