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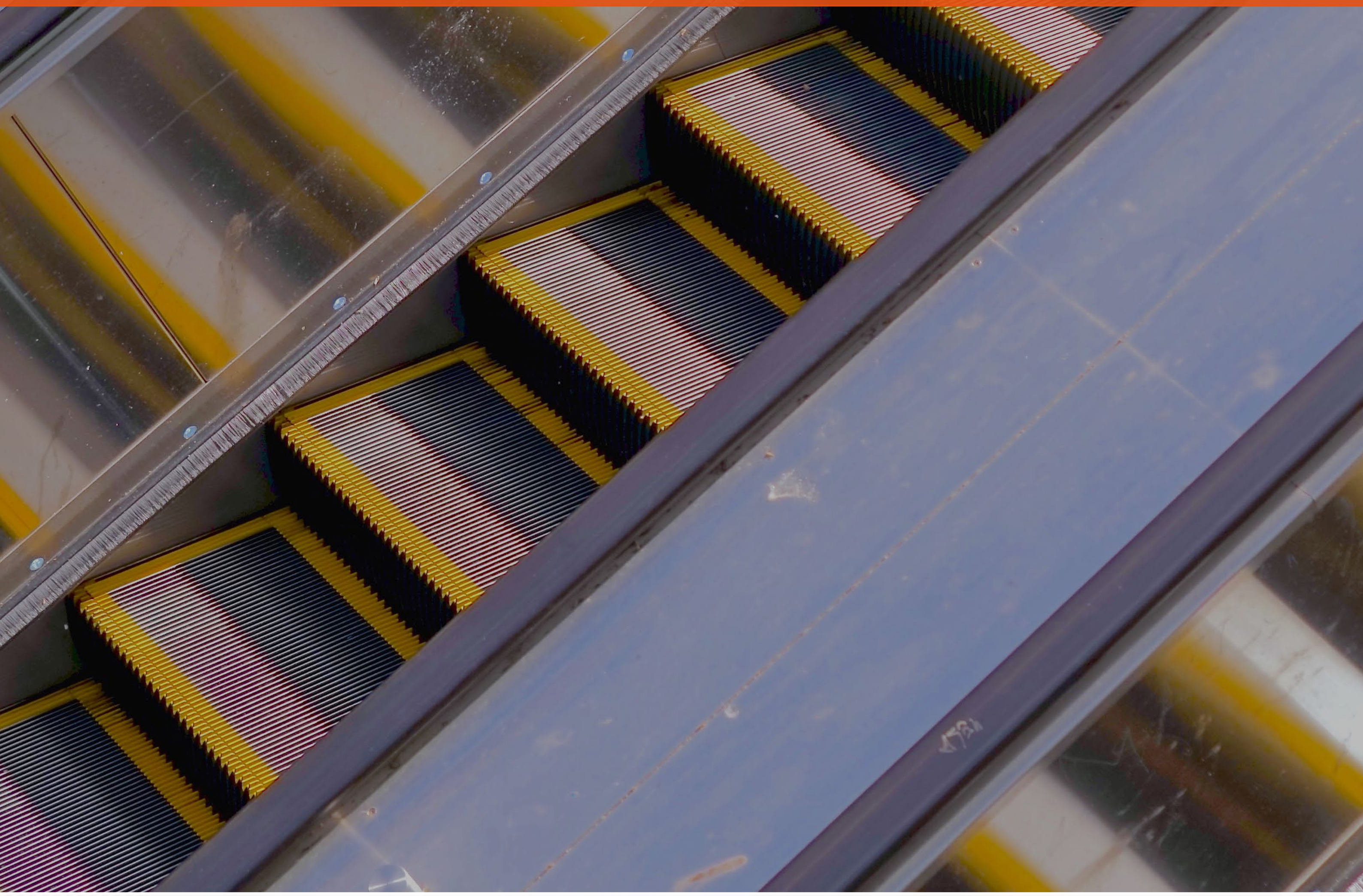

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In the framework of the project: „Implikationen des Pariser Klimaschutzabkommens auf nationale Klimaschutz-anstrengungen“

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Disclaimer
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The views expressed in this paper are strictly those of the authors and do not necessarily represent the opinion of the German Federal Environment Agency, nor of the German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety.

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Abbreviations

AIIB	Asian Infrastructure Investment Bank
API	American Petroleum Institute
BAU	Business as Usual
CAPP	Canadian Association of Petroleum Producers
DPJ	Democratic Party of Japan
EITE	Energy Intensive Trade Exposed
EPA	Environmental Protection Agency
EPR	Energy- and process-related emissions
ETS	Emissions Trading Scheme
EU	European Union
FYP	Five Year Plan
GDP	Gross Domestic Product
GHG	Greenhouse Gas
HDI	Human Development Index
HFC	Hydrofluorocarbon
IEA	International Energy Agency
IETA	International Emissions Trading Association
IMF	International Monetary Fund
IPCC	Intergovernmental Panel on Climate Change
ISEP	Institute for Sustainable Energy Policies
LPD	Liberal Democratic Party
LULUCF	Land use, land-use change and forestry
MACC	Marginal Abatement Cost Curves
MBD	Million Barrels per Day
MEE	Ministry of Ecological Environment
MEP	Ministry of Environmental Protection
METI	Ministry of Economy, Trade, and Industry
MNRE	Ministry of New and Renewable Energy
MOE	Ministry of the Environment
MOFA	Ministry of Foreign Affairs
NCSC	National Centre for Climate Change Strategy and International Cooperation
NDC	Nationally Determined Contribution
NGO	Non-Government Organisation
NPD	New Democratic Party
NRDC	National Development and Reform Commission
UN SG	United Nations Secretary General
UNFCCC	United Nations Framework Convention on Climate Change
WCI	Western Climate Initiative

Introduction

Keeping global warming well below 2°C and pursuing efforts to limit it to 1.5°C above preindustrial levels, as stipulated in the Paris Agreement, requires accelerated efforts to reduce greenhouse gas (GHG) emissions in all countries. Current mitigation targets for 2020 and 2030, as well as long-term targets, are inconsistent with these temperature limits (UNEP, 2018; Climate Action Tracker, 2019d). Parties to the United Nations Framework Convention on Climate Change (UNFCCC) are expected to update their Nationally Determined Contributions (NDCs) by 2020. Key political moments to do so include the United Nations Secretary General (UN SG) Climate Change Summit in September 2019 and the 25th Conference of Parties (COP) in December 2019.

This report shows the potential distribution of the emissions reduction efforts between different Parties and presents an in-depth assessment of the circumstances influencing the (over-) achievement of the currently suggested emissions reduction goals. The analysis focuses on the following countries: Brazil, Canada, China, Germany, India, Japan and the United States.

For each country, the report draws conclusions to what extent mitigation targets could be strengthened, based on the following elements:

- **The socioeconomic context**: The socioeconomic data, including up-to-date population levels, urbanisation and electrification percentages, rates of economic growth and the propensity for corruption, provide context for mitigation actions and their political feasibility. This section summarises data from international data sources, such as the World Bank, Transparency International and different UN organisations.
- **Greenhouse gas emissions and energy profiles**: GHG and energy profiles show which areas are most critical to consider for mitigation efforts. This section illustrates historical emissions data based on PRIMAP data (Gütschow *et al.*, 2018b) and energy consumption based on the IEA (IEA, 2018c).
- **Emissions projections in comparison to mitigation targets**: Some countries are set to (over-) achieve their mitigation targets, while others lag behind in implementation. This section illustrates the mitigation targets of the countries and projected emissions under implemented policies, based on the Climate Action Tracker.
- **Emissions pathways resulting from global least-cost pathways**: There are models that distribute global emission pathways in line with the temperature limits to countries, assuming a most cost-efficient distribution of efforts. This means that the cheapest mitigation options are used first, regardless of which country implements them. The cost-effective reduction shares in this report are based on recent marginal abatement cost curves (MACC) from the POLES database (ENERDATA, 2018), which were used to derive globally cost-effective national pathways. The model covers all energy- and process-related GHG emissions. MACCs are provided for 50 countries (including all countries assessed in this report) and 20 regions. Data is provided up to a maximum shadow carbon price of 1.200 EUR/t. The MACCs are based on the data from the EnerBlue scenario and describe mitigation potentials additional to the EnerBlue scenario. The EnerBlue scenario assumes the continuation of current policies in a way that the 2030 targets defined as part of the COP21 NDCs are successfully achieved.
- **Emissions pathways assuming an equitable distribution of mitigation efforts**: There are many studies that calculate the required contribution of countries to global mitigation efforts, based on different equity principles, such as historical responsibility or equality. This approach summarises data from the literature on what each country's "fair share" of global mitigation effort is for 2030 and 2050. All data for this approach are drawn from Climate Action Tracker (CAT) (Climate Action Tracker, 2017). Given the large variability of equity proposals, criteria and metrics, each country has a wide equity range covering a large number of results from the

literature. CAT further divides the equity range to determine the levels, where, if all countries adopted a similar ambition level, global temperature increase would be at 2°C and at 1.5°C.

- **Insights regarding the political context of mitigation ambition**: The technologies leading to emission reductions are already available and are in many cases competitive with the costs of high-emitting options, even if the external costs of the latter are excluded. Their deployment is still strongly dependent on the political landscape. The political feasibility of, for example, the phasing out of counterproductive measures such as fossil fuel subsidies, and increasing mitigation ambition overall is investigated in the last section of each country profile.

The results on global least-cost pathways and the equitable distribution of mitigation efforts originate from Wachsmuth et al. (2019).

1 Brazil

1.1 Introduction

Due to its heavy reliance on renewable energy sources (mostly hydro) for electricity production, Brazil has one of the least carbon intensive energy sectors in the world. This reliance on renewables was driven mainly by the desire to increase the country's energy security during the 1970's oil crisis as well as abundant national resources for hydro energy. While climate policy started to play a role in Brazil's policy-making process during the presidencies of Lula da Silva (2002-2010) and Dilma Rousseff (2010-2016), this has changed with the victory of Jair Bolsonaro who took over as the country's president on 1st January 2019. Bolsonaro's government has represented regression on climate action in Brazil, with important legislative changes including the weakening of the institutional and legal framework that helps fight deforestation and other environmental offenses, as well as reforms that substantially weaken the participation of civil society, including pro-environment groups, in policymaking and in oversight of policy implementation (Climate Action Tracker, 2019a). While it is hard to predict the effect these regulatory changes will have on emissions, most of them have the potential to drive up illegal deforestation and other environmental offenses which would result in a significant increase in the emissions from the land use, land-use change, and forestry (LULUCF) sector, as already evidenced in the unprecedented fires observed in the Amazon rainforest in 2019, directly related to deforestation activities.

Our results show that Brazil's 2030 NDC excl. LULUCF is in line with least-cost scenarios and the less ambitious end of equity-based approaches, at around the level of 2005 emissions. The equity-based approaches in this range rely on other countries to do more, to limit global temperature increase to 1.5°C. To move to a Paris compatible range, Brazil would need to reduce emissions by at least 50% below 2005, according to equity-based approaches.

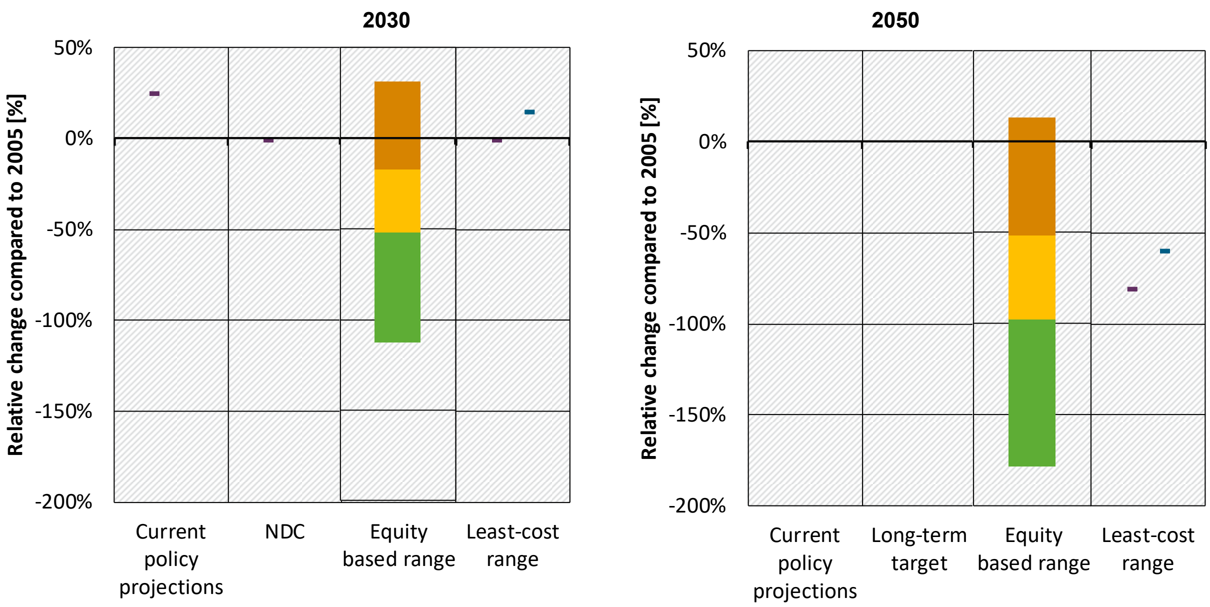


Figure 1: Brazil – Relative change in GHG emissions excl. LULUCF compared to base year for equity and cost-based approaches

Notes: Current policy projections, NDC and equity-based emissions reduction ranges from Climate Action Tracker—equity range from 2018 (December update), other data from (2019 April update). Legend: For equity-based range: orange (upper range) is >2°C consistent, yellow (middle range) is 2°C consistent, green (low range) is 1.5°C consistent. For least-cost range: lower limit for 1.5°C, upper limit for 2°C.

