

BROWN TO GREEN

THE G20 TRANSITION TOWARDS A NET-ZERO EMISSIONS ECONOMY | 2019



ABOUT CLIMATE TRANSPARENCY AND THIS REPORT

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Our global partnership brings together experts from research organisations and NGOs in the majority of the G20 countries.

20
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Our mission is to encourage ambitious climate action in the G20 countries: we inform policy makers and stimulate national debate.

80
INDICATORS



Our Brown to Green Report is the world's most comprehensive annual review of G20 climate action: we provide concise and comparable information on mitigation, finance and vulnerability.

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The *Brown to Green 2019* consists of this summary report and an in-depth country profile for each G20 country. The country profiles and a technical note on data sources and methodology can be downloaded at:

www.climate-transparency.org/g20-climate-performance/g20report2019



ABOUT THIS REPORT



"The Brown to Green Report is instrumental in understanding, where Indonesia stands in comparison to other G20 countries and contributes to stimulating the national debate about climate change and necessary action."

Rachmat Witoelar

*President's Special Envoy for Climate Change,
former State Minister of Environment of
Indonesia*



"I am already living in this future that others fear. Decisions made today will primarily affect future generations. The climate crisis needs to be taken seriously. We all need to show more action and fight together against climate change. The Brown to Green Report shows how far G20 countries are away from what they owe our future."

Yola Mgogwana

*Young Climate Activist, African Climate Alliance,
Earthchild Project, South Africa*



“China as one of the leading global emitters has a particular responsibility and an interest in transitioning to a low-carbon economy as soon as possible. Experts from G20 countries, drafting together the Brown to Green Report, provide great insights about what have been and could be done, which as a result drives the national debate forward.”

Sze Ping Lo

CEO of WWF China



“Climate change needs a response from both businesses and policy-makers that goes hand in hand. This requires an ongoing dialogue to achieve a regulatory framework which enables rapid, predictable and socially-balanced emission reductions to transition to net-zero emissions by 2050. The Brown to Green Report reinforces this dialogue and knowledge transfer by assessing recent policy developments and key opportunities in each G20 country.”

Oliver Bäte

CEO of Allianz SE

EXECUTIVE SUMMARY

In 2018, global emissions grew once again signalling that ever stronger efforts to reduce emissions are required to arrest global warming at 1.5°C. This means that G20 countries will have to ratchet up their 2030 emissions targets in 2020 and significantly bolster mitigation, adaptation, and finance measures over the next decade. The 'Brown to Green Report 2019' takes stock of where the G20 countries stand in terms of 1.5°C benchmarks and highlights key opportunities to enhance climate action across sectors.

01 ADAPTATION

Currently, extreme weather events lead to around 16,000 deaths and economic losses of US\$ 142 billion in G20 countries every year. Although less developed countries are generally more affected than industrialised ones, several G20 countries are among the top 31 worldwide with the highest annual death rates per total population from extreme weather events.

Limiting global temperature increase to 1.5°C – rather than 3°C – reduces negative impacts across sectors in G20 countries by over 70%. For example, it cuts down the average drought length by 68% and the number of days above 35°C a year from 50 to 30. It also limits the growing season's shrinkage and the reduction of rainfall, as well as substantially diminishing the risk of the heat waves that ravage crops.

All G20 countries have adaptation plans with the exception of Saudi Arabia. Climate change adaptation is increasingly a seminal policy goal that is inscribed in national adaptation strategies.

02 MITIGATION

Economic growth and emissions have not been fully decoupled: G20 energy-related CO₂ emissions increased in 2018 by 1.8% because of high economic growth and an ever greater fossil fuel energy supply. This boosted sales of all fossil fuels with the gas industry profiting most. Energy supply rose most steeply in the US and Canada as a result of strong growth and weather conditions. The energy supply from fossil fuels grew in nine G20 countries – Australia, Canada, China, India, Indonesia, Russia, South Africa, South Korea, and the US – mainly due to increased fuel usage in transportation and higher electricity demand. The energy system's carbon intensity fell only slightly. 82% of the G20's energy mix is still fossil fuels. This must fall to at least 67% by 2030 and to 33% by 2050 globally to be 1.5°C compatible, and ultimately to much lower levels – and to substantially lower levels without CCS.

G20 countries need to cut their current greenhouse gas (GHG) emissions by at least 45% in 2030 (below 2010 levels) to be in line with global benchmarks set by the IPCC report on 1.5°C. They must reach net-zero emissions by 2070. Industrialised G20 countries must bring down GHG emissions to net zero a few years earlier than the rest of the world.

NATIONALLY DETERMINED CONTRIBUTIONS (NDCS) – 2030 EMISSIONS TARGETS:

About half of the G20 countries (China, the EU and its G20 member states, India, Indonesia, Russia, Saudi Arabia, Turkey) are projected to meet or surpass their NDC targets, excluding land use, land-use change, and forestry (LULUCF) emissions. Saudi Arabia's progress, however, is difficult to assess. In addition, Saudi Arabia's NDC target along with those of Russia and Turkey are very far from what is required to achieve the Paris Agreement's long-term temperature goal. Indonesia is not likely to meet its NDC if emissions from LULUCF are considered.

South Korea, Canada and Australia are the G20 countries furthest off track to implement their NDCs. Argentina, Brazil, Japan, Mexico, South Africa, and the US may also miss their NDC targets without additional action. To limit global warming to 1.5°C, all G20 countries would have to increase their NDC ambition. This report underscores that there is plenty of room to scale up climate action in the 2020 NDC update.

LONG-TERM STRATEGIES – 2050 EMISSIONS TARGETS:

There is an increasing drive that has built momentum around net-zero emissions targets. France and the UK have net-zero 2050 emissions goals that are enshrined in law. Germany has adopted a net-zero 2050 emissions target and will put it into law soon. Argentina, the EU, Italy and Mexico announced the adoption of such targets as well.

Canada, France, Germany, Japan, Mexico, the UK and the US have submitted their long-term strategies for 2050 to the United Nations Framework Convention on Climate Change (UNFCCC). Argentina, China, the EU, India, South Africa, South Korea and Russia are currently preparing strategies.

POWER: In 2018, emissions in the power sector, including electricity and heat production, increased by +1.6%, similar to the annual average of the last ten years. Indonesia and Turkey are burning more coal than ever for electricity – and their power emissions increased the most in 2018. South Africa continues to have the highest emission intensity in the G20. All three countries urgently need to develop coal phase-out plans and stop building more coal power plants. Coal phase-out plans – with 2030 dates for OECD countries and 2040 deadlines for rest of the world – are also imperative for Australia, India, Japan, Mexico, Russia, South Korea and the US, which have yet to take substantial measures to exit coal.

France, Brazil and the UK reduced emissions in their power sectors considerably in 2018. While France and the UK, next to Canada and Italy, have 1.5°C compatible coal phase-out plans, Brazil and Germany are the only G20 countries with long-term renewable energy strategies. All G20 countries need to have zero-carbon electricity in 2050 in order to slow global warming to 1.5°C.

TRANSPORT: Transport emissions of the G20 continued to increase in 2018 (+1.2%). To keep global warming below 1.5°C, the share of low-carbon fuels in the G20 transport fuel mix (6%) would need to increase roughly ten times by 2050. The US, Canada and Australia have the highest transport emissions per capita among the G20. The US, for example, has 24 times higher per capita emissions than India. All three countries maintain policies that are insufficient for a 1.5°C-compatible transport transformation. Australia in particular lacks any significant policy, such as emissions or fuel efficiency standards for light duty vehicles. Nor is it shifting towards public transport.

Canada, France, Japan and the UK show progressive long-term plans to phase out fossil fuel cars by 2040/2050. The commitments of these four countries are however still insufficient. A phase-out by 2035 is the latest date possible to be 1.5°C compatible. China sold over one million electric cars in 2018, almost doubling numbers from 2017. It also has the most progressive public transport policy in the G20.



G20 aviation emissions are increasing with Australia, the US and the UK having the highest flight emissions per person. Australia has 53 times higher per capita emissions from aviation than India. G20 countries need to reduce government subsidies, tax jet fuel, target a reduction of air transport, and invest in electro-fuels.

BUILDINGS: G20 emissions in the building sector grew more than in any other sector in 2018 (+4.1%), although on average emissions had stabilised over the last decade. The US, Australia and Saudi Arabia had the highest building emissions per capita in 2018. The three countries lack ambitious policies to substantially reduce emissions in the sector. They have building codes for new buildings but lack a national strategy for all new buildings to be near zero energy as well as for the retrofitting of existing buildings.

The European countries lead with 1.5°C compatible strategies for zero-energy new buildings. The EU, France and Germany are the only G20 members with long-term strategies for the retrofitting of buildings. To be 1.5°C compatible, even these countries would require deeper renovation rates of annually 5% a year, compared to non-OECD countries with a needed deep renovation rate of 3% by 2020.



INDUSTRY: The G20's increase in industrial emissions (+3.1%) in 2018 remains highly problematic. Emission intensity in the sector is highest in Russia, India and China partly because of a shift of heavy industry away from developed countries towards emerging and developing countries. At the same time, India and China are among the G20 countries with the most progressive energy efficiency policies. India's mandatory efficiency policies cover more than 26–50% of industrial energy use as of 2017, while China's and Japan's cover 51% to 100%. However, no G20 country has a long-term strategy in place to reduce industrial energy emissions by 75–90% from 2010 levels by 2050, which would be 1.5°C compatible.

AGRICULTURE & LAND USE: Less consumption of animal products will lower G20 emissions in agriculture. High deforestation rates in Argentina, Australia, Brazil and Indonesia must be cut. G20 GHG emissions from agriculture continue to climb. Livestock rearing is the main driver and accounts for 40% of agricultural emissions. The four rainforest countries of the G20 – Argentina, Australia, Brazil, Indonesia – need to develop a strategy for net-zero deforestation by the 2020s in order to be 1.5°C compatible. At the UN Climate Action Summit in September 2019, Argentina announced it would aim for net-zero deforestation by 2030. India, China and Mexico rank highest for their long-term deforestation policies. India is the only G20 country with 1.5°C compatible forest policies.





03 FINANCE

FINANCIAL POLICIES AND REGULATIONS: G20 economies lead in greening the financial system.

All G20 countries have started to discuss green financial principles, such as national green finance strategies, climate-related financial risks, and the taxonomy of green and brown investments. The G20 emerging economies lead however in the implementation of policies that reduce climate-related risks for the financial system as a whole. Brazil, France and South Africa have climate-related risk disclosure requirements for financial institutions, and Canada and Indonesia have voluntary and mandatory climate-related risk assessments, respectively. China, India and Japan set capital and liquidity requirements for financial institutions that favour green loans and investments.

FISCAL POLICY LEVERS: G20 countries, excluding Saudi Arabia,^a provided about US\$ 127 billion in subsidies to coal, oil and gas in 2017 compared to US\$ 248 billion in 2013. This downward trend can be seen in nine G20 countries: Argentina, Brazil, China, India, Indonesia, Italy, Japan, UK and the US.

While overall there has been a downward trend in subsidies to coal mining, subsidies to coal-fired power continue, and subsidies to natural gas infrastructure and production have increased in several countries. All G20 countries need to phase out fossil fuel subsidies by 2025 at the latest. European countries are already committed to a 2020 phase-out.

A total of 18 G20 countries have implemented or are in the process of implementing explicit carbon-pricing schemes such as emission trading systems (ETS) and carbon taxes. Newcomers are South Africa – which launched Africa's first carbon tax in June 2019 – and Argentina, which passed a carbon tax in 2018 for most liquid fuels (The size of Argentina's tax, however, is negligible.). Australia and India have no explicit carbon-pricing schemes and are not considering them.

In 2015, on average 71% of the CO₂ emissions from energy in the G20 were not priced at EUR 30 or higher through carbon taxes, specific taxes on energy use, or the price of tradable emission permits. The pricing gap for G20 countries increases to 78% when EUR 60 per tonne is the

benchmark. Russia, Indonesia, Brazil, China and South Africa have the highest carbon-pricing gap.

PUBLIC FINANCE: G20 public institutions financed coal and coal-fired power production internationally at US\$ 17 billion and domestically at US\$ 11 billion on average in 2016–2017. The biggest G20 overseas financiers are China, Japan and South Korea. China's public finance institutions have financed US\$ 9.5 billion per year on average in 2016 and 2017, while Japan's provided US\$ 5.1 billion and South Korea's US\$ 1 billion.

Brazil, Canada, China, Germany, the UK and the US's development agencies and banks restrict public spending for coal. Germany and the UK are the only two G20 countries that announced restrictions on coal financing in their role as shareholders of multilateral development banks (over and above the 2013 commitments of the World Bank Group, the European Investment Bank, and the European Bank for Reconstruction and Development to restrict coal-fired power finance).

G20 countries reported US\$ 31 billion in climate finance to developing countries in 2015–2016. Per GDP, Japan (total amount: US\$ 12 billion), France (US\$ 4 billion), the UK (US\$ 4 billion) and Germany (US\$ 4 billion) provided the highest amounts. While Japan, Germany and France remain the largest bilateral funders, the UK provides the highest amount through multilateral funds. Under its current administration, the US has not submitted a third biennial report to the UNFCCC, instead offering only provisional data for these statistics.



^a The information presented here is based on the bottom-up inventory approach and database of the OECD, which includes subsidies data for all G20 countries with the exception of Saudi Arabia.

INTRODUCTION

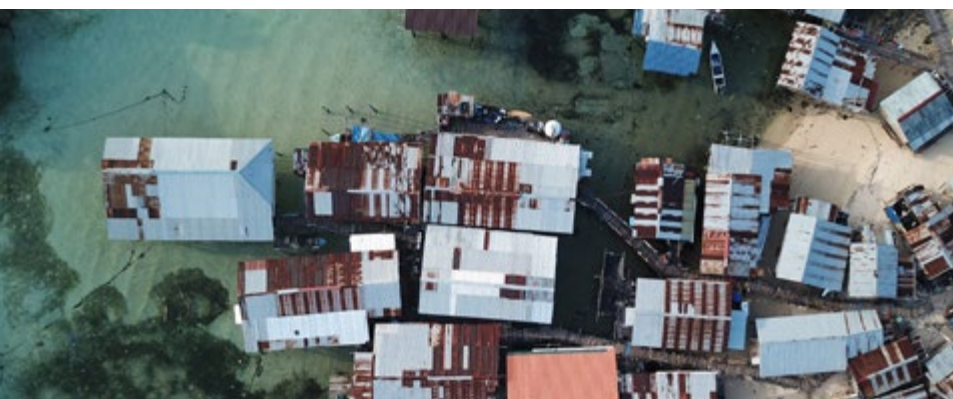
2020 is a vital year: higher ambition and quicker action is needed to respond to climate impacts.

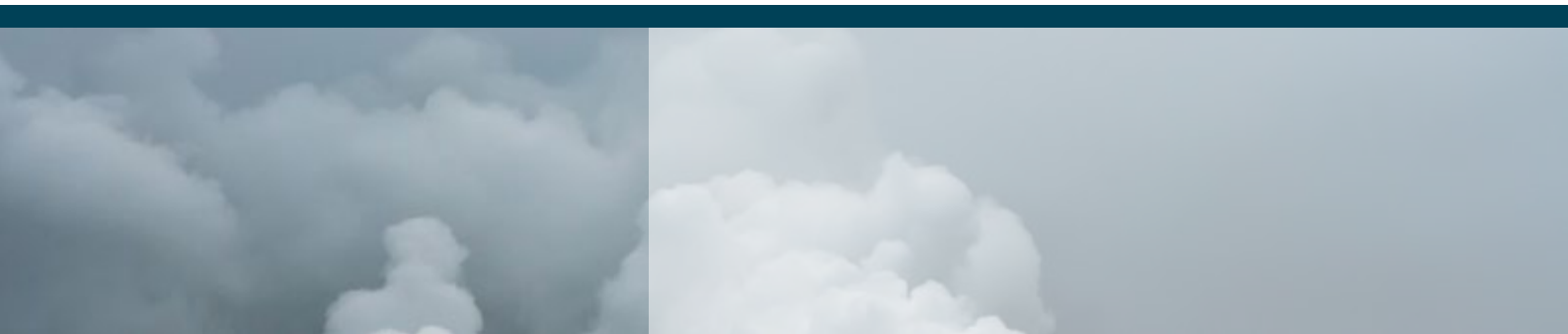
According to the IPCC Special Report on 1.5°C, global CO₂ emissions need to decrease to net zero by 2050 in order to keep global temperature rise below 1.5°C. If we continue at current emissions levels, the remaining carbon budget to stay below 1.5°C, namely 420 GtCO₂, will be expended in just over nine years.¹

Current NDCs would lead to about 3°C of global temperatures above pre-industrial levels by the end of the century and global GHG emissions continue to climb. At warming levels beyond 1.5°C, climate impacts will become stronger and there is a growing risk that critical tipping points will be crossed, at which point the Earth's system will experience major and largely irreversible changes. These tipping points will lead to the catastrophic rise of sea levels, as well as increased droughts and floods that put livelihoods at risk.²

2020 is the critical year to ramp up climate ambition. Countries must submit their updated NDCs with more ambitious emission-reduction targets as well as their long-term strategies (LTS). To keep the 1.5°C limit attainable, more ambitious 2030 targets through the NDCs and increased action in the next decade are crucial.

The UN Climate Action Summit in September 2019 marked the official start of a new wave of political momentum necessary to raise climate ambitions by 2020 in line with the Paris goals. Few G20 countries spoke with any specificity about enhancing their NDCs at the summit. President Ramaphosa of South Africa did not attend the summit, however he did commit his country to enhancing its mitigation NDC,³ along with 59 other countries, according to the incoming COP Presidency.⁴ A total of 66 countries, ten regions, 102 cities, 93 businesses, and 12 investors are working on a net-zero 2050 emissions goal. Some major G20 countries, however, have not yet signalled that they are ready to commit to a net-zero emissions future.





G20 countries have the political responsibility as well as economic interest and capability to limit global warming to 1.5°C.

G20 countries are responsible for approximately 80% of global GHG emissions. They account for 85% of the global GDP, two thirds of global outward foreign direct investment flows, and the majority of the funds of multilateral development banks. The decisions of G20 countries influence financial flows, technological innovation, lifestyle choices, and business models worldwide.

In a number of G20 countries, climate change is now seen as a top international threat (next to terrorism and cyberattacks)⁵ and popular support for climate action has grown strongly. For example, 92% of Europeans agree that GHG emissions should be reduced with the aim to make the EU economy climate neutral by 2050.⁶ G20 governments can also build upon the enhanced action of non-state actors such as companies, cities and societal organisations.

It is in the G20 countries' economic interest to act to prevent economic losses from climate impacts and stranded assets. More ambitious climate action improves health and yields economic gains of US\$ 26 trillion and 65 million more jobs worldwide by 2030.⁷

The Brown to Green Report takes stock of the climate actions of G20 countries in the context of 1.5°C benchmarks.

The report describes and compares G20 countries' performance in the areas of adaptation, mitigation and finance. It thereby complements the UN Global Stocktake that assesses collective action towards the Paris Agreement goals. Through the report's independent country comparisons, it enables peer pressure and learning across the G20 countries.

WHAT'S NEW IN THIS YEAR'S REPORT?

- As for the specific 1.5°C benchmarks, it shows where G20 countries need to go in sectors such as power and transport, and compares these benchmarks with where G20 countries currently are.
- Based on the diverse national circumstances, it points out concrete key opportunities how individual G20 countries could increase climate ambition and action.
- The report includes new indicators, such as more detailed policy assessments across mitigation sectors, an analysis of the impacts in single G20 countries, and their adaptation plans, as well as a comparison of policies and regulations to green the financial system in G20 countries.

A STOCKTAKE OF G20 CLIMATE ACTION

ADAPTATION



Cutting emissions drastically is essential to reduce the impacts of climate change. However, even with very ambitious climate-mitigation action, adaptation will be necessary as climate impacts are already felt across the world. While many of the worst impacts of climate change are endured by developing countries, G20 countries are also highly vulnerable. Different sectors will increasingly be exposed to higher levels of warming. This in turn increases the needs for, but also the costs of adaptation. The Global Commission on Adaptation found that every US dollar spent on adaptation today could result in two to ten dollars of net economic benefit by 2030.⁸

→ What climate impacts are G20 countries experiencing?

Extreme weather events lead to around 16,000 deaths and economic losses of US\$ 142 billion in G20 countries every year.

