3.9

Renewable Energy in Transport

Key findings

Demand trends

- Transport remains the sector of energy use with the lowest share of renewables, with more than 95% of energy needs coming from oil and petroleum products and less than 4% from biofuels and renewable electricity in 2018.
- Renewable energy sources – mostly renewable electricity and biofuels – contributed an estimated 11% of the energy use associated with global rail in 2019.
- Biofuels accounted for 91% of the renewable energy use in road transport in 2019, but further growth in biofuels is constrained by sustainability issues and competition between fuel and food sources.
- Aviation is among the fastest growing transport sectors; however, despite significant efforts to incorporate renewable energy in the sector, biofuels provided only around 0.01% of aviation fuel during 2019.

Emission trends

- Heavy-duty vehicles account for three-quarters of the energy demand and carbon dioxide (CO_2) emissions from freight, yet they remain the most challenging type of road vehicle to find cost-effective energy alternatives for.

Policy measures

- Policies to promote renewable energy in the transport sector continue to focus mainly on road transport, with rail, aviation and shipping receiving less attention despite being large energy consumers.
- As of the end of 2019, only 46 countries had some form of renewable energy target for transport, and just 11% of countries included measures for renewables-based transport in their Nationally Determined Contributions (NDCs) towards reducing emissions under the Paris Agreement.
- Biofuel blending mandates remain one of the most widely adopted policies for increasing renewable fuels in road transport; however, no new countries introduced such mandates in 2018 or 2019, with the total remaining at 70 countries.
- The maritime transport sector has scaled up efforts to incorporate renewable energy by using fuels generated from renewable sources and applying electrification and wind energy as complementary strategies.
- The increasing scope of policies to electrify road vehicles and other transport modes offers significant potential to increase the share of renewable energy in transport.

Impacts of the COVID-19 pandemic

- Due to the pandemic, oil demand was down nearly 5% in the first quarter of 2020, reflecting reduced demand for land-based transport, shipping and aviation; meanwhile, the demand for renewables grew.
- Economic recovery packages offer significant potential to align renewable energy and transport policies for a green and equitable recovery, but initial plans have fallen short in this area.

Overview

To achieve the energy transformation required for decarbonisation, the transport sector will need to rely increasingly on renewable energy sources.[1] The main entry points for renewables in the transport sector are:

- The use of biofuels blended with conventional fuels, as well as higher blends including 100% liquid biofuels;
- Natural gas vehicles and infrastructure converted to run on upgraded biomethane; and
- The electrification of transport modes, including through the use of battery electric and plug-in hybrid vehicles or of hydrogen, synthetic fuels, and electro-fuels, where the electricity is itself renewable.[2]

Some renewable energy carriers (such as biofuels) can be used in the internal combustion engines of conventional vehicles, whereas others require alternative drivetrains, such as in battery electric or fuel cell vehicles. Overall, fuels and vehicle technologies vary greatly in their technical maturity, costs, level of sustainability, climate mitigation potential, distribution and acceptance rates among users.[3] Renewable energy policy strategies are being implemented at different levels (from international to sub-national), and while some are relevant to the transport sector overall, others are specific to certain sub-sectors to accommodate the needs and preferences of different industries and users.

Plug-in hybrid and fully electric passenger cars, electric scooters, electric bicycles and electric waste trucks have become more common in an increasing number of countries, often as a result of policies and targets adopted in prior years.[4] Although rarely linked directly to renewable sources, the use of electricity in transport continued in 2019 and 2020, offering greater potential entry points for integration with renewable energy. Public subsidies can reduce the cost of sustainable transport measures. However, fiscal support from governments has remained limited, and many governments continue to heavily subsidise fossil fuels or fail to adequately tax them, artificially lowering the retail price of petrol below the price of crude oil on the world market, which continues to undermine climate action *(see Section 4 on Financing Climate Action in Transport)*.[5]

