MODULE 4 4.1

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Transport Energy Sources

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Key findings

Demand trends

- An analysis of 810 scenarios developed by the Intergovernmental Panel on Climate Change concluded that to limit global warming even to 2 degrees Celsius (°C), transport energy consumption would need to peak between 2030 and 2035 and then decrease. Scenarios compatible with a 1.5°C scenario would require earlier peaking and steeper reductions in energy use from the sector.
- In 2021, the growth in transport energy consumption rebounded somewhat (although it did not yet return to 2019 levels), indicating that the decline in 2020 was related to the COVID-19 pandemic and not to policy action in the sector.
- The Russian Federation's invasion of Ukraine in February 2022 led to fuel price spikes in the transport sector, underscoring the need to decouple transport from fossil fuel dependency. Towards the end of 2022, global cost inflation settled in the range of 5-10%.
- Improvements in engine technologies, the introduction of hybrid powertrains, and greater use of electric vehicles led to an 8.2% increase in the energy efficiency of cars and vans between 2015 and 2021. However, the increased popularity of sport utility vehicles (SUVs) and trucks poses a huge challenge to reducing energy consumption and emissions in the sector.
- In road transport, direct use of electricity is most efficient from an energy perspective, where this is technically and logistically feasible.
- The share of diesel among all oil products used in road transport increased from 39.1% to 45.5% between 2000 and 2020. This trend is driven largely by rising demand for freight transport, which is mostly diesel-powered.
- Biofuels are the largest renewable energy source in transport, accounting for 3.7% of the sector's energy consumption in 2021, up 0.8 percentage points since 2015. The main policies supporting biofuels are blending mandates set by countries.
- Hydrogen can play a role whenever direct electrification is impossible. Hydrogen is considered plausible for road transport (for use in heavy-duty vehicles for long distances) and for aviation and shipping.
- Despite the immense growth in electric vehicles over the last decade, electricity demand in road transport is still low, with electric vehicles accounting for around 1% of vehicles globally in 2022. Electric vehicles represented only 0.14% of total global electricity consumption in 2020.
- Electrification is most prominent in rail transport, accounting for 45% of the energy consumed by rail in 2021.
- Fossil fuels continue to account for the majority of electricity generation in the power sector, and thus for the majority of the electricity supplied for electric vehicles.
- More than 450,000 commercial flights used sustainable aviation fuel (SAF) in 2022, with SAF production increasing 200% compared to 2021. However, SAF still accounted for only 0.1% of all consumed aviation fuel as of 2022.

Emission trends

- Carbon dioxide (CO_2) emissions from road transport increased steadily between 2000 and 2020.
- Energy efficiency improvements and the use of renewable energy sources, mostly biofuels, helped reduce emissions from the transport sector. However, these savings continued to be outweighed by rising emissions from the overall growth in transport demand and from the modal shift towards higher-emitting forms of transport, leading to a net increase in emissions from the sector.
- The required shift to renewable energy in transport will have negative effects on employment in regions that are highly dependent on fossil fuels. Policies aimed at fostering the decarbonisation of transport will need to ensure an equitable and just transition towards more sustainable jobs. Globally, this shift is expected to result in a net gain in jobs.
- An "ambitious yet feasible" scenario from the International Council on Clean Transportation (ICCT) projects that the energy efficiency of light-duty vehicles will improve 0.75% annually between 2030 and 2050. Energy efficiency plays a major role in decarbonising the maritime and aviation sectors under this scenario.

Policy developments

- Mandatory standards for energy efficiency and for greenhouse gas emissions have proven to be effective instruments to drive efficiency and the shift to zero-emission vehicles.
- An increasing number of countries – mostly with limited or no domestic vehicle manufacturing – have established vehicle standards or other instruments to enhance the efficiency of imported vehicles.
- Fuel economy and greenhouse gas emission standards for heavy-duty vehicles are an important instrument to decarbonise the freight sector. In 2022, more than 70% of trucks sold were covered by fuel economy or vehicle efficiency regulations, although only seven countries or regions had such standards.
- Many countries have adopted vehicle labelling schemes to help consumers make informed choices by better understanding the life-cycle costs of vehicles.
- Biofuel blending mandates remain the most popular measure for increasing renewable energy in transport, with at least 56 countries and the European Union having established some form of obligation by the end of 2022.
- As of the end of 2022, at least six countries mentioned biofuel blending in their updated Nationally Determined Contributions (NDCs) towards reducing emissions under the Paris Agreement, with policy implementation yet to come.
- In aviation, some countries are considering biofuel blending mandates for sustainable aviation fuel.

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Overview

Fossil fuels continue to be the dominant energy source in the transport sector, determining trends for the sector's overall contributions to carbon dioxide (CO_2) emissions and air pollution. Solutions that aim to "Avoid" transport activity and to "Shift" to more efficient modes will help reduce overall energy demand, while at the same time providing broader sustainability benefits. However, for full decarbonisation, additional "Improve" measures are required to increase the energy efficiency of vehicles and reduce overall energy demand, and to replace fossil fuels with renewable energy alternatives to reduce the carbon intensity of energy use.

The fossil fuels used in transport emit large amounts of fine particulate matter, black carbon and other pollutants. In 2019, outdoor air pollution related in part to transport activity contributed to an estimated 4.2 million premature deaths.[1] This has motivated many countries to introduce fuel quality and emission standards for air pollutants and to increasingly supplement these with policies such as fuel economy and CO_2 emission standards, energy labelling schemes and differentiated taxation.

Energy use in transport must rapidly transition to renewable energy sources, including biofuels, biogas, hydrogen, synthetic fuels and renewable electricity.[2] Policies to scale up renewable fuels include biofuel blending mandates and incentives for alternative powertrains that would support the use of renewable electricity and fuels. Some renewable fuels – such as liquid biofuels, synthetic fuels and upgraded biomethane – can be used in conventional internal combustion engines with small adjustments. Railways are already significantly electrified, allowing for a quick uptake of renewables. Other sub-sectors require changes in vehicle technology, such as battery electric and fuel cell electric vehicles (*see Section 4.2 Vehicle Technologies*).

