

# POLICY UPDATE

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## Fuel economy standards and zero-emission vehicle targets in Chile

**Samantha Pettigrew**

In February 2021, the Chilean Ministry of Energy enacted the country's first energy efficiency law, Law 21305-2021,<sup>1</sup> which impacts construction, housing, heating, and transportation. For the transportation sector, the law requires energy efficiency (fuel economy) standards for new vehicles in three categories: light-duty (gross weight < 2,700 kg), medium-duty (gross weight between 2,700 and 3,860 kg), and heavy-duty (gross weight ≥ 3,860 kg). Standards have already been defined for light-duty vehicles, while standards for medium- and heavy-duty vehicles will be defined in 2024 and 2026, respectively. The law also allows the Ministry of Energy to regulate interoperability standards for electric vehicle (EV) charging infrastructure, and declares hydrogen an official fuel source.

As a complementary policy to the Energy Efficiency Law, and as part of its National Electromobility Strategy published in October 2021, Chile also has ambitious EV sales targets of 100% zero-emission technologies for light- and medium-duty vehicles, urban buses, and large machinery by 2035.<sup>2</sup> Sales of the rest of the fleet and of small machinery will be 100% zero-emission by 2045. This is an important achievement for Chile as it is the only country in Latin America with 100% zero-emission targets for all types of on- and off-road vehicles.

The transport sector is a major energy consuming sector worldwide and represented 31.9% of global energy consumption in 2019, with 92.2% of that energy derived from fossil fuels.<sup>3</sup> The situation in Chile is similar: 36.6% of energy consumption corresponds to the transport sector, and of this fraction, more than 99% is fossil

1 Ley 21305 sobre la Eficiencia Energética, Biblioteca del Congreso Nacional de Chile, (February 2, 2021), <https://www.bcn.cl/leychile/navegar?idNorma=1155887>.

2 "Estrategia Nacional de Electromovilidad," Ministerio de Energía, Gobierno de Chile, October 2021, [https://energia.gob.cl/sites/default/files/estrategia-nacional-electromovilidad\\_ministerio-de-energia.pdf](https://energia.gob.cl/sites/default/files/estrategia-nacional-electromovilidad_ministerio-de-energia.pdf).

3 IEA, *World Energy Outlook 2020*, (IEA: Paris, 2020), <https://www.iea.org/reports/world-energy-outlook-2020>.

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[www.theicct.org](http://www.theicct.org)

[communications@theicct.org](mailto:communications@theicct.org)

[twitter @theicct](https://twitter.com/theicct)

fuel-derived,<sup>4</sup> making transport responsible for about 25.5% of the country's total greenhouse gas emissions.<sup>5</sup> It is important to note that Chile is a net importer of oil, with 95% of its domestic supply purchased internationally in 2019.<sup>6</sup> Chile is also a net importer of cars; 100% of its fleet is imported, mainly from China, South Korea, and Japan.<sup>7</sup> The energy situation in Chile makes development of clean energy policy an urgent priority, as a means of reducing harmful effects on the environment and public health, and of reducing the country's dependence on imported fossil fuels and the vulnerability that such dependence brings with it.

This policy update summarizes the steps taken by Chile in relation to its new energy efficiency law and its targets for zero-emission vehicles (ZEVs), and it analyzes the implications of these two policies for the decarbonization of fleets regionally and internationally.

## ENERGY EFFICIENCY LAW

### FUEL ECONOMY

Chile has established a set of climate goals in recent years through passage of new legislation and through its work on a new national constitution, which is expected to contain important climate protections.<sup>8</sup> The issue is important for Chileans, given that global warming is already affecting Chile's diverse and vulnerable geography, which includes the driest desert in the world, 6,435km of coastline, and the Chilean Antarctic Territory.<sup>9</sup> In this context, and within the energy efficiency law framework, the Chilean government now has the power to establish fuel economy standards for new light-, medium-, and heavy-duty vehicles. Most notably, the law introduces the first standard for heavy-duty vehicles to be implemented in Latin America (by 2028).<sup>10</sup>

The standards under the new law will consist of corporate average fuel economy targets,<sup>11</sup> which are defined as the distance in kilometers traveled per liter of gasoline equivalent (km/l<sub>ge</sub>). The standard for light-duty vehicles was published in February 2022,<sup>12</sup> and importers or manufacturers of vehicles marketed in Chile will have to comply with them as of 2024.<sup>13</sup> For medium-duty vehicles, the standards will be

4 Ministerio de Energía, Gobierno de Chile, "Informe Balance Nacional de Energía 2019," (March 2021), [https://energia.gob.cl/sites/default/files/documentos/2020\\_informe\\_anual\\_bne\\_2019.pdf](https://energia.gob.cl/sites/default/files/documentos/2020_informe_anual_bne_2019.pdf).