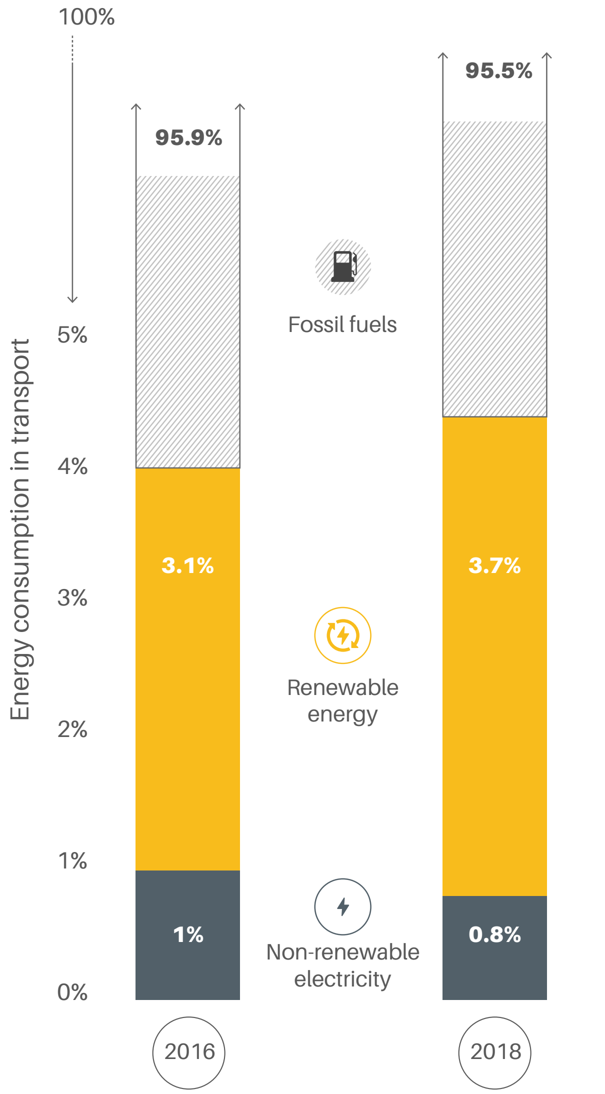
The COVID-19 pandemic led to a strong decline in oil demand as well as opportunities to shift investments towards renewable energy sources. Economic recovery packages offer significant potential to align renewable energy and sustainable transport policies (*see Box 1*).[6]

Demand trends

Transport remains the sector of energy use with the lowest share of renewables, with more than 95% of energy needs coming from oil and petroleum products and less than 4% from biofuels and renewable electricity in 2018 (*see Figure 1*).[7] Some countries have seen gradual increases in the use of renewable hydrogen and synthetic fuels for transport, but these remain minimal overall.[8] Road transport accounted for around 75% of global transport energy use in 2018, with passenger vehicles representing more than two-thirds of this.[9]

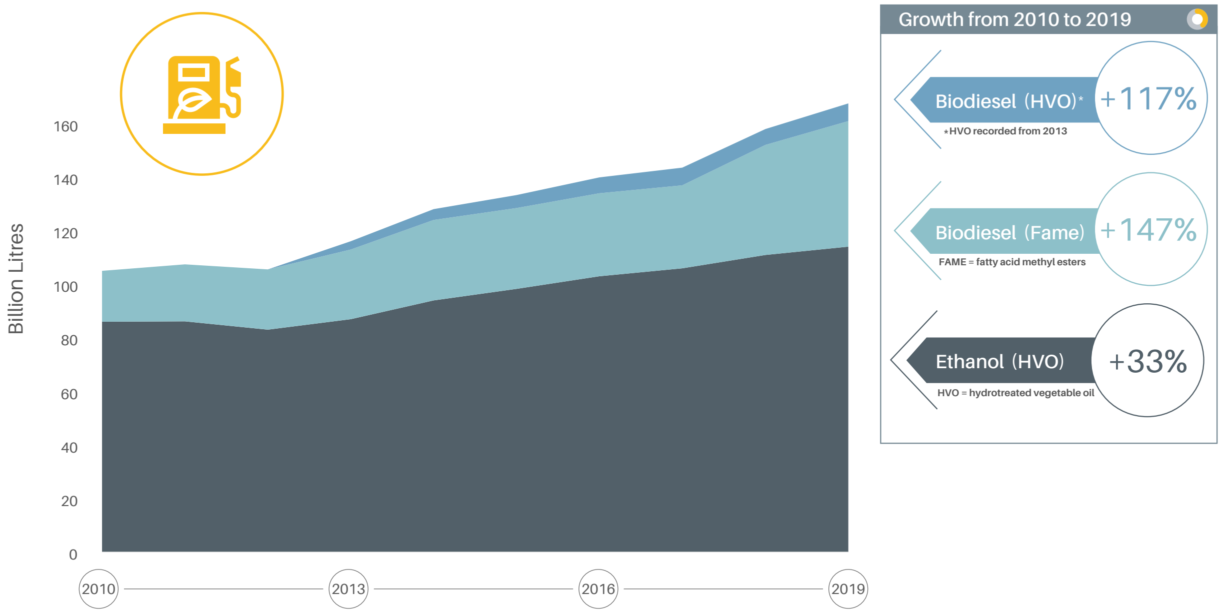
Renewable energy sources – mostly renewable electricity and biofuels – contributed an estimated 11% of the energy use associated with global rail in 2019.[10] In recent years, some jurisdictions have attempted to increase the link between renewable power generation and rail transport, since this remains the most highly electrified transport sub-sector.