GHG emissions have already increased global temperatures to about 1°C above pre-industrial levels, according to the IPCC 1.5°C Special Report. Temperature rise is likely to reach 1.5°C between 2030 and 2052.⁹ Already now, global warming increases the number and intensity of extreme weather events, including storms, strong rains,

floods, fires, and heat waves; it raises sea levels, melts glaciers, and renders seas more acidic and warmer.¹⁰ These climate impacts threaten lives and livelihoods, for example, through food scarcity and loss of shelter, and negatively affect economic growth.

In G20 countries, about 16,000 people have died annually (on average between 1998 and 2017) as a direct result of extreme weather events alone.¹¹ Economic losses from extreme weather events amount to around US\$ 142 billion per year (in purchasing power parity).¹² Numbers would be even higher if other climate impacts, such as sea level rise and air pollution, were taken into account.






Although less developed countries are generally more affected than industrialised ones, several of the G20 industrialised countries are among the top 31 countries worldwide with the highest annual average death rates per total population from extreme weather events ranging from 475 to 2,944 deaths per year.^b






b 181 countries analysed by the Global Climate Risk Index based on data from the Munich Re NatCatService.



01

Five highest ranked G20 countries in terms of deaths and economic losses from extreme weather events

	Annual average deaths	Death per 100,000 inhabitants	Rank out of 181 countries
Russia 	2,944	2.04	9
France 	1,121	1.82	11
Italy 	1,005	1.71	12
Germany 	475	0.58	31
India 	3,661	0.32	48

	Annual average losses (US\$ mn PPP)	Losses per unit GDP (%)	Rank out of 181 countries
US 	48,659	0.35	49
China 	36,601	0.29	56
India 	12,823	0.26	59
Australia 	2,394	0.25	60
Mexico 	2,955	0.17	73

Annual average numbers (1998-2017)

Source: Germanwatch – Global Climate Risk Index 2019

→ What could happen in G20 countries with a temperature rise of 1.5°C, 2°C and 3°C?

Limiting global temperature increase to 1.5°C – instead of 3°C – would pre-empt much of the negative impacts across sectors in G20 countries.

If countries worldwide implement the 2030 emission targets in their NDCs, global mean temperature would increase to around 3°C by 2100.¹³ The exposure to negative climate impacts across all sectors will increase in all G20 countries when global temperatures rise from 1°C to 1.5°C – and even more should warming climb to 2°C or 3°C.¹⁴ In many sectors in the G20, over 70% of impacts can be avoided by limiting global warming to 1.5°C compared to 3°C.¹⁵

WATER



→ At 3°C warming, the area in G20 countries that will experience an increase in water scarcity is nearly five times as high as at 1.5°C (around 6% at 1.5°C rather than up to 29% at 3°C).

Two G20 countries, Brazil and Mexico, are highly or very highly exposed to water scarcity at 1.5°C, seven countries are at 2°C, and twelve countries at 3°C.

→ Limiting global temperature increases to 1.5°C instead of 3°C would reduce the average length of drought in G20 countries by 68%.

Five G20 members (Brazil, the EU, France, Italy, Turkey) are highly or very highly exposed to droughts at 1.5°C, nine countries are at 2°C, and eleven countries at 3°C.

HEAT & HEALTH



→ At 3°C warming, there is a 95% likelihood that any given year will include an extreme tropical heatwave for G20 countries. A 1.5°C warming will decrease this likelihood to 43%.

Two G20 countries, Brazil and Indonesia, are highly or very highly exposed to extreme tropical heat waves at 1.5°C, five countries are at 2°C, and 17 countries at 3°C.

→ On average, G20 countries would be exposed to about 50 days above 35°C per year at 3°C, which can be limited to about 30 days on average at 1.5°C.

Six G20 countries (Australia, Brazil, India, Mexico, Saudi Arabia, South Africa) are highly or very highly exposed to days above 35°C at 1.5°C, eight countries are at 2°C, and eleven countries at 3°C.

AGRICULTURE



→ Climate change is projected to shorten the growing season for certain crops by approximately 14 days under 3°C. At 1.5°C, the growing season would only be reduced by five days.

In one G20 country, Argentina, the growing season for soybean crops is highly or very highly reduced at 1.5°C. At 2°C, seven countries face a high or very high reduction growing season for maize, rice, soybeans, and wheat; this increases to 15 countries at 3°C.

→ The risk of ever more frequent hot spells is reduced by 66–79% at 1.5°C compared to 3°C; such hot spells can severely damage maize, rice, soybean and wheat.

Three G20 countries, India (rice, wheat), Japan (rice), and Saudi Arabia (wheat) are highly or very highly exposed to hot spells at 1.5°C, five countries are at 2°C, and nine countries at 3°C.

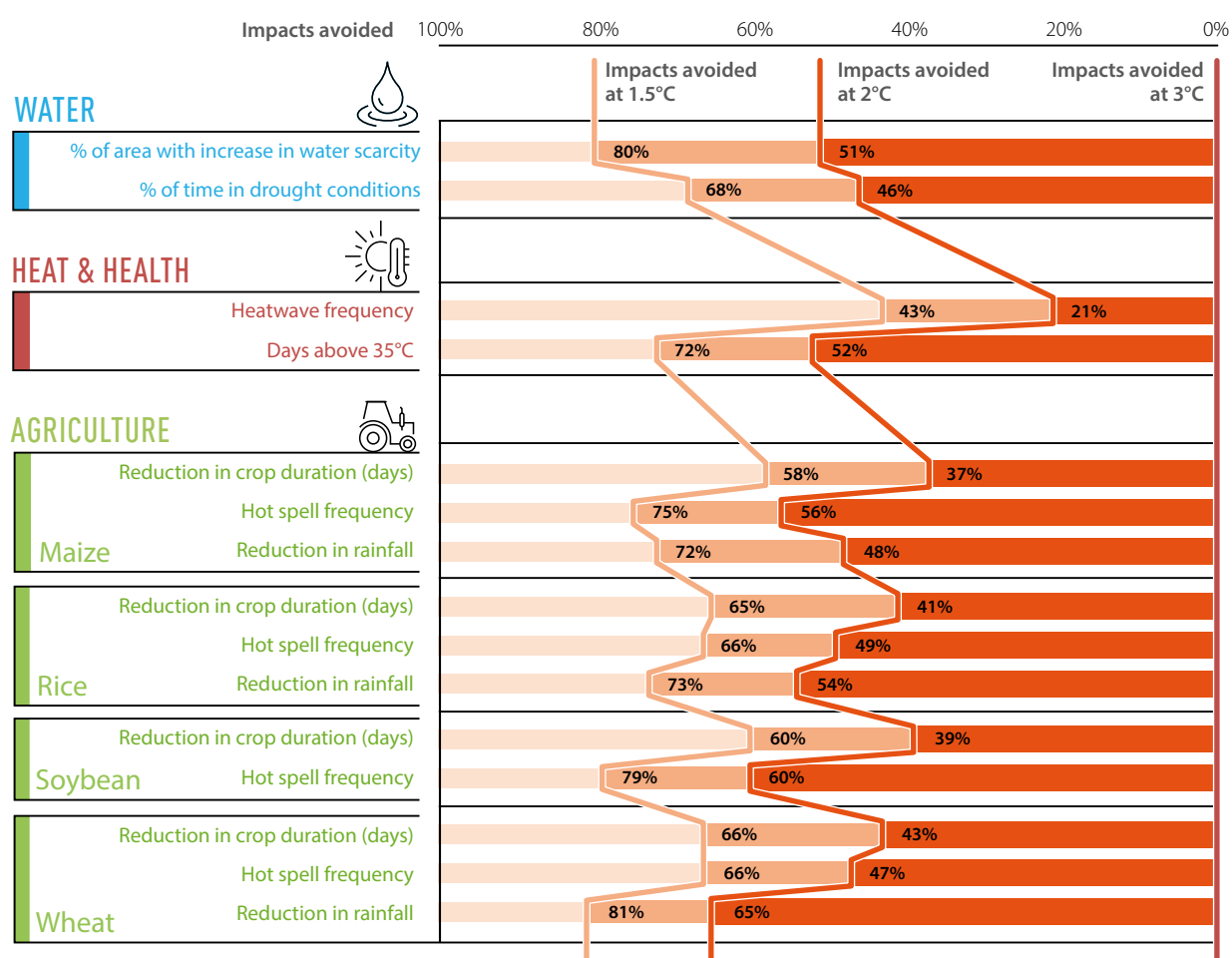
→ Climate change is projected to reduce growing season rainfall for certain crops by 14% under 3°C. At 1.5°C, growing season rainfall would be reduced by 12%.

Seven G20 countries are highly or very highly exposed to a reduction in rainfall at 1.5°C, seven countries are at 2°C, and eight countries are at 3°C. At 1.5°C, Brazil's soybean production is impacted to a high degree, as is wheat production in the EU, France, Germany, Italy, Russia and Turkey.

CLIMATE CHANGE



Avoided climate change impacts by keeping global warming below 1.5°C and 2°C compared to 3°C



Percentages of impacts avoided by keeping global warming below 1.5°C and 2°C relative to 3°C impact projections. Baseline values (100% of impacts avoided) correspond to the 1981–2010 mean, 0% of impacts avoided correspond to impacts at 3°C.

Source: own evaluation based on Arnell (2019)




→ What are G20 countries doing to adapt to climate change?

All G20 countries have adaptation plans with the exception of Saudi Arabia.

To reduce their high level of vulnerability to climate change, G20 countries should urgently increase adaptation measures. The Paris Agreement recognises adaptation as a critical component of the global response to climate change; the Katowice Climate Package rulebook articulates a clear mandate for all parties to undertake and document adaptation progress.¹⁶ Climate change adaptation is increasingly recognised as an important policy goal, and nearly all G20 countries have published a national adaptation strategy. Saudi Arabia is the exception. Russia is planning to publish its adaptation plan this year. Argentina is currently working on a national adaptation plan funded by the Green Climate Fund. Mexico is updating its national climate change strategy, which includes an adaptation component; it drafted an adaptation plan in 2019 that is not yet published. However, the existence of an adaptation strategy does not necessarily reflect its degree of implementation.¹⁷



National adaptation strategies of G20 countries

		Year	Agriculture	Biodiversity	Coastal areas & fishing	Education & research	Energy & industry	Finance & insurance	Forestry	Health	Infrastructure	Tourism	Transport	Urbanism	Water	M&E process
Argentina		<i>Adaptation plan under development</i>														
Australia		National Climate Resilience and Adaptation Strategy	2015	X	X	X		X		X	X	X		X	X	yes
Brazil		National Adaptation Plan to Climate Change	2016	X	X		X		X	X	X		X	X	X	yes
Canada		PAN-Canadian Framework on Clean Growth and Climate Change	2016			X	X			X	X					yes
China		National Strategy for Climate Change Adaptation	2013	X	X	X	X	X	X	X	X	X		X	X	yes
European Union		EU Strategy on Adaptation to Climate Change	2013	n/a												yes
France		Second National Adaptation Plan 2018-2022 (NAP-2)	2018	X	X	X	X		X	X	X	X	X		X	yes
Germany		German Strategy for Adaptation to Climate Change (DAS)	2008	X	X	X		X	X	X	X	X	X	X	X	n/a
India		National Action Plan on Climate Change	2008	X	X	X	X	X		X	X				X	n/a
Indonesia		National Action Plan for Climate Change Adaptation (RAN-API)	2014	X	X	X	X	X	X	X	X		X	X	X	yes
Italy		National Climate Change Adaptation Strategy	2015	X	X	X		X		X	X	X	X		X	yes
Japan		National Plan for Adaptation to the Impacts of Climate Change	2015	X		X	X	X	X	X	X	X	X	X	X	yes
Mexico		Mexico's National Strategy on Climate Change (ENCC)	2013	X	X	X	X	X		X	X	X			X	yes
Russia		<i>Adaptation plan to be published this year</i>														
Saudi Arabia		<i>No adaptation policy</i>														
South Africa		Draft National Climate Change Adaptation Strategy	2018	X	X	X	X	X	X	X	X	X	X		X	yes
South Korea		Korea's Adaptation Strategy to Climate Change	2011	X	X	X	X	X		X	X	X			X	yes
Turkey		Turkey's National Climate Change Adaptation Strategy and Action Plan	2012	X	X	X	X	X	X	X		X	X	X	X	n/a
United Kingdom		National Adaptation Programme and the Third Strategy for Climate Adaptation Reporting	2018	X	X	X	X	X	X	X		X	X	X	X	yes
United States		U.S. Environmental Protection Agency Climate Change Adaptation Plan	2014	X		X	X	X		X	X		X		X	yes

Source: Own evaluation

02

MITIGATION

GREENHOUSE GAS EMISSIONS:



→ Where do the G20 countries need to go?

**IPCC-based 1.5°C benchmark:**

- Global GHG emissions (including LULUCF) need to be 45% below 2010 levels by 2030 and reach net zero before 2070.
- Global total CO₂ emissions must be cut by 45% below 2010 levels by 2030 and reach net zero by 2050.

Source: Own evaluation based on IPCC 2018

GHG EMISSIONS: → Where are the G20 countries?

The G20 countries' current NDC targets would not result in an overall emission reduction in 2030, but rather to a slight increase. In 2030, emissions would then be more than twice as high as what is needed for 1.5°C.

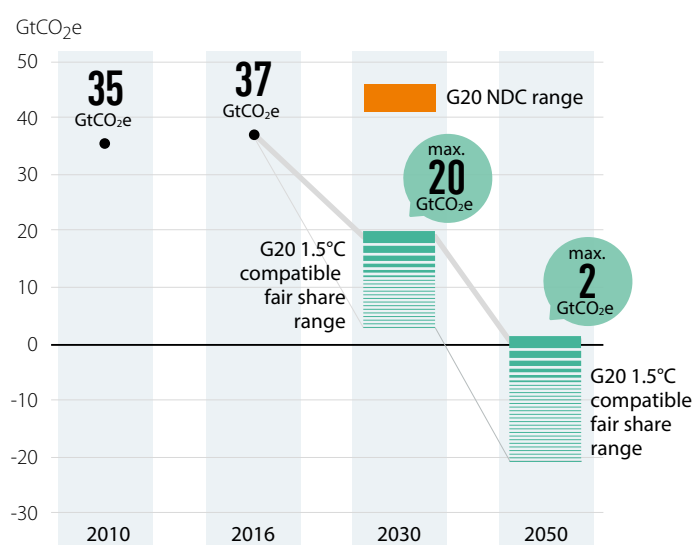
G20 countries together need to cut their GHG emissions by at least 45% in 2030 (below 2010 levels) and reach net zero by 2070 at the latest to be in line with the IPCC's 1.5°C global benchmarks. This covers total GHG emissions including LULUCF. The IPCC report's data show that OECD countries need to reach net zero a few years before the world as a whole.

Excluding LULUCF (due to country data inconsistencies and uncertainties), total GHG emissions of the G20 countries need to be at least 40% below 2010 levels in 2030 in order to hit global 1.5°C benchmarks derived from the IPCC report. Under a 'fair share' approach, allocated G20 GHG emissions excluding LULUCF would have to be even lower: at least 45% (below 2010) by 2030 and 95% by 2050. Considering the fair share benchmark, developed G20 countries have to reduce their emissions relatively more compared to the rest of the world and provide international climate finance so that developing countries can achieve their fair share of emission reductions.



NATIONALLY DETERMINED CONTRIBUTION

Gap between current G20 GHG emissions excluding LULUCF and 1.5°C compatible fair share 2030 and 2050 emission ranges



**Maximum and minimum values for G20 in aggregate were derived by simple addition of values for individual countries and EU28 (not adding individual EU28 countries). Under CAT methodology, an equity range for a group of countries would be calculated specifically, taking into account the relationships and circumstances of countries within that group. The 2030 NDC range includes the US's 2030 emissions projections based on current policies as the country only has a 2025 NDC target. The country has decided to withdraw from the Paris Agreement.*

Source: Own evaluation based on Climate Action Tracker 2019.

Nationally determined contributions

None of the G20 countries' NDCs are in line with limiting warming to 1.5°C. About half of the G20 countries are however projected to meet or overachieve their NDCs, which suggests plenty of room for increasing ambition in the 2020 NDC update.

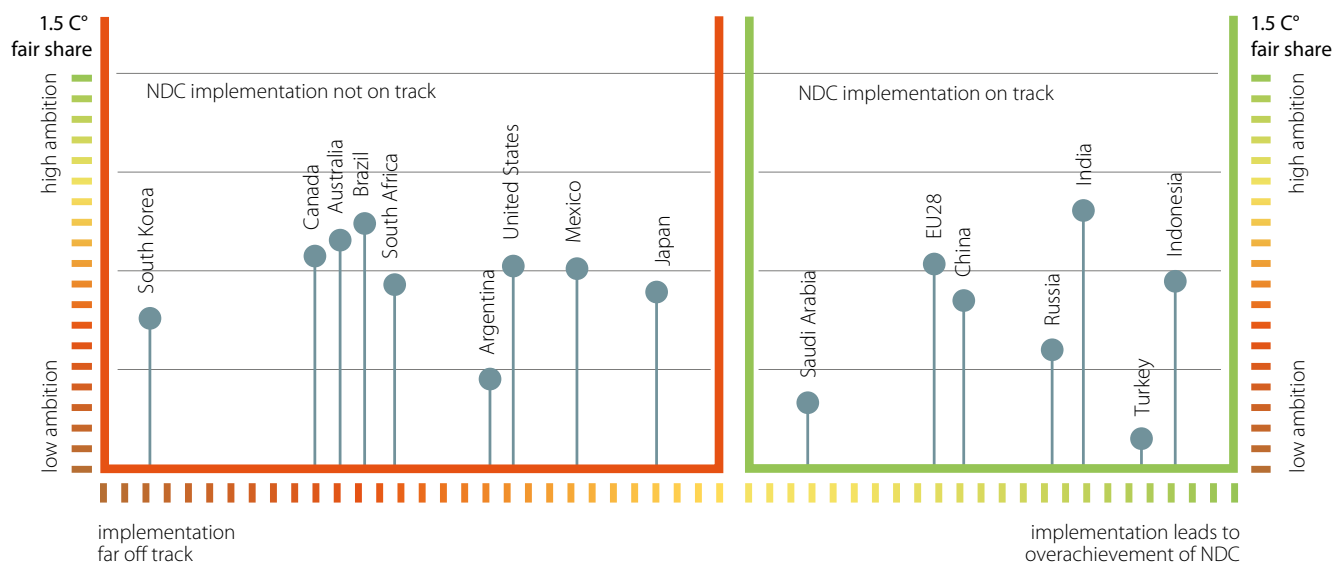
By 2020, countries are requested to communicate or update their 2015 NDCs to set new 2025 or 2030 targets. The 2020 NDC update is an opportunity to reflect major developments since 2015 in technology and cost reduction, for example for renewables and electric vehicles (EVs), and to build

upon the actions of non-state actors. Furthermore, more ambitious NDCs will avoid lock-in effects and increased transition costs, as well as seize opportunities for economic growth and synergies with the UN Sustainable Development Goals.

About half of the G20 countries (China, the EU and its G20 member states, India, Indonesia, Russia, Saudi Arabia, Turkey) are projected to meet or overachieve their NDCs (excluding LULUCF emissions).

However, Saudi Arabia's progress is difficult to assess. Indonesia is not likely to meet its NDC if LULUCF emissions are considered.


Ambition related to G20 countries' 1.5°C fair share ranges and current status of implementation




For comparability, Brazil's 2030 indicative NDC has been used. The US's NDC target is for 2025 only. This graph excludes LULUCF emissions due to data uncertainties, and for the purpose of comparability and consistency between countries. Taking LULUCF emissions into account, the rating in the graph changes for Indonesia. It is then likely to not be on track to implement its NDC, while it does not change for Argentina and Brazil.

Source: Own evaluation based on Climate Action Tracker 2019.

Among the G20 countries, India has the most ambitious NDC compared to its fair share of the global emissions budget in scenarios to limit warming to 1.5°C. However, it still needs to act now to prepare sectors for stringent emission reductions.

 A world leader in renewable energy investment, **India** is set to reach its NDC target of 40% of non-fossil energy generation capacity nearly a decade earlier than targeted.¹⁸ With a current trajectory of overachieving its NDC target, it thus has the opportunity to align with its 1.5°C fair share range, particularly if it continues to abandon planned coal-fired power plants in favour of cheaper renewable energy technology. India has to prove however that it is actually preparing for the deep transition required: namely by developing dense and energy-efficient cities, and building energy-efficient housing for the 80% of its built environment that will be constructed by 2030. Also, it must develop options to transition in particularly difficult sectors.