1.2 Socio-economic context for greenhouse gas emissions reductions

Brazil is the largest economy in Latin America and is the eighth largest in the world in terms of nominal GDP. Economic output is dominated by services and industry but agriculture, with the share of 6.6% in the GDP, playing an important role (CIA, 2019). Brazil has undergone major economic and political upheavals in the last years. In 2016, the ruling president Dilma Rousseff was impeached on grounds of alleged massive corruption. This political crisis was accompanied by the economic crises of 2015 and 2016, in which GDP fell by over 3% in both years (Macrotrends, 2019). After a sluggish growth in 2017 and 2018, Brazilian economy shrank again in early 2019 (Trading Economics, 2019).

In the last decades Brazil's economic growth has stimulated the growth of a middle class and improved the state of development, as seen by its high scores in the human development index (increase from 0.68 in 2000 to 0.76 in 2017), 100% electrification (increase from 94% in 2000), and high urbanisation rates. However, as indicated by the high value of the GINI Index, Brazil has the highest level of inequality among the countries analysed in this report.

Furthermore, Brazil faces the challenge of safeguarding its natural capital, especially the Amazonian forests. The pace of deforestation in the Amazon has been linked to cycles of economic highs and lows with the levels of deforestation increasing during times of economic crisis (Fearnside, 2017). Brazil's growing exports from agribusiness, involving agricultural and animal products, influences the rate of deforestation (MIT, 2018). In May 2019 the rate of deforestation increased significantly and by July has almost doubled in comparison to the preceding year (INPE, 2019), with an unprecedented forest fire season observed in August 2019, which has resulted in the Federal State of Amazonas to declare a state of emergency (Euronews, 2019).

Brazil is also a key exporter of crude oil. Significant reserves, which are regularly auctioned, were discovered in the pre-salt layers in 2007. In an auction on March 2018, 22 new blocks were acquired (ANP, 2018). This and future auctions can, according to some estimates, increase Brazil's oil extraction from 3.1 million barrels of oil per day (mbd) currently to 7.5 mbd in 2030 (Brazil Energy Insight, 2019).

1.2.1 Economic and development-related data

Table 1: Brazil – Key socioeconomic figures

Indicator	Value	World	Year	Source
Population [million]	209.5	7 594	2018	The World Bank
GDP [bn USD at current prices]	1 869	85 791	2018	The World Bank
GDP/cap [USD/cap]	8 921	11 297	2018	The World Bank
HDI [0 – 1]	0.76	Rank 79	2018	UNDP
GINI index [0 – 100]	53.3	n.a.	2017	The World Bank
Electrification rate [%]	100%	88.9%	2017	The World Bank
Corruption index	Score: 35/100	Rank: 105/180	2018	Transparency International
Urbanization [% of total]	86.8%	55.7%	2019	United Nations Population Division

Data sources: (Transparency International, 2018; United Nations Department of Economic and Social Affairs: Population Division, 2018; United Nations Development Programme (UNDP), 2018; Statista, 2019; The World Bank, 2019b, 2019a, 2019c).

1.2.2 Energy production and consumption

Due to the strong policy impetus on bioenergy and hydro in the past, Brazil is known to have one of the cleanest energy mixes in the world. Brazil's primary energy mix has had nearly equal shares of renewables and fossil fuels. Oil was the largest energy carrier in 2016 with a 39% share in total supply, followed by biomass and waste (30%), gas (11%), hydro (11%), and coal (6%).

However, Brazil's rapid economic growth until the financial crisis in 2008/2009 has also led to an increase in energy consumption, especially from fossil-fuels. Between 1990 and 2015 Brazil's total primary energy demand has more than doubled. While the absolute consumption of oil and traditional biomass and waste has increased steadily, their shares in the primary energy mix have declined moderately. The major upward trend has been in the rising share of natural gas, which has increased sharply from 2% in 1990 to 11% in 2016. The growth in demand can be particularly attributed to the rise in consumption of power and transportation fuels. Electricity is primarily produced from hydropower, with smaller shares from natural gas and coal. However, Brazilian hydropower has been vulnerable to draughts, which has led the government to invest in procuring power from other sources, including fossil fuels (Climate Action Tracker, 2019a).

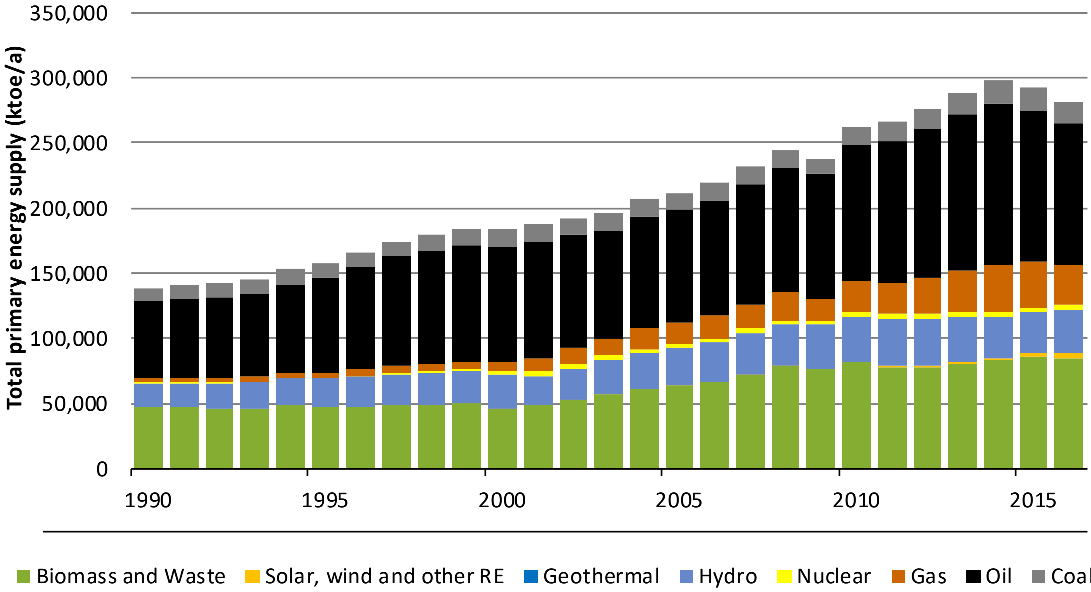


Figure 2: Brazil - Primary energy supply by energy carrier between 1990 and 2016

Data source: (IEA, 2018a)

1.3 Greenhouse gas emissions profile

Brazil emits 5.5% of global GHGs emissions, including emissions from LULUCF. Excluding the LULUCF sector Brazil's share of global emissions amounted to 2.3% (PRIMAP, 2019). Owing to a relatively clean energy profile, the energy intensity of GDP is lower than the world average. Historically, emissions from deforestation have dominated Brazil's emissions profile. While the share of deforestation emissions steadily decreased for several years, this remarkable progress in mitigating forestry emissions seems to have come to a halt in 2016. In comparison with 2015 levels, deforestation in 2016 increased by almost 30% with more than 50% of the deforestation occurring in the Amazon rainforest region, adding around 130 $MtCO_2$ to total net emissions in 2016 (Climate Action Tracker, 2018b). In 2018, Brazil recorded the world's highest loss of tropical primary rainforest of any country, reaching 1.3 million hectares, largely due to deforestation in the Amazon rainforest. National estimates show total deforestation reaching 7900 km^2 in 2018, which is an increase of 13.7% from 2017 levels and of 72% from the historic low reached in 2012 (Climate Action Tracker, 2019).

National data shows a continuation in the increasing deforestation in 2019, with deforestation rates almost doubling from 2018 rates. Despite the low energy intensity of GDP, emissions from the energy sector have been on a steady rise. The sub-sectors of transport and industrial energy use are major emitters in the energy sector (Ministry of Science and Technology of Brazil, 2016). Agriculture emissions, which account for around 40% of total emissions, are mostly from enteric fermentation from cattle ranching.

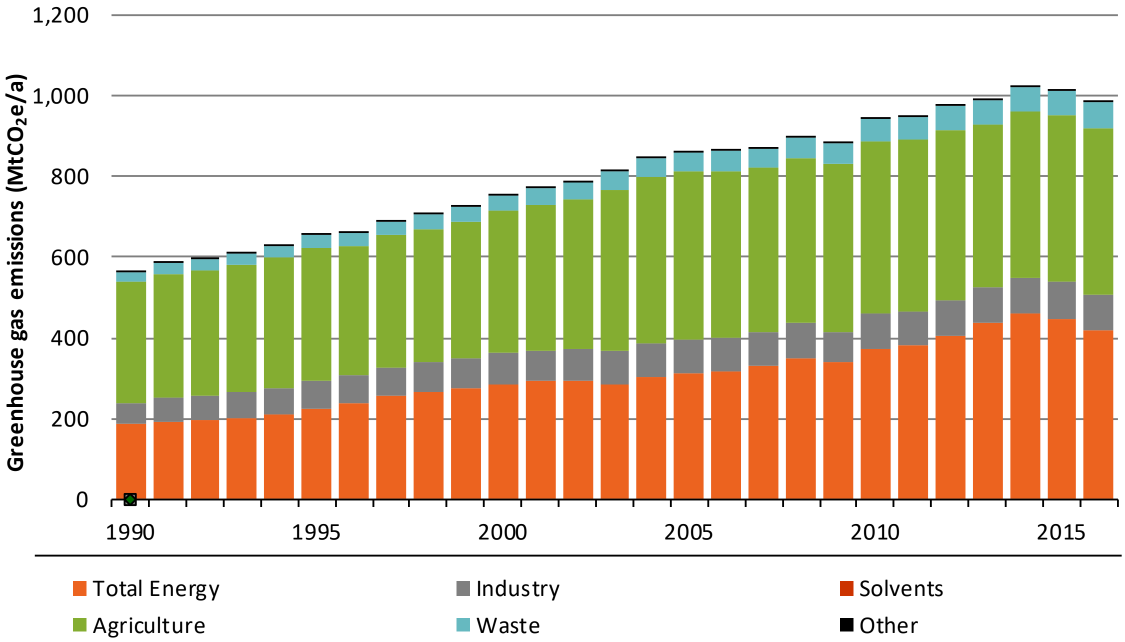


Figure 3: Brazil – Sectoral GHG emissions between 1990 and 2016

Data source: (Gütschow *et al.*, 2018a)

Table 2: Brazil – Key GHG emissions data

Indicator	Brazil	World	Year
GHG/cap [tCO_2e/cap]	4.76	6.15	2016
GHG/GDP [tCO_2e/mln USD]	551	603	2016
Energy/GDP [ktoe/mln USD]	0.14	0.18	2016
Global share of emissions [%]	5.54%	100%	2012

Data sources: (JRC and PBL, 2014; Gütschow *et al.*, 2018a; IEA, 2018b; The World Bank, 2018a). *GHG indicators were calculated using PRIMAP data and exclude contributions from the LULUCF sector.*

1.4 Development of future greenhouse gas emissions

1.4.1 Emission reduction targets and current policy projections

Brazil's NDC aims at reducing emissions to 1.3 GtCO2eq by 2025 and to 1.2 GtCO2eq by 2030. It also communicated a "subsequent indicative contribution" for 2030 of emissions reduction by 43% below 2005, including LULUCF (Federative Republic of Brazil, 2015). The Climate Action Tracker (CAT) calculates a relative change excluding LULUCF of 15% above 2005 for 2025 and 3% above 2005 for 2030. Brazil has a 2020 pledge of reducing emissions from 36.1 to 38.9% below BAU (incl. LULUCF). With implemented policies, Brazil will overachieve its 2020 target but miss its NDC targets (see Figure 39), both excluding LULUCF.

Note that the Climate Action Tracker excludes emissions from LULUCF in its outputs. To split up the Brazilian NDC into emissions excl. LULUCF and incl. LULUCF, it uses projections for emissions from LULUCF from the official national sources underlying the NDC document (Ministério da Ciência Tecnologia Inovações e Comunicações Brasil, 2017), however alternative national sources project much higher LULUCF emissions by 2030 (Rochedo et al., 2018), which would require much lower emission in other sectors for the achievement of the NDC targets.