Figure 1. Share of renewable energy in transport, 2016 and 2018



Source: See endnote 7 for this section

Figure 2. Global biofuel production, 2010-2019



Source: See endnote 15 for this section.

- In 2019, **Melbourne**, Australia connected a 128 megawatt solar photovoltaic system to its grid network specifically to power the city's tram system.[11]
- **Scotland**, UK adopted a Green New Deal package of policy measures in 2019 that included commitments to electrifying the rail network and battery-powered trains.[12]

Biofuels accounted for 91% of the renewable energy use in road transport in 2019, but further growth in biofuels is constrained by sustainability issues and competition between fuel and food sources.[13] In 2019, global production of liquid biofuels increased 5% to reach 161 billion litres (equivalent to 4 exajoules).[14] Ethanol increased 2%, while biodiesel increased 13% (*see Figure 2*).[15] Production of biomethane and advanced biofuels remained low, at less than 1% of the biofuel total.[16] Although efforts to develop advanced biofuels continue (and some new production capacity has been installed), so far only small quantities of these fuels have been produced and used.

Aviation is among the fastest growing transport sectors; however, despite significant efforts to incorporate renewable energy in the sector, biofuels provided only around 0.01% of aviation fuel during 2019.[17] Slow progress with renewables in aviation is due to the cost of advanced biofuels, challenges related to battery weight and range (for electrification), and jurisdictional issues in regulating cross-border industries.[18]

Technology exists for producing renewable electro-fuels for aviation, but costs remain much higher than for fossil-based fuels, and policy support is lacking.[19] Although interest in the electrification of aviation is increasing, so far only electric drones or small planes for 1 to 12 passengers have been developed (or are under development), while some companies are aiming for hydrogen-powered electric planes.[20]

Support for and use of renewable fuels in aviation made slight progress in recent years. In 2018, the International Civil Aviation Organization (ICAO) Council endorsed the 2050 ICAO Vision for Sustainable Aviation Fuels, which is expected to greatly increase commercial production of these fuels by 2050.[21]

- By early 2020, 119 ICAO Member States (representing 94.3% of global air traffic) had submitted State Action Plans to support the production and use of sustainable alternative[i] aviation fuels; these include drop-in fuels (which can be blended with or directly replace fossil fuels in transport systems) produced from biomass and from different types of organic waste.[22]
- More than 200,000 commercial flights had flown on blends of alternative fuels by early 2020, up from 150,000 in 2019.[23]
- At least 8 airports had regular distribution of blended alternative fuel as of early 2020, up from 5 in 2019, while at least 14 airports had batch deliveries of such fuels.[24]

i These include fuels produced from three families of bio-feedstock: the family of oils and fats, or triglicerides, the family of sugars, and the family of lignocellulosic feedstock.

Emission trends

Heavy-duty vehicles account for three-quarters of the energy demand and CO_2 emissions from freight, yet they remain the most challenging type of road vehicle to find cost-effective energy alternatives for.[25] Heavy-duty vehicles are the fastest growing source of oil demand worldwide, even though they account for less than a quarter of total freight activity.[26] The larger the vehicles and the longer the range, the more challenging it is to find cost-effective alternatives to diesel fuel.[27] Although not all alternative fuels come from renewable sources, many are already commercially viable, and technological development continues.[28]

- In 2019, **Volvo** introduced trucks running on liquefied biogas in **Finland** and **Sweden**.[29]
- In the USA states of **California**, **Oregon** and **Washington**, between 2011 and 2018, Class 3-8 trucks fuelled by renewable diesel saved 12.3 million tonnes of CO_2 and eliminated 1.8 million tonnes of nitrogen oxides.
- By 2030, the increased use of the cleanest diesel technologies is expected to deliver an additional 120.7 million tonnes of CO_2 reductions and eliminate an additional 5.5 million tonnes of nitrogen oxides collectively in these three West Coast states.[30]

Policy measures

Policies to promote renewable energy in the transport sector continue to focus mainly on road transport, with rail, aviation and shipping receiving less attention despite being large energy consumers.[31] In general, policy makers are turning greater attention to expanding the use of renewables in transport as a means to improve local air pollution and meet greenhouse gas emission targets.[32] However, the development of renewable energy policies in the transport sector has not nearly been as rapid as in other economic sectors, such as the power sector.

As of the end of 2019, only 46 countries had some form of renewable energy target for transport, and just 11% of countries included measures for renewables-based transport in their Nationally Determined Contributions towards reducing emissions under the Paris Agreement.[33] However, around 80% of countries worldwide have acknowledged the transport sector's role in mitigating emissions by including transport in their NDCs.[34]

More than 50 cities worldwide had targets for electric mobility as of early 2020, but most of these are not directly linked to renewable electricity.[35] At least 28 cities and 39 countries or other sub-national jurisdictions had separate targets for both electric vehicle deployment and renewable electricity generation, but only 6 cities and 2 countries explicitly linked the two.[36] Better aligning electric vehicle and renewable electricity targets offers significant opportunity to advance the use of renewables in transport, as current renewable transport targets are heavily skewed towards the use of biofuels.