Despite the rapid increase in electric vehicles and renewable power globally, as well as steady increases in biofuels, fossil fuels continued to account for nearly all (96%) of the energy used in transport in 2021 – a share that has barely changed over the past decade, due mainly to rising transport demand.[3] Electric vehicle targets do not automatically lead to the uptake of renewable energy, unless they are coupled with specific mandates. Electric vehicles accounted for around 1% of vehicles globally in 2022, while renewable energy supplied just over one-quarter of global electricity demand.[4] Sustainable aviation fuel (SAF) accounted for less than 0.1% of all aviation fuels consumed in 2022.[5]

These trends underscore the importance of prioritising measures to reduce overall transport demand and to shift to more sustainable modes, which can lead to greater emission reduction and broader sustainability benefits; it is also critical that the electricity used for electric vehicles is generated from renewable sources.[6]

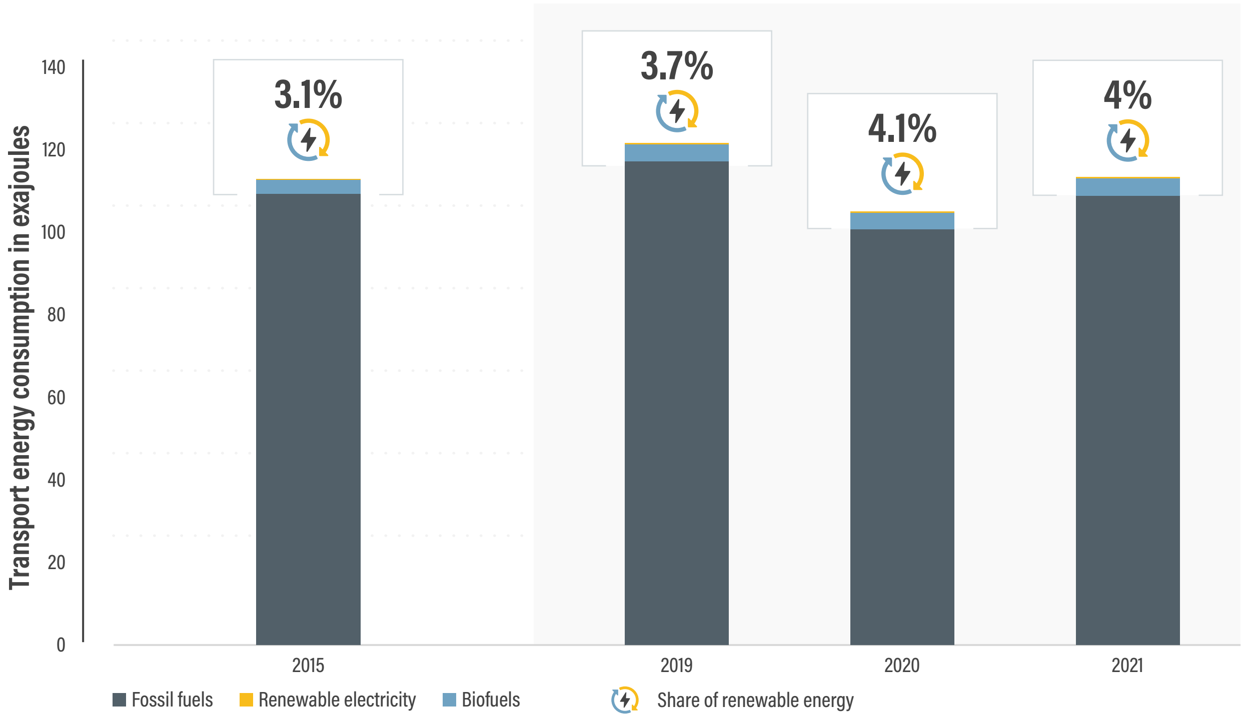
Demand trends

Several key trends, some of them contradictory, are driving greater energy consumption in transport. On the one hand, energy demand has declined due to the continuous increase in motor and vehicle efficiency and to greater use of electric vehicles (*see Section 4.2 Vehicle Technologies*). At the same time, however, energy demand has increased as both vehicle size and mass have grown (especially with the rising popularity of sport utility vehicles, SUVs), and as passenger and freight transport activity has risen overall (*see Section 1.1 Transport in Support of 1.5°C and the SDGs*).

The net growth in energy demand highlights the need to enhance efforts to rapidly improve vehicle efficiency, including by reducing vehicle weight and shifting to renewable energy sources to decarbonise the transport sector. In line with the Paris Agreement, energy demand must peak soon and then decrease rapidly. **An analysis of 810 scenarios developed by the Intergovernmental Panel on Climate Change concluded that to limit global warming even to 2 degrees Celsius (°C), transport energy consumption would need to peak between 2030 and 2035 and then decrease.**[7] **Scenarios compatible with a 1.5°C scenario would require earlier peaking and steeper reductions in energy use from the sector.**[8]

FIGURE 1 Energy consumption in transport, by energy source, 2015, 2019 to 2021

Source: See endnote 11 for this section.



In 2021, the growth in transport energy use rebounded somewhat (although it did not yet return to 2019 levels), indicating that the decline in 2020 was related to the COVID-19 pandemic and not to policy action in the sector.[9] Fossil fuels continued to dominate the sector, supplying 96% of transport energy consumption in 2020 and 2021, whereas biofuels supplied 3.7% and renewable electricity 0.35%.[10] Due mainly to the overall increase in transport demand, the share of renewables in transport remained low at 4% in 2021, up just 0.9 percentage points from 2015 (see Figure 1).[11]

The Russian Federation's invasion of Ukraine in February 2022 led to fuel price spikes in the transport sector, underscoring the need to decouple transport from fossil fuel dependency.[12] **Towards the end of 2022, global cost inflation settled in the range of 5-10%.**[13] Global oil demand and production remained relatively stable during the year, and the price of oil and subsequently transport fuels returned to mid-2021 levels by the end of 2022.[14] In some countries, pre-tax fuel prices for end users were twice as high in June 2022 as in July 2021.[15] The conflict also shifted trade for Russian oil from Europe and North America to India, China, and Türkiye, leading to a drop in container activity; however, lower trade volumes in bunker fuels were partly offset by longer transport routes (*see Section 3.8 Shipping*).[16]

Improvements in engine technologies, the introduction of hybrid powertrains and greater use of electric vehicles led to an 8.2% increase in the energy efficiency of cars and vans between 2015 and 2021.[17] The average specific fuel consumption (fuel use per 100 kilometres) has been declining (see Figure 2).[18] These improvements have been slowed by a trend towards increasing vehicle size and weight.[19] **In particular, the increased popularity of SUVs and trucks poses a huge challenge to reducing energy consumption and emissions in the sector.**[20] (*See Section 3.6 Road Transport and Section 4.2 Vehicle Technologies.*)

In road transport, direct use of electricity is most efficient from an energy perspective, where this is technically and logistically feasible. For road vehicles, the future renewable electricity demand will depend greatly on the vehicle propulsion technology used (see Table 1).[21] Battery electric vehicles are at least twice as efficient in terms of energy needed than fuel cell electric vehicles.[22] (*See also Section 4.2 Vehicle Technologies.*)

The share of diesel among all oil products used in road transport increased from 39.1% to 45.5% between 2000 and 2020 (see Figure 3).[23] **This trend is driven largely by rising demand for freight transport, which is mostly diesel-powered.** If fossil fuel-powered road freight continued, this

FIGURE 2 Specific fuel consumption of cars and vans versus sales shares of electric cars and sport utility vehicles, 2015-2021

Source: See endnote 18 for this section.