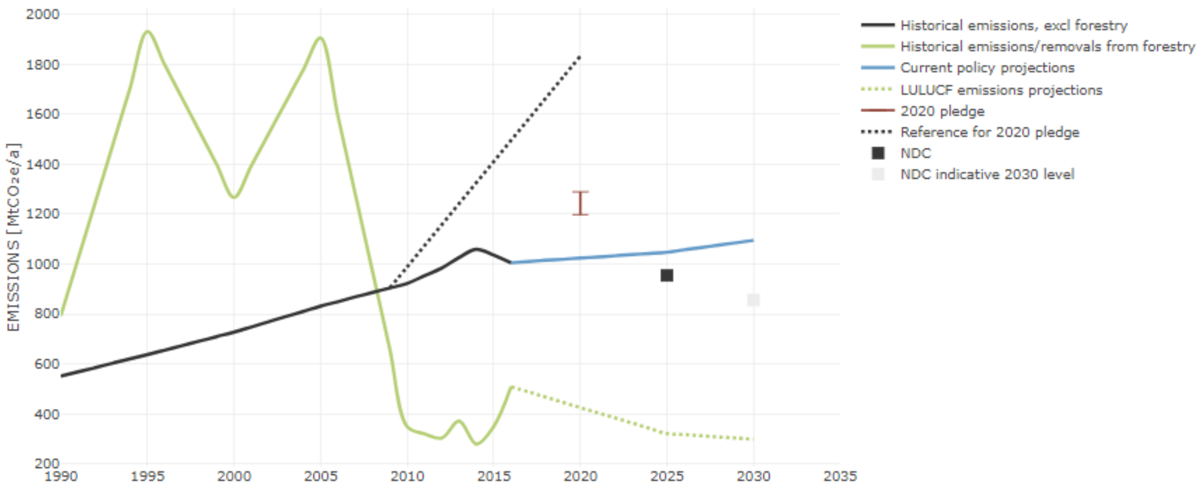


Figure 4: Brazil – Historical and projected emissions under current policies and target pathways

Data source: Climate Action Tracker 2018

1.4.2 Sectoral mitigation pathways until 2030

The highest share of energy- and process-related GHG emissions in 2015 in Brazil is allocated to the energy sector, amounting to 0.34 GtCO2eq. The energy supply sector is comprised of electricity generation as well as transformation (refineries, centralized heat, etc.). Substantial contributions also come from the transport sector, which is the source of one third of the total emissions in 2015. Emissions in the transport sector are mainly determined by road transport. About 0.17 GtCO2eq come from the industry sector, an amount that represents a share of 25% of Brazil's total emissions.

A comparison between global 1.5°C-consistent and 2 °C-consistent pathways based on recent marginal abatement cost curves (MACCs) for 2030 leads to the conclusion that the potential to reduce energy- and process-related emissions based on the MACC has to be exploited to a much larger extent to achieve 1.5 °C consistency. For Brazil, this would amount to a reduction of energy- and process-related emissions in 2030 by -30% compared to 2015 (-1% if compared to Brazil's NDC base year 2005), with the highest reduction in the energy supply sector (-50%). For the year 2030, industry, and building sectors would have an economic potential to mitigate GHG emissions ranging from 38% to 39%. Activity of the transport sector could continue to grow, with emissions' increase of 7% compared to 2015.

The cost-effective pathway compatible with 2°C by 2030 shows reductions in the energy supply sector of 49%. Emission reductions in the buildings and industry sectors are on the same level of about 20%. Transport emissions could even increase by +15%. Total emissions reductions achieved would be 19% compared to 2015 (+14% if compared to the NDC base year 2005).

For an NDC-consistent reference pathway for Brazil, the emissions reductions in the energy supply sector in 2030 amount to 29% compared to 2015 emission levels. There is no reduction of emissions achieved in the industry, building, and transport sector. On the contrary, emissions in the transport sector may increase by 23%.

The sectoral emissions reductions for the different pathways are summarized in Figure 7.

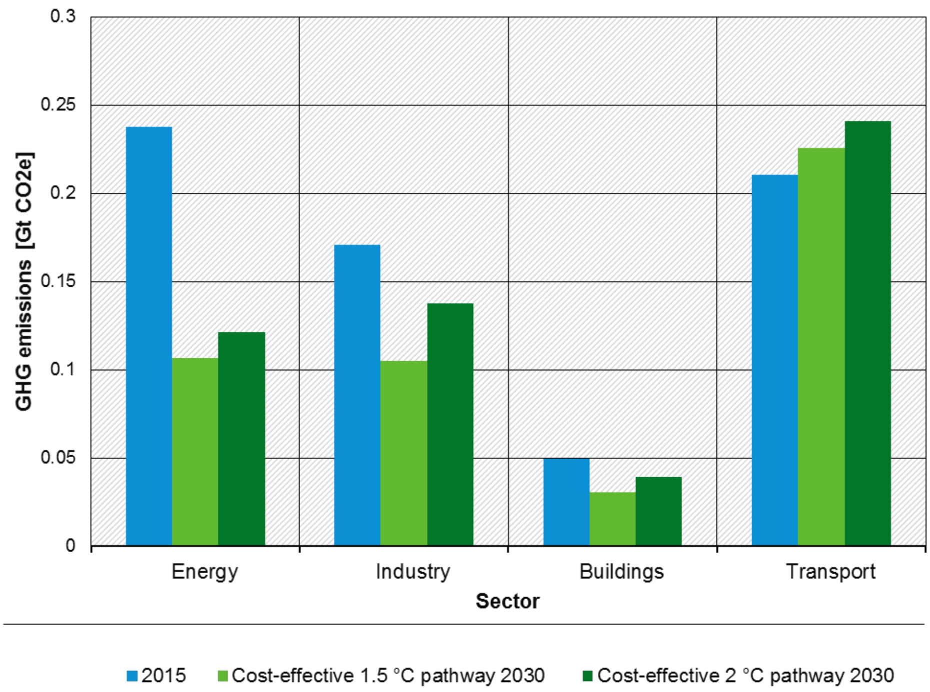


Figure 5:Brazil – Sectoral GHG reduction potentials until 2030 compared to 2015

Source: own calculation based on data from the POLES-Enerdata model

1.4.3 Emissions reduction targets suggested by equity considerations

According to different equity approaches, Brazil's emissions (excluding LULUCF) in 2030 should be at least 62% below 2015 levels (52% below 2005 levels) in order to stay within the 1.5°C temperature limit compatibility ranges of the Paris Agreement. Compatibility with the former 2°C goal would re-quire emission reductions by 34% below 2015 levels (17% below 2005 levels). These reduction ranges stand in stark contrast with the NDC reduction target excluding LULUCF (as estimated by the Climate Action Tracker) of 15% above 2005 for 2025 and 3% above 2005 for 2030.

When compared to cost-effective reduction ranges in 2030 (19-30% below 2015 levels), equity-based emissions allowances show more stringent reductions. They indicate that beyond achieving the maxi-mum potential emissions reductions domestically, to contribute its fair share to global mitigation efforts Brazil should engage actively in international cooperation for emissions mitigation. Given Brazil's huge role in the international agriculture and biofuel market, these sectors offer a large amount of potential for Brazil to get involved in international cooperation. In addition, given its remarkable progress in combating deforestation emissions between 2005 and 2015, the LULUCF sector is another area where

Brazil could engage actively in international cooperation through south-south cooperation initiatives and market activities.

In 2050, emissions allowances under equity considerations show reductions of 98% and 62% in comparison to 2015, respectively for each of the temperature targets (98% and 52% in comparison with 2005 levels). A more detailed look into Brazil's equity range shows that the categories of approaches that are focusing on responsibility as well as on a mix of responsibility, capability, and need define the lower ends of the equity ranges, for both 2030 and 2050. However, for 2030, these categories represent a broad range of emissions reductions covering – especially for 1.5°C limit – almost the whole range described above. This is explained mainly by the big differences behind the various considered studies in the share of Brazil's historical responsibility and capability to mitigate depending on the underlying metrics, starting points, and weights given to each factor.

Staged approaches, as well as approaches focusing on equal cumulative emissions per capita, lead to less stringent emission reductions and define the upper end of the full equity range for Brazil, both in 2030 and 2050. These approaches, in particular the equal cumulative emissions per capita, have a much narrower range due to convergence of the main underlying assumptions behind the studies considered (population projections in this case).

1.5 Political context

1.5.1 General disposition of the country towards climate policy

In the past years, political and economic crises have polarized climate discourses in Brazilian politics, moving the country closer to a type of all or nothing binarism. Advancements of climate policy under the Labour Party were labelled as ideologically leftist, to be fought back by the market-aligned right. The national narrative was further fuelled and legitimised by international factors, such as policies put forward by Donald Trump in the United States, in particular his announcement to withdraw from the Paris Agreement. The most recent presidential elections in 2018 won by Jair Bolsonaro have moved Brazil farther away from raising its climate ambition and from fulfilling its commitments under the Paris Agreement. Victory of his allied or aligned parties in 15 out 27 states in Brazil, including São Paulo, Minas Gerais, Rio de Janeiro, and Amazonas, also point to a general disengagement from climate ambition at the subnational level (Vilela, 2018).

The agricultural lobby has funded parliamentarians and re-forged a consensus on the inherently "leftist" character of environmental preservation. This has forced even more centrist parties to minimise or drop altogether mentions of the fight against deforestation, which plays a pivotal role in the country's emissions and in the decarbonisation, plans laid out in the Brazilian NDC. The agricultural caucus has been a strong supporter of president Bolsonaro, who signalled alignment with the lobby's anti-climate agendas throughout his campaign. Brazilian NGOs, Observatório do Clima, identifies the "Bolsonaro effect" as one of the causes for the 36% increase in deforestation rates during the presidential election campaign, between June and September 2018, owing to the legitimation Bolsonaro provided to loggers when he was the candidate ahead of the polls (Observatório do Clima, 2018).

The central role of agriculture in the Brazilian economy has granted the "agriculture caucus" the ability to form the second largest coordinated legislative group in National Congress, with wide representation in the national and state legislatives (Kadanus, 2018). The group responds to demands by the agricultural lobby, which generally opposes preservation efforts brought forth by environmentalists and indigenists. International pressure, national public opinion, and fear of commercial reprisals to Brazilian exports, including agricultural commodities, led the then candidate Bolsonaro to shift his core narrative. Ahead of elections, he announced he would no longer defend the Brazilian withdrawal from the Paris Agreement (Deutsche Welle, 2018). These three forces together, particularly the international threat to the rural lobby's interests, should remain decisive for curtailing blatantly anti-climate policies of

Bolsonaro's administration. An example of the international pressure in the making was clearly visible in French president's Macron opposition to the trade deal between the EU and Mercosur in reaction to the massive forest fires in August 2019 (Politico, 2019). Soon after, Bolsonaro announced sending military to tackle Amazon fires (DW, 2019a).

Nonetheless, while the levels of deforestation have been decreasing since 2016, since May 2019 this increase accelerated significantly with 2,072 km^2 of the Amazon forest cut down only in June 2019 (INPE, 2019b). This is more than a quarter of the total deforestation that took place in 2018 – already a year with the highest levels of deforestation since 2012 (PRODES, 2019).

Extraction of oil and gas in Brazil is heavily subsidized. Direct subsidies to extraction of fossil fuels amounted to USD 4.9 billion in 2015, through tax exemptions and direct spending by public bodies (ODI, 2015). In December 2017, the government approved a new tax waiver to oil and gas production up to 2040. That could sum up to BRL 40 billion per year (approximately USD 11 billion) if only the recently discovered pre-salt reserves are considered (Lima, 2017).

Renewables have a privileged role in Brazilian climate politics, with all of the candidates of the most recent presidential election vowing to promote renewable sources of energy if elected. Economics explain a big part of this consensus. Even though coal generation was controversially allowed to participate in the energy auction (A6) in August 2018, due to the national coal lobby, not a single coal unit was contracted. In fact, out of the 2.1 GW contracted, 1.25 GW or 60% of the total went to wind energy installations, with the average price of BRL 90,45 ($24,27) per MWh (Costa, 2018). A fifth of the remaining capacity went to hydroelectric power plants and 1.36% to biomass. The only contracted energy from fossil fuel came from a single gas power plant which represented 17.3% of the total at a price of BRL 179.98 ($48,29) per MWh.

1.5.2 Relevant political processes in the foreseeable future

After the general elections in 2018, the next presidential, gubernatorial and congressional elections are scheduled to take place on the first Sunday in October 2022. Should none of the presidential candidates reach 50% majority, the second round of elections will be held on the last Sunday of that month. The congressional elections will lead to electing one third of the 81 Senators and all members of the Chamber of Deputies. In the meantime, one could expect comparatively stable government accompanied with protests against the Bolsonaro's radical policies.