Turkey and Russia are likely, and Saudi Arabia could, meet or surpass their NDCs. However, together with Argentina, they have the least ambitious NDCs in the G20. Indonesia, the EU and China are on track to meet or surpass their NDC targets, and have room to improve their NDCs in a way that would enable them to contribute their fair share to a 1.5°C world.

 **Turkey** is likely to surpass its unambitious Intended National Determined Contribution based on current policy projections. The government's recent commitment to invest almost US\$ 11 billion in energy efficiency would even further reduce its projected emissions.¹⁹ Turkey is the only G20 country that has not ratified the Paris Agreement.



Saudi Arabia's plan "Vision 2030", released in 2016, includes a 9.5 GW renewable energy target by 2023 that will be updated over time, as well as the intention to phase out fossil fuel subsidies. However, the fossil fuel subsidy phase-out was slowed in 2017 in order to reduce economic effects.²⁰ These low-ambition policy developments are in line with Saudi Arabia's unambitious NDC. If Saudi Arabia follows through with its planned 200 GW solar project, it could overachieve its NDC, which suggests that the country has great scope for enhancing its NDC. However, as Saudi Arabia has not provided a baseline projection for its NDC and there is limited data to support current policy projections, progress is difficult to assess.



Russia's emissions continue rising until at least 2030 under current policy projections. Yet, the country is on track to meet its unambitious NDC, which uses 1990, the end of the Soviet era, as a base.²¹ Russia announced its ratification of the Paris Agreement at the UN Climate Action Summit in September. Recent draft legislation envisions a cap-and-trade system for major carbon emitters by 2025, which would facilitate the ratcheting up of Russia's climate policy goals.



Argentina's NDC is far from its fair contribution to limiting global warming to 1.5°C. Based on current policy projections, it is set to miss its NDC target. This is unlikely to change if LULUCF were considered.²² A current push from the Argentinian government to exploit domestic fossil fuel reserves threatens to stall progress on climate mitigation. The country recently announced a suite of energy policies and measures that would reduce its 2030 emissions by 11–17% compared to current policy projections. If implemented, the additional measures included under these scenarios would enable Argentina to meet its NDC target.



If **Indonesia** constructs approximately 27 GW of planned new coal-fired generation capacity by 2028, GHG emissions would roughly double by 2030 compared to 2013 levels (excl. LULUCF).²³ The continued expansion of coal-fired power generation will inhibit the country's ability to decarbonise and increase costs as the price of renewable energy continues to fall. When LULUCF emissions are taken into account,²⁴ Indonesia is unlikely to meet its NDC. Excluding LULUCF, Indonesia is likely to overachieve even on its conditional NDC target, which means there is considerable scope for increasing its NDC ambition in the energy sector.



China's emissions rose again in 2018 after levelling out between 2014 and 2016. Under its current policies, China's emissions are set to rise until at least 2030. An ambitious commitment to renewable energy growth could stabilise energy emissions in the next few years. China is on track to meet its NDC.²⁵



In 2018 and 2019, the **EU** adopted more ambitious renewable energy and energy efficiency targets and policies, as well as vehicle emission standards. Moreover, it has reformed its ETS. This significant increase in policy ambition will lead the EU to overachieve its NDC if fully implemented, and provides scope for a more ambitious NDC in 2020, which it is currently discussing.²⁶

- **France's** coal phase-out by 2021, an end date of 2040 for internal-combustion-vehicle sales, and the July 2019 adoption of 2050 carbon neutrality legislation are positive recent policy developments. Based on government projections, however, France will miss its national GHG emissions reduction target, which is in line with the overall EU target: 40% below 1990 levels by 2030.²⁷
- **Germany:** Stagnating emission reductions in the industry sector over the last decade and in the transport sector since 1990 are the key reasons that Germany is projected to miss its 2030 emissions target.²⁸ The government has recently adopted additional policies and draft legislation to achieve its 55% target, but needs to revise this target in order to align it with the Paris Agreement and with its long-term target of becoming GHG neutral by 2050.
- **Italy's** 2019 draft National Energy and Climate Plan outlines a planned share of gross final energy consumption from renewables of 30% by 2030. This includes roughly tripling its solar PV output from 2017 levels and more than doubling electricity from wind.²⁹ With the plan set to be finalised in December 2019, now is the ideal time for it to boost its climate commitments.
- The **UK** recently enshrined into law its aim to achieve net-zero GHG emissions by 2050. With legally binding emissions budgets every five years, significant progress has already been made on the decarbonisation of its energy system. It has decided to phase out coal by 2025 and the sale of internal-combustion-engine vehicles by 2040. Although there is significant recent policy momentum, the UK is not on track to meet its fourth carbon budget for 2023–2027.³⁰

South Korea, Canada and Australia are the G20 countries furthest off track in implementing their NDCs.



South Korea's 2017 Plan for Electricity Supply and Demand dictates a higher share of renewable energy generation, which would mean the country's emissions peak in 2020. Emissions reductions are projected to stagnate afterwards, however. New coal-fired power plants are still under consideration and would account for a third of generated electricity in 2030. South Korea is not on track to implement its NDC.³¹



In **Canada**, a coal phase-out strategy and recently introduced carbon price are significant positive developments. However, emissions projections still show that Canada is far from reaching its NDC.³²



Australia's emissions have been rising since 2015 – after carbon pricing was abolished. Current policy projections show Australia failing to achieve its NDC of a 26–28% reduction below 2005 levels.³³ The country intends to halve its abatement task 2021–2030 under the Paris Agreement by using Kyoto carry-over credits (emissions that could have been released under the Kyoto Protocol 2008–2020, but were not). There is no intention to establish a new renewable energy target for after 2020, and with the 2020 target already achieved, investments in renewable energy are already starting to fall. In the transport and industry sectors, where emissions are rising, the government has nearly no policies in place.

Brazil, Japan, Mexico, South Africa, and the US are projected to miss their NDC targets based on current policies. To limit global warming to 1.5°C, they all would have to increase their NDC targets that currently range in the middle of the G20 field.



Since the election of **Brazil's** President Jair Bolsonaro, 95% of the environment ministry's climate change budget has been cut. Brazil is currently not on track to meet its 2025 and indicative 2030 NDC targets. If LULUCF emissions (updated independent projections) were taken into account, the country would miss its NDC targets by an even bigger margin.³⁴ Progress in recent years on slowing the rate of deforestation has been reversed by the forest fires and land clearing that have dramatically increased since the 2018 election.



Japan's current plans to construct additional coal-fired power stations could mean that up to a third of its electricity is supplied by coal in 2030. The Basic Energy Plan adopted in July 2018 did not specify how to move beyond its renewable energy target of 22–24% by 2030, which is projected to be achieved with current policies.³⁵ Japan's current policy projection range shows that it might not meet its NDC.³⁶ This is unclear, however, due to uncertainties relating to developments in the energy sector.



Since the presidential elections in 2018, **Mexico** has taken a step backward on climate policy. It has prioritised funding for 'modernising' fossil fuel power plants, and in 2018 it cancelled a key renewable energy auction. Not only is it now doubtful that Mexico will meet its NDC target, but achievement of its clean energy targets of 30% and 35% by 2021 and 2024, respectively, has also been called into question.³⁷ However, some studies do find that Mexico may achieve its NDC.³⁸



South Africa's 2019 Integrated Resource Plan indicates a shift away from coal and an increased adoption of renewables. However, new coal capacity included in the draft plan threatens South Africa's ability to meet its NDC. The overall increase in its energy-policy objectives places South Africa on the cusp of meeting the upper range of its NDC.³⁹ A carbon tax came into effect in June 2019, but with 60–95% of emissions exempt until 2022, it is likely to have limited impact on emission reductions in the short term.



While the **US** has made considerable progress in recent years on renewable energy expansion and coal-fired power plant closures, President Trump's intention to withdraw from the Paris Agreement and recent rollbacks of existing climate policy have halted such progress. Emissions reductions are expected to stagnate until 2030, which would mean that the US would miss its 2025 NDC target.⁴⁰ There is, however, tremendous climate action happening on a sub-national level and by non-state actors that could bring the US within striking distance of its NDC commitment.

Long-term strategies and net-zero emissions by 2050

France has a net-zero 2050 carbon emissions target and the UK a net-zero 2050 GHG-emissions target, both enshrined in law. Germany has adopted a net-zero emissions target for 2050 and is in the process of putting this into law. Argentina, the EU, Italy and Mexico announced the adoption of a net-zero 2050 emissions target.

The Paris Agreement invites countries to submit their 'mid-century long-term low-GHG emissions development strategies,' or LTSs, by 2020. These long-term plans are crucial to inform short-term decisions. They are a benchmark of the countries' next round of NDCs – to be delivered in 2020. They also help avoid investments that are not in line with a zero-carbon, climate-resilient future. If combined with a broader development agenda, these strategies represent not only mitigation plans, but also tools for the modernisation and innovation of the economy and a just transition.

Australia, Brazil, Italy, Saudi Arabia and Turkey are the only G20 countries that have not submitted their LTSs to the UNFCCC and no information indicates that they are currently working on a strategy for 2020 or beyond. Australia had announced earlier, in 2017, the development of its LTS by 2020.

There is accelerating global momentum for net-zero emissions targets with countries, states, cities, companies and whole industries committing to act. These targets differ: some include only carbon emissions, others all GHG emissions across sectors, and some exclude the use of non-physical carbon sinks (no CCUS, just LULUCF natural absorptions).





















The G20 countries are however not the frontrunners in this movement. So far only France, the UK, Germany, the EU, Italy, Argentina and Mexico belong to the 70 countries worldwide that have committed to or discuss going net-zero by 2050 or before.⁴¹

- In September 2019, **France** adopted a law on carbon neutrality by 2050 (without using international carbon credits) including a 40% reduction in fossil fuel consumption by 2030.⁴²
- In June 2019, the **UK** government passed its net-zero emissions law (bringing all GHG emissions to net zero including the use of international carbon credits) putting 'clean growth at the heart of their modern industrial strategy'.⁴³ The target was recommended by the Committee on Climate Change, the UK's independent climate advisory body, and is monitored through the UK's five-year carbon budgets.
- **Germany** adopted a long-term strategy in 2016 with the objective of becoming 'largely greenhouse gas neutral' in 2050. In its draft climate-change law, it aims at GHG neutrality by 2050.
- In June 2019, four of the 28 **EU** states blocked the adoption of a common EU net-zero carbon emissions target. The issue will be taken up again in the European Council in late 2019. The EU plans to submit its LTS in 2020.
- **Argentina, Italy and Mexico** are currently discussing a 2050 zero-emissions target based on their announcement at the UN Climate Action Summit 2019.

LONG-TERM STRATEGIES



G20 long-term strategies and net-zero emissions targets by 2050

		Net-zero target	LTS	
Argentina		Under discussion	In preparation	Has established a participatory process for addressing energy and land use.
Australia		No action/information	No action/information	Announced in 2017 the intention to develop a strategy by 2020. No information on the process having started.
Brazil		No action/information	No action/information	The Brazilian Forum on Climate Change adopted a long-term strategy in 2018, and submitted it to former president Michel Temer in December 2018. The proposal was to completely decarbonise Brazilian economy by 2060. It is still unclear whether President Bolsonaro will follow up on this proposal.
Canada		No action/information	Submitted to UNFCCC	No 2050 target; exploring options for -80% from 1990 levels.
China		No action/information	In preparation	There are several research projects in China focusing on a mid-century strategy in which researchers and policy makers are involved.
European Union		Under discussion	In preparation, expected by 2020	The European Commission presented its long-term strategic climate vision in 2018, including a target of climate neutrality by 2050. The European Council is expected to decide on the target by the end of 2019 as the basis for development of the Long-Term Low Greenhouse Gas Emissions Development Strategy.
France		Enshrined in law	Submitted to UNFCCC	Adopted a law on carbon neutrality by 2050 (without using international carbon credits) including a 40% reduction in the consumption of fossil fuels by 2030.
Germany		In draft law	Submitted to UNFCCC	2050 target: 'largely greenhouse gas neutral'/-80 to -95% from 1990 levels (without LULUCF); net-zero GHG emissions target by 2050 in draft climate-change law.
India		No action/information	In preparation	No further information.
Indonesia		No action/information	No action/information	Three low-carbon development scenarios have been established to support the development of mid-term national development planning 2020–2024.
Italy		Under discussion	No action/information	No further information.
Japan		No action/information	Submitted to UNFCCC	80% reduction by 2050 (no base year provided), 'decarbonized society' as early as possible in the second half of this century.
Mexico		Under discussion	Submitted to UNFCCC	2050 target: -50% from 2000 levels; net-zero target under discussion.
Russia		No action/information	In preparation	No further information.
Saudi Arabia		No action/information	No action/information	No further information.
South Africa		No action/information	In preparation, expected by 2020	A draft of South Africa's Low-Emission Development Strategy 2050 was published in December 2018 and updated after a public consultation in 2019.
South Korea		No action/information	In preparation, expected by end 2020	Draft expected in late 2019.
Turkey		No action/information	No action/information	No further information.
United Kingdom		Enshrined in law	Submitted to UNFCCC	Enshrined its net-zero GHG emissions target by 2050 into law.
United States		No action/information	Submitted to UNFCCC	No 2050 target; exploring options for -80% or more below 2005 levels (strategy was submitted by previous administration but is not supported by the current one).

Source: Own evaluation

CO₂ EMISSIONS AND ENERGY SUPPLY:

→ Where do the G20 countries need to go?



IPCC-based 1.5°C benchmark:

- Global total CO₂ emissions must be cut by 45% (below 2010 levels) by 2030 and reach net zero by 2050. Global energy and process-related CO₂ emissions must be cut by 40% (below 2010 levels) by 2030 and reach net zero by 2060.
- The share of fossil fuels globally needs to fall to 67% of global total primary energy by 2030 and to 33% by 2050 and to substantially lower levels without CCS.

Source: Own evaluation based on IPCC 2018



CO₂ EMISSIONS AND ENERGY SUPPLY:

→ Where are the G20 countries?

Economic growth and emissions have not been fully decoupled: G20 energy-related CO₂ emissions further increased in 2018 as a result of high economic growth and associated growth in energy demand.

In 2018, G20 energy-related CO₂ emissions – the highest share of GHG emissions – grew by +1.8% compared to 2017. These include emissions from fossil fuel combustion: electricity, heating, industry, and transport. While the 2018 growth rate is slightly below that in 2017 (+2.2%), it is above the annual average of earlier years (+1.4%, 2005–2016). In G20 OECD countries, emissions had stabilised between 2005–2016, but this trend reversed in 2017 and 2018. In 2018, emissions grew by +0.2%. G20 non-OECD countries now account for 56% of G20 emissions. Their emissions keep increasing steadily (+3% in 2018). However, their CO₂ emissions per capita, despite increasing, are still significantly below those of G20 OECD countries.⁴⁴

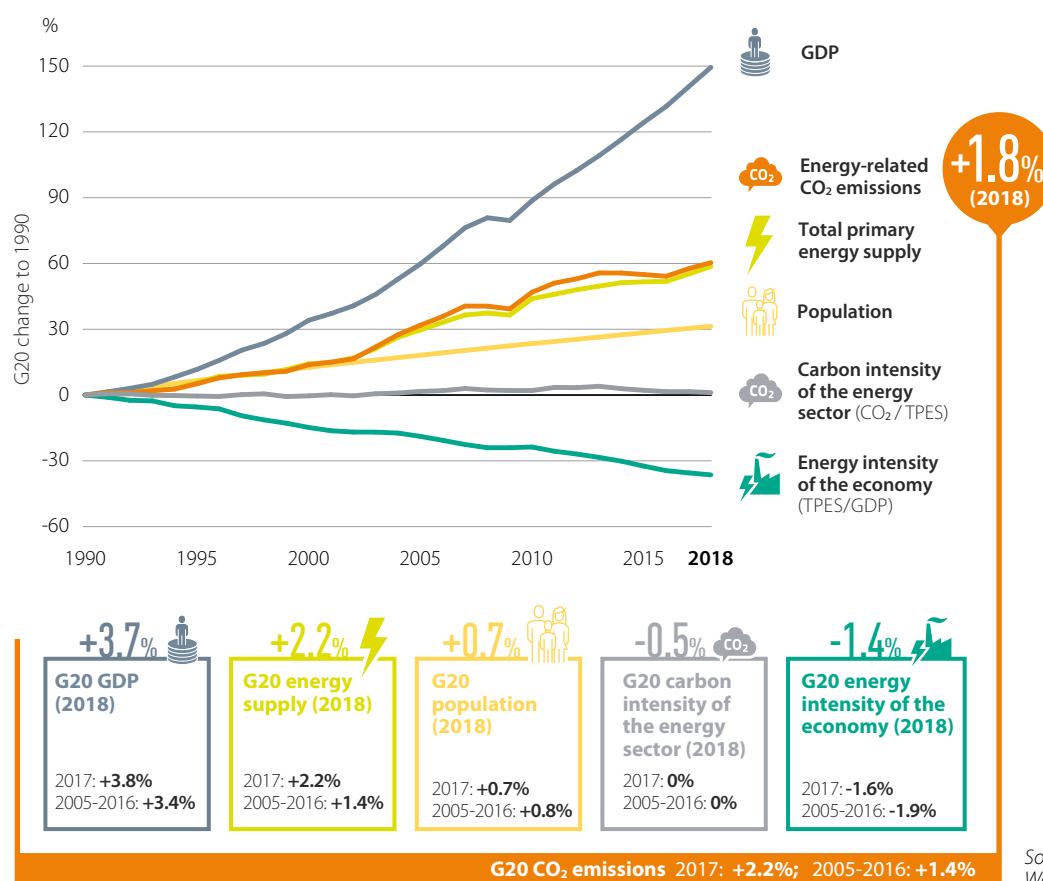
The main factors that explain rising CO₂ emissions in 2018 are high economic growth (+3.7%) in G20 countries, which have led to a new record of energy supplied (+2.2%).⁴⁵ The level of energy supply grew particularly in the US and Canada because of strong economic growth rates and changing weather conditions. Both countries experienced a cold winter and a hot summer, which increased the demand for heating and air conditioning. In contrast, Germany experienced a remarkable decrease in energy supply in 2018 (-3.5%) due to mild winter weather, increased fuel prices, and better energy efficiency.⁴⁶ A striking decrease of energy supply could also be observed in Mexico and Saudi Arabia, as well as in Argentina and Turkey, where this was mainly due to the latter two states' economic slowdowns.⁴⁷

Progress in the energy efficiency of G20 economies has slowed in 2018.

How much energy is supplied depends, among other things, on the efficiency of the economy – namely how much energy per unit of GDP is used. Energy efficiency is thus crucial as it will help to make the transition to a zero-carbon economy much easier. The energy efficiency of G20 countries has improved since 1990, although annual efficiency gains have recently slowed. In 2018, the energy intensity of the G20 economies decreased only by -1.4% compared to -1.6% in 2017, and -1.9% annually on average in 2005–2016.⁴⁸ Improvements in previous years were mainly driven by Asia, particularly China, as a result of efficiency improvements in coal plants and changes in the economic structure from heavy industry to services.⁴⁹ Innovation and more ambitious policy measures on energy efficiency are thus needed in the G20 to increase energy efficiency.



Main factors influencing the increase in G20 CO₂ emissions in 2018



Source: Enerdata 2019, World Bank 2019

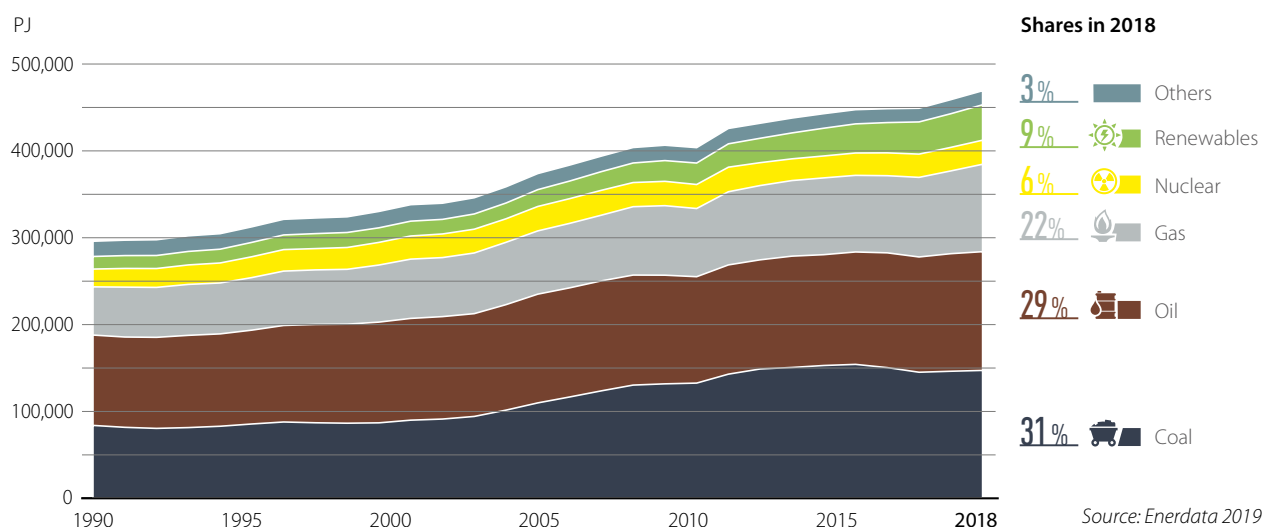
Energy is not getting cleaner: the need for greater energy supply in 2018 boosted all fossil fuels with gas in the lead. The carbon intensity of the energy system was only reduced slightly. 82% of the G20 energy mix comes from fossil fuels.