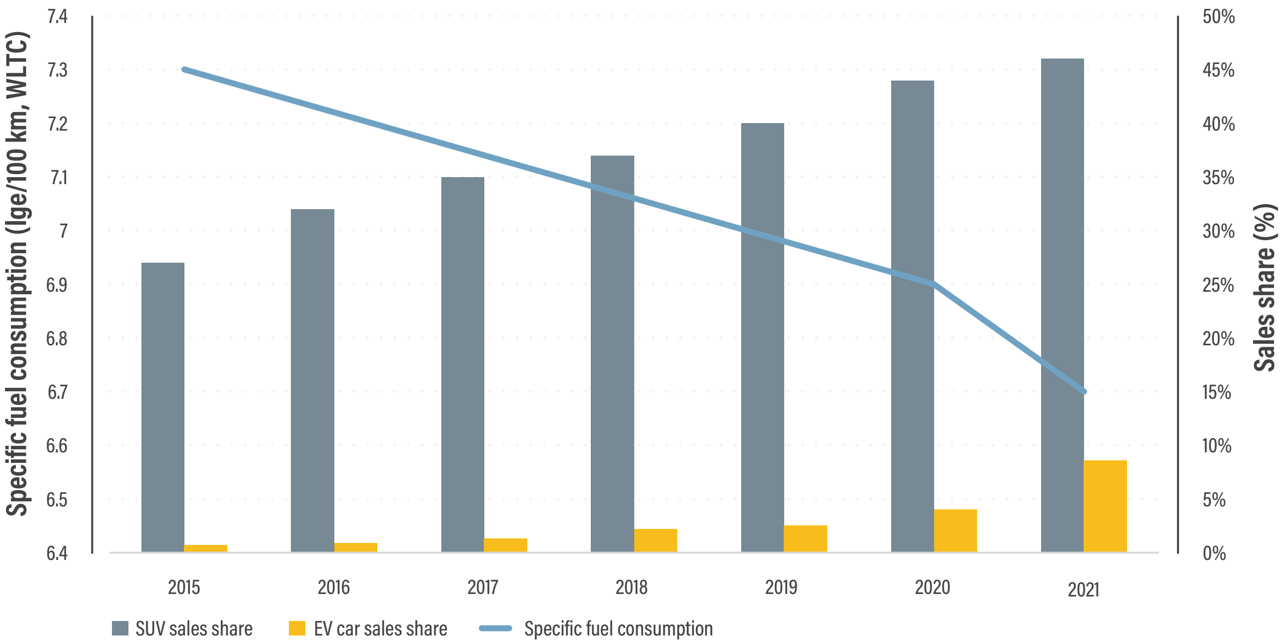


TABLE 1. Electricity requirements of different vehicle propulsion technologies

Source: See endnote 21 for this section.

Propulsion technology	Energy to generate 1 megajoule (MJ) of traction power
Battery electric vehicles	1.7 MJ
Fuel cell electric vehicles using liquid hydrogen	4.6 MJ
Synthetic fuels based on renewable electricity	7.7 MJ

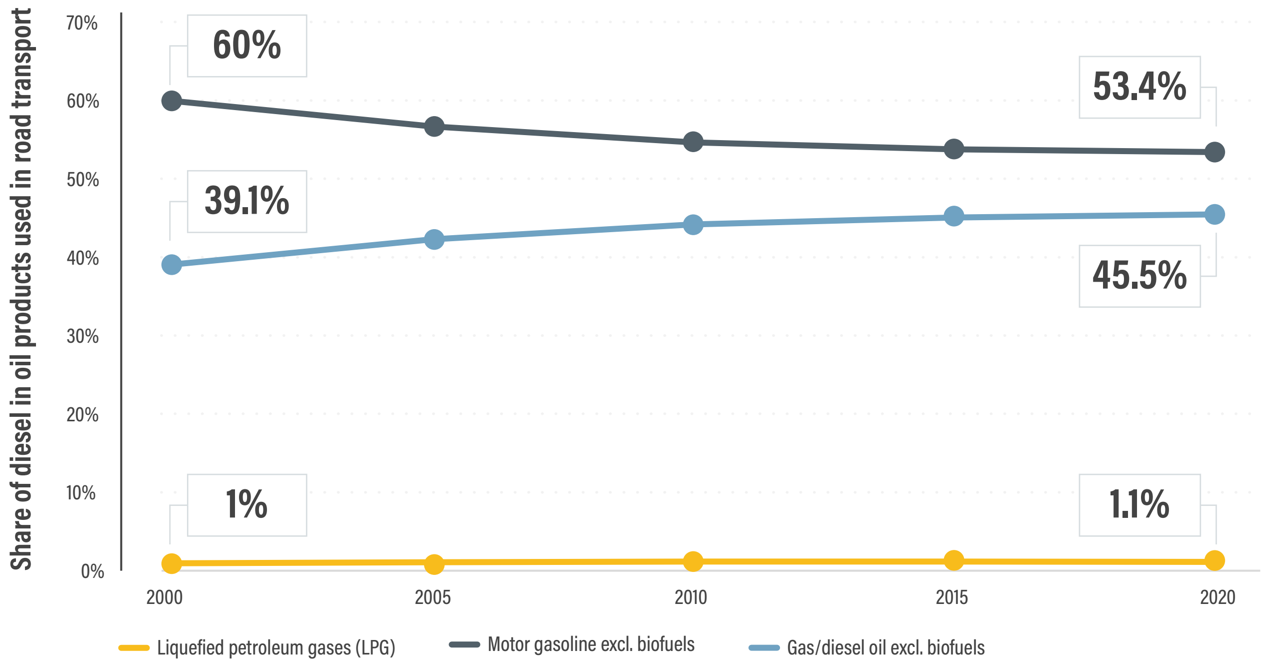
will influence the future demand for biofuels. Meanwhile, in the European Union (EU), the share of new passenger cars that run on diesel fell from 27.9% in 2020 to 19.6% in 2021.[24]