1.5.3 Prospects for a review and increase of the national climate ambition

The prospects for increasing the level of national ambition is rather bleak. Bolsonaro's response to the international critique of a significant increase in deforestation was either indifference (in reaction to German threat to cut funding for forest and biodiversity projects in Brazil) or counteraccusations (towards Norway accusing it for "sponsoring the killing of whales" with misleading pictures) (DW, 2019b; France24, 2019a). The fact that – as described earlier - Bolsonaro decided to take action against the forest fires following the threat of President Macron's opposition to the free trade agreement between Mercosur and the EU, shows that international pressure seemingly can only work if there is a potential for a negative impact on Brazil's agricultural sector that could benefit significantly from exports to the EU (France24, 2019b). But, while reducing the damage, it can hardly be expected that international pressure will lead the Brazilian government to increase the level of ambition in the area of climate action.

Brazil's emissions will rather be shaped by such factors as the increasing demand for soybeans by China resulting from US-China trade war, the price of oil, which determines the rationale for the extraction of new oil and gas fields, and the solution of the dispute between Petrobras and the Brazilian government over contract that specified the details of extracting a big part of the resources (Bloomberg, 2019b, 2019a). The continuous fall in the costs of renewables may, on the other hand, further decrease the chances of fossil fuels in the energy auctions.

1.5.4 Civil society

Climate awareness is generally high in Brazil, but it is not followed directly by higher levels of engagement. According to the Pew Research Center's survey from early 2019, 72% of Brazilians perceived climate change as a major threat to their country – the highest share, ahead even of the condition of global economy (Poushter and Huang, 2019). Inversely, a survey on the implementation of the sustainable development goals in 2017 showed that only 3% of Brazilians felt eager to contribute to fighting climate change (United Nations Brazil, 2018).

The 2018 elections showed that although they were aware of the problems, climate and environmental concerns were not sufficient to influence the votes of the majority of Brazilians. During campaigns, president elect Jair Bolsonaro signalized opposition to the Paris Agreement, to the reduction of greenhouse gas emissions, to the maintenance of protected areas, to the protection of indigenous communities and traditional black communities, to ensuring environmental licensing, and to cutting fossil fuel subsidies (Vialli, 2018). An August 2019 survey reported that 53.7% of Brazilians presently criticised Bolsonaro's presidential performance, and 93.5% feel that preserving the environment is very important to them (CNT&MDA, 2019).The conflict resulting from this opposition has made the country a place where many environmentalists are killed every year, with 57 deaths in 2017 or roughly 28% of the total in the world (Global Witness, 2018). Unlike agriculture, forestry, and land use, the energy sector in Brazil tends to be less polarized, for good and for bad. The fact that over 61% of all cargo in the country was transported by road in August 2018, against less than 21% by railroad and 14% by water (CNT, 2018), means that fuel prices have a big impact on the price of basic products such as food, influencing inflation and poor households. Measures to reduce the government's artificial control over fuel prices, and instead leave it to fluctuate according to international markets, led to a mass 10-day strike by truck drivers, paralysing roads and creating food shortages all over the country in May 2018 (Phillips and Cowie, 2018).

One of the major climate-focused NGOs in Brazil is Observatório do Clima. Comprised of many civil organizations, Observatório do Clima is committed to promoting transparent, inclusive public engagement within climate change dialogues in Brazil. Founded in 2002, the group's primary objectives concerns protecting Brazil's existing forest assets from deforestation, creating a forum focused on public climate interest, and promoting an environment-centred cultural shift. In its long participation in the fight against climate change, it has conducted research, monitored and publicized federal climate action, and maintained its core mission of supporting an increase in climate action (Observatório do Clima, 2019).

An important role in voicing concern about the impact of climate change on the Amazon rainforest is played by organizations representing indigenous groups. Since 1989 the action of Indigenous organizations has been coordinated by the Coordination of the Indigenous Organizations of the Brazilian Amazon (COIAB), representing 75 organizations and 160 indigenous communities populated by 430.000 people. It has repeatedly criticized government's actions towards some of these communities as "arrogant and disrespectful". COIAB has also blamed the forest fires in August 2019 on the "anti-indigenous and anti-environmental discourse" spread by the Bolsonaro's administration (COIAB, 2019a, 2019b). Indigenous communities were also organizing protests calling Bolsonaro's environmental policies "genocidal" (The Globe Post, 2019).

1.5.5 Potential NDC review process and historical precedent

While Bolsonaro backed down on his initial plans to leave the Paris Agreement, one cannot expect a significant increase in the level of ambition of Brazil's NDC. Such expectations are further weakened by the increasing discrepancy between the existing NDC and the emissions trends, resulting especially from the accelerating deforestation.

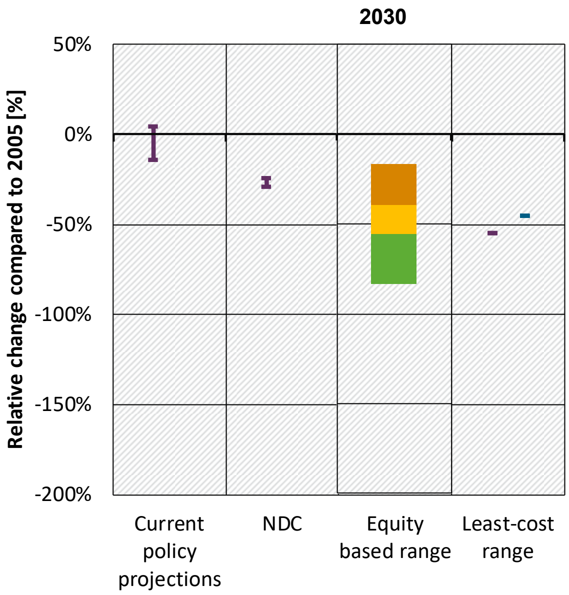
Should such an increase in the level of ambition nonetheless take place, it may take the form of a conditional pledge, made dependent on substantial external funding.

2 Canada

2.1 Introduction

Implementing the policies necessary to meet Canada's current NDC goals appears politically infeasible at present, making a political commitment to even more challenging goals seem improbable. However, Canada's history highlights a separation between the political feasibility of setting ambitious goals and enacting the policies that achieve them—securing a higher target may be a possibility, but it would be under a high risk of not being met, save for a change in politics.

Both equity and least-cost based approaches indicate that a stronger target is necessary for a globally cost-efficient and fair distribution of efforts to limit temperature increase to 1.5°C. Both approaches foresee significant emission reductions for 2030. In 2050, least-cost approaches suggest emissions decreasing by almost 100%, while equity-based approaches indicate the need for negative emissions allowances (negative physical emissions or support of other countries' mitigation efforts).



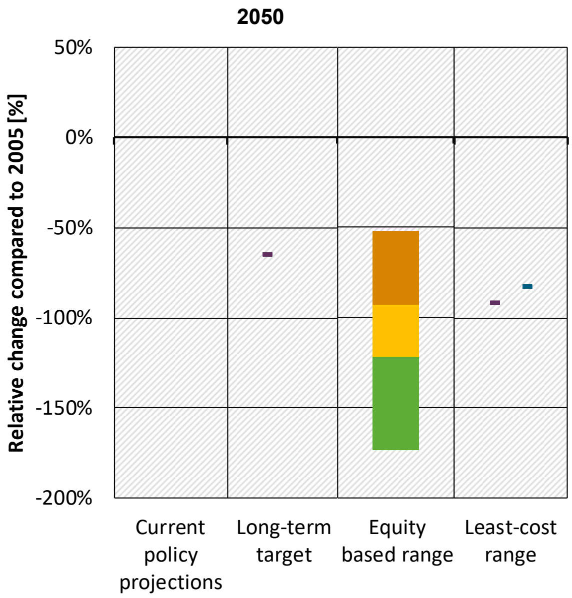


Figure 6: Canada – Relative change in GHG emissions excl. LULUCF compared to base year for equity and cost-based approaches

Notes: Current policy projections, NDC and equity-based emissions reduction ranges from Climate Action Tracker—equity range from 2018 (December update), other data from (2019 April update). Legend: For equity-based range: orange (upper range) is >2°C consistent, yellow (middle range) is 2°C consistent, green (low range) is 1.5°C consistent. For least-cost range: lower limit for 1.5°C, upper limit for 2°C.

2.2 Socio-economic context for greenhouse gas emissions reductions

Canada is the second largest country in the world in terms of land area. It is sparsely populated for its size with 37 million residents, a fifth of which are immigrants. The Canadian populace enjoys a fairly high standard of living. Canadian GDP stands at 1.7 trillion USD and represents an export-oriented economy. Canada is rich in valuable natural resources, including natural gas and petroleum, which form a significant part of the Canadian economy and exports. The United States is Canada's largest trade partner and importer of Canadian oil. The Canadian economy has grown moderately in the last years. The IMF foresees a slight slowdown in GDP growth in 2019 to 1.5 per cent due to slowing global growth and low export rate (IMF, 2019a).

2.2.1 Economic and development-related data

Table 3: Canada – Key socioeconomic figures

Indicator	Value	World	Year	Source
Population [million]	37	7 594	2018	The World Bank
GDP [bn USD at current prices]	1 709	85 791	2018	The World Bank
GDP/cap [USD/cap]	46 125	11 297	2018	The World Bank
HDI [0 – 1]	0.93	Rank 12	2018	UNDP
GINI index [0 – 100]	34.0	n.a.	2013	The World Bank
Electrification rate [%]	100%	88.9%	2017	The World Bank
Corruption index	Score: 81/100	Rank: 9/180	2018	Transparency International
Urbanization [% of total]	81.4%	55.3%	2018	United Nations Population Division

Data sources: (Transparency International, 2018; United Nations Department of Economic and Social Affairs: Population Division, 2018; United Nations Development Programme (UNDP), 2018; Statista, 2019; The World Bank, 2019b, 2019a, 2019c).

2.2.2 Energy production and consumption

Canada's primary energy demand has been on the rise. Oil (34%) was the largest energy carrier in 2017, followed by gas (35%), hydro (11%), nuclear (9%), coal (6%) and biomass and waste (5%). Between 1990 and 2017, natural gas use steeply increased to replace coal (whose share reduced by half in the period) and to a lesser extent oil. Canada is the fourth largest producer and exporter of natural gas. Nu-clear and hydro have grown at a stable pace, contributing close to 60% of Canada's power supply. While a federal level effort to promote renewables is missing, Canadian provinces have pushed for renewable power sources such as solar and wind. This is reflected by an increase of their share in the energy mix in 2017.

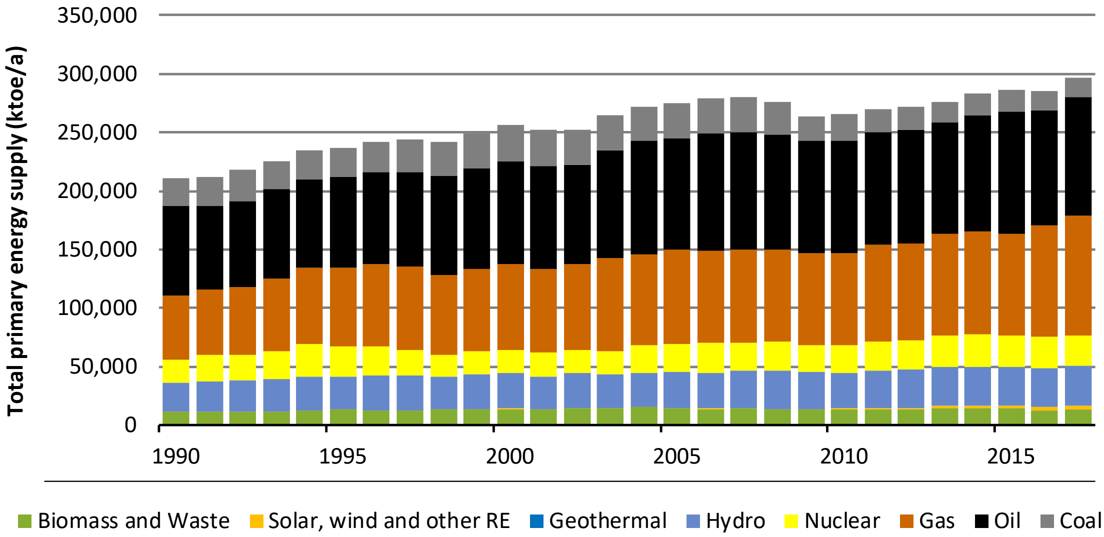


Figure 7: Canada – Primary energy supply by energy carrier between 1990 and 2017

Data source: (IEA, 2018b)

2.3 Greenhouse gas emissions profile

Canadian emissions are mainly driven by energy use, emitting 82% of the total emissions (excluding LULUCF). With a relatively clean grid, the Canadian power sector emissions have a smaller share. Emissions from the oil and gas sector and transport sector make up a major share of energy combustion emissions, followed by the building sector. Canadian reported LULUCF emissions have shown a trend towards net removals (i.e. more CO2 was removed from the sector than added to it). However, it is notable that Canada excludes natural disturbances including forest fires, which have been a recurrent challenge for Canada, in its national inventory. If those were included, the trend may look different.