- Cities that have adopted separate targets for electric mobility and renewable electricity include **Amsterdam**, Netherlands; **Cape Town**, South Africa; **Dubai**, United Arab Emirates; **Hamburg**, Germany; **Portland**, Oregon, US: and **Toronto**, Canada.[37]
- **Austria** and **Japan** were the only two countries with a policy directly linking renewables with electric vehicles as of early 2020.[38]

Biofuel blending mandates remain one of the most widely adopted policies for increasing renewable fuels in road transport; however, no new countries introduced such mandates in 2018 or 2019, with the total remaining at 70 countries.[39] Some countries with existing blending mandates added new ones, and several existing mandates were strengthened (*see Figure 3*).[40] At least 8 countries had mandates for advanced biofuels, and at least 24 countries had future targets for advanced biofuels.[41]

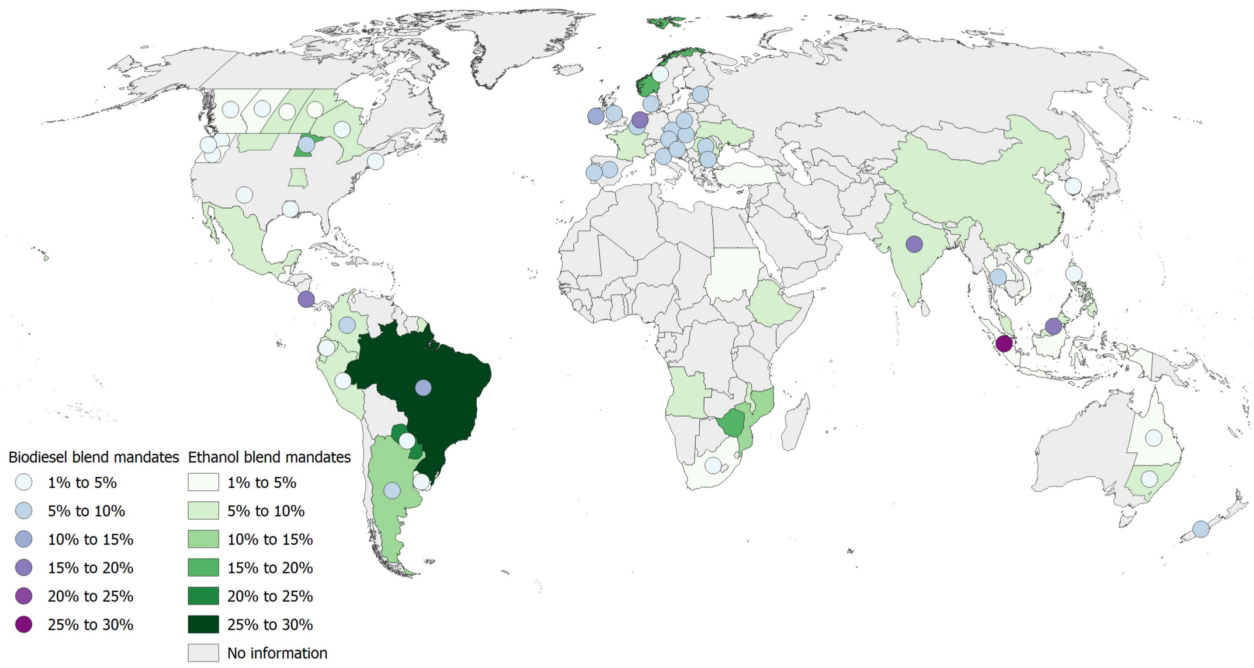
Policies supporting the production and use of biofuels, including ethanol and biodiesel, continue to be the most common type of direct renewable energy policies in the transport sector (to support energy security and economic development, and also because of biofuels' similarity to liquid petroleum fuels).[42] These policies include blending mandates, financial incentives, public procurement, and support for fuelling and blending infrastructure and advanced biofuels.