The share of natural gas used in transport increased from 3.6% to 4.5% between 2015 and 2021.[25] Natural gas consumption for trucks and buses remained stable over this period.[26] However, the number of passenger vehicle fleets running on compressed natural gas (CNG) has increased (especially in India, which has the world's largest CNG vehicle fleet), due to the rapid expansion of fuelling infrastructure and to incentive programmes for CNG vehicle purchases and retrofits.[27]

Biofuels are the largest renewable energy source in transport, accounting for 3.7% of the sector's energy consumption in 2021, up 0.8 percentage points since 2015.[28] The main policies supporting biofuels are blending mandates set by countries.[29] Biofuel growth is driven mainly

FIGURE 3 Shares of oil products used in road transport, by fuel type, 2000-2020

Source: See endnote 23 for this section.



by increased use of biodiesel, particularly fatty acid methyl ester (FAME), the dominant biodiesel type, which grew 52% between 2015 and 2021.[30] Production volumes of advanced renewable diesel in the form of hydrogenated vegetable oil (HVO) and hydroprocessed esters and fatty acids (HEFA) remain low but have grown the fastest among all biofuels, up 160% between 2015 and 2021 (see Figure 4).[31]

Whereas ethanol production fell during the COVID-19 pandemic as overall passenger transport declined, biodiesel growth continued almost unhampered, since freight activity was much less affected, with activity levels (in tonne-kilometres) remaining almost constant. In addition, an increasing number of companies (for example, in the United Kingdom), relied on **biogas** for road freight, although at a much smaller scale.[32]

Hydrogen can play a role whenever direct electrification is impossible.[33] **Hydrogen is considered plausible for road transport (for use in heavy-duty vehicles for long distances) and for aviation and shipping.**[34] Although fuel cell electric vehicles are less efficient than battery electric vehicles, they could be an option for reducing emissions from heavy-duty vehicles in the medium term.[35] However, most fuel cell vehicles (82%) were light-duty vehicles as of 2021.[36] In addition, less than 1% of global hydrogen production that year was low emission (so-called green or renewable hydrogen), while the majority was sourced from fossil fuels (grey hydrogen).[37] As of 2020, green hydrogen was at least three times more expensive to produce than grey hydrogen.[38]

Despite the immense growth in electric vehicles over the last decade, electricity demand in road transport is still low, with electric vehicles accounting for around 1% of vehicles globally in 2022 (*see Section 4.2 Vehicle Technologies*).[39] **Electric vehicles represented only 0.14% of total global electricity consumption in 2020** (see Figure 5).[40] However, demand for electricity for road vehicles increased 730% between 2015 and 2021, with most of this growth in China.[41]

Electrification is most prominent in rail transport, accounting for 45% of the energy consumed by rail in 2021.[42] Together with the small share of biodiesel used in rail transport, this resulted in a renewable energy share for rail in 2021 of 12.2%, the highest in the transport sector.[43] In aviation, the use of direct electric propulsion is so far limited to smaller aircraft and shorter distances.[44] In shipping, electrification is used only for shorter distances (such as in ferries and small vessels) or in diesel-electricity hybrid systems (*see Section 3.8 Shipping*).[45]

Fossil fuels continue to account for the majority of electricity generation in the power sector, and thus for the majority of the electricity supplied for electric vehicles.[46] The share

FIGURE 4 Biofuel production, by type, 2015-2021

Source: See endnote 31 for this section.

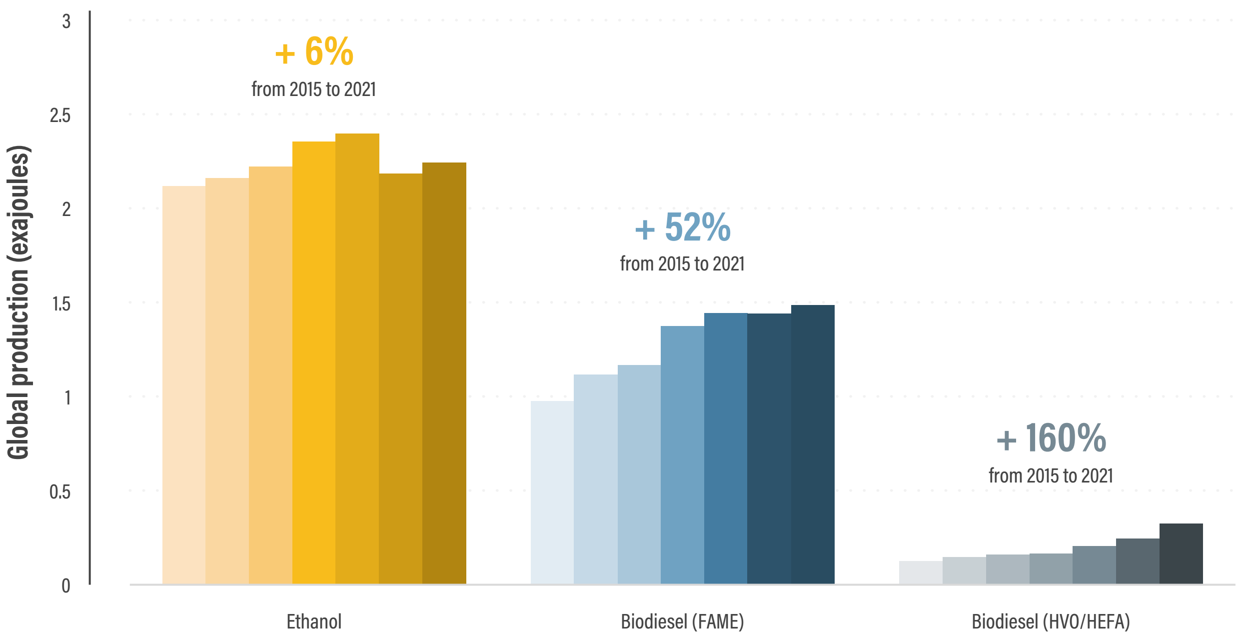
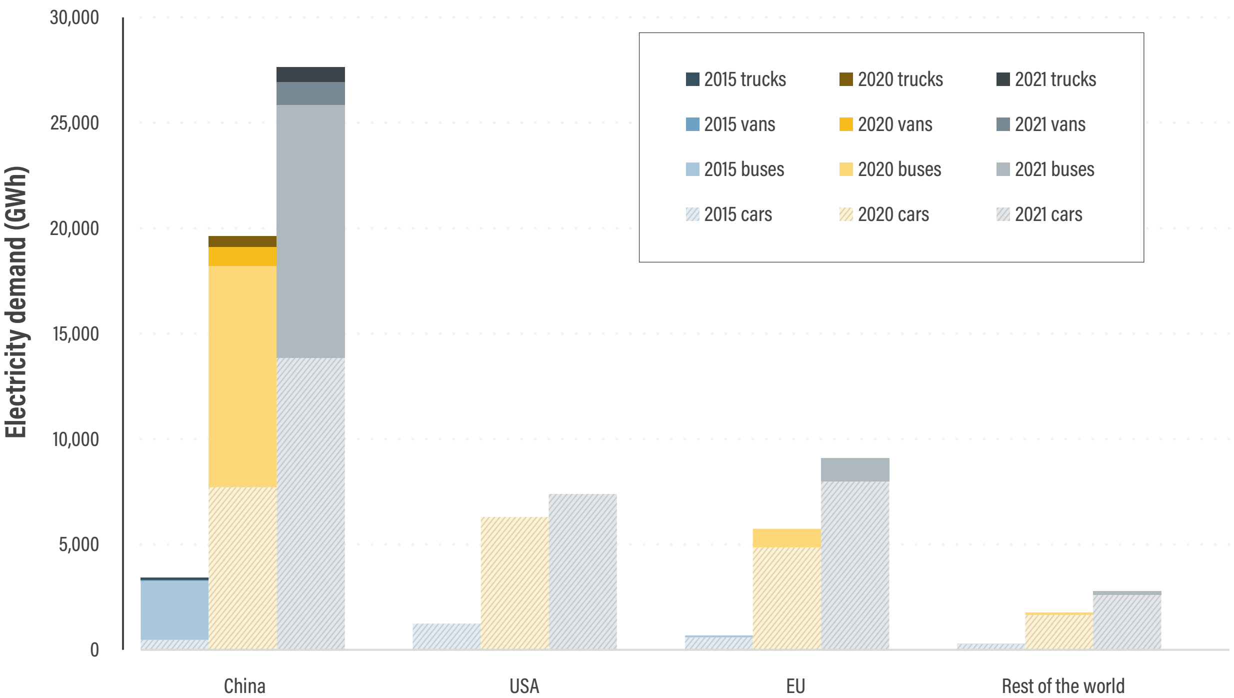