5 Ministerio del Medio Ambiente, Gobierno de Chile, "Informe del Inventario Nacional de Chile 2020: Inventario nacional de gases de efecto invernadero y otros contaminantes climáticos 1990-2018," (December 2020), [https://snichile.mma.gob.cl/wp-content/uploads/2021/06/Informe\\_del\\_Inventario\\_Nacional\\_de\\_GEI\\_serie\\_1990-2018.pdf](https://snichile.mma.gob.cl/wp-content/uploads/2021/06/Informe_del_Inventario_Nacional_de_GEI_serie_1990-2018.pdf).

6 Ministerio de Energía, Gobierno de Chile, "Energía 2050: Política Energética de Chile," (2017), [https://www.energia.gob.cl/sites/default/files/energia\\_2050\\_-\\_politica\\_energetica\\_de\\_chile.pdf](https://www.energia.gob.cl/sites/default/files/energia_2050_-_politica_energetica_de_chile.pdf); Ministerio de Energía, Gobierno de Chile, "Informe Balance Nacional de Energía 2019," (March 2021), [https://energia.gob.cl/sites/default/files/documentos/2020\\_informe\\_anual\\_bne\\_2019.pdf](https://energia.gob.cl/sites/default/files/documentos/2020_informe_anual_bne_2019.pdf).

7 Data obtained from AgenciaSE and the Asociación Nacional Automotriz de Chile.

8 Oscar Delgado and Samantha Pettigrew, "New legislation in Chile shows its climate leadership," (ICCT: Washington, DC), April 12, 2022, <https://theicct.org/chile-latam-lvs-leg-en-apr22/>.

9 "Impactos y adaptación al cambio climático en Chile," Pontificia Universidad Católica de Chile, Centro UC Cambio Global, accessed April 14, 2022, <https://cambioglobal.uc.cl/comunicacion-y-recursos/impactos-y-adaptacion-al-cambio-climatico-en-chile/>; "Encuesta 'Urgencias ambientales para Chile 2022': Rechazo a Domingo y escasez de agua deben ser las prioridades del próximo gobierno, según los chilenos," Greenpeace, accessed April 15, 2022, <https://www.greenpeace.org/chile/noticia/issues/bosques/encuesta-urgencias-ambientales-para-chile-2022-rechazo-a-dominga-y-escasez-de-agua-deben-ser-las-prioridades-del-proximo-gobierno-segun-los-chilenos/>.

10 Brazil is in the process of creating its own heavy-duty standard, initially scheduled for publication in 2027 and implementation in 2032.

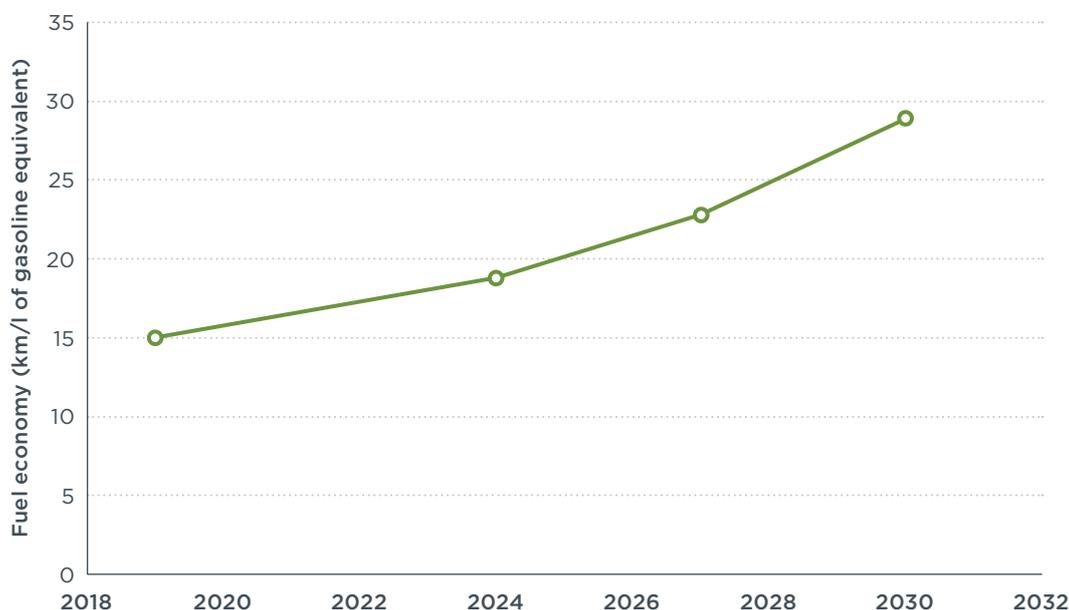
11 The United States National Highway Traffic Safety Administration's Corporate Average Fuel Economy (CAFE) standards regulate the distance in miles vehicles must travel on a gallon of fuel or its equivalent. In the Chilean case, this will be measured in kilometers per liter of gasoline equivalent (km/l<sub>ge</sub>).