Canada's per capita emissions are more than three times the world average due to its small, affluent population. In total, Canada emitted close to 2% of global emissions in 2012.

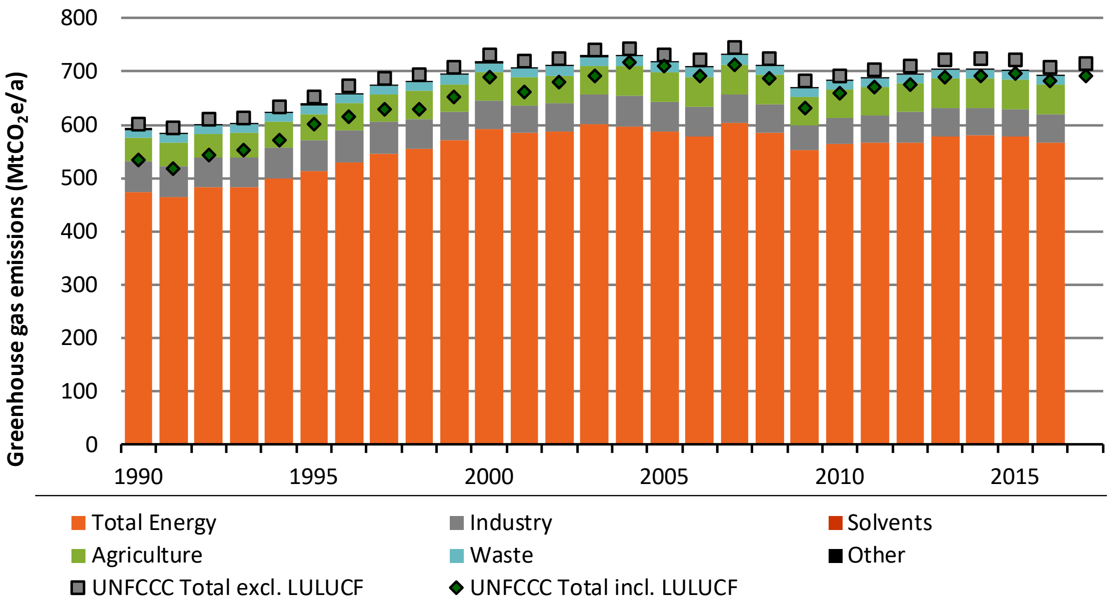


Figure 8: Canada – Sectoral GHG emissions between 1990 and 2016

Data sources: (Gütschow *et al.*, 2018a; UNFCCC, 2019)

Table 4: Canada – Key GHG emissions data

Indicator	Canada	World	Year
GHG/cap [tCO_2e/cap]	19.11	6.15	2016
GHG/GDP [tCO_2e/mln USD]	451	603	2016
Energy/GDP [ktoe/mln USD]	0.18	0.18	2017 (World: 2016)
Global share of emissions [%]	1.9%	100%	2012

Data sources: (JRC and PBL, 2014; Gütschow *et al.*, 2018a; IEA, 2018b; The World Bank, 2018b). *GHG indicators were calculated using PRIMAP data and exclude contributions from the LULUCF sector.*

2.4 Development of future greenhouse gas emissions

2.4.1 Emission reduction targets and current policy projections

Canada's NDC aims at reducing emissions by 30% below 2005 levels by 2030 including LULUCF. The CAT calculates equal corresponding reductions below 2005 levels excluding LULUCF, based on an interpretation of the Canadian NDC text on LULUCF accounting which resulted in an increase of emissions by 4% above 1990 levels. Canada has a 2020 pledge of reducing emissions by 17% below 2005 levels (incl. LULUCF). Under the Kyoto Protocol, Canada had a target of reducing emissions by 6% be-low 1990 levels for the first commitment period, however, the Canadian government withdrew from the Protocol in 2011. Canada has a long-term emission reduction target of 80% below 2005 levels by 2050.

With already implemented policies, Canada will achieve its 2020 target under the scenarios that assume slower economic growth and high oil and gas prices, according to a Climate Action Tracker analysis (see Figure 9). Projections show the country achieving its NDC targets, with additional use of LU-LUCF accounting rules.

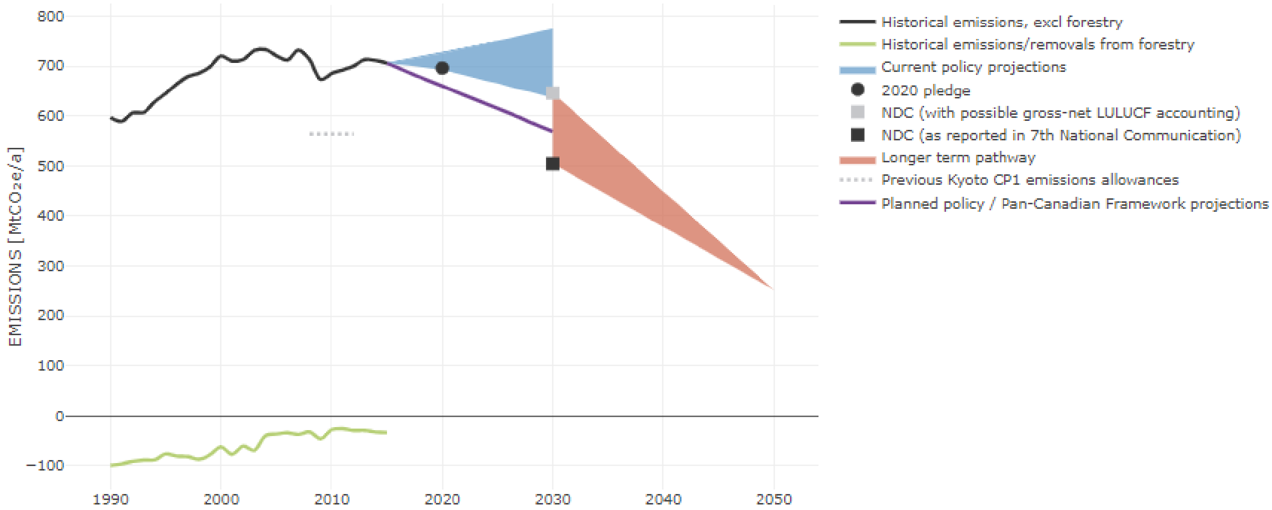


Figure 9: Canada – Historical and projected emissions under current policies and target pathways

Source: Climate Action Tracker 2018

2.4.2 Sectoral mitigation pathways until 2030

In 2015, the highest share of energy- and process-related GHG emissions in Canada occurred in the energy sector followed by the transport, industry and building sectors (see Figure 10). Emissions in the transport sector are mainly determined by road transport. The energy supply sector is comprised of emissions from electricity generation as well as transformation (centralized heat, refineries, etc.).

A comparison between global 1.5°C consistent and 2 °C consistent pathways based on MACCs for 2030 leads to the conclusion that the potential to reduce energy- and process-related emissions has to be exploited to a much larger extent to achieve 1.5 °C consistency. For Canada, this would amount to a reduction of energy- and process-related emissions in 2030 by 53% compared to 2015 (55% if com-pared to the base year 2005 selected for the NDC). The potential is highest within the energy supply sector with 61% compared to 2015, followed by industry with 59% and the buildings sector with 50%. The transport sector shows the lowest potential with reductions of 39% compared to 2015.

When assuming a global cost-effective pathway compatible with 2°C by 2030, the economic potential to reduce energy- and process-related emissions in Canada amounts to 43% compared to 2015 and 45% compared to NDC's base year of 2005. The emissions reduction potentials stay the same: reductions in the energy supply sector amount to 53% compared to 2015, followed by industry with 42%, the building sector with 36% and the transport sector with 31%.

In an NDC-compatible reference pathway, the total mitigation amounts to 30% in 2030 compared to 2015. The highest emission reduction comes from the energy supply sector with 41%. The sectoral GHG reduction pathways are summarized in Figure 10.

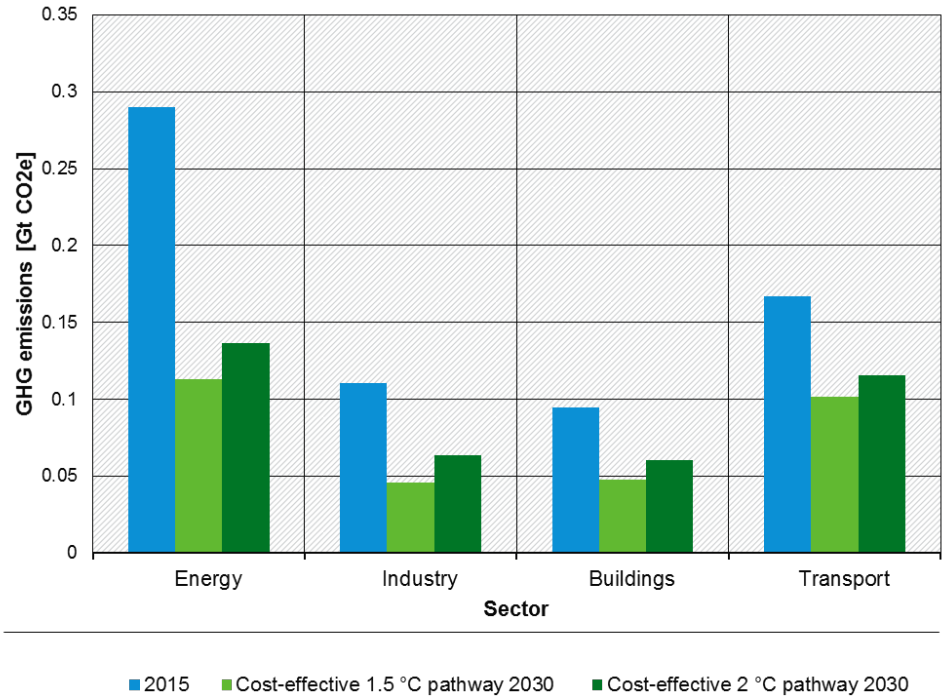


Figure 10: Canada – Sectoral GHG reduction pathways until 2030 compared to 2015

Source: own calculation based on data from the POLES-Enerdata model

2.4.3 Emissions reduction targets suggested by equity considerations

In comparison to the division of effort based on cost-effective approaches, the fairness-based effort-sharing approaches require similar reduction levels for Canada in 2030 but much lower emission allowances in 2050. Equity-based emissions allowances consistent with the 2°C goal require emissions reductions of at least 38% below 2015 levels (39% below 2005 levels), whereas allowances consistent with the 1.5°C limit require emissions reductions by at least 54% below 2015 levels (55% below 2005 levels).

In 2050, emissions allowances under equity considerations show reductions of 123% and 93% in comparison to 2015, respectively for each of the temperature targets (same per cent reduction in comparison with 2005 levels). This means that the full range of 1.5°C compatible emissions allowances for Canada represent negative emissions levels by 2050, pointing to the large role Canada should play in international cooperation to global mitigation efforts (including carbon markets and climate finance).

A more detailed look into Canada's equity range shows that the categories of approaches focusing on equal cumulative emissions per capita and historical responsibility define the lower ends of the equity ranges, both for 2030 and 2050. This reflects Canada´s relatively high share of historical responsibility for global emissions and its high current emissions levels on a per capita basis (due to its relatively small population size).

In contrast, staged approaches lead to less stringent emissions reduction and define the upper end of the full equity range for Canada in 2030 and the second highest allowances in 2050. Other approaches, such as ones involving capability, cover a broad range of allowances similar to the full equity range, due to large divergence of the main underlying assumptions behind the studies considered (share of global GDP vs GDP per capita vs HDI in this case).

2.5 Political context

2.5.1 General disposition of the country towards climate policy

Canada's disposition toward climate action over the past two decades has been strongly linked to the respective government in power. Those affiliated with the centre-left Liberal party[1] generally highlight the need for climate action and have committed Canada to ambitious targets, while the decade in which the country was led by the Conservative Party under Stephen Harper (2006-2015) saw less political support at the federal level for climate change action.[2] However, political disposition and actual emissions trajectories do not correlate: annual Canadian emissions rose by roughly 115 $MtCO_2eq$ in the "Liberal-led" years of 1993-2005 to about 720 $MtCO_2eq$, whereas they were at similar levels (having dipped significantly around the 2008 recession) when Harper left office.[3] No Canadian governments' ambition for climate action has lined up with its actual emissions reduction policies. The importance and political weight of fossil fuel extraction has caused conflict between energy and climate policies under all Canadian governments throughout the past decades and continues under the current Trudeau government in the form of what activists have called "climate hypocrisy" (Bill McKibben, 2017).[4]

The Trudeau government's greatest offense occurred in May 2018, when the administration announced that it would purchase and complete the Trans Mountain pipeline system and expansion project, which was until then owned and halted by Texas-based company Kinder Morgan (NPR, 2018),[5] for C$4.5 billion in taxpayer money (Walkom, 2018; Government of Canada, 2019a).[6] The structure will carry an estimated 890,000 barrels of oil per day, significantly increasing Canada's emissions through the extraction, transport and preliminary processing of the product in addition to its combustion in recipient countries (Issawi and Cruickshank, 2019).