FIGURE 5 Electricity demand from electric vehicles in selected countries/regions, by vehicle type, 2015, 2020 and 2021

Source: See endnote 40 for this section.



of renewables in total global electricity generation was an estimated 28% in 2021, up just 5 percentage points from 2015.[47] However, the share of renewables in global power generation capacity *additions* has increased rapidly since 2010, reaching 83% by 2020.[48] Despite such rapid increases in capacity, the overall growth in electricity demand globally has slowed potential gains in the share of renewables.

More than 450,000 commercial flights used sustainable aviation fuel[i] **(SAF) in 2022, with SAF production increasing 200% compared to 2021.**[49] **However, SAF still accounted for only 0.1% of all consumed aviation fuel as of 2022.**[50] SAF is currently blended with fossil fuel at rates of between 5% and 50%, but the first flight using 100% SAF took off in January 2023, raising hopes of increasing use rates in the future.[51] By the end of 2022, 60 airports, mainly in Europe and the United States, provided continuous supply of SAF blends, up from 46 in 2020, and 30 more airports provided batch deliveries, up from 23 in 2020.[52] (*See Section 3.7 Aviation*.)

i Produced from bioenergy, municipal waste, or synthetically through carbon captured from the air.

Emission trends

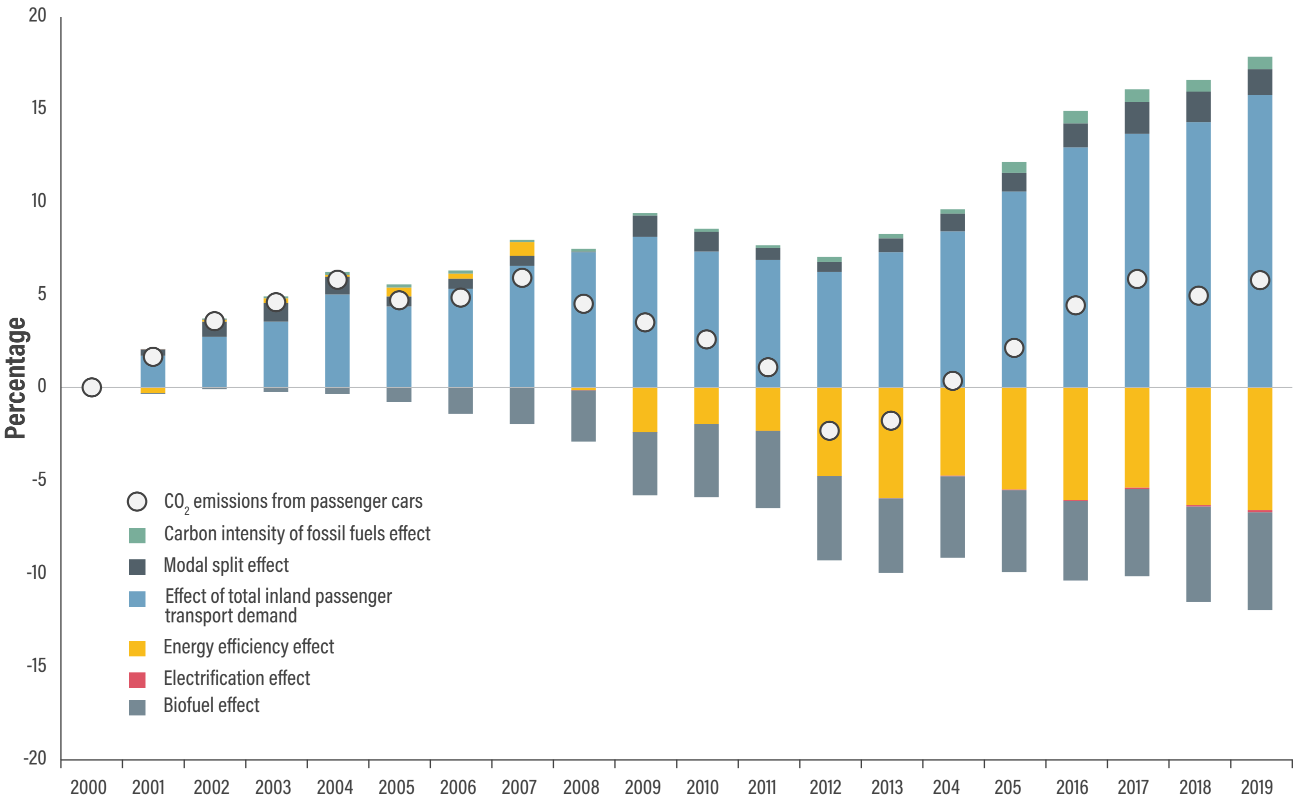
Carbon dioxide (CO_2) emissions from road transport increased steadily between 2000 and 2020 (*see Section 3.6 Road Transport*).[53] Even regions where emission standards were increasingly strict saw growth due to rising transport demand. In the EU, emissions from passenger cars increased 5.8% between 2000 and 2019, despite a 6% decline in energy consumption per passenger-kilometre.[54] The use of biofuels dampened emission increases during this period, as did energy efficiency standards, but electrification did not play a significant role in decarbonising passenger cars in the EU up to 2019 (see Figure 6).[55]