12 Fija estándar mínimo de eficiencia energética para vehículos motorizados livianos, Diario Oficial de la República de Chile, February 12, 2022, [https://energia.gob.cl/sites/default/files/documentos/diario\\_oficial\\_estandar\\_de\\_eficiencia\\_energetica\\_para\\_vehiculos\\_livianos.pdf](https://energia.gob.cl/sites/default/files/documentos/diario_oficial_estandar_de_eficiencia_energetica_para_vehiculos_livianos.pdf).

13 Fija estándar mínimo, Diario Oficial de la República de Chile.

defined in 2024 and will take effect in 2026. The heavy-duty vehicle standards will be defined in 2026 and take effect in 2028.

Light-duty vehicles are slated for a progression of fuel economy targets as shown in Figure 1, increasing from a baseline in 2020 of 14.9 km/l<sub>ge</sub> for passenger vehicles. From 2024 to 2026, the target is 18.8, increasing to 22.8 in 2027 and to 28.9 in 2030.



**Figure 1.** Fuel economy values for new light-duty passenger vehicles in Chile in km/l of gasoline equivalent

Source: Chilean Ministry of Energy

After 2030, government and industry will continue to work together to (1) double the fuel economy of all new light-duty vehicles entering the country by 2035 and (2) quadruple their output by 2050, from a baseline of 2019. These post-2030 targets are yet to be legally defined. Light commercial vehicles are also included in the current regulation, but with slightly lower target values, considering these vehicles' heavier weight. This is shown in detail in Figures 3 and 4 (pg. 8) and on ICCT's [transportpolicy.net](https://www.transportpolicy.net) page.<sup>14</sup>

## ELECTROMOBILITY IN THE ENERGY EFFICIENCY LAW

In addition to the clauses concerning internal combustion engines in the energy efficiency law, zero-emission vehicles are also addressed. The law, for example, gives zero-emission vehicles three times the energy efficiency credits of traditional vehicles, which encourages ZEV adoption and helps improve the corporate average. Company-owned zero-emission vehicles and plug-in hybrids have an accelerated depreciation that translates into lower taxes for a period of ten years after the law goes into effect.

As an added boost to electromobility, the Ministry of Energy has also been empowered to regulate the interoperability of EV charging systems to facilitate charging network access for more users. Aiming to achieve an integrated and homogeneous infrastructure, the law also imposes charging service requirements, communication protocols, and a simplification of the payment process carried out by users, all to ensure access to public chargers. The payment process, a key aspect

<sup>14</sup> Chile: Light-duty: Fuel Economy, transportpolicy.net, accessed June 15, 2022, <https://www.transportpolicy.net/standard/chile-light-duty-fuel-economy/>.

of the law, seeks to eliminate barriers and promote electromobility in Chile.<sup>15</sup> In early 2022, a draft interoperability regulation was under review by the government.<sup>16</sup>

## PUBLIC RESOURCE AVAILABILITY

Various public-private initiatives and platforms from the Ministry of Energy, each supplying public information about energy efficiency and electromobility, are described below.

**Vehicle Consumption website.** This interactive web page is a portal of energy consumption and vehicle emissions indicators to assist consumers in calculating the fuel economy of their vehicles, according to brand, model, and mode of propulsion.