Growing motorisation across G20 countries led to a higher demand for oil (+1%) in 2018. Coal use grew by +0.7% mainly for electricity production, particularly in Argentina, China, India, Indonesia, Russia and Turkey.⁵⁰ Notably, gas supply increased dramatically in 2018 in the G20 (+5.7%), disproportionately high in China (+18%) and the US (+10%). China is pursuing a coal-to-gas and renewables transition, and the US has an abundant and cheap supply of natural gas. The US has the highest total energy supply from gas. Coal production and fracking led to strong atmospheric methane (CH₄) growth from 2014 to 2017. These unexpected increases in methane add to the greenhouse effect of burning fossil fuels.⁵¹

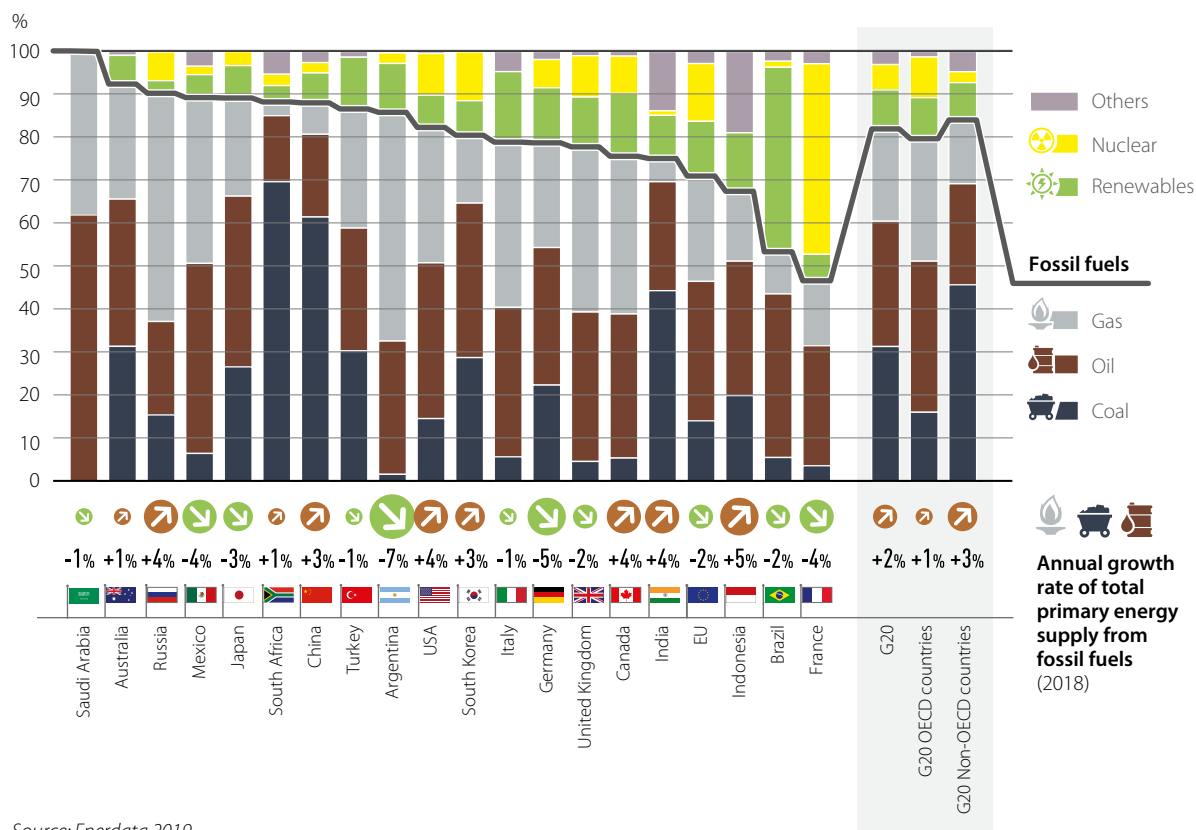
The total energy supply from renewables in the G20 grew strongly in 2018 (+5.3%), stronger than fossil fuels (+2%). Globally, the installation of new renewable energy capacity has however slowed after almost 20 years of strong annual growth.⁵² Moreover, the total supply of fossil fuels in 2018 increased in several G20 countries – Australia, Canada, China, India, Indonesia, Russia, South Africa, South Korea, and the US – mainly due to increased fuel usage for transport and higher electricity demand.⁵³ Consequently, the G20 countries' carbon intensity decreased by only -0.5% in 2018 – too slowly to reach the Paris Agreement goals. 82% of the G20 energy mix comes from fossil fuels. It needs to fall to 67% by 2030 and to 33% by 2050 globally.

To decarbonise the energy sector, however, it is not only crucial to decarbonise the energy supply and improve energy efficiency, but also to reduce overall energy demand in G20 countries.

G20 total primary energy supply



The energy mix in G20 countries, 2018



Source: Enerdata 2019

POWER SECTOR:



→ Where do the G20 countries need to go?



IPCC-based 1.5°C benchmark:

- Global electricity generation has to be decarbonised before 2050; renewable energy is the most promising option.

Further 1.5°C benchmarks:

- Unabated coal must be phased out in the EU/OECD no later than 2030, in the rest of the world no later than 2040. Total coal (incl. coal with CCS) has to be close to 0% of electricity generation by 2050.

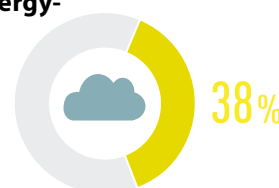
Source: Own evaluation based on IPCC 2018

+1.6%

G20 emissions from the power sector in 2018

2017: **+1.7%** | 2005-2016: **+1.5%**

Power sector's share of energy-related CO₂ emissions



POWER: → Where are the G20 countries?

Indonesia and Turkey's electricity emissions increased rapidly in 2018 as coal-generated electricity grew more than renewables. South Africa continues to have the highest emission intensity in the G20. None of these three countries has a plan to phase out coal or stop building coal capacity.

Electricity accounts for the highest share of G20 energy-related CO₂ emissions (38%) including heat from electricity production, which is partly used for district heating. In 2018, emissions in the power sector including heat from electricity production have increased by +1.6%, similar to the annual average of the last ten years.⁵⁴ In 2018, emissions increased the most in Indonesia (+6.8%) and Turkey (+6.2%). In both countries, the use of fossil fuels, and in particular coal, increased proportionally more in their electricity mix than renewables. Indonesia and Turkey are thus also the two G20 countries with the highest increases of emission intensity in the power sector over the last five years (2013–2018). South Africa is the G20 country with the highest intensity of emissions in its power sector with only a slight decrease of -2.8% in the last five years.⁵⁵ None of these three countries however has policies to phase out coal (low policy rating) or, despite the existence of some support schemes, any long-term strategies to expand renewables (medium policy rating).

- **Indonesia** intends to install 6 GW of coal-fired power generation by 2020 and 27.1 GW by 2028, doubling coal capacity by 2028. Furthermore, the coal industry is heavily subsidised both directly (loan guarantees, tax exemptions, royalties, tax rates) and indirectly (the price of domestic

coal for power stations is capped at US\$ 70 per ton). Indonesia has a feed-in tariff, but it is not attractive enough for investments in renewables. Yet, the country is not considering a coal phase-out.⁵⁶

- **Turkey** aims to increase its installed coal-fired power capacity to 30 GW by 2023 from a current capacity of around 20 GW. In May 2019, the Ministry of Energy and Natural Resources announced the sale of 500 coal mines to potential investors in public tenders. Turkey aims to increase the share of renewables to 38% of total installed capacity by 2023, but has no long-term strategy for renewable energy. The production of renewable energy is mostly promoted through a feed-in tariff, pre-license tenders, and capacity auctions.⁵⁷

- **South Africa** does not have a coal phase-out policy. The 2019 Integrated Resource Plan includes investment in 1,500 MW of new coal plants before 2030. South Africa's current coal fleet would then mainly retire in the 2030s and 2040s, with several plants remaining operational in 2050. The 2019 plan also proposes an expansion of renewable energy capacity from 3,800 MW (excluding large hydro) to a total of 26,700 MW (plus a projected 6,000 MW in distributed PV) in 2030. However, no new renewable energy has been procured since 2015, and there is no 2050 renewables target.⁵⁸

In addition to Indonesia, Turkey, and South Africa, a coal phase-out plan is also needed in Australia, India, Japan, Mexico, Russia, South Korea and the US, which currently lack any action to reduce coal (hence receiving a low policy rating on their coal transitions).

France, Brazil and the UK reduced emissions in the power sector considerably in 2018. While France and the UK, next to Canada and Italy, have a 1.5°C compatible coal phase-out plan, Brazil together with Germany are the only G20 countries with long-term renewable energy strategies.

In 2018, France (-25.7%), Brazil (-13.6%), and the UK (-10.4%) had the G20's highest emission reductions in the power sector. Phasing out fossil fuels from their electricity mix, they are also the G20 countries with the highest reductions in emission intensity in the power sector between 2013 and 2018, next to China and the US.⁵⁹

→ In the G20, **France** has the lowest power emissions, including heat from electricity production, due to the abundant supply of French nuclear and hydropower generation.⁶⁰ Emissions dropped even further in 2018 as nuclear increased by +3.7% in the French power mix in 2018, proportionally higher than other electricity sources.⁶¹

France's energy and climate bill sets an emissions cap (550g CO₂/kWh) for existing fossil fuel-based power plants. It provides a basis to shut down France's remaining four coal-fired power plants by 2022 (frontrunner coal policy rating).⁶²

→ In **Brazil**, renewables growth increased at a higher pace than other energy sources in 2018.⁶³ Brazil already has a high share of hydropower and aims to increase the share of other renewables to 23% by 2030. The latest Ten-Year Energy Expansion Plan envisages an installed capacity of 8.64 GW of solar and 26.67 GW of wind by 2027, which the government supports through auctions. The government plans to publish a 2050 energy plan by the end of 2019.⁶⁴ It is thus the only G20 country next to Germany that has a long-term renewable energy vision (high renewables policy rating).

→ In the **UK**, emissions in the power sector decreased in 2018 due to lower non-electric energy use in the industrial and residential sectors, and a shift away from coal towards renewables.⁶⁵ Pollution laws, carbon taxes, and a 2015 commitment to phase out coal by 2025 led to the closure of ageing coal plants in the UK, with three major plants shut down in 2016 alone.⁶⁶ Together with Canada, it launched the Powering Past Coal Alliance in 2017 (frontrunner coal policy rating). The UK has no long-term strategy beyond 2020 for renewable energy (medium renewable policy rating). The Contract for Difference auction system supports the deployment of largescale renewables and

in 2019 the government committed to subsidise offshore wind to provide as much as 30% of the UK's electricity by 2030. Support is no longer provided for new solar PV or onshore wind projects under this system and the latter continue to face a de facto ban in England.⁶⁷

→ **China** reduced its emission intensity in the power sector substantially between 2013–2018 through an increase in renewables, nuclear and hydro. Concerns about air pollution and its health effects motivated this shift, which was supported by a carbon cap-and-trade scheme including more than 1,700 companies in the power sector (medium coal and renewable policy rating).⁶⁸

→ In the **US**, the coal industry is in decline despite support from the federal government. Lower costs and abundant natural gas and renewable energy, as well as regulations designed to reduce emissions and protect public health – such as requirements to install pollution controls – have driven the decline. This has led several coal companies to declare bankruptcy, including four industry giants between 2015 and 2018.⁶⁹

The US has no 2050 target for renewable energy and the 2019 Affordable Clean Energy rule, which repealed Obama's Clean Power Plan, does not include specific emissions-reduction targets in the power sector for states. Federal clean energy tax credits and state-level support policies are in place (low renewables policy rating).⁷⁰



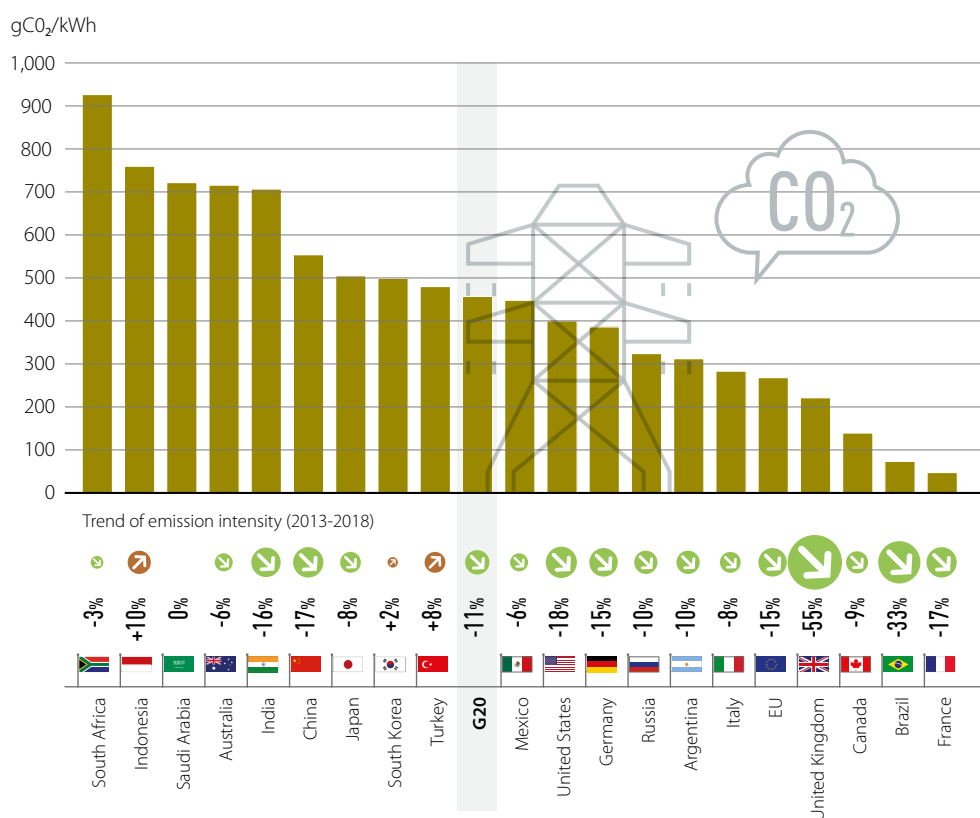
Several G20 countries address the social consequences of a transition in the power sector. In 2019, Canada, Germany and South Africa made progress on the development of just transition plans for coal workers and regions.

A coal phase-out can have implications for workers, communities, enterprises, and lower-income households, depending on the importance of coal for the national and regional economies. Several measures could ensure a just transition for the workforce, such as retraining or the development of new green jobs.⁷¹

Moreover, phasing out subsidies and establishing carbon pricing can lead to higher energy prices. Subsidy reforms and carbon pricing can be complemented by compensation for lower-income households. Revenues generated from carbon pricing and phasing out fossil fuel subsidies can support public goods such as energy access, health, education, and sustainable infrastructure.⁷²

In various G20 countries, the debate on just transition has begun with the engagement of trade unions and affected regions. There are national and regional government initiatives in Australia, Canada, China, the EU, France, Germany, Indonesia, South Africa and the US.

Emission intensity of the power sector in the G20, 2018



Source: Enerdata 2019

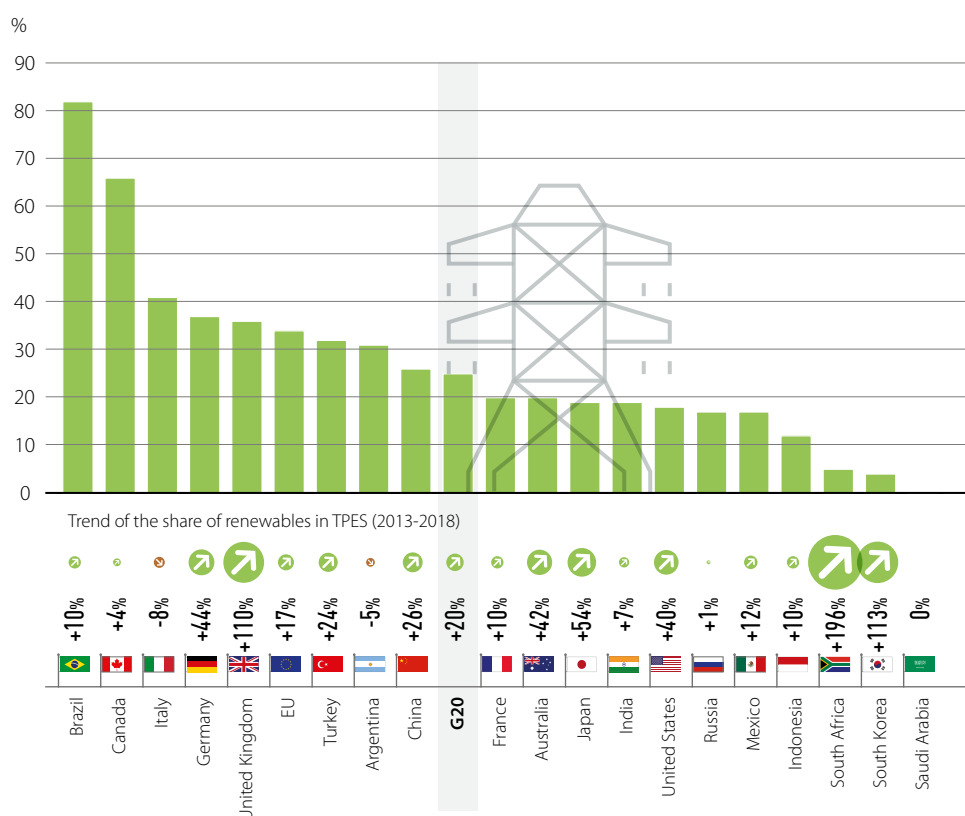
→ In January 2019, **Germany's** multi-stakeholder Commission on Growth, Structural Change and Employment recommended a coal phase-out by 2038 at the latest, and the allocation of EUR 40 billion to coal-intensive states for structural changes, and alternatives and compensation for affected workers. The recommendations have been approved by the government and legislative processes will be finalised by year's end.⁷³

→ **Canada's** Just Transition Task Force published its report in March 2019 with recommendations for a just transition plan for coal workers and communities.⁷⁴

→ A social dialogue process to reach pathways for a just transition has been started by **South Africa's** National Planning Commission. A series of multi-stakeholder dialogues has resulted in the identification of key priorities, including analysis of the employment vulnerabilities of affected workers, and the identification of pilot 'hotspots' for intervention, such as closing mines and power plants.⁷⁵








Share of renewables in power generation (incl. large hydro) in the G20, 2018








Source: Enerdata 2019



Power sector: Policy rating

	 low	 medium	 high	 frontrunner
	No policy to increase the share of renewables	Some policies	Policies and longer-term strategy/target to significantly increase the share of renewables	Short-term policies + long-term strategy for 100% renewables in the power sector by 2050 in place
Renewable energy in power sector	Australia Canada Mexico US	Argentina China EU France India Indonesia Italy Japan Russia Saudi Arabia South Africa South Korea Turkey UK	Brazil Germany	

	 low	 medium	 high	 frontrunner
	No target or policy in place for reducing coal	Some policies	Policies + coal phase-out decided	Policies + coal phase-out date before 2030 (OECD and EU28) or 2040 (rest of the world)
Coal phase-out in power sector	Australia India Indonesia Japan Mexico Russia South Africa South Korea Turkey US	Brazil China EU	Germany	Canada France Italy UK

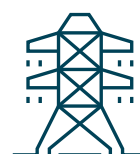
Source: Own evaluation

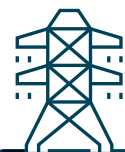
POWER: → How can the G20 countries get to a 1.5°C world?