- **Brazil**'s RenovaBio programme scales up biofuel production through the use of tax exemptions that provide financial support for increased sugarcane production.[43] The programme also introduced emission reduction targets for fuel distributors, with the option of demonstrating compliance by buying traded emission reduction certificates awarded to biofuel producers.[44]
- In 2019, **Indonesia** became the first country to implement B30 (30% blending of biodiesel in diesel) – the highest such blending mandate in the world – in an effort to boost renewable energy use in the country.[45]
- At the sub-national level, **Quebec**, Canada has proposed lowering the blending requirements for ethanol that contains at least 10% cellulosic content.[46]

The maritime sector has scaled up efforts to incorporate renewable energy by using fuels generated from renewable sources and applying electrification and wind energy as complementary strategies. The International Maritime Organization agreed on stricter energy efficiency targets and new fuel and emission standards beginning in January 2020, while the industry called for speed limits on commercial vessels to reduce emissions.[47] By early 2020, trials had begun on using ammonia as a shipping fuel, with the potential to produce it with renewable electricity.[48]

In September 2019, maritime industry leaders launched the Getting to Zero Coalition, with the objective of operating zero-emission vessels along deep-sea trade routes by 2030.[49] World leaders in shipping and the oil industry joined the coalition to co-ordinate the launch of improved propulsion technologies and "clean" fuels.[50] Some ports have adopted their own targets to increase energy efficiency, decrease greenhouse gas emissions and/or increase the use of renewable fuels.

Figure 3. Biofuel blending mandates worldwide, by blend level, as of 2020



Source: See endnote 40 for this section.

- By the end of 2019, at least 11 ports in **Europe** and the **United States of America** (USA) had joined the World Ports Climate Action Programme to develop measures related to efficiency, emissions and renewables, up from 7 ports the year before.[51]
- In 2019, some shipping companies in **Scandinavia** entered into agreements to use liquefied biogas.[52]
- The **Port of Houston**, Texas announced in 2019 that it would purchase renewable electricity port-wide starting in 2020, making it the first **USA** port to administer such a programme.[53]
- **Norway** released an Action Plan for Green Shipping in 2019, stating the government's ambition to halve emissions from domestic shipping and fisheries by 2030 and to promote low- and zero emission solutions for all vessel categories.[54]
- The **UK** published a Clean Maritime Plan, the "Route Map" for its Maritime 2050 strategy, which includes research on incentives for zero-emission shipping and consultations on encouraging the uptake of low carbon fuels.[55]

The increasing scope of policies to electrify road vehicles and other transport modes offers significant potential to increase the share of renewable energy in transport.[56] Policies aimed at the electrification of transport, particularly road transport, increased in importance and frequency in 2019 and 2020.[57] These policies can promote the use of renewable electricity in the transport sector, both indirectly and directly.

Indirectly, in jurisdictions that support growing shares of renewable energy in the power grid, any policy that promotes electric mobility also increases the penetration of renewables in the transport sector


Credit: Clean Energy Ideas

(*see Section 3.8 on Electric Mobility*).[58] Policies can also directly support the use of renewable energy, for example by requiring that electric vehicles be charged using renewable power, or through tariffs that incentivise "smart" charging during times of peak renewable power generation. Railways are the most highly electrified transport mode and thus are particularly good candidates for renewable energy linkages.

- In 2019, **Cabo Verde** developed an integrated set of policies to promote electric vehicle adoption. The country's Electric Mobility Policy Charter (CPME) includes policies aimed at developing nationwide charging infrastructure by 2030, electrifying the public fleet by 2030 and replacing all internal combustion engine vehicles with electric vehicles by 2050.[59]
- **New Delhi**, India approved a target in 2019 to completely electrify its railway network by 2022-2023.[60]
- In 2019, **Pakistan** approved a national electric vehicle policy with targets and incentives aimed at having electric vehicles comprise 30% of all passenger vehicle and heavy-duty truck sales by 2030, and 90% by 2040.[61]
- The first urban train service in **Japan** relying entirely on renewable energy sources began operation in 2019.[62]

Initiatives supporting renewable energy in transport

- The **BioFuture Platform** is a country-led, multi-stakeholder mechanism for policy dialogue and collaboration among leading countries, organisations, academia and the private sector. As of late 2020, 20 participating countries had agreed to scale up their bioenergy commitments and develop sustainable biofuel targets, and the Mission Innovation Sustainable Biofuels Challenge was launched to stimulate and co-ordinate efforts to bring new sustainable biofuels to the market.[63]
- **Future of Fuels**, a collaborative initiative led by the non-governmental organisation Business for Social Responsibility, aims for a sustainable transition to low carbon commercial road freight with new tools, convenings and partnerships. Outcomes include the Sustainable Fuel Buyers' Principles and a Fuel Sustainability Tool.[64]
- The **Low Carbon Technology Partnership initiative on Low Carbon Freight**, led by the World Business Council for Sustainable Development, is a coalition of companies, governments and customers that aims to share and scale replicable models to achieve emission reductions in road freight globally.[65]
- **RE100**, a global initiative led by The Climate Group in partnership with CDP, involves more than 130 influential businesses committed to 100% renewable electricity, including companies in the transport sector. Members include FIA Formula E, the first electric single-seater championship where all cars run on 100% renewable power, and the French mail service La Poste, whose express delivery service Chronopost has used 100% renewable electricity to power its electric delivery vehicles in 18 French cities since mid-2020. [66]
- **The Transport Decarbonisation Alliance** (**TDA**) was launched in 2018 as a unique collaboration to accelerate the worldwide transformation of the transport sector towards a net zero emission mobility system before 2050. The TDA brings together countries, cities/regions and companies (the "3Cs") as the major drivers in sustainable, low carbon mobility.[67]