**Electromobility Platform.** This web platform is a compilation of diverse information about electromobility allowing residents to learn more about the topic via knowledge sharing. This website was launched in 2019 and includes some notable sub-platforms:

**EV catalogue of Chile.** Aimed at consumers who want to swap their traditional vehicle for an EV, this page explains consumer options based on comprehensive information regarding different brands and the characteristics of each vehicle, to help generate greater confidence around purchase decisions.

**EV Project Evaluator.** This interactive tool can be used to financially evaluate a vehicle fleet renewal project that incorporates EVs and charging infrastructure. It supports informed decision-making by institutions seeking electric transport solutions.

**EcoCarga.** This mobile application gives useful information about charging EVs, such as public access points and data on the characteristics of each charger (power in kW, type of connector, and number of connectors). EcoCarga indicates the location of public charging stations across the country. In addition, it shows, by vehicle make and model, the time needed to charge a battery to 80%.

**Public-private partnership for electromobility.** Begun in 2017, this series of documents was born from a declaration of intent that public and private actors have presented to civil society and to the Ministries of Energy, the Environment, and Transport and Telecommunications, the main stakeholders of electromobility. The objective of this commitment is for different institutions to learn about the initiatives, advance collaboratively, and coordinate with each other. The most recent statement is from 2022.

## HYDROGEN AS AN OFFICIAL FUEL

Within the drive to transform and decarbonize the transport sector in Chile, one clause in the energy efficiency law is currently replicable in very few countries. It expressly names hydrogen as an official fuel source. This means that the Ministry of Energy can now regulate hydrogen and treat it as an energy resource. Due to the wide availability of natural resources in Chile, it will be possible to produce large amounts of green hydrogen—hydrogen created using renewable energy—and use it to eventually replace gasoline and diesel. This is important because hydrogen can be used in applications in which battery technology is insufficient to provide the required range and charging time, including in some instances of long-haul trucking and for air and maritime transport. More detail on Chile's plans for hydrogen can be

15 El Ministerio de Hacienda del Gobierno de Chile, "Aprueba reglamento que establece la interoperabilidad de los sistemas de carga de vehículos eléctricos," 2021 draft, [https://energia.gob.cl/sites/default/files/borrador\\_reglamento\\_interoperabilidad\\_consulta\\_-\\_final.pdf](https://energia.gob.cl/sites/default/files/borrador_reglamento_interoperabilidad_consulta_-_final.pdf).

16 El Ministerio de Hacienda del Gobierno de Chile, "Aprueba reglamento que establece la interoperabilidad de los sistemas de carga."

found in its National Green Hydrogen Strategy.<sup>17</sup> By 2030, Chile is expected to be a leading global producer and exporter of green hydrogen.

## ZERO-EMISSION VEHICLE TARGETS

The electromobility actions described above are the fruit of not only the energy efficiency law but also collaboration between the Ministry of Energy and many actors over several years, together with official energy transition and electromobility strategies. Chile began working with the Global Fuel Economy Initiative (GFEI) in 2009 to complete a baseline analysis of vehicle fuel economy in 2010. As a result, it became the first country in Latin America to adopt vehicle fuel-efficiency labeling in 2013. Subsequently, in 2014, the country introduced a green tax (a charge applied to all new vehicles, scaled by vehicle fuel economy performance) with the aim of incentivizing the use of less-polluting vehicles.<sup>18</sup>

Just prior to the new wave of global decarbonization actions, the first Chilean National Electromobility Strategy was published in 2017. The main objective of this strategy was for 40% of private vehicles and 100% of public transport to be electric by 2050, and the strategy document detailed the short- and medium-term actions necessary to achieve this goal.

Since the launch of the strategy in 2017, Chile has focused on the integration of electromobility in efficient and sustainable ways. Chile has since taken action in many public policy areas and has taken other actions to combat climate change. Several initiatives have established strategic axes, policies, and goals that advance the accelerated and sustainable development of electric transport.<sup>19</sup> The National Electromobility Strategy for 2021 introduced several new targets, most notably advancing the target date for the 100% public transport sales goal from 2050 to 2035.