The key opportunities for G20 countries to limit global warming to 1.5°C in the power sector are:

→ **G20 OECD countries need to phase out coal-fired electricity generation no later than 2030 and G20 non-OECD countries no later than 2040.** Brazil, China, the EU and Germany have policies to reduce coal, but should plan for a 1.5°C compatible phase-out (in Germany, the 2038 end date for coal is not 1.5°C compatible). Australia, India, Indonesia, Japan, Mexico, Russia, South Africa, South Korea, Turkey and the US need to urgently start with substantial policies to reduce coal use and ensure no further investments in new coal capacities, while at the same time developing a phase-out plan.

→ **G20 countries need to have 100% zero-carbon electricity in 2050**, ideally through renewables that have fewer environmental and human rights issues than nuclear and hydro. To reach this target, Argentina, China, the EU, France, India, Indonesia, Italy, Japan, Russia, Saudi Arabia, South Africa, South Korea, Turkey and the UK have to develop long-term strategies to build up and improve their national incentive schemes. Australia, Canada, Mexico and the US need to urgently introduce incentive schemes, targets, and roadmaps, as well as other policy frameworks to accelerate renewable investments and phase out fossil fuel subsidies.





What are the incentives and benefits?

Improving public health:

- Coal is a major – and often the leading – contributor to air pollution. Coal burning is responsible for more than 800,000 premature deaths a year globally and many millions of cases of serious and minor illness. This also has economic implications, such as increased healthcare costs and a higher number of lost working days.⁷⁶

Reducing costs and using economic growth opportunities:

- Renewable energy has rapidly emerged as the lowest cost option of new power generation in almost all countries around the world, rendering coal increasingly unattractive. And this is without taking into account the environmental and health costs of fossil fuels.⁷⁷
- Batteries are increasingly cost-effective (costs have decreased by 79% since 2010) which makes EV prices more competitive.⁷⁸

Preventing stranded assets:

- Economic shifts and policy changes may turn fossil fuel infrastructure into stranded assets. For example, in India 40 GW of coal-fired power capacity that has been commissioned or is under construction is already 'stressed'.⁷⁹ If China implements its NDC, there could be stranded assets of US\$ 90 billion from coal power plants by 2030.⁸⁰

Gaining energy independence and maximising fiscal benefits:

- Reducing fossil fuel imports fosters energy independence, improves balance of payments, and can reduce geopolitical tensions.

Increasing energy access

- Off-grid renewables enable increased energy access in developing and emerging markets.



TRANSPORT SECTOR:



→ Where do the G20 countries need to go?



IPCC-based 1.5°C benchmark:

→ Globally, the share of low-carbon fuels in the transport fuel mix must increase to about 60% by 2050.

Further 1.5°C benchmarks:

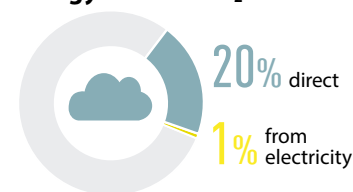
- The last internal-combustion-engine vehicle should be sold in 2035, worldwide.
- Globally, freight trucks need to be almost fully decarbonised by around 2050.

Source: Own evaluation based on IPCC 2018, Climate Action Tracker 2016

+1.2% G20 emissions in the transport sector in 2018

2017: **+1.4%** | 2005-2016: **+1.4%**

Transport sector's share of energy-related CO₂ emissions



TRANSPORT: → Where are the G20 countries?

The transport emissions of the G20 continued to increase in 2018 (+1.2%). To keep global warming below 1.5°C, the share of low-carbon fuels in the G20 transport fuel mix (6%) would need to increase roughly ten times by 2050.

Transport accounts for 20% of the G20 energy-related CO₂ emissions. Emissions in the sector have continued to increase rapidly over the last ten years. In 2018, G20 transport emissions grew by +1.2% (compared to +1.4% in 2017 and +1.4% on average annually between 2005 and 2016).⁸¹ Several factors explain the continuous growth trend: increased economic development and global trade have increased passenger and freight transport. People continue to purchase larger and heavier vehicles in the US and increasingly in Asia and Europe⁸² – globally 36% of cars sold in 2018 were SUVs compared to 33.8% in 2017.⁸³ This cancels out the fuel efficiency gains from new cars.

The G20 final energy consumption of transport has nearly doubled between 1990 and 2018.⁸⁴ This demand is largely fed by oil.⁸⁵ In 2018, 92.3% of the G20's transport energy mix came from oil. In contrast, the share of low-carbon fuels – biofuels and electricity – accounted for only 6%.⁸⁶ This small low-carbon share would need to increase to about 60% globally in 2050 to limit temperatures to 1.5°C.⁸⁷

China and India, which had the highest economic growth rates in 2018, also have the highest growth rates in total transport emissions: +5.4% and +4.7% respectively. Their per capita emissions in the sector have risen the most in the G20 between 2013–2018: by 20% and 28% respectively (with the

highest growth seen in Turkey: 38%).⁸⁸ Their 2018 level is however significantly below the G20 average because fewer people in those countries own cars.

The US, Canada and Australia have the highest transport emissions per capita in the G20. Australia does not have emissions or fuel efficiency standards for light vehicles, let alone for heavy duty vehicles (HDVs).

To stay within the 1.5°C limit, G20 countries need to develop ambitious long-term plans to: 1) ban sales of fossil fuel-based cars by 2035; 2) phase out emissions from HDVs (freight sector); and 3) enable a modal shift to non-motorised mobility (walking and cycling), and shared and public transport for passengers and freight.

The US, Canada and Australia are the largest emitters per capita in the transport sector (excluding aviation emissions). For example, US per capita emissions are 24 times higher than those in India. None of these countries' policies are sufficient for a 1.5°C compatible transport transformation, with Australia, in particular, lacking significant policy.

→ The **US** has the highest total and per capita emissions in the G20, both with an upward trend. The US has no substantial national policy to reduce emissions from cars (medium policy rating). In August 2018, the government proposed freezing Obama-era fuel efficiency rules instead of raising them each year between 2020 and 2026; it is currently working on a revised plan.⁸⁹ There are national tax credits for EVs, but 24 states have imposed special EV fees in the form of higher annual registration costs.⁹⁰ While the US has no long-term strategy for reducing emissions from freight transport or shifting to

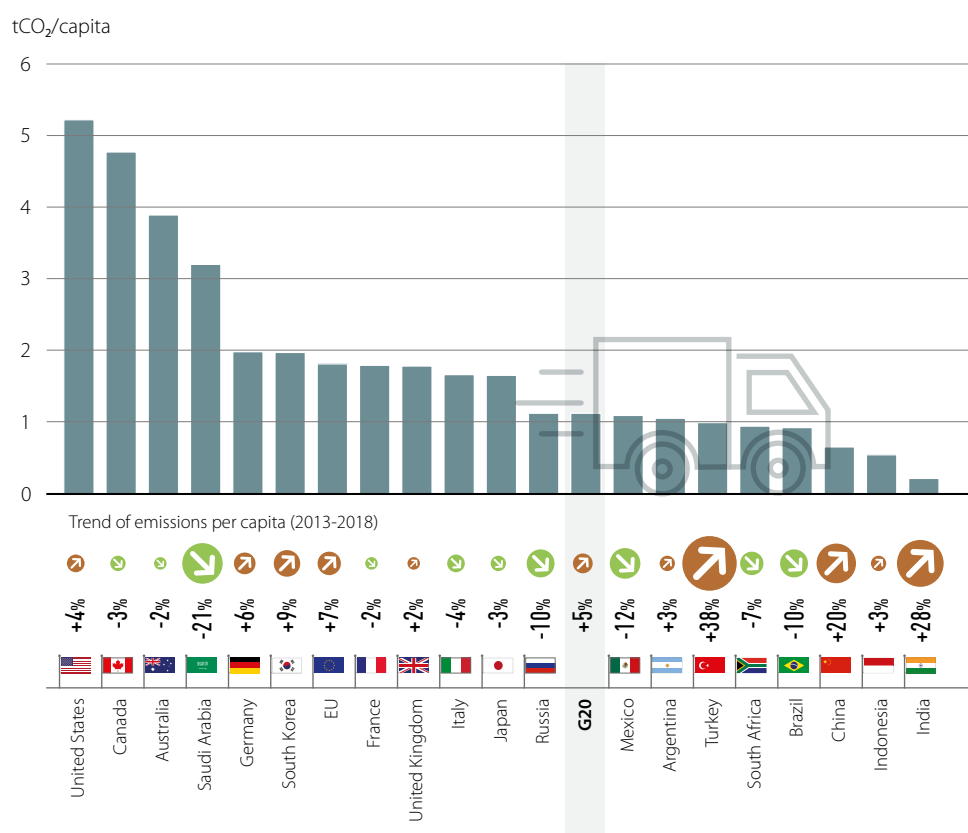
public transport, energy efficiency standards for HDVs and public transport programmes exist (medium policy rating). However, the president's budget proposal for 2020 would eliminate federal funding for Amtrak long-distance trains.

→ **Canada's** total transport emissions increased by +2% in 2018, higher than the average growth rate in the G20. It has the second highest per capita emissions (4.8 tCO₂) in the G20. This might change with its new Zero-Emission Vehicle (ZEV) Infrastructure Program, which aims at 100% of sales by 2040 (100% by 2025 would be 1.5°C compatible), and is supported by a federal purchase incentive (high policy rating).⁹¹ Canada still lacks a long-term strategy for reducing the emissions of trucks

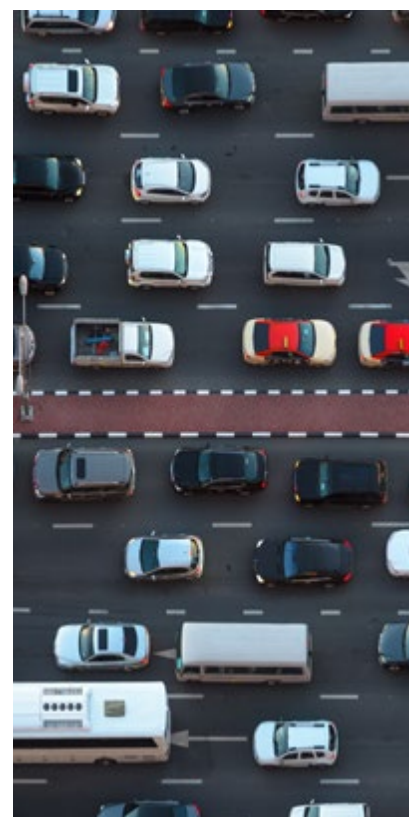
(though it has emission standards for HDVs) or shifting towards public transport (medium policy rating).

→ **Australia** has the third highest transport emissions per capita in the G20 and its total transport emissions are still growing. It is also one of the two G20 countries (alongside Russia) that have no policies regarding: 1) the shift away from fossil fuel cars; 2) the decarbonisation of HDVs; and 3) modal shift in (ground) transport. In particular, Australia has no emissions or fuel efficiency standards for light duty vehicles (LDV), despite the fact that nearly 80% of light duty vehicles globally are subject to some standard. Australia still has no strategy or policy for zero emissions vehicles.
















Transport emissions per capita (excluding aviation) in the G20, 2018



Source: Enerdata 2019, World Bank 2019



Transport sector: Policy rating

	 low	 medium	 high	 frontrunner
	No policy for reducing emissions from light duty vehicles	Some policies such as energy/emissions performance standards or bonus/malus support	Policies + national target to phase out fossil fuel LDVs	Policies + Ban on new fossil-based LDVs by 2035
Phase-out of fossil fuel cars	Australia Indonesia Russia	Argentina Brazil China EU Germany India Italy	Mexico Saudi Arabia South Africa South Korea Turkey US	Canada France Japan UK
	 low	 medium	 high	 frontrunner
	No policy	Some policies such as energy/emissions performance standards or support	Policies + strategy to reduce absolute emissions from freight transport	Policies + innovation strategy to phase-out emissions from freight transport by 2050
Decarbonise heavy duty vehicles	Australia Indonesia Mexico Russia Saudi Arabia South Africa Turkey	Argentina Brazil Canada China EU France Germany	India Italy Japan South Korea UK US	
	 low	 medium	 high	 frontrunner
	No policy	Some policies such as support programmes to shift to rail or non-motorised transport)	Policies + longer-term strategy	Policies + longer-term strategy consistent with 1.5°C pathway
Modal shift in (ground) transport	Australia Russia	Argentina Brazil Canada China EU France Germany India Indonesia	Italy Japan Mexico Saudi Arabia South Africa South Korea Turkey UK US	

Source: Own evaluation

Canada, France, Japan and the UK are leading with plans to phase out new fossil fuel cars. China nearly doubled the number of EVs in one year.

No G20 country is yet to embark on a comprehensive transition in the transport sector that is 1.5°C compatible. However, Canada, France, Japan and the UK have progressive long-term plans to phase out new fossil fuel cars. Canada, France and the UK have committed to ban the sale of fossil fuel cars by 2040. Japan set a long-term strategy with the goal that every vehicle produced by Japanese automakers will be electric, including hybrid vehicles, plug-in-hybrid vehicles, battery EVs and fuel cell vehicles, by 2050. However, these four countries' commitments are insufficient since 1.5°C compatibility requires a phase-out of new fossil fuel cars by 2035 at the latest.

With the exception of Australia, Indonesia and Russia, all G20 countries have some policies in place to reduce car emissions. These range from energy or emission performance standards to direct support for electric vehicles. Nevertheless, the market share of EVs in new car sales remained low in 2018. China sold over one million electric cars in 2018 (battery and plug-in-hybrid electric vehicles), reaching a market penetration of 4.5%, almost doubling numbers from 2017 (Norway has a market share of 46%).⁹² With more than 400,000 electric buses, China has the biggest electric bus fleet worldwide.⁹³

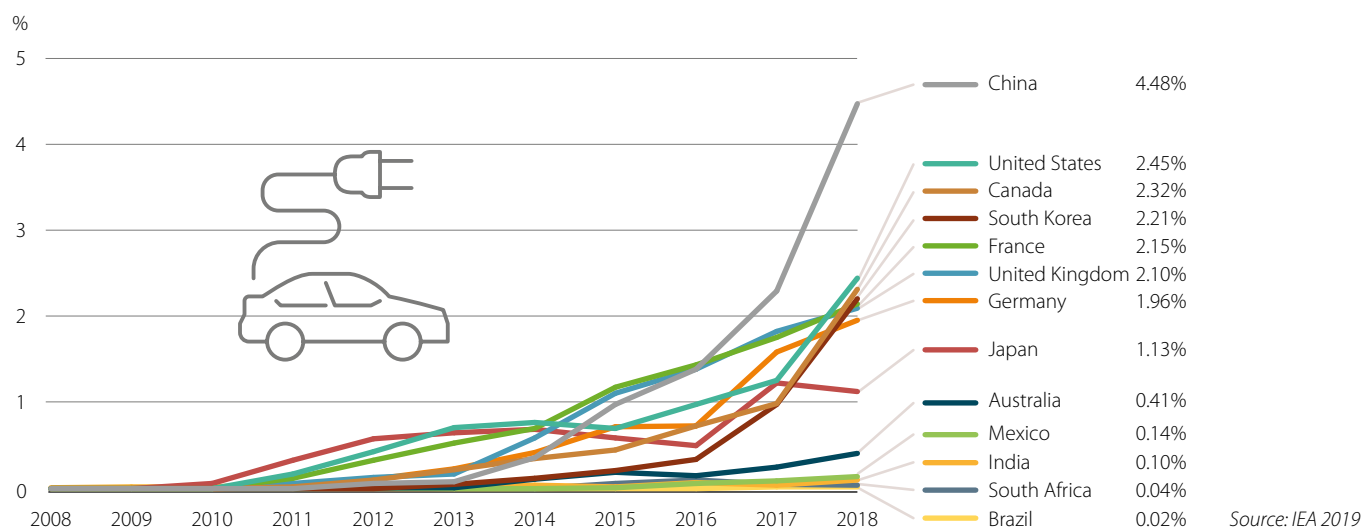
China has progressive policies to shift to public transport. But no G20 country has a long-term strategy for a modal shift.

China also has the most progressive policy for a modal shift to public transport. It aims for public transport to account for 30% of motorised travel in urban centres by 2020. The 2011 Transit Metropolis Programme supports cities in improving their public transport systems, inter-modal integration, and transit-oriented developments. Public transport development is a key policy area in China. The length of metro lines doubled between 2012 and 2017 (now totalling 5,767 km), and there is a further 6,000 km of track under construction. More than 30 cities in China have announced plans to electrify their bus and taxi fleets by 2022.⁹⁴

G20 aviation emissions are increasing with Australia, the US and the UK having the highest flight emissions per capita.

The aviation industry has come under increasing pressure to reduce emissions. The industry produces about 2% of global CO₂ emissions and 12% of global transport emissions.⁹⁵ Aircraft emit other substances in addition to CO₂, which means that aviation's warming effect is at least twice that of its emitted CO₂.⁹⁶ Flying is the most carbon-intensive form of transport: per kilometre, a person emits

Market share of electric vehicles in new car sales



twice as much travelling by airplane than by road transport, and 18 times as much as by rail – in all cases depending on the number of people being transported.⁹⁷

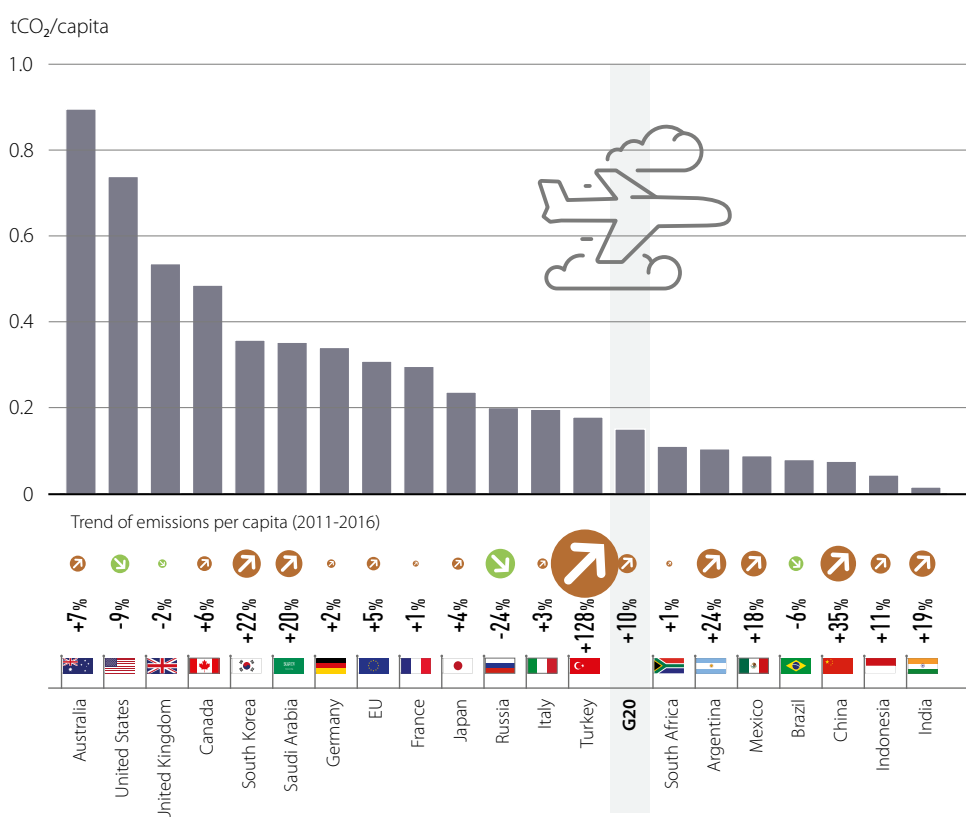
The aviation industry has already committed to improving fuel efficiency by 1.5% a year from 2009 to 2020 and to reduce total CO₂ emissions by 50% in 2050 compared to 2005 levels.⁹⁸ But the challenge remains huge: neither the aviation industry nor G20 governments are investing at the required scale to develop and scale up carbon-neutral synthetic fuels production. Moreover, the aviation sector is heavily subsidised. At the same time, the number of flight passengers is increasing: a result of increasing income levels and living standards in many countries. In 2018, passenger numbers grew by +7.5%.⁹⁹ Over the next two decades, the number is expected to double, reaching 8.2 billion in 2037.¹⁰⁰

In 2016, Australia, the US and the UK had the highest aviation emissions per capita in the G20 (domestic and international aviation). Emissions per capita in emerging economies are much lower. Australia's per capita emissions from aviation are 53 times higher than India's. Between 2011–2016, the majority of G20 countries experienced a growth in per capita aviation emissions while Turkey's emissions increased by far the quickest.