Box 1. Impacts of the COVID-19 pandemic on renewable energy

Due to the pandemic, oil demand was down nearly 5% in the first quarter of 2020, reflecting reduced demand for land-based transport, shipping and aviation; meanwhile, the demand for renewables grew. The declines in oil demand offered an opportunity to shift investment towards greater uptake of renewable energy in transport. Fossil fuels are subject to increasing competition from renewables as well as growing concerns about air pollution and carbon emissions.

Economic recovery packages offer significant potential to align renewable energy and transport policies for a green and equitable recovery, but initial plans have fallen short in this area. So far, recovery packages have not included direct linkages between transport and renewable energy.

Source: See endnote 6 for this section.

Key indicators

	2017*	2019*	% change
Policy Landscape Indicators			
Biofuel mandates (# of countries)	70	70	0%
Advanced biofuel mandates (# of countries)	2	8	+300%
Renewable transport targets (# of countries)	42	46	+10%
100% renewable energy in transport target (# of countries)	1	1	0%
Policies for electric vehicles combined with renewable electricity (# of countries)	2	1	-50%
Renewable electricity target and electric vehicle targets (# of countries)	44	39	-11%
Market Development Indicators			
Share of renewable energy in transport (%)	3.3%	3.7% (2018)	+12%
Share of biofuels in transport (%)	3%	3.4% (2018)	+13%
Share of renewable electricity in transport (%)	0.3%	0.32% (2018)	+7%
Share of renewable energy in road transport (%)	4.2% (2016)	4.4% (2018)	+5%
Share of renewable energy in rail transport (%)	9% (2016)	11%	+22%
Biofuels global production (billion litres)	143.2	161	+12%
Ethanol global production (billion litres)	104	114	+10%
Biodiesel (FAME) global production (billion litres)	33	47.4	+44%
Biodiesel (HVO) global production (billion litres)	6.2	6.5	+5%
Biofuel use in road transport (mboe/d)	1.7 (2016)	2 (2018)	+18%
Biofuel use in aviation and maritime (mboe/d)	< 0.1	< 0.1	0%

(*) Data are for the indicated year unless noted otherwise.

FAME = fatty acid methyl esters; HVO = hydrotreated vegetable oil; mboe/d = million barrels of oil equivalent per day

Source: See endnote 68 for this section.

In Practice: Additional Policy Responses

Policy targets set

Aviation

- By the end of 2019, **Brazil**, **Finland**, **Indonesia** and **Norway** had announced biofuel targets for aviation, while other countries adopted policies that could indirectly support the use of renewables in the sector.[69]
- In July 2019, the government of **Finland** announced a 30% biofuel target to be achieved by 2035 through a biofuel blending obligation for aviation.[70]
- In Scotland, **UK**, the 2019 Green New Deal policy package included a commitment for net zero aviation by 2040.[71]
- In 2019, the **USA** announced up to USD 55 million in funding for two programmes to support the development of electric aviation technology and powertrain systems, although these are not directly linked to renewable electricity.[72]

Policy measures implemented

Financial incentives

- **Thailand** subsidised the retail price of B10 (10% biodiesel blend in diesel) to encourage its use until January 2020, when B10 replaced B7 as the mandatory diesel option at pumps.[73]
- In the **US**, the biodiesel tax credit of USD 1 per gallon (USD 0.26 per litre) that expired in 2017 was extended retroactively until 2022, and the cellulosic ethanol tax credit was extended through 2020.[74]

Public procurement

- In 2019, **Toronto**, Canada began installing new equipment to transform biogas produced from the city's organic waste into renewable natural gas (RNG) to fuel its waste collection trucks.[75]
- **Santa Barbara**, US replaced petroleum diesel with renewable diesel in its municipal bus fleet in 2019.[76]

Infrastructure support

- In 2019, the USA state of **Minnesota** enacted a grant programme that provides funding for biofuel blending infrastructure.[77]

Energy utilities

- In 2019, the public utility commission in **Uttar Pradesh**, India implemented electric vehicle-specific electricity pricing structures for utility customers specifically designed to encourage the uptake of electric vehicles.[78]
- In 2018, the public utility commission for the USA state of **New York** introduced a time-of-use rate for residential customers charging electric vehicles, and the **Maryland** public utility commission required utilities to develop time-of-use rates and rebates for residential chargers.[79]

Annex: Methodological Note

Data usage

Time period for data:
The report strives to utilise the most recent publicly available data and information just prior to the time of publication (as of 31 May 2021). The figures in the report were developed between September and December 2020 using the most recent data available.