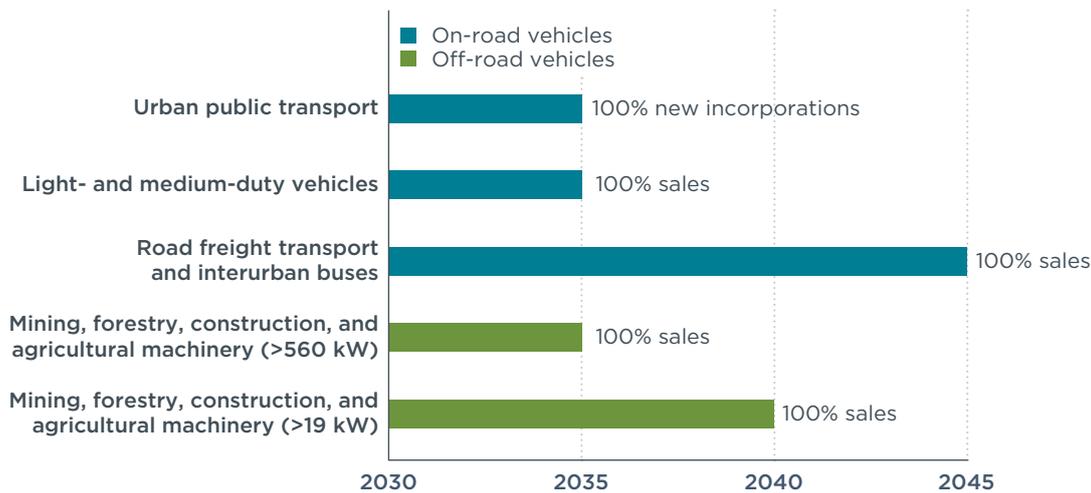
Chile's ambitious targets require that by 2035, 100% of the sales of most vehicles be zero-emission. Light- and medium-duty vehicles and urban public transport (including buses and taxis) will all be zero-emission. For heavy-duty trucks and intercity buses, 100% of sales are expected to be zero-emission by 2045. This official goal for heavy-duty vehicles is consistent with the global memorandum of understanding that Chile signed at COP26, along with 14 other countries, and which also establishes that 100% of heavy-duty vehicle sales will be zero-emission by 2045.<sup>20</sup> Additionally, large mobile machinery (power > 560 kW) will be zero-emission by 2035 and smaller machinery (power > 19 kW) will achieve this by 2040. These sales targets are shown in Figure 2.

17 Ministerio de Energía del Gobierno de Chile, "Estrategia Nacional de Hidrógeno Verde," (2020), [https://energia.gob.cl/sites/default/files/estrategia\\_nacional\\_de\\_hidrogeno\\_verde\\_-\\_chile.pdf](https://energia.gob.cl/sites/default/files/estrategia_nacional_de_hidrogeno_verde_-_chile.pdf).

18 International Energy Agency (IEA) (2019), *Fuel Economy in Major Car Markets: Technology and Policy Drivers 2005-2017*, <https://www.globalfueleconomy.org/media/708177/gfei-wp19.pdf>.

19 Delgado and Pettigrew, "New legislation in Chile."

20 "Memorandum of Understanding on Zero-Emission Medium- and Heavy-Duty Vehicles", *Global Drive to Zero*, accessed April 15, 2022, <https://globaldrivetozero.org/site/wp-content/uploads/2021/11/Global-MOU-ZE-MHDVs.pdf>.



**Figure 2.** Sales targets for zero-emission vehicles in Chile, through its National Electromobility Strategy

Source: Ministry of Energy of Chile

## REGIONAL AND INTERNATIONAL CONTEXT

### A REGIONAL MILESTONE

The new energy efficiency law, along with zero-emission sales targets for 2050 or earlier for all vehicles, set a new precedent for Latin America. Chile is the first country in Latin America to have an energy efficiency law for all three traditional transport segments (light-, medium-, and heavy-duty). This gives the region an environmental boost and lays out a path for other countries to follow. Other Latin American countries with fuel economy standards in transport include Brazil<sup>21</sup> and Mexico;<sup>22</sup> however, their policies currently cover only light-duty vehicles.

Other countries in the region, such as Colombia, have taken actions that highlight the need to increase the sales of light-duty EVs.<sup>23</sup> However, there is no official target in Latin America outside of Chile to fully decarbonize the light-duty fleet. Table 1 shows the progress of countries with 100% zero-emission sales targets.