G20 countries are taking some initial steps to reduce aviation emissions. France now plans to introduce a tax on passenger flights from 2020, ranging from EUR 1.5 to EUR 18 per ticket.¹⁰¹ Similarly, Germany plans to raise levies on all flight tickets by EUR 3 to EUR 17 per ticket, both for domestic and long-distance trips by 2020.¹⁰²



Aviation emissions per capita (domestic and international) in the G20, 2016



Source: IEA 2019

TRANSPORT: → How can the G20 countries get to a 1.5°C world?

The key opportunities for G20 countries to limit global warming to 1.5°C in the transport sector are:

- **G20 countries need to ban the sale of new fossil fuel vehicles by 2035 at the latest.** Argentina, Brazil, China, EU, Germany, India, Italy, Mexico, Saudi Arabia, South Africa, South Korea and Turkey need to improve their current policies to reduce car emissions and develop phase-out plans. Australia, Indonesia and Russia urgently need to start phasing out fossil fuel cars by implementing emission or efficiency standards for cars, or bonus-malus vehicle incentive systems as a first step. Canada, France, Japan and the UK need to bolster the ambitiousness of their current 2040/50 bans and increase incentives for low-carbon vehicles.
- **G20 countries need to develop and implement a long-term strategy to phase out emissions from freight transport by 2050.** As a first step, Argentina, Australia, Indonesia, Mexico, Russia, Saudi Arabia, South

Africa and Turkey urgently need to start reducing emissions from HDVs by implementing emissions or efficiency standards.

- **All G20 countries need to develop and implement long-term strategies to support a modal shift towards non-motorised transport modes and electricity-powered public transport. Policies to shift consumption patterns are equally necessary.** This is a vital element of a 1.5°C compatible transport sector that must go beyond a shift from high- to low-carbon fuels. It includes reducing emissions from aviation and shipping.
- **All G20 countries need to increase efforts to phase out CO₂ emissions from aviation** by reducing subsidies to the sector, taxing jet fuel, and reducing air transport. G20 countries also need to develop strategies for zero-emissions aviation and massively increase their investment in power-to-X, or 'electrofuels' production, given that most aviation emissions are from flights beyond the range of battery-electric planes.



What are the incentives and benefits?

Improving public health:

- **Health benefits from reduced air pollution:** In 2016, air pollution was responsible for 4.2 million deaths. Air pollution is estimated to cause 26% of respiratory infection deaths and 16% of lung cancer deaths.¹⁰³
- **Health benefits from more physical activity:** Walking and riding bicycles tend to lower levels of cardiovascular disease, obesity and other health issues related to sedentary lifestyles.¹⁰⁴
- **Health benefits from a reduction in noise-related stress:** Noise pollution can lead to anxiety, depression, sleep disturbance and a number of illnesses. In the EU, 69,000 hospital admissions and 15,900 cases of premature deaths are attributed annually to environmental noise.¹⁰⁵

Reduced costs and economic opportunities:

- **Limiting health care costs:** Air pollution-related healthcare costs could increase to EUR 176 billion in 2060. The number of lost working days increases thus slowing economic development.¹⁰⁶
- **Low-carbon alternatives are becoming cheaper:** 2024 is the projected crossover point when EVs are cheaper than their combustion-engine counterparts. The key to this development is that batteries are ever cheaper.¹⁰⁷

Less congestion, increased safety, higher quality of life:

- The development of better public transportation systems, congestion zones, and other means for cities to reduce congestion leads to a reduction of parking slots and an increasing urban space for pedestrians and cyclists.¹⁰⁸
- Increased public transport and speed limits for cars reduce accidents.¹⁰⁹

BUILDING SECTOR:



→ Where do the G20 countries need to go?



IPCC-based 1.5°C benchmark:

→ Global emissions from buildings need to be halved by 2030, and cut to about 80% (below 2010 levels) by 2050, mostly through increased efficiency, reduced energy demand, and electrification, in conjunction with a complete decarbonisation of the power sector.

Further 1.5°C benchmarks:

- All new buildings must be zero energy by 2020 (OECD) or 2025 (non-OECD).
- The existing building stock needs annual deep renovation rates of 5% (OECD) or 3% (non-OECD) by 2020.

Source: Own evaluation based on IPCC 2018, Climate Action Tracker 2016

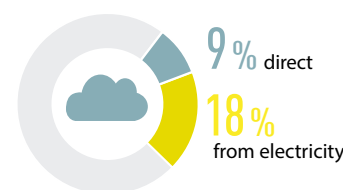
+4.1%



G20 emissions from the building sector in 2018

2017: **+3%** | 2005-2016: **-0.1%**

Building sector's share of G20 energy-related CO₂ emissions



BUILDINGS: → Where are the G20 countries?

Emissions in the building sector grew more than in any other sector in 2018, having stabilised in the last decade.

Buildings account for 9% of energy-related CO₂ direct emissions. Direct emissions strongly increased in 2018 (+4.1%), having stabilised over the last decade (+3%, 2017; -0.1%, 2005–2016).¹¹⁰ Changing lifestyles lead to larger living areas and thus higher heating and cooling demand; in some regions this is partly reinforced through changes in climate conditions. In addition, electricity use in buildings makes up 18% of G20 energy-related CO₂ emissions.

The building stock structure is very different across the G20. OECD countries often have a large and ageing building stock that needs urgent renovation, while new buildings play a smaller role. In contrast, many non-OECD countries will construct many new buildings over the coming decades. These states should thus focus on developing zero-energy strategies for new buildings.

In 2018, the US, Australia and Saudi Arabia had the highest building emissions per capita including electricity-based emissions.¹¹¹ These three countries lack ambitious policies to substantially reduce emissions in the sector. They all have building codes for new buildings in place (medium policy rating) but lack a national strategy for all new buildings to be near zero-energy by 2020/25, which would be 1.5°C compatible.¹¹²

To limit global warming to 1.5°C, OECD countries would also need to achieve annual deep renovation rates of 5%

annually, compared to non-OECD countries with a minimal deep-renovation rate of 3% by 2020.¹¹³ The US has building codes that address the renovation of existing buildings, while Australia and Saudi Arabia have no such policies at all (low policy rating).

Several countries with increasing emissions per capita in the building sector from 2013 to 2018 – China, India, Indonesia, Russia – are also rated low for their policy performance in the building sector. They must scale up ambition and action.¹¹⁴

European countries lead with 1.5°C compatible strategies for zero-energy new buildings.

The 2010 Energy Performance Building Directive requires EU member states to introduce minimum performance requirements. As of 31 December 2020, all new buildings will be required to be near zero-energy.¹¹⁵ Japan, Mexico, South Africa and South Korea are ranked high as they have long-term plans to reduce emissions in new buildings, although they are not 1.5°C compatible.

→ **Japan's** 2014 Strategic Energy Plan aims to make all newly constructed public buildings net zero-energy by 2020, and newly constructed private buildings net-zero-energy by 2030 (2020 for all new buildings would be 1.5°C compatible). Grants and subsidies support implementation.¹¹⁶

→ In 2017, the **Mexican** government presented a roadmap for reducing energy consumption in the building sector by 35% through energy efficiency measures, and to build only near zero-energy buildings by 2050 (2020 would be 1.5°C compatible). The roadmap also envisages that all states should enforce an energy building code by 2030.¹¹⁷

→ **South Africa's** National Development Plan sets a 2030 goal for zero-emissions buildings (a 2025 goal for new buildings would be 1.5°C compatible).¹¹⁸ The draft National Energy Efficiency Strategy foresees a 54% improvement in the average energy performance of new commercial buildings by 2030, compared to the 2015 baseline.¹¹⁹ There are mandatory building codes for new residential and non-residential buildings.¹²⁰ The building codes are ambitious on energy efficiency and saving, but will need to be monitored for effective implementation.

→ In **South Korea**, mandatory energy codes apply to both residential and commercial buildings. All new buildings will have to meet zero-energy requirements by 2030 (2020 would be 1.5°C compatible). South Korea has gradually strengthened energy standards, offers incentives for the public sector, and has implemented a Zero Energy Building Certification System since 2017.¹²¹

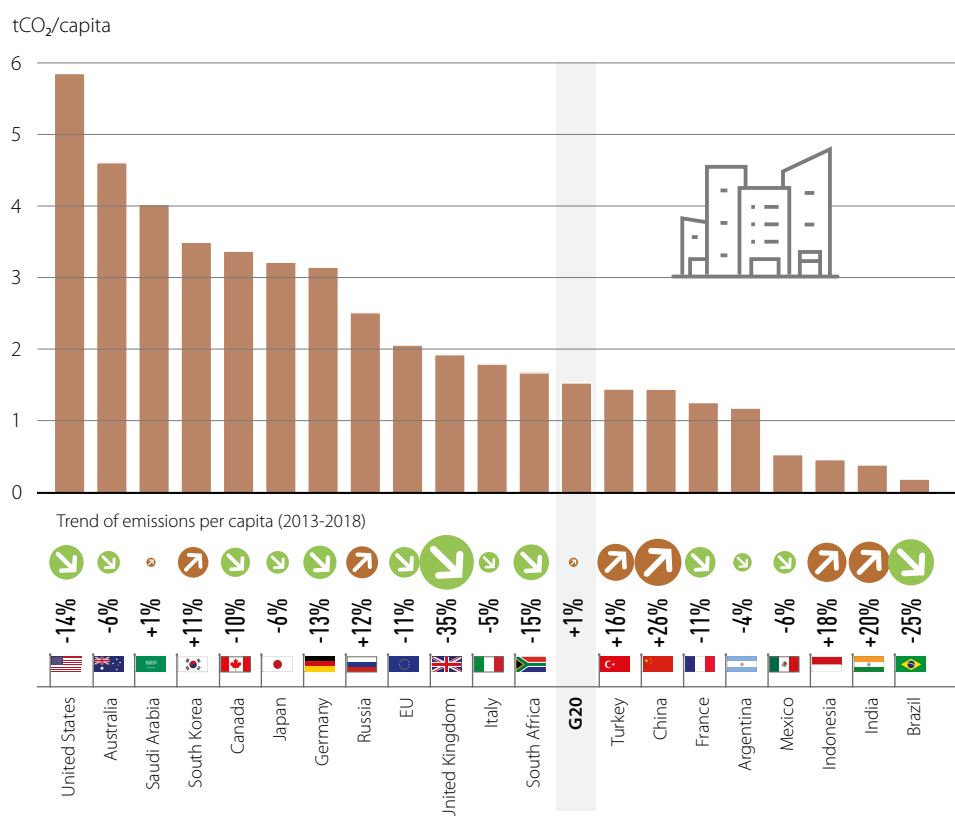
The EU, France and Germany are the only G20 members with long-term strategies for the retrofitting of existing buildings (high policy rating), although the schedule is not 1.5°C compatible.

→ The **EU** Energy Performance Building Directive, revised in 2018, requires EU states to submit long-term renovation strategies by the end of 2019 to achieve full decarbonisation of the building stock by 2050 with specific milestones for 2030 and 2040.¹²² This would mean an annual renovation rate of approximately 3% (5% by 2020 would be 1.5°C compatible).¹²³

→ **France** aims to reduce energy consumption in the building sector by 28% by 2030 and achieve carbon neutrality for the building stock by 2050. A mandatory building code for renovations is in place. France's 2018 National Low Carbon Strategy (SNBC) plans for 500,000 thermal renovations a year between 2015–2030, and 700,000 for 2030–2050 in the private and tertiary building sector. However, current renovations are insufficient in terms of numbers and performance (low-carbon certification was only awarded to 3% of renovated homes in 2014).¹²⁴






→ **Germany's** Climate Action Plan 2050 aims to make the entire building stock virtually climate-neutral by 2050 (80% energy reduction from 2008 levels). This would require at least doubling of current annual renovation rates (currently 1%). A renovation rate of 5% would be 1.5°C compatible.¹²⁵






Building emissions per capita in the G20, 2018



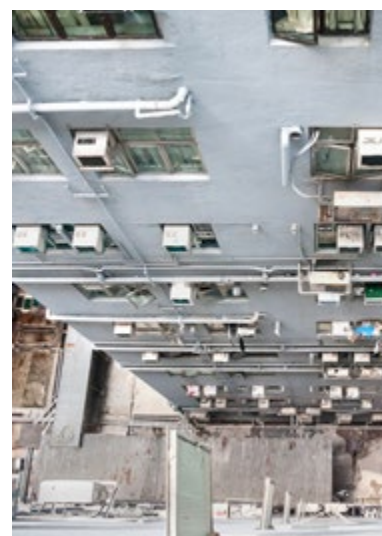
Source: Enerdata 2019,
World Bank 2019

Building sector: policy rating

	 low	 medium	 high	 frontrunner
	No policies	Some policies such as building codes, standards or fiscal/financial incentives for low emission options	Policies + national strategy for near-zero energy buildings	Policies + national strategy for all new buildings to be near zero-energy by 2020 (OECD) or 2025 (non-OECD)
Near zero-energy new buildings	Argentina China Indonesia Russia	Australia Brazil Canada India	Saudi Arabia Turkey US Japan Mexico South Africa South Korea	EU France Germany Italy UK

	 low	 medium	 high	 frontrunner
	No policies	Some policies such as building codes, standards or fiscal/financial incentives for low emissions options	Policies + retrofitting strategy	Policies + strategy to achieve annual deep renovation rates of 5% (OECD) or 3% (non-OECD by 2020)
Retrofit of existing buildings	Argentina Australia Brazil India	Indonesia Mexico Saudi Arabia	Canada China Italy Japan Russia	South Africa South Korea Turkey UK US EU France Germany

Source: Own evaluation



INDUSTRY SECTOR:



→ Where do the G20 countries need to go?



IPCC-based 1.5°C benchmark:

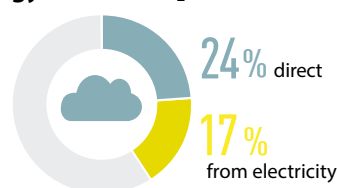
→ Global industrial CO₂ emissions need to be reduced by 65–90% from 2010 levels by 2050.

Source: Own evaluation based on IPCC 2018

+3.1% G20 emissions from the industry sector in 2016

2015: **+1.6%** | 2003–2014: **+3.7%**

Industry sector's share of G20 energy-related CO₂ emissions



INDUSTRY: → Where are the G20 countries?

Industry has the highest emissions share in the G20; and emissions in the sector keep rising.

CO₂ emissions in the industrial sector result primarily from direct emissions (conversion of energy), indirect emissions (electricity and co-generated heat), and process emissions (iron, steel, and non-metallic minerals – predominantly cement).¹²⁶ In 2018, industry accounted for the highest share of G20 energy-related CO₂ emissions as an end-use sector with 24% of direct energy-related emissions and 17% of indirect emissions from electricity and co-generated heat.¹²⁷

In 2016, G20 GHG emissions from industry (direct and process emissions) grew at +3.1%, a rate slightly below the long-term average of +3.7% between 2003–2014.¹²⁸

Emission intensity in industry is highest in Russia, India and China partly because of a shift of heavy industry from developed countries towards emerging and developing countries. At the same time, India and China are among the G20 countries with the most progressive energy efficiency policies.

Many developed countries have outsourced heavy industry. In 2016, Russia, India and China had the G20's highest emission intensity in their industries (direct and process emissions). China and India are at the same time among the most advanced in terms of their energy efficiency policies in industry. While India, next to Indonesia, is rated medium – as its mandatory energy efficiency policies cover more than 26–50% of industrial energy use as of 2017 – China and

Japan are the only G20 countries rated high with policies covering 51% to 100% of industrial energy use.¹²⁹

→ **China's** lead in the energy efficiency policy rating in industry might however change. Its landmark Top 10,000 Energy-Consuming Enterprises Programme from 2006 expired recently. This mandatory target-based programme was the main driver behind energy savings. It is uncertain whether it will be extended.¹³⁰

→ **Japan's** mandatory energy efficiency policies covered 26–50% of industrial energy use in 2017, according to the International Energy Agency (IEA). However, the Act on the Rational Use of Energy (revised in 2018) covers 90% of industrial energy use. The act established energy efficiency benchmarks for industry sub-sectors such as iron and steel, cement, and electricity supply. Companies covered by the scheme must take energy efficiency measures and report their energy use annually.¹³¹

→ **India's** Perform, Achieve and Trade scheme aims to reduce energy consumption in energy-intensive industries with a white certificate scheme. The next compliance cycle (phase III from 2017–20) targets savings of 3% of the designated entities' energy consumption.¹³²

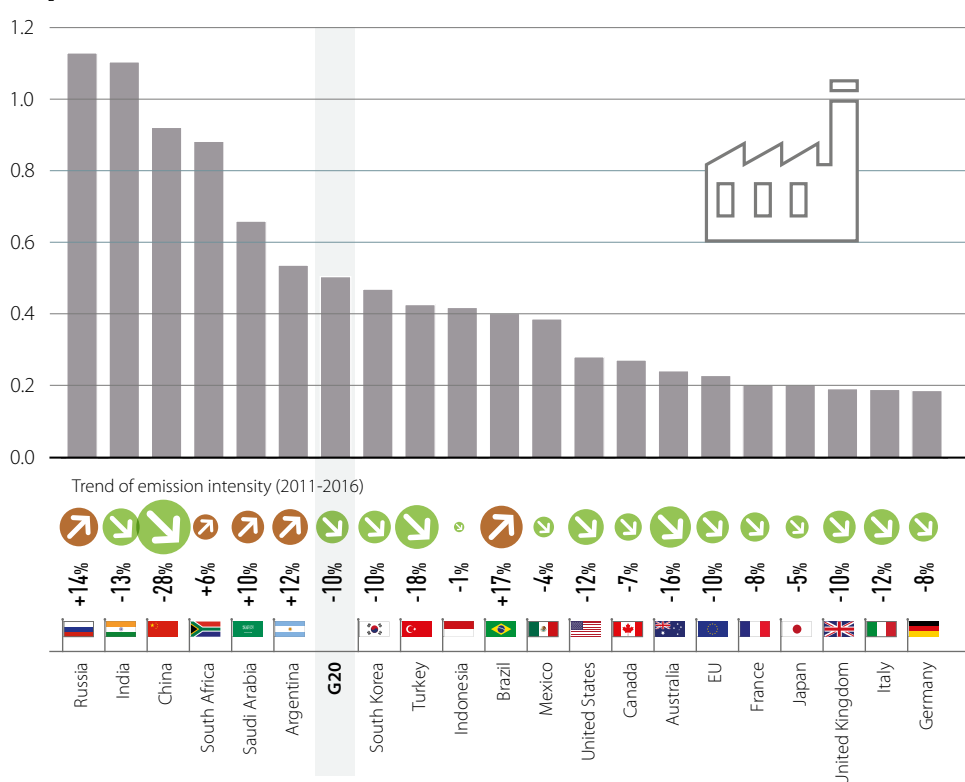
→ **Indonesia** has energy management policies, mandates for energy managers, and energy audit requirements. However, there are no performance standards for motors or policies to encourage the deployment of Combined Heat and Power (CHP) technologies. A 2009 regulation promised financial incentives for energy efficiency measures, but these incentives have not been introduced.¹³³

Reducing emissions in the industry sector must go beyond energy efficiency measures. Over the last two to three decades, high energy costs have driven continuous improvement worldwide in energy and process efficiency. In addition, measures and innovation on emissions efficiency,

material use efficiency and recycling, and demand reductions are necessary.¹³⁴ However, no G20 country has a long-term strategy in place to reduce industrial energy emissions by 75–90% from 2010 levels by 2050. This would be required for the 1.5°C IPCC benchmark.¹³⁵






Industry emissions intensity in the G20, 2016

tCO₂e/US\$2015 GVA



Source: Enerdata 2019, PRIMAP 2019, World Bank 2019

Industry sector: policy rating

	 low	 medium	 high	 frontrunner
	Mandatory energy efficiency policies cover less than 25% of industrial energy use	Mandatory energy efficiency policies cover 26–50% of industrial energy use	Mandatory energy efficiency policies cover 51–100% of industrial energy use	Policies + strategy to reduce industrial CO ₂ emissions by 65–90% from 2010 levels by 2050
Energy efficiency in industry	Argentina Australia Brazil Canada EU France Germany Italy	Mexico Russia Saudi Arabia South Africa South Korea Turkey UK US	India Indonesia	China Japan

Source: Own evaluation

AGRICULTURE & LAND USE:



→ Where do the G20 countries need to go?