Energy efficiency improvements and the use of renewable energy sources, mostly biofuels, helped reduce emissions from the transport sector. However, these savings continued to be outweighed by rising emissions from the overall growth in transport demand and from the modal shift towards higher-emitting forms of transport, leading to a net increase in emissions from the sector.

The required shift to renewable energy in transport will have negative effects on employment in regions that are highly dependent on fossil fuels. Policies aimed at fostering the decarbonisation of transport will need to ensure an equitable just transition towards more sustainable jobs.[56]

FIGURE 6 Evolution of CO_2eq emissions from passenger cars in the EU-27, by contributing factor, 2000-2019

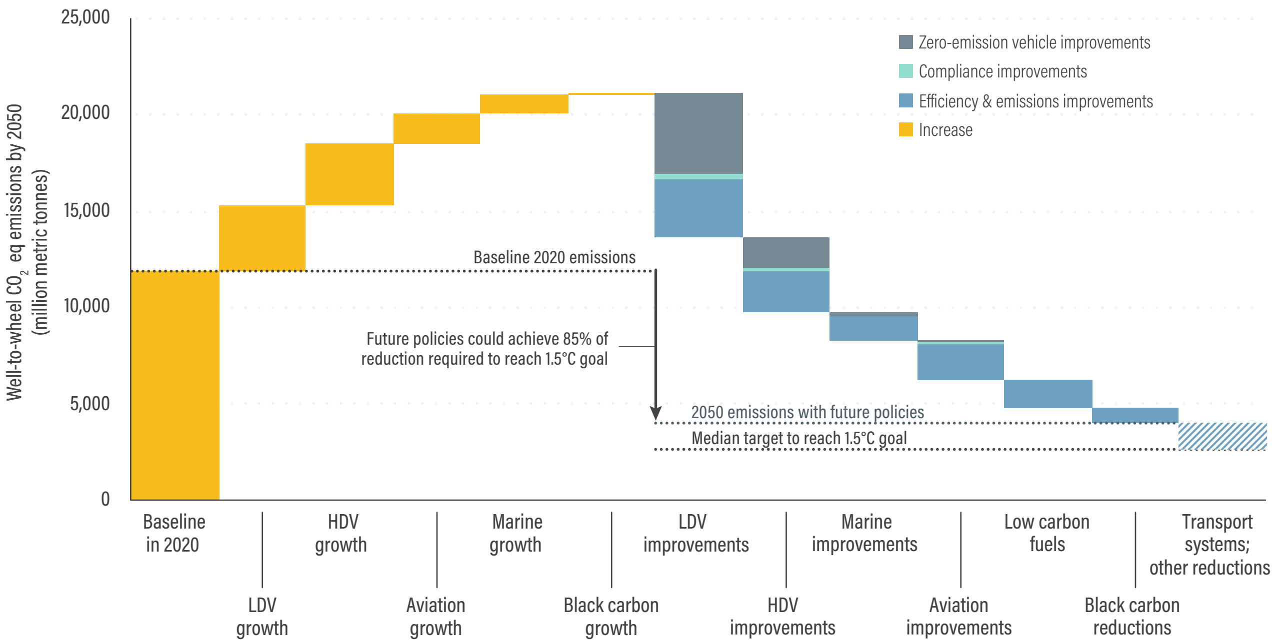
Source: See endnote 56 for this section.



Note: Emission data are measured in CO_2 equivalent emissions and shown as a percentage change compared to the year 2000.

FIGURE 7 Baseline emissions from transport in 2020, and the mitigation potentials from different sectoral activities to 2050

Source: See endnote 62 for this section.



Note: Figure does not show potential reductions from "Avoid" and "Shift" measures.
HDV = heavy-duty vehicle; LDV = light-duty vehicle.

Globally, this shift is expected to result in a net gain in jobs.[57] It is crucial to find tailored solutions that mitigate negative developments and create a more equitable and sustainable system for all stakeholders.[58] According to a 2022 report, the top five countries leading the way on measures to achieve a just transition were Costa Rica, Portugal, Sweden, Argentina, and Spain, while China, Brazil, India, the United States and Europe (as a region) led in renewable energy jobs.[59]

An "ambitious yet feasible" scenario from the International Council on Clean Transportation (ICCT) projects that the energy efficiency of light-duty vehicles will improve 0.75% annually between 2030 and 2050.[60] In the future, zero-emission vehicles are projected to play a major role in emission reductions, especially for road transport. Widespread electrification with renewable sources also offers high potential for emission reductions, and must counteract the expected growth in emissions from rising transport activity and the use of heavier vehicles (see Figure 7).[61]