21 Zifei Yang, *Brazil light-duty vehicle efficiency standards factsheet*, (ICCT: Washington, DC, 2015), [https://theicct.org/sites/default/files/Brazil\\_PVstds-facts\\_jan2015.pdf](https://theicct.org/sites/default/files/Brazil_PVstds-facts_jan2015.pdf).

22 "NORMA Oficial Mexicana NOM-163-SEMARNAT-ENER-SCFI-2013, Emisiones de dióxido de carbono (CO<sub>2</sub>) provenientes del escape y su equivalencia en términos de rendimiento de combustible, aplicable a vehículos automotores nuevos de peso bruto vehicular de hasta 3857 kilogramos," Secretaría de Gobernación de México, June 21, 2013, [http://www.dof.gob.mx/nota\\_detalle.php?codigo=5303391&fecha=21/06/2013](http://www.dof.gob.mx/nota_detalle.php?codigo=5303391&fecha=21/06/2013).

23 Ley No. 1972, República de Colombia – Gobierno Nacional, July 18, 2019, <https://dapre.presidencia.gov.co/normativa/normativa/LEY%201972%20DEL%2018%20DE%20JULIO%20DE%202019.pdf>.

**Table 1.** Countries in Latin America with fuel economy standards and 100% zero-emission sales targets

Country	Fuel economy standards			100% zero-emission sales targets				
	Light	Medium	Heavy	Light	Medium	Heavy	Urban buses	Intercity buses
Brazil	2012							
Chile	2022	2024	2026	2035	2035	2045	2035	2045
Colombia							2035	
Costa Rica							2050	2050
Ecuador				2025 (taxis)			2025	2025
Mexico	2013							
Uruguay						2045	2045	2045

Note: For fuel economy standards, years specify the first year of implementation. For 100% zero-emission sales targets, years specify when the country promises to meet the goal in fleet sales.

For heavy-duty vehicles, Uruguay joins Chile in setting a 100% zero-emission sales goal, the result of having endorsed the same memorandum of understanding that Chile signed at the COP26. For buses, Colombia has committed to a 100% zero-emission urban bus fleet by 2035, and Costa Rica has also committed to having a fully decarbonized bus fleet (urban and intercity) by 2050.<sup>24</sup> Ecuador has set a goal of 100% zero-emission taxis and buses by 2025.<sup>25</sup>

Aside from these actions by Chile, Colombia, Costa Rica, Ecuador, and Uruguay, no other firm initiative for the complete decarbonization of fleets exists in the remaining fifteen countries in the region. Chile's targets are notable because they cover several market segments in their entirety: light-, medium-, and heavy-duty vehicles (freight and urban and intercity buses), in addition to off-road vehicles.<sup>26</sup> Colombia's targets exist in two vehicle segments. Costa Rica, Ecuador, and Uruguay have one goal per country.

## INTERNATIONAL REPLICABILITY

Chile is classified as an emerging economy and its climate actions suggest that comparable economies may be similarly positioned to adopt policies to decarbonize transport, including setting fuel economy standards and comprehensive zero-emission vehicle targets.

Other developing countries with fuel economy policies include Saudi Arabia,<sup>27</sup> Brazil,<sup>28</sup> and Mexico.<sup>29</sup> In each, the policy applies to light-duty vehicles. Chile is the first and only developing country, aside from Brazil, with fuel economy policies officially proposed for heavy-duty vehicles. Brazil's heavy-duty standard is scheduled for publication in 2027 and for implementation in 2032.<sup>30</sup> Figures 3 and 4 show the fuel economy of passenger cars and light commercial vehicles in developed countries, including Chile

24 "Decarbonization Plan: Commitment of the Bicentennial Government," Gobierno de Costa Rica, 2019, <https://2050pathways.org/wp-content/uploads/2019/02/Decarbonization-Plan-Costa-Rica.pdf>.

25 Tanzila Khan, Zifei Yang, Sumati Kohli, Josh Miller, *A critical review of ZEV deployment in emerging markets*, (ICCT: Washington, DC, 2022), <https://theicct.org/wp-content/uploads/2022/02/ZEV-EMDE-white-paper-A4-v3.pdf>.

26 "Internal combustion engine phase-outs," (ICCT: Washington, DC, 2022), <https://theicct.org/ice-phase-outs/>.