Secondary data:
SLOCAT relies on secondary data and information collected and provided by SLOCAT partners and other entities and does not make use of any internal modelling tools.

Data on sustainable mobility: A call to action

The report benefits directly from data collected by a wide range of stakeholders working in different areas of transport.

Data are important for providing a comprehensive picture of the status of sustainable, low carbon transport and are essential for both policy and investment decision making. In these times of change, it is critical to upgrade data and policy collection and interpretation capacities to better understand progress and the hurdles that must be addressed.

The data limitations mentioned below are not new. Obtaining regular, reliable and public data across regions and transport modes remains an outstanding issue. When an increasing number of stakeholders are collecting data and policy information, more and better open-access data and capacity building efforts for data interpretation are supported by many multi-stakeholder partnerships in the sustainable, low carbon movement.

If you share our passion for open-access data and knowledge towards greater impact on policy and investment decision making worldwide and/or would like to contribute data or knowledge to our collective efforts on this report, **please reach out to the research team in the SLOCAT Secretariat at tcc-gsr@slocatpartnership.org**.

Specific data used in this report

Data on emissions

The data in this edition of the report point to the direct carbon emissions from transport activity; they do not cover the indirect emissions and land-use impacts associated with certain modes of transport. The report primarily utilises CO_2 emission data compiled in the Emissions Database for Global Atmospheric Research (EDGAR) from the Joint Research Centre of the European Commission, as this represents the most recent, comprehensive dataset on transport CO_2 emissions. However, this global dataset does not convey in full detail the unique situations of individual countries.

EDGAR provides estimates for fossil CO_2 emissions from all anthropogenic activities with the exception of land use, land-use change, forestry and the large-scale burning of biomass. The main activities covered are CO_2 emissions emitted by the power sector (i.e., power and heat genertion plants), by other industrial combustion (i.e., combustion for industrial manufacturing and fuel production) and by buildings and other activities such as industrial process emissions, agricultural soils and waste. Transport activities covered within EDGAR include road transport, non-road transport, domestic aviation, and inland waterways on a country level, as well as international aviation and shipping.[1]

For the world, regions and countries, the CO_2 emission data (provided by EDGAR) span through 2019. In a few places in the report, CO_2 data for 2020 are shown to illustrate the impact of the COVID-19 pandemic; however, these data are based on a different methodology than the EDGAR dataset and should not be compared directly with the data from previous years.

The latest CO_2 emission data for individual transport modes are for 2018 and have been compiled only at the global level. For passenger and freight transport, the data on global CO_2 emissions are for 2017, as this is the latest year with robust data. Data on passenger activity (passenger-kilometres) and freight activity (tonne-kilometres) – provided mainly in the country fact sheets – are based on the latest available year, as indicated in the report analysis.

Information on greenhouse gas emissions – provided in CO_2 equivalent (CO_{2eq}) – include not only CO_2 but also methane, nitrous oxide, and industrial gases such as hydrofluorocarbons, perfluorocarbons, sulphur hexafluoride and nitrogen trifluoride.[2] These data are less up-to-date. As of 31 May 2021, data on greenhouse gas emissions were not readily available for the period 2019-2020. In some cases, additional data sources were used to provide detailed information about other climate pollutants besides CO_2.

All data on CO_2 and other greenhouse gas emissions, as well as CO_{2eq}, are provided in metric tonnes.

Data on car ownership

Information on car ownership rates is based on a global dataset from the International Organization of Motor Vehicle Manufacturers (OICA), with the latest release (as of 31 May 2021) dating from 2015.[3] Although newer information is available for some individual countries, using these data would hinder accurate global comparisons. Data on passenger and commercial vehicle sales were available only up to 2019.

Policy landscape data

The policy-related information presented in this report is not intended to be comprehensive. The data for the policy landscape indicators provided in Section 3 were gathered through desk research unless otherwise indicated. Barriers to accessing such information include language and limited availability of information through online media (e.g., websites, press releases and news articles).

Data in country fact sheets

Information in the fact sheets is based on desk research and on contributions from the national focal points. The data were collected to the best of the authors' knowledge and based on data availability, and thus may not be complete or show the most recent status. When no information was available for a given indicator, the term "Not available" is used.