Climate policies abound at both the federal and provincial levels, with the current government's "Pan-Canadian Framework on Clean Growth and Climate Change"—upon which its NDC is based—setting a national baseline or "backstop" for emission reduction through carbon pricing. The latter was implemented through the Greenhouse Gas Pollution Pricing Act, which went into effect in January 2019.[7] Individual provinces can tailor carbon pricing measures (e.g., emission trading programs or carbon taxes) to their economic and political circumstances as long as they meet the framework's overall requirements (Government of Canada, 2019b). The backstop itself is enshrined in Canada's revised NDC, submitted in 2017, which connects the domestic climate policy to the country's international pledge (Government of Canada, 2017a).

[1] Chrétien from 1993-2003, Martin from 2003-2005, and the current Trudeau government since 2015

[2] Superficially, the country's "behaviour" on the international stage reflects this difference: it was under Liberal governments that Canada set its Kyoto Protocol targets and ratified the treaty, while it was the Harper government that withdrew Canada from the accord in 2011.

[3] Harper's reason for pulling Canada out of the Protocol was its inability to meet the target set by his government's predecessor more than an effort to appeal to an electorate disinterested in climate change action. In fact, Canadian public opinion polls shortly after Harper became prime minister showed unusually strong support for climate action, leading him to re-instate elements of the previous government's regulatory programme on emissions despite his party's traditional opposition to regulation in favour of voluntary measures. See Compston and Bailey (2008) "Turning Down the Heat: The Politics of Climate Policy in Affluent Democracies." New York: Palgrave Macmillan, 2008. Pages 227-229.

[4] Trudeau supports continuing to extract, and building pipelines to export, oil from deposits known as the oil- or tar-sands which are famously carbon intensive to process compared to other sources because of their high bitumen content. Advocates of mitigation push for an end to oil sands exploitation on climate and general environmental grounds, pointing out that leaving the estimated 173 billion barrels of tar sands oil in the ground would avoid the massive GHG emissions their extraction, refining, transport and of course combustion would cause (Bill McKibben, 2017).

[5] The pipeline expansion had been stalled due to opposition from indigenous groups and citizens of British Columbia because of increased likelihood of heavy oil spills in their region (NPR, 2018).

[6] That cost (=US$3.5 billion) covers only the acquisition of Kinder Morgan's assets – it does not include the estimated C$7.4 billion cost of the expansion (Smith, 2018; Walkom, 2018).

[7] The Canadian government provides information on the workings of the Act online at https://www.canada.ca/en/revenue-agency/campaigns/pollution-pricing.html

In 2017, Canada co-founded the Powering Past Coal Alliance to help accelerate clean growth and climate protection through the rapid phase-out of traditional coal-fired electricity (Government of Canada, 2017b). In February 2018, the Minister of Environment and Climate Change announced amendments to existing regulations to phase out traditional coal-fired electricity in Canada by 2030. Additional performance standards on coal and natural gas-fired power stations were adopted in December 2018 to ensure the 2030 goal is met (Climate Action Tracker, 2019b).

Despite general acceptance of climate policy in the past, there has recently been strong pushback to federal carbon pricing at the provincial level, amongst others by Manitoba, Ontario and Saskatchewan, followed by the leader of the conservative party promising a roll back of the federal carbon tax in the wake of the general elections in October 2019 (Carbon Pulse, 2018a, 2018b; Reuters, 2019). A national climate emergency was declared by the House of Commons in June 2019, following a motion by Trudeau. The declaration urges the country to meet its national emissions target under the Paris Agreement and calls for "making deeper reductions in line with the Agreement's objective of holding global warming below two degrees Celsius and pursuing efforts to keep global warming below 1.5 degrees Celsius". However, because it was passed as a resolution and not an order, it is simply a declaration of purpose and will not have any specific policy impacts (Connolly, 2019).

2.5.2 Relevant political processes in the foreseeable future

Canada will hold a national election in or before October 2019. The two parties with the highest representation at the federal level are the Conservatives and the Liberals, followed by the New Democratic Party (NDP), which espouses a social democracy platform. A win for the Liberals would continue Canada's current federal climate policy approach, whereas the current leader of the Conservatives, Andrew Sheer, recently unveiled a climate plan that would eliminate the federal carbon pricing requirement and initially voted against Canada acceding to the Paris Agreement (although he voted to re-affirm Canada's ratification a year later).NDP leader, Jagmeet Singh, opposes the oil pipeline projects supported by other leaders and favours an emission reduction target of 30% below 2005 levels by 2025—rather than by 2030 as currently laid out in the country's NDC. His party supports phasing out coal, a zero-emissions vehicle agenda and subsidizing low-emission companies. It would seem, therefore, that an NDP win (or at least substantial increase in parliamentary seats) is the 2019 federal election outcome most conducive to Canada going beyond its current NDC in terms of ambition. As history has shown, however, policy *ambition* at the Canadian federal level rarely correlates with policy *outcomes* in terms of climate change mitigation (Canada's National Observer, 2017; CBC News, 2019; Climate Action Tracker, 2019b; Levesque, 2019).

At the subnational level, the climate policy ambition of ruling Parties has historically correlated more closely with outcomes. The country's four most populous provinces have had (and, with the exception of Ontario, continue to have) carbon pricing measures in place: Alberta has had an intensity-based emission reduction crediting system in place since 2007, British Columbia a carbon tax since 2007 as well, and Ontario and Quebec form part of the Western Climate Initiative (WCI) with California, although Ontario left the market in summer 2018 after a change in government (C2ES, 2016; Busch, 2018). With the exception of Alberta, emissions in all four provinces have decreased since 2005 (Government of Canada, 2019c). Ontario has phased out coal-fired power generation, and Quebec taxes fossil fuels in addition to covering its industrial sector with the emissions trading scheme. The degree to which these provincial policies can be sustained and strengthened determines the feasibility of Canada (as a whole) being able to realistically increase its NDC ambition. However, at the time of writing, the first case in a series of four provincial challenges to the federal carbon tax is making its way to the Supreme Court. Additionally, Alberta's recently elected conservative government has already begun rolling back climate policy (Climate Action Tracker, 2019b).

2.5.3 Prospects for a review and increase of the national climate ambition

Given the importance of climate action at the *sub*national level in Canada, interactions between provincial and federal climate change policies (and related timelines) strongly affect the nation's mitigation ambition. Canada's overarching framework law provides provinces the flexibility to implement their own policies as long as they meet or surpass the backstop federal carbon pricing system, which applies in any province that does *not* have its own carbon pricing system in place by January 2019.[8] Originally this date was January 2018, but was extended by a year in December 2017 (Rabson, 2017). This delay does not reflect well on the government's ability to set up and enforce policies geared at achieving the country's current level of climate mitigation ambition, let alone more ambitious climate action.

Provinces had until the 30th of March 2018 to let the federal government know if they planned to use the federal backstop as their provincial carbon pricing policy—not a single province did so (Canada's National Observer, 2018). In October 2018, Canada's government announced it had assessed the compatibility of provinces' own carbon pricing plans with federal requirements and concluded that those of Alberta, British Columbia, Newfoundland and Labrador, Nova Scotia and Quebec met the requirements. The federal backstop—consisting of a carbon levy and emissions limits for industrial emitters—entered into force in Ontario, Saskatchewan, Manitoba, and New Brunswick in early 2019. A scaled-down version was applied to Canada's remote northern territories, whose distance, small population, and extreme climate make them far more fuel dependent than the larger provinces (Government of Canada, 2019b).

The provincial pushbacks against federal carbon pricing will reduce the feasibility of the expected emissions reductions. In June 2018, following Ontario's rollbacks of carbon pricing, businesses lost billions of dollars tied to cap-and-trade related investments and cancelled several clean energy and energy efficiency activities. Four provinces (Saskatchewan, Manitoba, Ontario, and New Brunswick) filed court cases against the carbon pricing backstop. The first case was decided in favour of the federal government in June 2019, but will be appealed to the Supreme Court (Mondaq, 2019). In addition, New Brunswick and Alberta have newly elected governments that campaigned on fighting a carbon price—in June 2019 Alberta cancelled its provincial carbon pricing system (IPS, 2019). Given that Canadian emissions are unlikely to achieve the goals espoused in its *existing* NDC even under conditions in which the federal carbon pricing plan is fully implemented (Rissman *et al.*, 2018),[9] the political feasibility of *more* ambitious domestic climate change mitigation action is very low.

In contrast to their US counterparts, relevant Canadian industry groups do not publicly oppose national climate change mitigation efforts and GHG reduction targets, but instead lobby for policies aiming to meet those targets through market-based mechanisms that exempt or provide alternatives for energy intensive trade exposed (EITE) industries. The climate change policy stance of the powerful Canadian Association of Petroleum Producers (CAPP), for instance, calls for environmental regulations that preserve the international competitiveness of Canadian industries and avoid carbon leakage, e.g., by

[8] The federal benchmark requires putting a price on carbon that starts at C$20/tonne CO_2 equivalent and rachets up by C$10 per year to reach C$50/tonne by 2022. Provinces with carbon pricing plans must modify them to the extent necessary to reach carbon prices of this trajectory, as assessed by the federal Ministry of Environment. Those whose policies are deemed inadequate will be subject to the federal backstop. The backstop in turn consists of two components: a carbon levy applied to fossil fuels where they enter the supply chain (i.e. paid by fuel distributors or importers) and an output-based pricing system for industrial facilities that emit above a certain threshold, with an opt-in capability for smaller facilities. The latter will operate as a baseline-and-credit system, with facilities that emit less than their quota able to earn surplus credits that can be sold to over-emitting facilities. For more details, see (Government of Canada, 2018).

[9] Modeling of the Pan-Canadian Framework plan by two North American think tanks in March 2018 showed that even if the plan's policies are fully implemented, Canada's 2030 emissions will exceed the NDC target by 161 million tonnes - a gap 3.7 times larger than the 44 million tonne shortfall predicted by the Canadian government (Rissman *et al.*, 2018)

allowing industrial emissions to be offset domestically and internationally.[10] To the extent highly emitting industries are involved in policy decisions on climate change mitigation, they lobby less on the *ambition* and more on the policy *design*, favouring measures that exempt resource extraction by allowing for global offsetting. Furthermore, several prominent mining and energy companies[11] are members of the International Emissions Trading Association (IETA), which lobbies for market-based carbon pricing policies. With IETA's North American headquarters in Toronto, the group has voiced strong opposition to Ontario's new government cancelling the province's emissions trading system and thereby removing it from the Western Climate Initiative carbon market. The IETA has also been involved in public consultation around the design of California's carbon market going forward and of the federal climate change mitigation programme under the Trudeau government (IETA, 2019).

2.5.4 Civil society

Canadian non-governmental groups have the same level of prominence and influence on climate action as they do in other industrialised countries. Many are, in fact, part of the Canadian national branch of international non-governmental environmental organizations like Friends of the Earth Canada, Oxfam Canada, Greenpeace Canada and WWF Canada. Two uniquely Canadian institutions with significant policy influence on climate change mitigation are the David Suzuki Foundation and the Pembina Institute (Canadian Dimension, 2004). Few groups are explicitly known for their opposition to climate change action in Canada, beyond individual party platforms or members of parliament in the government that deny climate change or do not prioritize climate action. There are no non-governmental organizations that oppose climate change mitigation as a concrete advocacy goal (Howlett and Oliphant, 2010).

While Canadian trade unions play a much less significant role in policymaking than their counterparts in Europe, their engagement in climate policy is more pronounced. In Canada, union focus on a "just transition" has spawned creation of the network "Adapting Canadian Work and Workplaces to Respond to Climate Change", which features databases on collective agreements' "greening" clauses and on green (re-)education and training (Adapting Canadian Work, 2019).

2.5.5 Potential NDC review process and historical precedent

There is no formally announced process for the 2020 review of Canada's NDC. Elections are due in 2019, likely pointing to a review in late 2019 at the earliest. As stated, the current stage of implementation and recent policy changes puts achievement of the existing NDC into question. The inability to accomplish announced mitigation actions and/or implement the policies needed to do so is not new for Canada. Previous Canadian governments' efforts to implement comprehensive regulations designed to meet an emissions target—under both Conservative and Liberal leadership—have failed (Silvia Maciunas and Saint-Geniès, 2018).