-0.4%

G20 emissions from the agricultural sector in 2016

2015: **+1.7%** | 2003-2014: **+0.6%**



IPCC-based 1.5°C benchmark:

- Global methane emissions (mainly enteric fermentation) need to decline by 10% by 2030 and by 35% by 2050 (from 2010 levels). Nitrous oxide emissions (mainly from fertilisers and manure) need to be reduced by 10% by 2030 and by 20% by 2050 (from 2010 levels).
- Global deforestation needs to be halted and change to net CO₂ removals by around 2030.

Source: Own evaluation based on IPCC 2018

AGRICULTURE & LAND USE: → Where are the G20 countries?

Agriculture, forestry and other types of land use account for 23% of global GHG emissions, according to the IPCC 2019 Special Report on Climate Change and Land. Higher demand for food, feed, water, and more resource-intensive consumption and production, are likely to increase these emissions. Global warming, on the other hand, can lead to water scarcity, land degradation, and food insecurity.¹³⁶

G20 GHG emissions from agriculture continue to increase because of population growth and changing diets. Livestock breeding is the main driver and already accounts for 40% of agricultural emissions.

In 2016, G20 GHG emissions from agriculture decreased slightly by -0.4%. Before 2016, emissions had been increasing: +1.7% in 2015; +0.6% between 2003–2014.¹³⁷ This increase resulted from increases in crop and livestock production; the global population has been growing and more people can afford to eat meat on a regular basis.

In 2016, G20 agriculture emissions resulted mostly from enteric fermentation (40%),¹³⁸ the GHG methane (CH₄) that cattle, sheep and goats produce as part of their digestive process. Lower consumption of animal products can reduce these emissions. Further contributors are manure (26%) and synthetic fertilisers (18%), leading to the high emittance of nitrous oxide (N₂O) and CH₄. Rice cultivation (10%), through its cycles of flooding of rice paddies followed by dry periods, produces high nitrous oxide emissions in addition to methane. The continuous increases of methane and nitrous oxide counter the IPCC's 1.5°C benchmark of drastically

reducing these globally by 35% (methane) and 20% (nitrous oxide) by 2050 from 2010 levels.¹³⁹

Livestock and feed do not only contribute directly to GHG emissions, but also indirectly through the destruction of forest for grazing and pasture.

The four rainforest countries of the G20 – Argentina, Australia, Brazil, Indonesia – need to develop strategies for net-zero deforestation by the 2020s. Australia is the only developed-country deforestation hotspot.

While Argentina, Brazil and Indonesia have modest policies to reduce deforestation or support afforestation, Australia and Canada have no policies at all.

- The annual deforestation rate in the **Brazilian** Amazon fell sharply between 2004 and 2012 (from 2.88 Mha to 0.46 Mha) after the implementation of efficient command and control policies (reinforcing fiscalisation) and economic instruments that cut public financing to producers who promoted illegal deforestation. From 2012 to 2018, deforestation began to rise again (from 0.46 Mha to 0.75 Mha) mainly due to insufficient resources and weakened fiscalisation policies.¹⁴⁰

Brazil aims to restore and reforest 12 million ha of forest to achieve zero illegal deforestation by 2030 and to compensate for GHG emissions from the legal suppression of vegetation by 2030. In 2017, the government launched a revised monitoring system to fight illegal logging.

However, in 2019 the Bolsonaro government replaced officials in top positions at the environment ministry and deforestation-monitoring authorities, and eased the appeals processes against fines for illegal logging.¹⁴¹

In the first eight months of 2019, Brazil recorded the highest number of forest fires since 2010. It is likely that the fires had been started by farmers and loggers.¹⁴² The current government has not yet presented plans or policies to reduce deforestation rates in the Amazon (medium policy rating).

- From 2001 to 2018, **Indonesia** lost 25.6 Mha of tree cover: equivalent to a 16% decrease since 2000, and 10.5 Gt of CO₂ emissions. The main drivers are forest clearing for palm oil and timber harvesting, which contribute to around two fifths of total deforestation.¹⁴³

In August 2019, the president declared a permanent moratorium on the clearing of primary forest and peatland. However, the instruction neither creates a firm legal basis nor does it include secondary forests. Indonesia has not set a target to halt deforestation and is still facing alarmingly high rates of commodity-driven deforestation (medium policy rating).¹⁴⁴

- From 2001 to 2018, **Argentina** lost 5.77 Mha of tree cover: a 15% decrease since 2000. The main drivers are intensive cattle raising and the transformation of woodland into farmland for cultivating soy.¹⁴⁵ In 2017, Argentina adopted a National Action Plan on Forests and Climate Change that aims to reduce GHG emissions from the forest sector by at least 27 Mt CO₂e by 2030, however without providing a baseline. The 2007 Native Forests Law aims to reduce deforestation of native forests. In September 2019 at the UN Climate Action Summit, Argentina announced to aim for net-zero deforestation by 2030 (medium policy rating). Only 4.5% of the budget required by law for the implementation of the Native Forest Law has been allocated under the 2019 budget.¹⁴⁶

- With strong government focus in **Australia** on supporting the forest and timber industries, there are no policies to achieve (net) zero deforestation. The country experienced alarming deforestation rates: 4,000 hectares of native vegetation were cleared in Queensland in 2015–2016. Australia is the only developed-country deforestation hotspot in the world: three to six million hectares of forest could be lost in Eastern Australia alone by 2030.¹⁴⁷






India, China and Mexico rank high for their long-term deforestation policies. India is the only G20 country with 1.5°C compatible forest policies.

Reaching zero deforestation by the 2020s would be 1.5°C compatible. **India** is the only G20 country that has adequate targets and policies in place. The government is currently revising its forest policy to align it with its NDC target; to do so, it must have at least one-third of the total land area under forest and tree cover, and thus increase the current cover of 24.4%. India's 2018 REDD+ strategy proposes to develop an institutionalised system for addressing drivers of deforestation and forest degradation.¹⁴⁸

China has not established a target of net-zero deforestation but pledges to increase its forest area by 40 million ha by 2020 compared to 2005 levels.¹⁴⁹ However, China's consumption patterns and its wastewood-based manufacturing sector are dependent on the use of foreign raw materials that drive deforestation abroad.¹⁵⁰

Mexico's 2017–2030 LULUCF strategy aims to reach net-zero deforestation by 2030 (zero deforestation by the 2020s would be 1.5°C compatible). However, avocado plantations, subsidised by the government, have recently been driving deforestation in Mexico. The federal government has halved the budget for the fire brigades that prevent and fight forest fires.¹⁵¹

Land use sector: policy rating

	 low	 medium	 high	 frontrunner
	No policy or incentive to reduce deforestation in place	Some policies: Incentives to reduce deforestation or support schemes for afforestation / reforestation in place	Policies + national target for reaching netzero deforestation	Policies + national target for reaching zero deforestation by 2020s or for increasing forest coverage
 (Net) zero deforestation	Australia Canada	Argentina Brazil EU France Germany Indonesia Italy Japan Russia South Africa South Korea Turkey UK US	China Mexico	India

Source: Own evaluation

FINANCE



03

→ Where do the G20 countries need to go?



IPCC-based 1.5°C benchmark:

- Global investment in green energy and infrastructure needs to outweigh fossil fuel investments by 2025.

Source: Own evaluation based on IPCC 2018

FINANCE: → Where are the G20 countries?

Under the Paris Agreement, countries committed to 'making finance flows consistent with a pathway towards low greenhouse gas emissions and climate-resilient development' (Article 2.1c).¹⁵² The challenge is not only to grow 'green' public and private finance at the necessary speed and scale, but also to shift away from 'brown' finance. The IPCC refers to a global stock of US\$ 386 trillion of financial capital (US\$ 100 trillion in bonds, US\$ 60 trillion in

equity and US\$ 226 trillion of loans managed by the banking system) that need to be aligned.¹⁵³ However, data on the green-brown breakdown of these figures is currently limited.

Governments – finance ministries, central banks, financial regulators – can deploy financial policies and regulations, fiscal policy levers, and public finance to increase the supply of public and private climate-compatible finance while also reducing the supply of climate incompatible finance at a domestic and international level.

How governments can shape the transition from brown to green finance

Tool	Financial policies and regulations	Fiscal policy levers	Public finance
Objective	Influencing behaviour through binding laws and regulations and enforcement	Influencing behaviour through price signals	Influencing behaviour through shifting financial risk
Examples	<ul style="list-style-type: none"> → Green financial principles → Climate risk disclosure → Climate-related risk assessment and climate stress tests → Enhanced capital and liquidity requirements 	<ul style="list-style-type: none"> → Fossil fuel subsidies → Carbon pricing 	<ul style="list-style-type: none"> → Domestic and international public finance for fossil fuels (including divestment commitments from financial institutions) → International climate finance

Source: Own evaluation

CLIMATE COMPATIBLE FINANCE



Financial policies and regulations

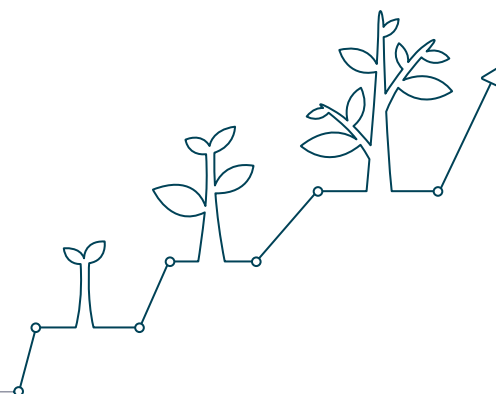
G20 economies lead in greening the financial system.

The World Economic Forum declared climate-related risks as the top of the most likely global risks for 2019 followed by data fraud and cyber-attacks, and the second greatest risk after weapons of mass destruction.¹⁵⁴





















Climate change leads to financial risks: 1) floods and droughts can destroy assets (physical risks); 2) parties can seek compensation for losses they suffered from climate impacts (liability risks); and 3) assets can become stranded if investments, particularly in oil-, gas- and coal-intensive industries, are not aligned with long-term climate policies in a country (transition risks).¹⁵⁵

Government institutions – including heads of states, and finance and sectoral ministries – can work to mitigate these risks by enacting policies and regulation to align the financial system with low-carbon, climate-resilient development. All G20 countries – although to different degrees – have acknowledged the need to adjust national financial architectures and are discussing or have implemented **green financial principles**, such as national green finance strategies, climate-related financial risks, and the taxonomy of green and brown investments.

Central banks and financial regulators, in particular, are important as they can develop **macroprudential policies** that manage the systemic risks of the financial system as opposed to asset-level or company-level risk management. They can set market rules that shift investments, often driven by short-term yields, to long-term sustainable solutions. These macro-prudential instruments are directed at financial institutions such as commercial banks, insurance and investment companies, investment banks, etc. They include: 1) climate-risk disclosure requirements and climate-related risk assessment/climate stress tests; as well as 2) liquidity instruments, lending limits, and differentiated reserve requirements. G20 emerging economies in Asia (China, India, Indonesia) lead in adopting mandatory macroprudential regulation. Other emerging economy examples with either mandatory or voluntary approaches include Brazil and South Africa. G20 industrialised economies (with the exception of France and Canada) are lagging behind; the relevant policies are largely under discussion.¹⁵⁶



Financial policies and regulations in G20 countries supporting a brown to green transition

Category		Green financial principles	Enhanced supervisory review, risk disclosure and market discipline		Enhanced capital and liquidity requirements			
Instruments		N/A	Climate risk disclosure requirements	Climate-related risk assessment and climate stress test	Liquidity instruments	Lending limits		Differentiated reserve requirements
Objective		General discussion/ process of implementation of principals aligning prudential and climate change objectives in the national financial architecture	Disclose the climate-related risks to which financial institutions are exposed	Evaluate the resilience of the financial sector to climate shocks	Mitigate and prevent market illiquidity and maturity mismatch	Limit the concentration of carbon-intensive exposures	Incentivise low-carbon-intensive exposures	Limit misaligned incentives and canalise credit to green sectors
Argentina		Yes	none	none	none	none	none	none
Australia		Yes	none	none	none	none	none	none
Brazil		Yes	mandatory	none	none	none	none	none
Canada		Yes	under discussion	voluntary	none	none	none	none
China		Yes	none	none	none	none	mandatory	none
European Union		Yes	none	none	none	none	none	none
France		Yes	mandatory	under discussion	none	none	none	none
Germany		Yes	under discussion	under discussion	none	none	none	none
India		Yes	none	none	mandatory	none	mandatory	none
Indonesia		Yes	none	mandatory	none	under discussion	none	none
Italy		Yes	none	none	none	none	none	none
Japan		Yes	under discussion	none	voluntary	none	none	none
Mexico		Yes	none	none	none	none	none	none
Russia		Yes	none	none	none	none	none	none
Saudi Arabia		Yes	none	none	none	none	none	none
South Africa		Yes	voluntary	none	none	none	none	none
South Korea		Yes	none	none	none	none	none	none
Turkey		Yes	none	none	none	none	none	none
United Kingdom		Yes	under discussion	under discussion	none	none	none	none
United States		Yes	none	none	none	none	none	none

Source: Own evaluation

i. Enhanced supervisory review, risk disclosure, and market discipline

Brazil and France are the only G20 countries with mandatory climate-related disclosure requirements; South Africa has voluntary standards.

The disclosure of climate-related risks enables investors to learn about the risks to which specific banking institutions are exposed.

- In 2014, the Central Bank of **Brazil** published a mandatory Resolution on Social and Environmental Responsibility for Financial Institutions. It was also the world's first banking regulator to request that banks monitor environmental risks as part of their implementation of Basel III, a global, voluntary regulatory framework for finance.
- Under Article 173 of the 2015 Energy Transition and Green Growth Law, **France** requires companies, asset managers, and institutional investors, as well as bank and credit providers, to report on financial risks relating to climate change.
- The Banking Association of **South Africa** introduced voluntary Principles for Managing Environmental and Social Risk in 2014.

Indonesia is the only G20 country with a mandatory climate-related risk assessment of its financial institutions; Canada has voluntary standards.

Climate-related risk assessments and stress tests can identify the extent to which a financial institution is exposed to emission-intensive or non-climate resilient assets.

- Under the Sustainable Finance Umbrella Policy (2017), **Indonesia's** Financial Services Authority (OJK) requires financial institutions to submit an annual plan that details how they are incorporating green finance principles into organisational restructuring, risk management (including exposure to transition risks such as asset stranding), corporate governance and statements of position.¹⁵⁷
- The **Canadian** Association of Pension Supervisory Authorities amended its guidance in February 2017 to list environmental, social, and governance issues as typical risks to be evaluated by pension trustees on a voluntary basis.¹⁵⁸

ii. Enhanced capital and liquidity requirements

India employs mandatory liquidity instruments to foster green investments by banks; Japan uses voluntary instruments.

Banks are required to hold capital in reserve to protect them against liquidity crises. This means that holding both enough cash and vault reserves (liquidity coverage ratio, or LCR) and being able to ensure that their long-term assets match long-term liabilities. Given the longer-term debt profile of low-carbon assets, existing liquidity regulations often favour the short-term liquidity of high-carbon assets. For example, by setting a lower LCR, liquidity instruments can encourage low-carbon investments. This enables banks to provide loans to green projects at lower interest rates.

- In 2015, the Reserve Bank of **India** issued a directive of Priority Sector Lending that explicitly targeted renewable energy and agriculture, including the provision of subsidised liquidity to banks for lending to environmentally-friendly projects.¹⁵⁹
- In 2004, the Environmentally Rated Loan Programme was established by **Japan's** development bank. It provides preferential interest rates by evaluating a company's environmental management. In 2010, sectors and requirements for liquidity support were identified by the Bank of Japan, including those relating to green sectors.¹⁶⁰

India encourages green lending by commercial banks through mandatory lending limits, while China encourages banks to limit carbon-intensive loans through mandatory credit reporting.

Central banks and financial regulators can set requirements for commercial banks that limit the latter's exposure to specific sectoral activities and loan categories. These requirements limit the maximum loss that a bank could face in the sudden event of a debtor's failure to a degree that does not endanger the bank's solvency. Similarly, banks can limit exposure to carbon-intensive loans or those that are not resilient to climate impacts. This requires the respective beneficiaries to disclose their climate-related risks. Additional lending requirements include minimum credit floors for 'green' loans and maximum credit ceilings for 'brown' loans.

- As part of its 2015 Priority Sector Lending policy, the Reserve Bank of **India** promotes loans for renewable energy and agriculture, and imposes a minimum credit floor.¹⁶¹
- The **China** Banking Regulatory Commission launched a mandatory Green Credit Statistics System in 2014 that requires banks to report on green credits.¹⁶²

No G20 country sets lower reserve requirements for banks with green loans.

Some central banks set reserve requirements that require commercial banks to hold a minimum of reserves at the central bank. This amount is in proportion to the commercial bank's deposits. Reserve requirements could be reduced in proportion to the commercial bank's lending to green sectors thereby subsidising green credit. In other words, the commercial bank's money-creating ability increases in case of a 'green' loan portfolio, rendering the latter more profitable for commercial banks than a 'brown' loan portfolio.¹⁶³

The effectiveness of such a policy must however be tested to prevent the banking system from creating excessive credit to ensure its and the economy's stability. More specifically, the effectiveness of such a policy is likely to depend on where it is implemented.¹⁶⁴



Fiscal policy levers

Fiscal policy levers can shift private investment decisions and consumer behaviour towards low-carbon, climate-resilient activities. Phasing out fossil fuel subsidies and increasing subsidies for renewables, and introducing carbon-pricing schemes, reduce the cost of investment in sustainable activities. Targeted investment incentives for renewables such as feed-in tariffs, renewable certificates, and public tenders across G20 countries have increased investment in renewables between 2000 and 2014.¹⁶⁵

Fossil fuel subsidies are decreasing in some G20 countries but remain unchanged in others. Subsidies to natural gas infrastructure and production have increased in several countries.

G20 countries, excluding Saudi Arabia,^c provided about US\$ 127 billion in subsidies (tax exemptions and budgetary support towards production and consumption of fossil fuels) to coal, oil and gas in 2017 – showing a gradual year-on-year decrease from a ten-year high of US\$ 248 billion in 2013.¹⁶⁶

This downward trend in total amount of subsidies over the past 3–5 years can be seen in nine of the G20 countries: Argentina (2014: US\$ 16.6 billion vs. 2017: US\$ 8.6 billion), Brazil (2012: US\$ 35.2 billion vs. 2017: US\$ 7 billion), China (2012: US\$ 37 billion vs. 2017: US\$ 17.3 billion), India (2013: US\$ 20.7 billion vs. 2017: US\$ 10.8 billion), Indonesia (2012: US\$ 33.8 billion vs. 2017: US\$ 7.7 billion), Italy (2013: US\$ 16.1 billion vs. 2017: US\$ 11.6 billion), Japan (2013: US\$ 3.8 billion vs. 2017: US\$ 1.8 billion), UK (2013: US\$ 23.9 billion vs. 2017: US\$ 14.1 billion) and the US (US\$ 2012: 12.2 billion vs. 2017: US\$ 7.1 billion). However, trends must be interpreted with caution as subsidy amounts fluctuate with the global prices of fossil fuels; therefore the decline since 2014 is primarily linked to the dramatic fall in oil, as well as gas and coal prices.

Even at lower fossil fuel prices, two G20 countries, France and Turkey, have gradually increased their fossil fuel subsidies between 2012 and 2017, signalling a larger increase proportionally. In the rest of the G20 countries, subsidies remained at around the same level during this period, with minor annual fluctuations. While there has been a downward trend in subsidies to coal mining, subsidies to coal-fired power continue.¹⁶⁷ In many countries (as well as in the EU's budget),¹⁶⁸ subsidies to

^c The information presented here is based on the bottom-up inventory approach and database of the OECD, which includes subsidies data for all G20 countries except for Saudi Arabia.