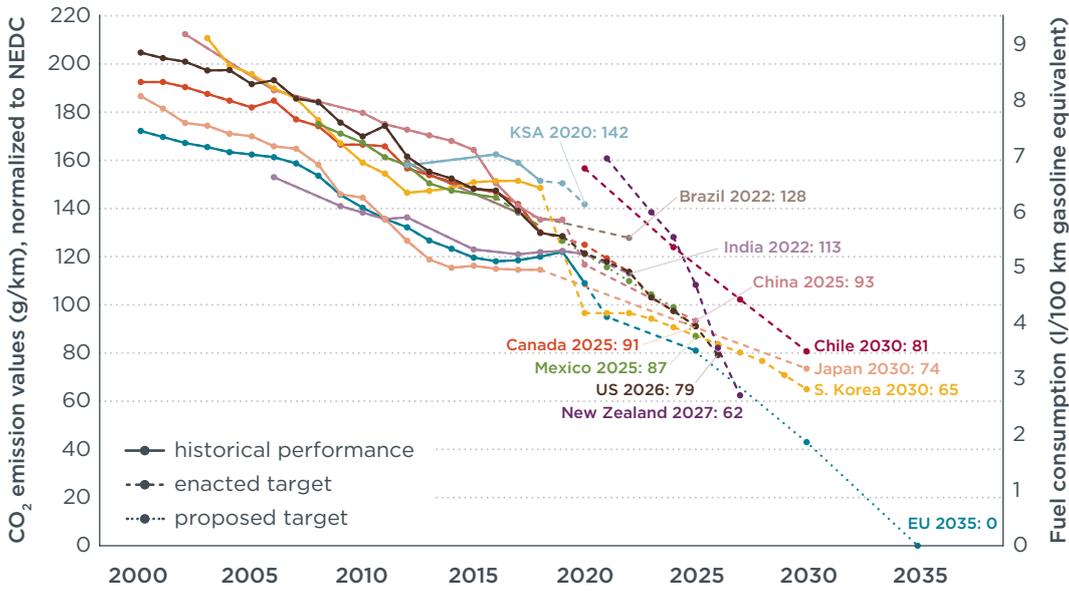
27 Anup Bandivadekar, Francisco Posada, *Proposed Saudi Arabia corporate average fuel economy standard for new light-duty vehicles (2016–2020)*, (ICCT: Washington, DC, 2014), [https://theicct.org/wp-content/uploads/2021/06/ICCTupdate\\_KSA-CAFE-proposal\\_20141218.pdf](https://theicct.org/wp-content/uploads/2021/06/ICCTupdate_KSA-CAFE-proposal_20141218.pdf).

28 Yang, *Brazil light-duty vehicle efficiency standards*.

29 "NORMA Oficial Mexicana NOM-163-SEMARNAT-ENER-SCFI-2013", Secretaría de Gobernación de México, [http://www.dof.gob.mx/nota\\_detalle.php?codigo=5303391&fecha=21/06/2013](http://www.dof.gob.mx/nota_detalle.php?codigo=5303391&fecha=21/06/2013).

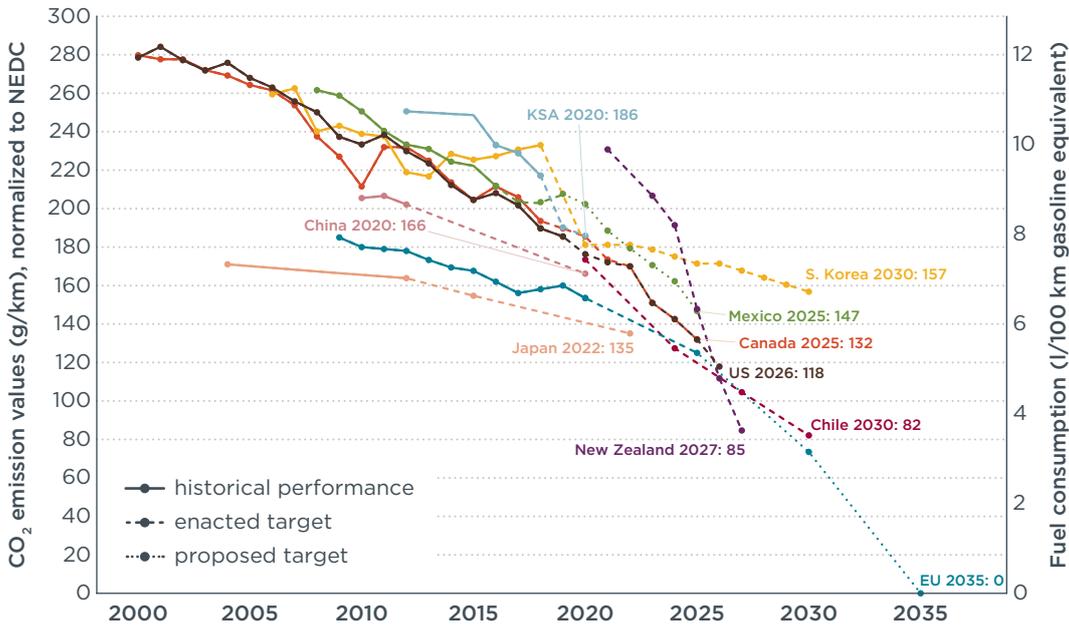
30 *Portaria Nº 2.200-SEI, de 27 de Dezembro de 2018*, Diário Oficial da União, Ministério da Indústria, Comércio Exterior e Serviços/Gabinete do Ministro, December 27, 2018, [https://www.in.gov.br/materia/-/asset\\_publisher/KujrwoTZC2Mb/content/id/57220399](https://www.in.gov.br/materia/-/asset_publisher/KujrwoTZC2Mb/content/id/57220399).