[10] In the UNFCCC context, CAPP thus supports the Canadian government's efforts to allow and codify the use of internationally traded mitigation outcomes (ITMOs - tradable units of quantified emission reduction, including offset credits from projects in other countries) in the Paris Agreement. At both the domestic and international level, CAPP does not oppose regulations that impose carbon caps or emissions targets, but calls on governments to "Create protection mechanisms for EITE sectors to help avoid carbon leakage" (*Competitive Climate Policy is Crucial*, March 2018).

[11] IETA's membership includes major oil companies that do business in Canada (BP, Shell, Enbridge, Iberdrola, Suncor) as well as mining company RioTinto and pipeline/power transmission operator TransCanada (IETA, 2019).

3 China

3.1 Introduction

Current projections expect China to overachieve its carbon intensity targets in both 2020 and 2030 and find that the country's non-fossil targets are also likely to be achieved. This alone indicates the plausibility of a revision to China's NDC for the 2020 round of submissions to the UNFCCC. Least-cost approaches indicate that a cost-effective global pathway in line with limiting temperature increase to 1.5°C suggests emissions levels significantly below 2005 levels in 2030 already, which is at the most ambitious end of the range of equity-based results. The 2050 data shows much deeper reductions, and, similarly, least-cost approaches demand reductions beyond the lower end of the equity range. Effort sharing approaches suggest that China should decrease its emissions to 2005 levels or lower in 2030, and significantly further by 2050. It is important to note that these are allowances based on equity considerations. Physical global CO2 emissions have to become net-zero around 2050, and total GHG emissions shortly thereafter (IPCC, 2018a). Based on China's capability and responsibility, the Chinese government could increase the ambition of its NDC and underlying policy actions. To reach the full cost-efficient mitigation potential, developed countries should support China in reducing emissions for a globally cost-efficient and fair solution.

Senior Chinese government officials have indicated several times in the last few years that China will likely peak its CO2 emissions earlier than 2030. It seems possible that China will upwardly revise its current NDC by 2020. For the 2020 revision of the NDCs under the Paris Agreement, the Chinese government has already started to review the progress so far and discuss the possibility of updating its NDC.

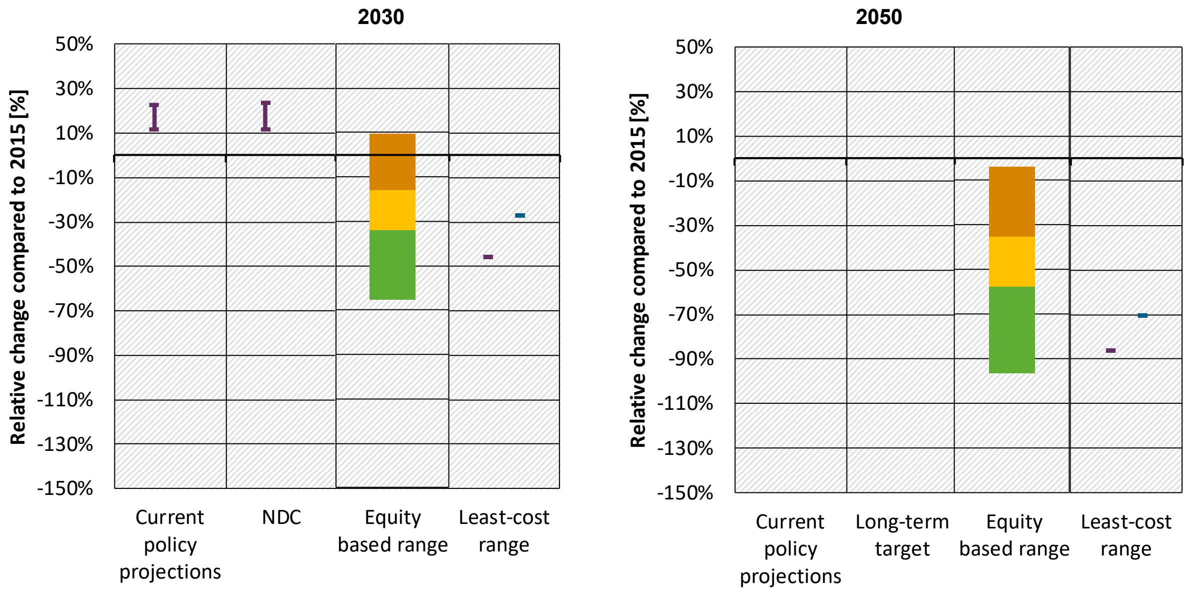


Figure 11: China – Relative change in GHG emissions excl. LULUCF compared to base year for equity and cost-based approaches

Notes: Current policy projections, NDC and equity-based emissions reduction ranges from Climate Action Tracker—equity range from 2018 (December update), other data from (2019 April update). Legend: For equity-based range: orange (upper range) is >2°C consistent, yellow (middle range) is 2°C consistent, green (low range) is 1.5°C consistent. For least-cost range: lower limit for 1.5°C, upper limit for 2°C.

3.2 Socio-economic context for greenhouse gas emissions reductions

In terms of GDP, China has the second largest global economy. China comes in only after the US, although it surpassed the US in purchasing power parity in 2014. This rapid growth is attributed to the massive and gradual market reforms of the communist government in the 1970s, which hurled China into becoming a manufacturing and services hub in the following decades. China has also been the world's largest exporter since 2010, the 2017 export volume being 2.157 trillion USD (CIA, 2019). However, the GDP per capita is lower than the world average and income distribution is unequal. It's 1 billion plus population is the engine of China's industrial development. However, the demographic profile is rapidly shifting as the Chinese population ages rapidly.

China's performance in the human development index has improved from 0.50 in 1990 to 0.74 in 2015. However, China continues to face challenges towards improving the developmental conditions of the populace. The disparate economic development in the western provinces compared to the rest of the nation and accompanying migration are raising serious urbanisation challenges. China also faces severe air pollution and environmental degradation. The Chinese government has begun to address local air pollutants by shutting down coal power plants and outlining a new three-year action plan for air pollutants (China State Council, 2018).

3.2.1 Economic and development-related data

Table 5: China – Key socioeconomic data

Indicator	Value	World	Year	Source
Population [million]	1 393	7 594	2018	The World Bank
GDP [bn USD at current prices]	13 608	85 791	2018	The World Bank
GDP/cap [USD/cap]	9 771	11 297	2018	The World Bank
HDI [0 – 1]	0.75	Rank 86	2018	UNDP
GINI index [0 – 100]	38.6	n.a.	2015	The World Bank
Electrification rate [%]	100%	88.9%	2017	The World Bank
Corruption index	Score: 39/100	Rank: 87/180	2018	Transparency International
Urbanization [% of total]	60.3%	55.7%	2019	United Nations Population Division

Data sources: (Transparency International, 2018; United Nations Department of Economic and Social Affairs: Population Division, 2018; United Nations Development Programme (UNDP), 2018; Statista, 2019; The World Bank, 2019b, 2019a, 2019c).

3.2.2 Energy production and consumption

China fuelled its impressive economic growth through the extensive use of coal, which makes up 65% of Chinese primary energy supply. Oil (18%), gas (6%), traditional biomass (4%) and hydro (3%) contribute smaller shares. The share of coal in the energy mix increased by 6% while that of traditional biomass use drastically declined from 23% in 1990. In absolute terms, coal use almost quadrupled in China between 1990 and 2017. The use of gas also increased 4.5 times, although its share reduced 4%. Since the early 2000s, China has invested heavily in renewables, particularly solar and wind. Primary energy from renewables rose from 33 ktoe in 1990 to 49,200 ktoe in 2016. Non-hydro renewables have a 2% share in China's primary energy mix.

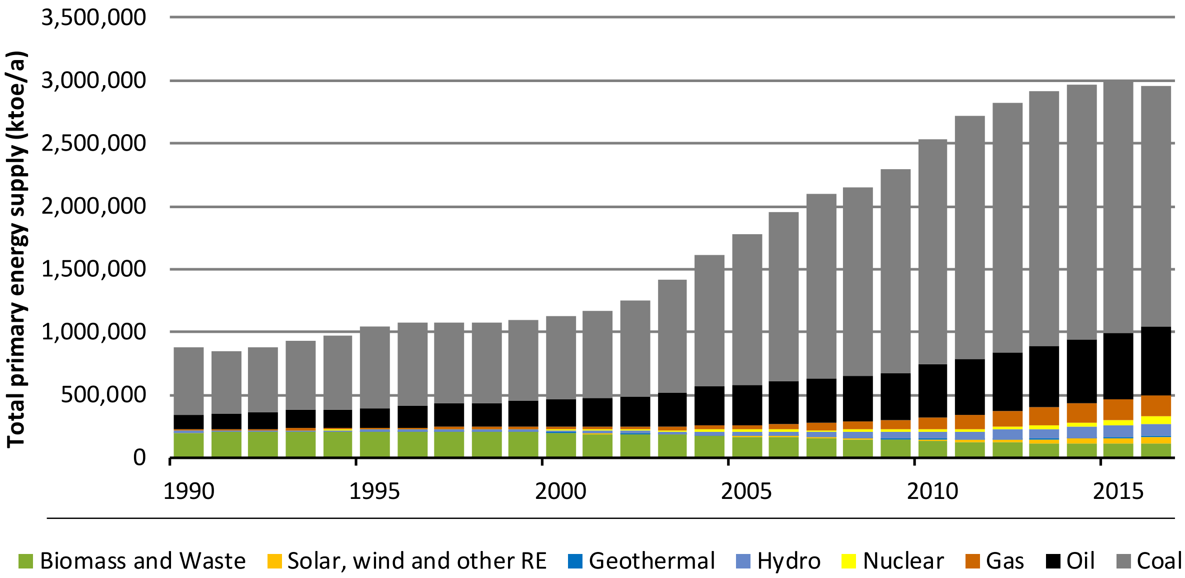


Figure 12: China – Primary energy supply by energy carrier between 1990 and 2016

Data source: (IEA, 2018b)

3.3 Greenhouse gas emissions profile

Chinese GHG emissions closely mirror its energy use profile and GDP growth. Energy combustion emissions contribute a majority (77%) to China's overall emissions and come mostly from the use of coal in power generation. Industrial emissions account for another 14% and have increased four times since 2000. Per capita emissions in China are relatively low at 9 tCO2e/cap, owing to its large population. However, China alone emits 23% of global emissions.

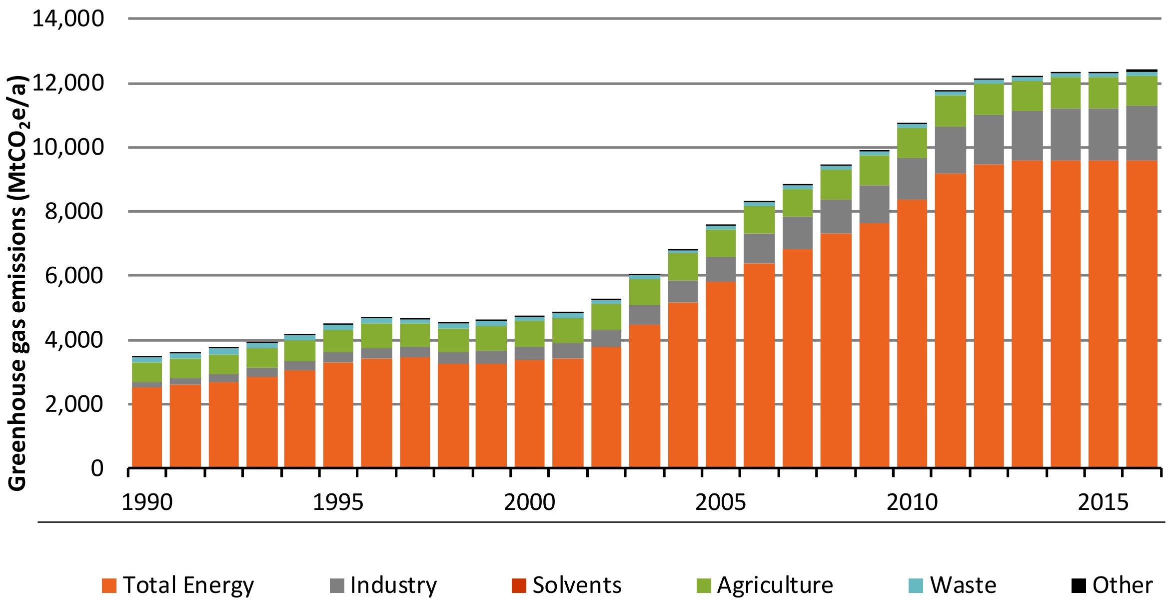


Figure 13: China – Sectoral GHG emissions between 1990 and 2016

Data source: (Gütschow *et al.*, 2018a)

Table 6: China – Key GHG emissions data

Indicator	China	World	Year
GHG/cap [tCO_2e/cap]	8.99	6.15	2016
GHG/GDP [tCO_2e/mln USD]	1,108	603	2016
Energy/GDP [ktoe/mln USD]	0.26	0.18	2016
Global share of emissions [%]	23.09%	100%	2012

Data sources: (JRC and PBL, 2014; Gütschow *et al.*, 2018a; IEA, 2018b; The World Bank, 2018b). *GHG indicators were calculated using PRIMAP data and exclude contributions from the LULUCF sector.*

3.4 Development of future greenhouse gas emissions

3.4.1 Emissions reduction targets and current policy projections

China's NDC includes four main elements:

- peak CO_2 emissions by 2030 or earlier if possible;
- increase the share of non-fossil energy sources in the total primary energy supply to around 20% by 2030;
- lower the carbon intensity of GDP by 60-65% below 2005 levels by 2030;
- increase the forest stock volume by around 4.5 billion cubic metres compared to 2005 levels.