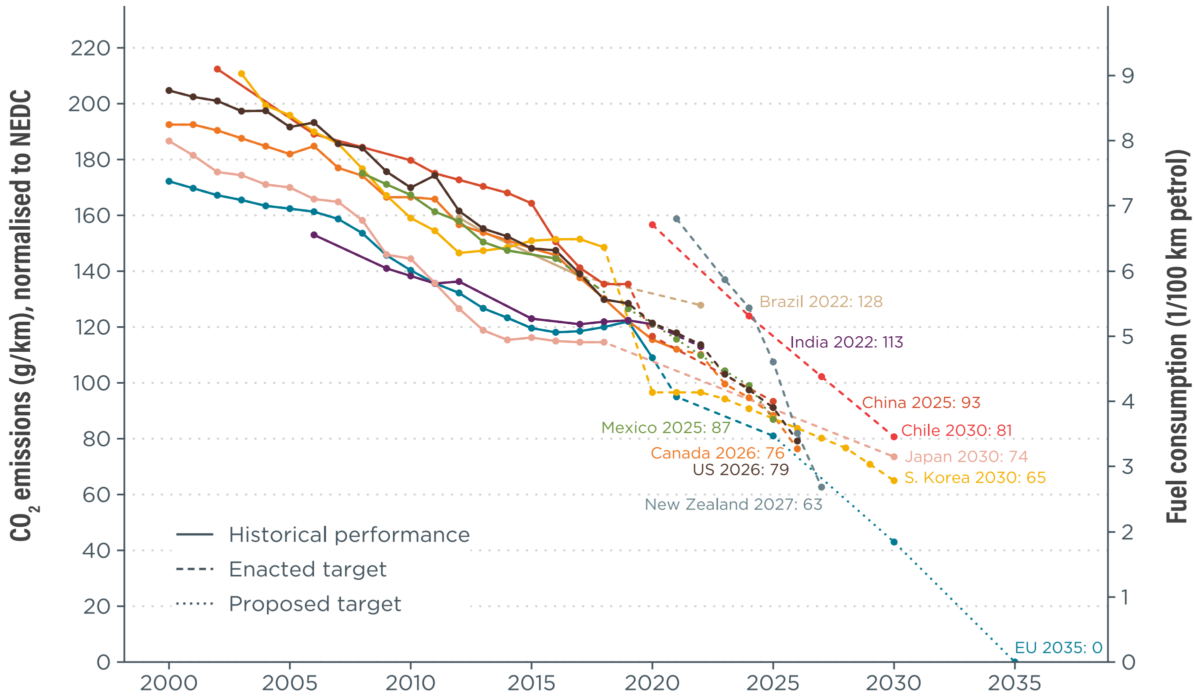
Energy efficiency plays a major role in decarbonising the maritime and aviation sectors under the ICCT's "ambitious yet feasible" scenario. The scenario assumes an improvement in ship efficiency of 70% by 2040, with only 17% of energy demand being met by zero-emission vessels.[62] In aviation, emissions are projected to decrease 40% between 2020 and 2050, with only 10% of liquid fuels being replaced by electrification.[63]

Policy developments

Mandatory standards for energy efficiency and for greenhouse gas emissions have proven to be effective instruments to drive efficiency and the shift to zero-emission vehicles. At least 11 countries plus the EU-27 – covering more than 80% of global passenger car sales – have established or enacted fuel efficiency or greenhouse gas emission standards for passenger cars and light trucks; some countries have proposed strengthening their standards, and at least one new country (Malaysia) has proposed enacting

FIGURE 8 Equivalent passenger car CO_2 emissions and fuel consumption in countries with mandatory vehicle efficiency or emissions standards, 2000-2035

Source: See endnote 66 for this section.



Note: Differences in the test procedures across standards are converted to the New European Driving Cycle (NEDC), a testing method to check fuel economy and emissions. Switzerland and the United Kingdom have adopted EU greenhouse gas emission standards and are included under "EU" in the graph.

mandatory standards.[64] Countries where such standards have been implemented have seen significant reductions in both emissions and fuel consumption (see Figure 8).[65]

- Chile adopted new vehicle efficiency standards under its energy efficiency law, which will come into effect in 2024 for light-duty vehicles and 2026 for medium-duty vehicles, progressing from 18.8 kilometres per litre in 2024 to 28.9 kilometres per litre by 2030 for light-duty vehicles.[66]
- The United States revised its fuel economy standards in 2022, with the new standards aimed at increasing fuel efficiency 8% annually for model years 2024-2025 and 10% annually for model year 2026.[67]
- As part of its Fit for 55 package, the EU adopted higher fleet-wide CO_2 emission reduction targets for new passenger cars and vans, raising reductions to 55% for cars and 50% for vans by 2030, and 100% for both by 2035, effectively banning fossil fuels.[68]
- Malaysia issued a voluntary standard in 2021 for energy-efficient vehicle certificates – including vehicle labelling – and started a public consultation process in 2022 for mandatory greenhouse gas emission standards.[69]

An increasing number of countries – mostly with limited or no domestic vehicle manufacturing – have established vehicle standards or other instruments to enhance the efficiency of imported vehicles. By mid-2020, 67 countries had age restrictions on the import of used vehicles, which influence the fuel efficiency.[70]

- In 2023, New Zealand began operating a Clean Car Standard system that grants importers CO_2 credits for vehicles that have fewer emissions than the individual vehicle target, and imposes charges for vehicles that have higher emissions.[71] The scheme applies to new and used cars and light commercial vehicles; targets are set annually up to 2027, and rates for exceeding the target will increase in 2025.[72]
- In 2020, the 15 member states of the Economic Commission of West African States (ECOWAS) adopted age limits of 5 years for imports of light-duty vehicles and 10 years for heavy-duty

vehicles; members have 10 years to implement the restrictions under the region's new fuel economy roadmap.[73]

- In January 2023, Kenya started enforcing its import bans for motor vehicles older than eight years and for trucks up to 30 tonnes that are older than three years.[74]
- Uganda imposed a ban on the import of motor vehicles older than nine years as of 1 July 2022.[75]
- After the end of Brazil's Invar Auto programme in 2017, which provided tax credits for meeting corporate average vehicle efficiency targets, the country set an efficiency improvement target of 11% over 2017 levels starting in 2022 under its Rota 2030 scheme.[76]

Fuel economy and greenhouse gas emission standards for heavy-duty vehicles are an important instrument to decarbonise the freight sector, particularly given the challenges in finding alternative fuels and propulsion systems for heavy-duty trucks. **In 2022, more than 70% of trucks sold were covered by fuel economy or vehicle efficiency regulations, although only seven countries or regions had such standards** (Canada, China, the EU, India, Japan, the United Kingdom and the United States).[77]