(the red dotted line). Chile's targets are similar to those of the few other governments with standards announced through 2030, making Chile a global leader in light-duty fuel economy for both passenger vehicles and light commercial vehicles.



**Figure 3.** CO<sub>2</sub> emissions and fuel consumption of passenger vehicles, normalized to the New European Driving Cycle (NEDC)

Source: ICCT



**Figure 4.** CO<sub>2</sub> emissions and fuel consumption of light commercial vehicles, normalized to NEDC.

Source: ICCT

With respect to zero-emission vehicle targets, and according to 2022 ICCT analyses on zero-emission vehicle uptake, among 117 emerging economies including Chile, five outside of Latin America have adopted zero-emission vehicle targets: Cabo Verde

(2035, for all vehicles), Israel (2030, for private vehicles), Singapore (2030, for cars), Thailand (2035, for cars), and Vietnam (2040 for cars and motorcycles).<sup>31</sup>

Among developing countries, including those in Latin America, Ukraine and Jordan had the highest sales shares of EVs, at 0.9% and 0.8%, respectively. Costa Rica, Colombia, and Thailand had EV sales shares of 0.6% each, while Chile's share was 0.5%.<sup>32</sup>

## TAKEAWAYS

In recent years, Chile has created several public policies for clean transportation. Chile's leadership is notable both in Latin America and internationally; it arguably has the potential to inspire similar climate policies in other countries. Particularly noteworthy are the energy efficiency law and the zero-emission sales targets. The law not only addresses the efficiency of light-, medium-, and heavy-duty vehicles, but also includes tax incentives for zero-emission vehicles, provides for interoperability of recharging systems for EVs, and designates hydrogen as an official fuel. The zero-emission sales targets will be in effect for all types of vehicles and machinery by 2045, which is an especially important achievement.

The Chilean government has many pending tasks on the path to achieving these ambitious goals. For example, while the efficiency standards for light-duty vehicles have been defined, the standards for medium- and heavy-duty vehicles have not; it will be important to define them without delay. It will be necessary for manufacturers to comply with the new standards in the period described, and to guarantee interoperability of charging infrastructure across various manufacturers and vehicles. Another critical issue for Chile is to promote equitable access to EV charging infrastructure. Chile must also think beyond 2030, when the current defined standards for light-duty vehicles cease to increase in stringency. Once in place, standards for light-, medium-, and heavy-duty vehicles will need to become stricter to reduce the percentage of internal combustion vehicles projected to be on the road until at least 2045, and to gradually phase out internal combustion vehicles completely.

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<sup>31</sup> Khan, Yang, Kohli, and Miller, *A critical review of ZEV deployment*; Hongyang Cui, Dale Hall, *Annual update on the global transition to electric vehicles: 2021*, (ICCT: Washington, DC, 2022), <https://theicct.org/wp-content/uploads/2022/06/global-ev-update-2021-jun22.pdf>.

<sup>32</sup> Khan, Yang, Kohli, and Miller, *A critical review of ZEV deployment*.