Data gaps

Major data gaps exist in areas where there is no globally accepted data collection methodology. For example, the mapping of cycling and walking infrastructure is not currently done in all regions. Also, the modal share can be surveyed through different methods, leading to inconsistencies in available data. In addition, data on paratransit (informal transport), a predominant form of transport in many parts of the world, are largely lacking. This results in an incomplete picture of the impact of transport on climate change and sustainable development.

Methodological approach

Countries and regions

The report follows the M49 Standard of the United Nations Statistics Division.[4] In total, 196 countries have official United Nations membership and are also party to the United Nations Framework Convention on Climate Change. The available data have been put in a common structure for the United Nations member countries, regions and income groups to enable a consistent assessment. Income groups are based on the World Bank's classification of 2019.[5]

Economic calculations

The per capita and gross domestic product (GDP) calculations are based on the United Nations World Population Prospects 2019 and on World Bank GDP data using constant 2010 USD.[6]

Spatial and temporal scales

The geographic scale (global, national, city-level, etc.) as well as time scale (annual, monthly, daily) used in this report depends largely on the available dataset, as noted in the relevant figures and text. The detailed data forming the basis of the calculations and analysis are provided in the SLOCAT Transport Knowledge Base.[7]

Criteria for selection

The report covers policies, targets, emission reductions (achieved or envisioned) and market measures. To merit inclusion in the analysis, the policies, projects and trends must have been announced or completed between 2018 and 2020. Significant developments from January through May 2021 were included when deemed relevant, with the understanding that the next edition of the *Transport and Climate Change Global Status Report* will cover a period starting in 2021.

Pre- and post-COVID-19 pandemic trends

The year 2020 was pivotal for the world, and the COVID-19 pandemic has had substantial impacts on many of the transport trends monitored in this report. This edition attempts to differentiate between long-term trends and impacts due to the pandemic. To the extent possible, the analysis notes "pre-pandemic" (up to the end of 2019 or latest by February 2020) and "during pandemic" trends (starting in March 2020 until the end of 2020), as in some cases the pandemic led to reversals in long-term trends, at least for a specific period of time. In each section, a box describes the impacts that the pandemic has had on specific regions and sub-sectors.

Assembling the report

Global Strategy Team

This edition of the report was guided by a global strategy team consisting of 20 experts in the field who provided inputs over the span of six meetings between September 2019 and October 2020. Additionally, small group consultations were organised in February 2021, following the peer review process.

Authors and contributors

The report was collaboratively drafted by 22 authors and contributors from 16 organisations, led by the SLOCAT Secretariat. This includes additions and high-level inputs from the copy editor and from the special advisor who also co-authored the Executive Summary. Authors researched and compiled relevant facts and figures for the five sections of the report, including the Focus Features, with supporting review and inputs from several other organisations.

Peer review: A peer review process was carried out from 18 December 2020 to 20 January 2021 with 1,700 comments received from 74 reviewers. Each comment was individually reviewed by the SLOCAT Secretariat and considered in finalising the report.

National focal points: The report benefited from the contributions of voluntary national focal points, or experts from various regions and countries who have been essential to overcome language and information barriers. A public call for participation to provide information on policies and data resulted in several hundred initial registrations. Out of these registrations, 78 national focal points provided inputs through a first survey from 24 January to 3 February 2020; and through a second survey (focused on the country fact sheets) from 6 to 30 August 2020. All national focal points that contributed to the surveys are listed in the Acknowledgements.

Endnotes

3.9 Renewable Energy in Transport

1 Renewable Energy Policy Network for the 21st Century (REN21) (2020), *Renewables 2020 Global Status Report*, Paris, https://www.ren21.net/wp-content/uploads/2019/05/gsr_2020_full_report_en.pdf.

2 Plug-in hybrids differ from simple hybrid vehicles, as the latter use electric energy produced only by braking or through the vehicle's internal combustion engine. Therefore, only plug-in hybrid electric vehicles allow for the use of electricity from renewable sources. Although not an avenue for increased penetration of renewable electricity, hybrid vehicles contribute to reduced fuel demand and remain far more numerous than electric vehicles. Electro-fuels, also known as e-fuels, are synthetic fuels that do not chemically differ from conventional fuels such as diesel or petrol, generated in procedures known as Power-to-Liquids (PtL) and Power-to-Gas (PtG). Renewable electro-fuels are generated exclusively from electricity from renewable sources. Verband der Automobilindustrie (2017), "Synthetic fuels – power for the future", https://www.vda.de/en/topics/environment-and-climate/e-fuels/synthetic-fuels.html (accessed 1 May 2021); N. Aldag (2018), "Role for e-fuels in EU transport?" Sunfire, 12 January, https://www.transportenvironment.org/sites/te/files/Industry%20perspectives%20on%20the%20future%20development%20of%20electrofuels%2C%20Nils%20Aldag.pdf.

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Annex: Methodological Note

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