- In 2023, the EU proposed enhanced standards for 2030 that would raise the efficiency improvement target to 45% up from the current 30% and reduce emissions 90% by 2040.[78]
- Chile's Energy Efficiency Law introduces the first standards for medium- and heavy-duty vehicles, which for medium-duty vehicles would be defined in 2024 and take effect in 2026 (and for heavy-duty vehicles in 2026 and 2028, respectively).[79]
- New Zealand adopted a new procurement requirement in 2022 that requires all public transport buses purchased starting in January 2025 to be zero emissions.[80]
- In 2021, 15 countries and regions endorsed the Global Memorandum of Understanding on Zero-Emission Medium and Heavy-Duty Vehicles, committing to 100% zero-emission new truck and bus sales by 2040; as of February 2023, the measure had a total of 27 endorsees including manufacturers, fleet owners, utilities and sub-national entities.[81]
- California (USA) enacted in 2020 the Advanced Clean Trucks regulation, the first regulation worldwide requiring manufacturers to increase the sales share of zero-emission trucks. By 2035, the rule requires a zero-emission share of 40% for tractor trucks (class 7-8), 75% for rigid trucks (class 4-8) and 55% for pick-up trucks and vans (class 2b-3).[82]

Many countries have adopted vehicle labelling schemes to help consumers make informed choices by better understanding the life-cycle costs of vehicles. Several other policies influence the energy efficiency of vehicles, with vehicle taxation often used to steer consumers towards more efficient vehicles.

- In 2022, Viet Nam extended its vehicle labelling scheme to include externally charged hybrid and fully electric vehicles.[83]
- Thailand is adapting its labelling to include watts-per-kilometre for electric vehicles; labelling is particularly relevant in the country because the information is directly linked to vehicle excise tax.[84]
- New Zealand launched an updated vehicle labelling scheme in April 2022 that includes CO_2 emissions and Clean Car Discount eligibility.[85]
- In 2021, Indonesia reformed its vehicle tax structure to include fuel consumption and emission levels.[86]

Biofuel blending mandates remain the most popular measure for increasing renewable energy in transport, with at least 56 countries and the EU having established some form of obligation by the end of 2022.[87] Biofuels policies are driven and restricted by the availability of feedstocks, cost and resulting demand. Countries with abundant feedstocks are more likely to implement blending mandates and generally support biofuel production infrastructure. Requirements regarding the sustainability of biofuels and life-cycle greenhouse gas emissions including land use vary across countries. Several changes to existing mandates emerged in 2021, many in direct response to rising fuel prices:

- Canada replaced its Renewable Fuels Regulations with Clean Fuels Regulations, which take a life-cycle approach and require suppliers to reduce the carbon intensity of diesel and petrol sold in the country, starting in 2023.[88]
- The United Kingdom introduced the mandatory provision of E10 (10% ethanol blend) petrol as the standard in petrol stations, although E5 blends will remain available.[89]
- India released its 2025 ethanol roadmap, which would move up by five years the country's blending mandate for 20% ethanol, to 2025. The roadmap places a renewed focus on food-based feedstocks, despite past challenges in meeting ethanol blend rates, in a departure from the Ethanol Blended Program laid out under the National Policy on Biofuels, which prioritised second-generation feedstocks.[90]
- Argentina lowered its biodiesel blending mandate from 10% to 5% in June 2021 to control rising fuel prices and split its 12% ethanol blending requirement to 6% from sugar cane and 6% from corn.[91] In June 2022, the mandate was raised to 7.5% to increase supply, and in October the government launched a Biofuel Commission, which calls for a 15% ethanol blend mandate and a 1% blend mandate for SAF.[92]
- In 2021, Brazil cut its biodiesel blending mandate from 13% to 10% to counter rising costs; however, government data suggest that blending could return to 15% in March 2023.[93] Still, the country's RenovaBio programme remains the world's largest programme supporting biofuels.[94] In 2023, the

programme updated its mandatory emission reduction targets, while the federal government published guidelines for the implementation of a carbon credit market among biofuels producers and importers.[95]

- Finland temporarily reduced its biofuel blending obligations from 19.5% to 12% for 2022 and from 21% to 13.5% for 2023, in an effort to reduce end-user fuel prices.[96] To compensate for the additional emissions, the government plans to increase its blending obligation for 2030 from 30% to 34%.[97]
- Malaysia pushed the roll-out of its biodiesel blend mandate from 2020 (when it was delayed by the pandemic) to early 2022.[98]

Changes to existing biofuel mandates in 2022 included the following:

- Colombia reduced its ethanol blending mandate from 10% to 6%, while Thailand reduced its biodiesel mandate from 7% to 5%.[99]
- The Czech Republic, Latvia, Peru and Zimbabwe temporarily suspended their biofuel blending mandates.[100] At the sub-national level, New Mexico (USA) also suspended its mandate.[101]
- The Republic of Korea increased its biofuels mandate from 3% to 3.5%, with further increases to occur in 2024 (4%) and 2030 (8%).[102]
- Poland increased its biofuels mandate from 4.95% to 6.2%.[103]

New biofuel policies under development as of 2022 included:

- New Zealand is set to introduce targets to reduce the emission intensity of fuels 2.4% by 2024 (and 9% by 2035) through its Sustainable Biofuels Obligation Bill, which had its first reading in Parliament in November 2022.[104]
- Indonesia was road-testing a 40% biodiesel blend that could lead to a higher ethanol blending mandate by 2025.[105]

As of the end of 2022, at least six countries mentioned biofuel blending in their updated Nationally Determined Contributions (NDCs) towards reducing emissions under the Paris Agreement, with policy implementation yet to come.

- Blends mentioned in countries' NDCs include Eswatini (E10 by 2030), Guatemala (B10 by 2032), Lao People's Democratic Republic (10% of transport fuels by 2030), Malawi (E20 by 2040), Mali (5.4% biodiesel and 11% ethanol by 2030) and Vanuatu (B20 by 2030).[106]
- Other countries have set renewable energy targets for the sector in their NDCs, such as Dominica (100% by 2030) and the Republic of North Macedonia (10% by 2030).[107]

In aviation, some countries are considering biofuel blending mandates for sustainable aviation fuels. Additionally, the EU is revising its Emission Trading System (ETS) to apply the polluter pays principle by phasing out free allowances for the aviation sector by 2026.[108] As part of the Fit for 55 package agreed to in December 2022, the EU would include emissions from maritime transport in its ETS starting in 2024, and would create a separate ETS for buildings, road transport and fuels.[109]

- The EU's Fit for 55 package aims to establish an SAF blending mandate starting in 2025, with shares increasing up to 2050.[110]
- In 2022, the United Kingdom confirmed a SAF blending mandate from 2025 requiring at least 10% of jet fuel to be made from sustainable feedstocks by 2030.[111]

Endnotes

4.1
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