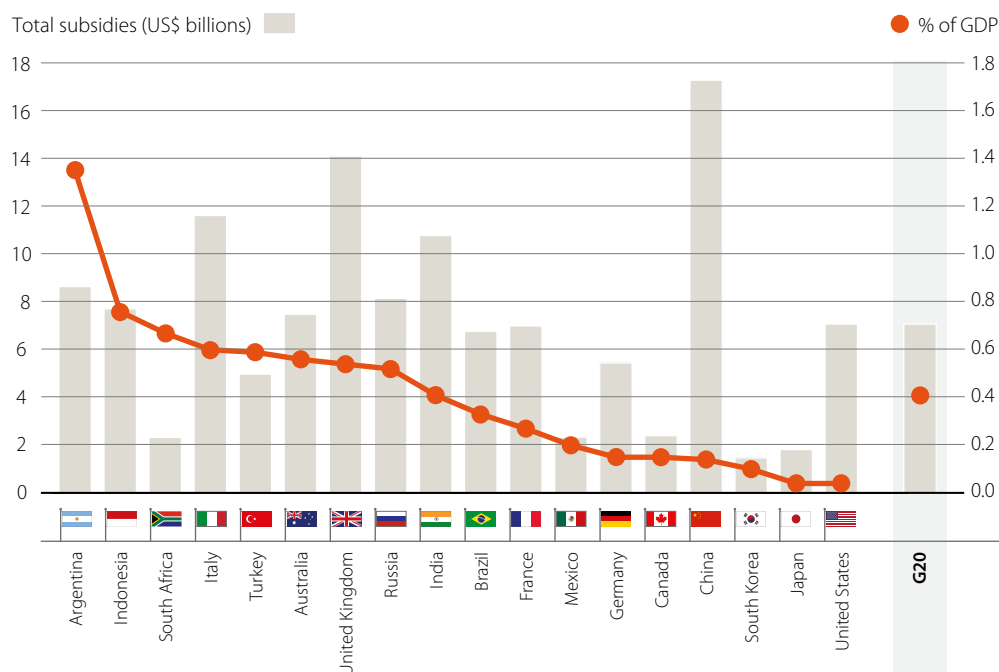
natural gas infrastructure and production have increased with gas seen as a 'bridge fuel'. This new gas infrastructure risks locking in fossil fuels.

Nevertheless, there are also positive signs of progress in subsidy reform. Canada and Argentina have removed some incentives to upstream fossil fuel companies, and saved US\$ 260 million and US\$ 780 million, respectively, in recent years. Indonesia reformed inefficient and untargeted subsidies for gasoline and diesel in 2015 and saved US\$ 15.6 billion. Data on subsidies for coal in EU countries suggests that they are mostly on track to meet their commitment to phase out subsidies for hard-coal mining by the end of 2018.¹⁶⁹

Argentina, Indonesia, South Africa, Italy, Turkey, Australia, the UK and Russia provide the highest fossil fuel subsidies per unit of GDP in the G20.

Several countries with decreasing subsidies still provide high amounts in proportion to the size of their economies. The countries that provide the highest amount per unit of GDP are (in order of magnitude): Argentina, Indonesia, South Africa, Italy, Turkey, Australia, the UK, and Russia.¹⁷⁰ In Argentina, Indonesia, South Africa, Italy and Turkey, the vast majority of subsidies are for fossil fuel consumption, and mainly constitute fuel and energy tax breaks to different sectors.¹⁷¹ In Russia and the UK, conversely, production subsidies make up 92% and 54% of those identified. These include budgetary support and tax incentives for the production of oil and gas.

Fossil fuel subsidies in G20 countries, 2017



* No comparable data exists for the European Union and Saudi Arabia.

Source: OECD 2019



Most G20 countries have or are considering an explicit carbon-pricing scheme.

Most G20 countries have implemented or are in the process of implementing explicit carbon-pricing schemes such as ETSs and carbon taxes. Newcomers are South Africa – the first African nation that launched a carbon tax in June 2019 – and Argentina, which implemented a (negligible) carbon tax in 2018 for most liquid fuels.

Brazil and Turkey are considering the implementation of a national carbon tax or pricing scheme, and Indonesia is considering a market-based carbon pricing policy, including an ETS, for the power and industry sectors. Germany plans to introduce a carbon price in the transport and building sector as of 2021. The Russian government is currently working on a cap-and-trade scheme and Saudi Arabia's Energy Minister announced in October 2019 that the country plans to launch a carbon trading scheme. Australia and India have no explicit carbon pricing schemes and are not considering it. The US only has a carbon pricing scheme at the state level.¹⁷²

Explicit carbon-pricing schemes can raise significant revenues. These revenues can be redistributed to protect the poor and vulnerable affected by the transition, and boost investment and economic growth: through investments in the necessary infrastructure and public goods such as education and health, and social safety nets.

In 2018, France and Canada were the two G20 countries with the highest carbon revenues as a proportion of GDP, with total revenues of US\$ 10 billion and US\$ 3 billion respectively.¹⁷³

In addition to explicit carbon pricing schemes, all G20 countries besides Russia and Saudi Arabia (where no information is available) have implicit carbon pricing schemes – namely specific taxes on fossil fuels.

On average, about 70% of CO₂ emissions in G20 countries are unpriced or priced insufficiently; Russia, Indonesia, Brazil, China and South Africa have the highest carbon-pricing gap.

The damage from climate change resulting from a tonne of CO₂ emissions can conservatively be estimated at EUR 30. The costs from carbon emissions will increase over the years with rising temperatures. EUR 60 per tonne of CO₂ is considered a midpoint estimate of carbon costs in 2020 and a low-end estimate for 2030.¹⁷⁴ To put these values in perspective, the recommended price on carbon necessary in order to align with the Paris goals is estimated



at between US\$ 40-80/tCO₂ by 2020 and between US\$ 50-100/tCO₂ by 2030.^{d, 175}

In 2015, an average of 71% of the CO₂ emissions from energy in the G20 failed to be priced at EUR 30 or higher through carbon taxes, specific taxes on energy use, or the price of tradable emission permits (explicit plus implicit schemes). The pricing gap for G20 countries increases to 78% when EUR 60 per tonne is the benchmark.

The pricing gap is even higher in non-road transport sectors as taxes on road transport fuels are often much higher than in other sectors, and are usually not introduced for climate reasons. This can therefore present a distorted picture whereby the level of carbon taxation across other sectors of the economy, as well as taxation motivated by climate considerations, is actually much lower.

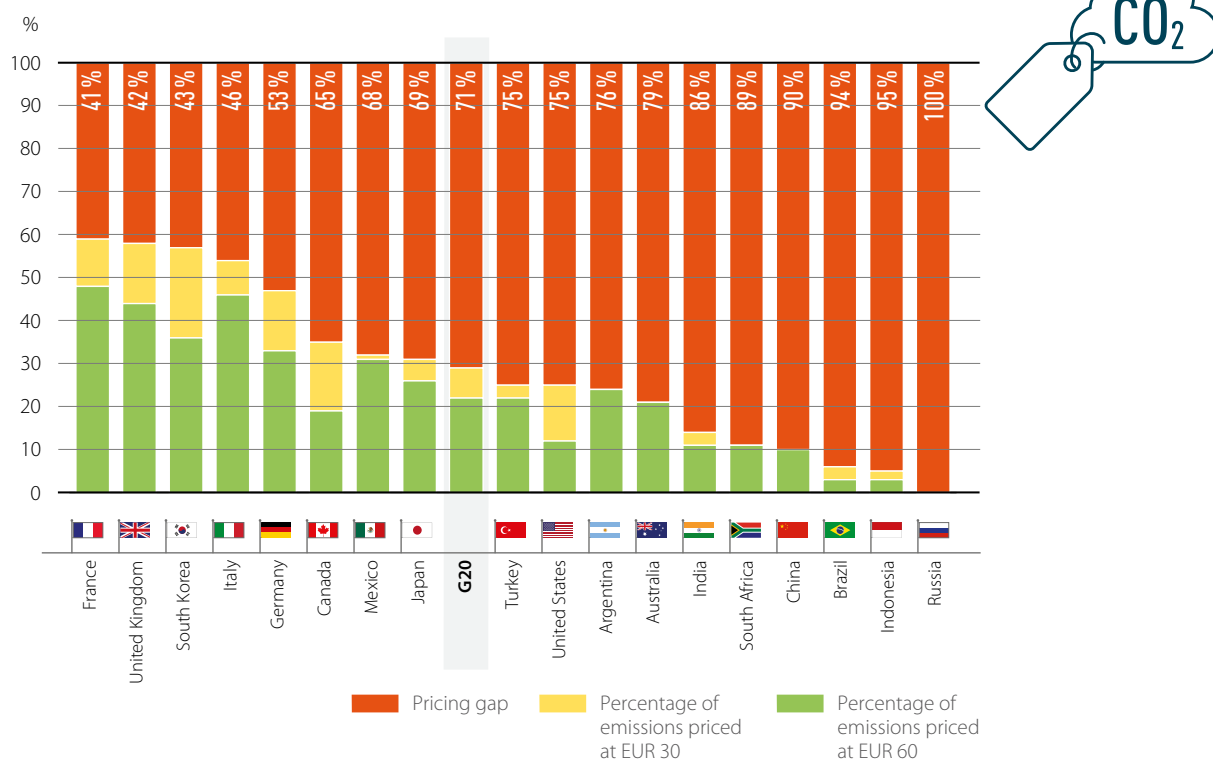
All G20 countries need increased coverage of emissions and higher prices. Russia (100%), Indonesia (95%), Brazil (94%), China (90%) and South Africa (89%) have the highest gaps in carbon pricing. This might change for Brazil, which is currently planning a carbon tax on national and subnational levels, and China, continuing the implementation of its national ETS, aimed at covering 30% of domestic emissions in the power sector. In contrast, a lower carbon-pricing gap such as those in France, South Korea and the UK (41%, 43%, 42%, respectively) signals to investors that a country is transitioning towards low-carbon development, although not to the degree needed to meet the Paris goals.

France, India, South Korea, Mexico and the UK all reduced their carbon-pricing gaps between 2012 and 2015 as a result of the following actions:

- France and Mexico reformed taxes on energy use.
- India increased its excise duties on transport fuels.
- South Korea introduced a national ETS.
- The UK set a price floor for electricity sector emissions covered under the European ETS.

^d These price ranges are higher than the benchmarks used by OECD in their carbon-pricing gap calculations. This is because the OECD benchmarks are low-end estimates for 2020 and 2030, whereas the ranges provided here are from the High-Level Carbon Pricing Commission's report, which explored multiple lines of evidence on the level of carbon pricing consistent with achieving the Paris Agreement, including technological roadmaps, analyses of national mitigation and development pathways, and global integrated assessment models.

Carbon-pricing gap in G20 countries, 2015



* No data exists for the European Union and Saudi Arabia.

Source: OECD 2018

Public finance

Through public funding, G20 governments can support climate action at home and overseas – or, conversely, lock countries into high-carbon growth. By lowering the cost and risk of capital, governments can encourage private investment in a low-carbon, climate-compatible transition. Countries steer investments through their public finance institutions, including development banks and green investment banks. Developed G20 countries also have an obligation to provide financing to developing countries; public sources are a key aspect of these obligations under the UNFCCC.

On average, G20 public institutions financed coal and coal-fired power production internationally at US\$ 17 billion and domestically at US\$ 11 billion in 2016–2017.

Between 2016 and 2017, G20 countries provided around US\$ 27.6 billion of public finance per year for coal and coal-fired power production, of which the majority – US\$ 16.8 billion – supported projects overseas.¹⁷⁶ Public finance includes the provision of grants, equity, loans, guarantees and insurance by majority government-owned financial institutions, such as national and multilateral development banks, export credit agencies, and domestic banks that are majority state-owned.^e

^e This data does not include financing for coal G20 governments provide through Multilateral Development Banks.

The biggest G20 overseas financiers are China, Japan and South Korea. China's public finance institutions financed an average of US\$ 9.5 billion per year in 2016–2017, Japan's US\$ 5.2 billion, and South Korea's US\$ 1 billion. Most of this financing goes to coal-fired power; recipients of the highest amounts are Bangladesh, Indonesia, Pakistan, and Vietnam.

India provided by far the highest amount of domestic finance for coal in the G20 — US\$ 10.6 billion per year (2016–2017 average). But this number must be interpreted with caution in comparison to other countries as the majority of India's commercial banks are state-owned. Financing for coal in other countries mostly comes from private banks, which are not counted as public finance.

Public financial institutions in Brazil, Canada, China, Germany, the UK and the US restrict public spending on coal.

One encouraging development in recent years has been the commitments made by multilateral development banks and nationally owned development banks to mainstream climate considerations in their operations and lending.

The commitments of public finance institutions in G20 countries to end or restrict public spending for coal can be classified under one of three categories:¹⁷⁷

1. Multilateral development banks (MDBs): MDBs have a development mandate and are backed by member governments. This allows them to provide finance to governments and the private sector at lower interest rates and on better terms than commercial lenders. Germany and the UK are the only two G20 countries that announced restrictions on coal financing in their role as MDB shareholders. This financial engagement is in addition to the 2013 commitments of the World Bank Group, the European Investment Bank, and the European Bank for Reconstruction and Development to restrict coal-fired power finance. In the US, the current administration replaced prior treasury department guidance that proscribed support for coal projects through MDBs.

2. National development agencies (NDAs) and development banks (NDBs): They can finance coal domestically and abroad, often providing support to the private sector to encourage investment. In 2013, the US developed a policy to end public financing by development finance institutions (DFIs) for new coal-fired

power plants overseas, except in rare circumstances; the UK and some non-G20 European countries joined in this practice. Germany's development bank (KfW), the Brazilian development bank (BNDES), and France's development agency (AFD) have guidelines restricting coal finance, the most ambitious of which is the AFD, which aims to align its entire lending with the Paris Agreement in 2017. China's green credit policy and associated regulations pushed all Chinese public and private banks to reduce financing to highly polluting industries, including coal. However, it must be noted that these restrictions were not thorough-going.

3. National/domestic export credit agencies (ECAs):

ECAs, usually an official or quasi-official branch of government, provide government-backed loans, credits, and guarantees for the international operations of corporations from their home country. They back public finance for risky projects, including coal mines and power plants.









































In January 2019, the OECD guidelines covering 35 ECAs were extended to allow only financing for large coal-fired power plants with 'ultra-supercritical technology,' or with an emissions intensity of below 750g of carbon dioxide per kilowatt hour (CO₂/kWh). This would exclude every operating coal-fired power plant in Australia and India. All G20 OECD countries' ECAs are currently participants in this arrangement, yet this is not sufficient to meet the Paris goals.

ECAs in Canada, France and the US have their own export policies that go beyond OECD regulations. For example, according to Export Development Canada's new climate change policy: 'No new financing for coal-fired power plants, thermal coal mines or dedicated thermal coal-related infrastructure – regardless of geographic location.'

Despite these restrictions, the highest levels of ECA coal financing comes from Japan, China, South Korea, Germany, France and India.¹⁷⁸



Commitments of G20 public finance institutions to restrict the financing of coal and coal-fired power

		MDB level	National development agencies and banks	Domestic export credit agencies	Export credit restriction in OECD
Argentina					
Australia					
Brazil					
Canada					
China					
France					
Germany					
India					
Indonesia					
Italy					
Japan					
Mexico					
Russia					
Saudi Arabia					
South Africa					
South Korea					
Turkey					
United Kingdom					
United States					

Source: Own evaluation

 yes
  no
  not applicable

G20 countries reported providing US\$ 31 billion in climate finance to developing countries in 2015–2016.

The eight industrialised G20 countries and the EU (Annex II Parties of the UNFCCC) obliged to provide international climate finance reported amounts of US\$31 billion annually between 2015 and 2016.

This includes a) bilateral climate finance, b) finance through the multilateral climate change funds and c) support to multilateral and bilateral institutions that parties cannot specify as climate-specific (e.g. that to MDBs and UN bodies).¹⁷⁹ In terms of GDP, Japan (total amount: US\$ 12 billion)^f, France (US\$ 4 billion), the UK (US\$ 4 billion) and Germany (US\$ 4 billion) provided the highest amounts. While Japan, Germany and France remain the largest bilateral funders, the UK provides the highest amount through multilateral funds. Under its current administration, the US has not submitted a third biennial report to the UNFCCC, instead offering only provisional data to calculate these statistics.

In late October 2019, the Green Climate Fund raised US\$ 9.8 billion^g through its first replenishment for activities in 2020 to 2023.¹⁸⁰ While this falls short of civil society calls for all countries to double their commitments, the amount just exceeds that from the initial resource mobilisation of the Fund (US\$9.3 billion). Pledges from G20 countries – UK (US\$1.9 billion), France (US\$1.7 billion), Germany (US\$1.7 billion) and Japan (US\$1.5 billion) – comprise over 50% of the total amount pledged by 27 countries. Germany, France and the UK doubled their commitment compared to 2014. Although South Korea is not obliged to provide climate finance to developing countries, it hosts the Green Climate Fund's headquarters and has pledged US\$200 million for the coming four years. In contrast, neither the US nor Australia pledged new commitments to the Green Climate Fund. Climate change is a divisive election issue in both countries, with the administration in Australia announcing in early 2019 its decision not to replenish the Green Climate Fund. The US has not only failed to pledge so far to the replenishment, the Trump administration has prevented the delivery of US\$2 billion of the US\$3 billion commitment made to the fund in 2014 under the Obama administration.

The non-Annex I countries have contributed to multilateral funds on a voluntary basis.

FINANCE: → How can the G20 countries get to a 1.5°C world?

The key opportunities for G20 countries to limit global warming to 1.5°C by shifting financial flows are:

- **G20 countries should ensure the integration of both physical and transition-related climate risks into monitoring and prudential supervision of the finance sector.** This should include implementing 'robust and internationally consistent climate- and environment-related disclosure,' such as the recommendations of the Task Force on Climate-related Financial Disclosure. Where applicable, G20 countries should also consider implementing enhanced capital and liquidity requirements to incentivise a shift in investment from brown to green sectors.
- **All G20 countries need to phase out fossil fuel subsidies by 2025 at the latest;** European countries are already committed to doing so by 2020.
- **All G20 countries need to introduce carbon pricing schemes** with a price of US\$ 40–80/tCO₂ by 2020 and US\$ 80–100/tCO₂ by 2030.
- **All G20 countries need to end public finance for fossil fuels** immediately through all development finance institutions and their intermediaries. This includes terminating finance for coal, as well as oil and gas, both domestically and internationally.
- **As we reach 2020 – the year when developed country parties to the UNFCCC committed to mobilise at least US\$ 100 billion a year from public and private sources to help developing countries mitigate and adapt to climate change – the G20 countries should signal the ongoing, predictable provision of support to developing countries to this end.** Member countries should look to ambitious countries such as the UK, which have recently committed to double their climate finance over the next five years, as well as those that have recently committed to doubling their pledges to the replenishment of the Green Climate Fund (France, Germany, the UK).
- **All G20 countries are advised to include information on aligning financial flows in their NDCs and LTS,** in particular policies greening the financial system, fiscal policies, and public finance.

^f A large proportion of Japan's funding is delivered through bilateral channels including the Japanese Bank for International Cooperation. It includes export credits and funding for relatively efficient coal technologies. Export credits for efficient coal technologies is also provided by France, Germany, US, Canada and Italy (albeit not to the same degree as Japan). Australia's international climate finance also includes efficient coal technologies.

^g The US\$ figure represents the conversion of national currencies in order to facilitate aggregation. There is a difference between the nominal amount of US\$9,658 million and the formal announced amount of US\$9,776 million to account for countries that have indicated that they will pay in their contributions faster than required which in turn, means they are likely to be faster in seeking investment income (calculated with 1.5% return). Note that the end of the pledging period is technically 2023 which means that further countries might contribute (this report does not include, for example, potential pledges made at COP25).



What are the incentives and benefits?

Raising or saving significant government revenues:

- In 2017, worldwide carbon-pricing schemes raised around US\$ 33 billion in government revenue. If strong carbon prices were widely adopted, annual revenues could be in the trillions.¹⁸¹
- Pricing carbon and the removal of fossil fuel subsidies could generate an estimated US\$ 2.8 trillion in government revenues in 2030, more than the GDP of India today.¹⁸²

Preventing financial risks and guaranteeing macroeconomic stability:

- In 2017, economic damage from disasters triggered by weather and climate-related hazards amounted to US\$ 320 billion; the figure for 2018 was US\$ 160 billion.¹⁸³
- Economic shifts and policy changes may turn fossil fuel infrastructure into stranded assets. For example, in India, 40 GW of coal-fired power capacity that has been commissioned or is under construction is already 'stressed'.¹⁸⁴ If China implements its NDC there could be stranded assets of US\$ 90.4 billion from coal power plants by 2030.¹⁸⁵

Using economic growth opportunities:

- Increased climate action could trigger US\$ 26 trillion in investments and generate 65 million more jobs worldwide by 2030.¹⁸⁶
- Low-carbon alternatives are becoming cheaper. By 2025, electricity generation from new renewable energy infrastructure will be cheaper than from new coal infrastructure.¹⁸⁷ As batteries drop in price, EVs will by 2024 become cheaper than their counterparts with combustion-engines.¹⁸⁸

Preventing a competitive disadvantage:

- Relying on imported fossil fuels can cause economic vulnerability making countries and businesses subject to volatile fuel prices.¹⁸⁹



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