The CAT calculates that this will amount to GHG emissions reductions of 12.7 to 13.8 $GtCO_2e$ in 2030 excluding LULUCF, compared to less than 12 $GtCO_2e$ in 2015. Considering only the intensity target, the target would imply even higher emissions—up to 15.6 $GtCO_2e$ in 2030, depending on GDP projections. At the time of writing, China has not indicated any long-term climate targets.

With implemented policies, China will likely achieve its targets, according to a Climate Action Tracker analysis (see Figure 14).

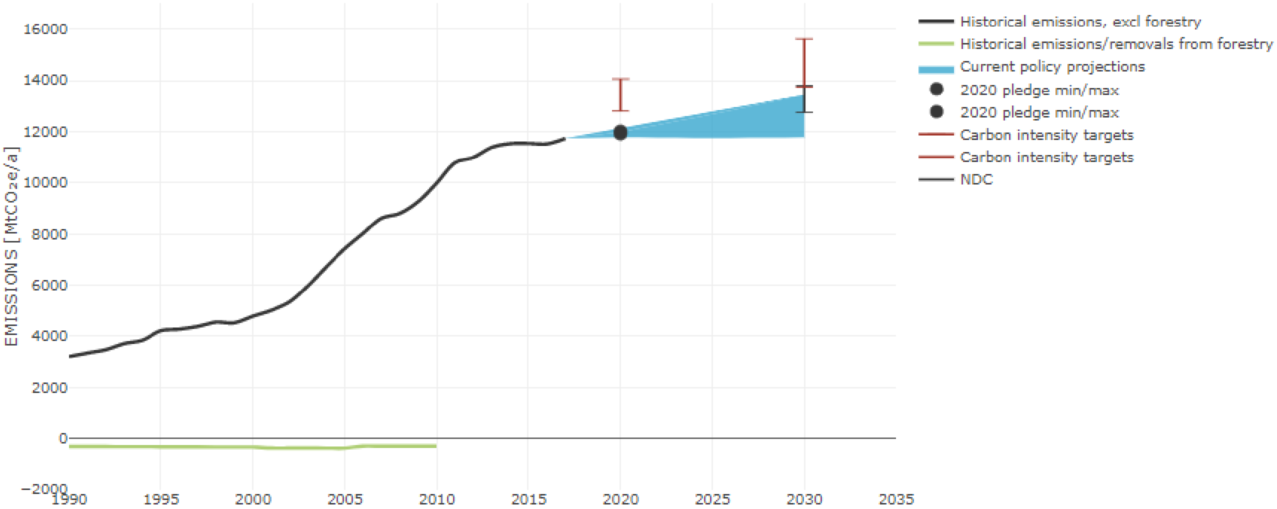


Figure 14: China – Historical and projected emissions under current policies and target pathways

Source: Climate Action Tracker 2018

3.4.2 Sectoral mitigation pathways until 2030

In 2015, the energy supply and industry sectors were the highest contributors to the total energy- and process-related GHG emissions in China. Emissions from these two sectors together account for 88%

(10.64 $GtCO_2$-eq) of China's total emissions, see Figure 15. The energy supply sector is comprised of GHG emissions from energy electricity generation and other transmissions. While still high in international comparisons, the emissions from the building (0.79 $GtCO_2$-eq) and transport sectors (0.70 $GtCO_2$-eq) have proportionally low shares in China's total emissions. Emissions in the transport sector are mainly determined by road transport.

A comparison between global 1.5°C consistent and 2°C consistent pathways based on recent MACCs for 2030 leads to the conclusion that the potential to reduce energy- and process-related emissions has to be exploited to a much larger extent to achieve 1.5 °C consistency. For China, this would amount to a 46% reduction in energy- and process-related emissions by 2030 when compared to emission levels in 2015 (11% compared to China's NDC base year 2005). For 2030, the highest economic mitigation potential would be in the building sector, achieving a 58% reduction compared to 2015. GHG emissions from the energy supply sector would be reduced by 55%, in the industry sector by 41%, while in the transport sector emissions could increase by 16%.

When assuming a global least-cost pathway compatible with 2°C by 2030, the ranking of the different sectors according to their mitigation potential stays the same. Compared to 2015, the reductions achieved in the building sector would amount to 40%. Those are followed by emission reductions of 36% in the energy supply sector and 23% in the industry sector. Still, in the transport sector, the emissions would increase by 33%. Total reductions compared to the year 2015 amount to 27% (but if compared to the NDC base year 2005 these end up being an *increase* of 19%).

In comparison, an NDC-consistent reference pathway shows emission increases in all four sectors. For such a pathway, China's total energy- and process-related emissions increase by 12% until 2030. The increase is highest in the transport sector (48%). GHG emissions increase in the industry sector by 12%, while the increases in the building and energy supply sectors do not exceed 10%.

For China, the sectoral mitigation pathways until 2030 are summarized in Figure 15.

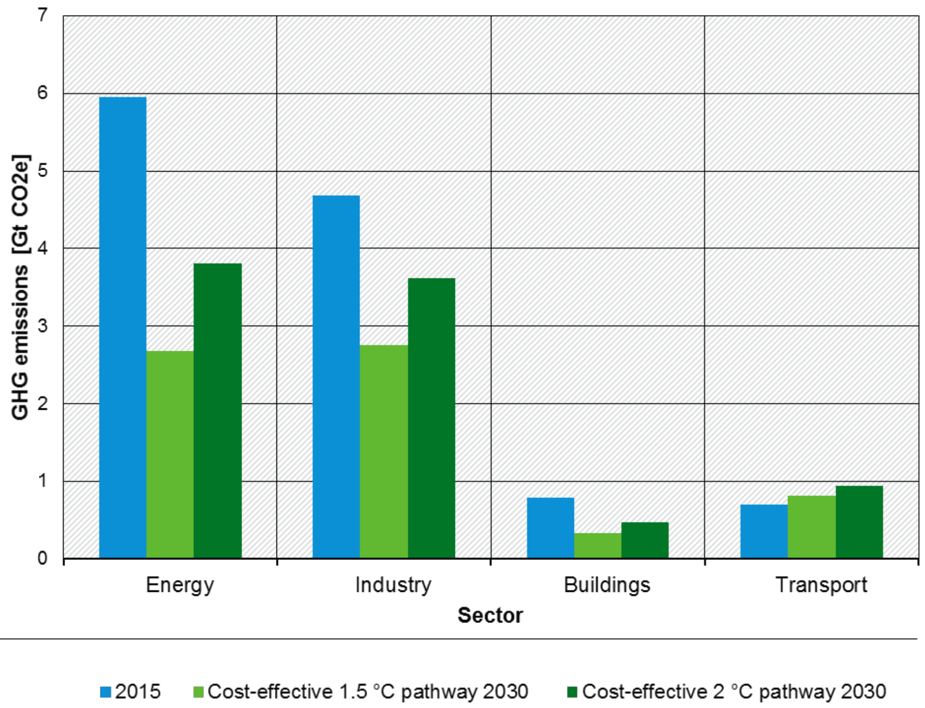


Figure 15: China – Sectoral GHG reduction potentials until 2030 compared to 2015

Source: own calculation based on data from the POLES-Enerdata model

3.4.3 Emissions reduction targets suggested by equity considerations

According to different equity-based approaches, China's emissions (excluding LULUCF) in 2030 would need to decrease by at least 34% below 2015 levels (10% above 2005 levels) in order to stay within the Paris Agreement's 1.5°C temperature compatible ranges. Compatibility with the former 2°C goal would require an emissions reduction of 16% below 2015 levels (40% above 2005 levels). These reduction ranges stand in stark contrast with the NDC reduction target excluding LULUCF that effectively allows China to continue increasing emissions until at least 2030.

When compared to cost-effective reduction ranges in 2030 (27-46% below 2015 levels), equity-based emissions allowances show less stringent reductions, indicating that China´s domestic emission reduction potential is larger than the emission allowances it would get if only equity considerations were considered. This reflects China's relatively low emissions and GDP per capita indicators. Under these considerations, China could benefit from international cooperation and markets to achieve its full mitigation potential.

In 2050, emissions allowances under equity considerations show reductions of 58% and 35% in comparison to 2015 (a decrease of 29% but increase 8% in comparison with 2005 levels), respectively for each of the temperature targets.

A more detailed look into China's equity range shows that the categories of approaches focusing on equal cumulative emissions per capita define the lower ends of the equity ranges, both for 2030 and 2050—not reaching negative emissions in any of the categories. Staged approaches, as well as approaches taking into account historical responsibility, lead to less stringent emissions reductions and define the upper ends of the equity ranges for China. However, it must be noted that most of the equity categories for China (except for per capita convergence) represent a broad range of emissions reductions, covering almost the whole range described above. This is explained mainly by the large differences between the various considered studies in terms of underlying metrics, starting points and weights given to each factor.

3.5 Political context

3.5.1 General disposition of the country towards climate policy

In the last 15 years, China has emerged as a key player in the UNFCCC negotiations. During this period, China surpassed the US to become the largest GHG emitter between 2000 and 2005 (EDGAR 4.3.2). With its influence on global GHG emissions and the role it played in the Paris process, China has been regarded as one half of the 'G-2', together with the USA (Bodansky, 2016).

As the leader of the G77 bloc in the UNFCCC, China has always been vocal about keeping a distinction between rich and poor countries in the negotiation process in light of the 'common but differentiated responsibilities and respective capabilities' principle (CBDR-RC), which still creates tension between negotiation blocs like the EU and the Umbrella group (Darby, 2018). At the same time, China has been working constructively with the EU and the US. In the lead up to the 2015 Paris climate conference (COP21), the joint announcement made by China and the US in 2014 boosted confidence among many observers that COP21 would be a success, and the joint presidential statement in September 2015, which laid out a joint vision for the COP21, strengthened this confidence (Bodansky, 2016). Furthermore, in recent years, the EU and China have held bilateral talks to accelerate climate action (European Commission, 2018b).

For China, climate change mitigation is one of the important policy areas to enhance regional economic and political cooperation and influence. Under the 'One belt one road' initiative (Xinhua, 2015), the promotion of a low-carbon and green economy is mentioned under 'infrastructure connectivity' as a priority area for cooperation (Huang, 2016). The Asian Infrastructure Investment Bank (AIIB) is a key institution in mobilising finance for infrastructure development projects.

3.5.2 Relevant political processes in the foreseeable future

Regarding political stability, the constitution has recently been amended to remove term limits to the presidency (previously the office was limited to two consecutive terms) (Xinhua, 2018). Therefore, the Xi Jinping presidency will likely remain stable for the foreseeable future and thus, significant fluctuations to China's climate policy are not expected.

The National People's Congress (NPC) is the Chinese legislature which meets every March to discuss reports from government leaders and approve laws (Sandalow, 2018). China is currently implementing its 13th Five-Year Plan (FYP) for 2016–2020, the 14th FYP will likely be set up in 2021, and the 15th FYP in 2026. Therefore, China's governance timeline more or less coincides with the NDC update/revision timeline under the Paris Agreement's 'rachet mechanism'.

3.5.3 Prospects for a review and increase of the national climate ambition

The climate policy-making process in China is highly centralised and is "undertaken within the senior echelons of the Chinese Communist Party and central government through top-down administrative planning" (Averchenkova *et al.*, 2016). For priority topics, 'leading groups' are created to coordinate work among top officials; they bring together key stakeholders and help shape consensus (Sandalow, 2018). For climate policy, the National Leading Group on Climate Change, Energy Conservation, and Emissions Reduction (hereinafter, 'Leading Group on Climate Change') chaired by Premier Li Keqiang, second in rank in the Communist Party after President Xi Jinping, facilitates top-level decision-making (Sandalow, 2018).

China is currently going through a major reshuffling of Cabinet level ministries; the proposed procedure to do so was approved by the National People's Congress in March 2018 (People's Daily Online, 2018). As a result, the responsibility for managing GHGs and climate action has been passed from the National Development and Reform Commission (NDRC) to a new Ministry of Ecological Environment (MEE), which superseded the former Ministry of Environmental Protection (MEP). Both climate action and pollution control will now be handled under the MEE. Experts expect this reshuffling will boost bureaucratic efficiency on climate policy planning and implementation (Tianjie and Qin, 2018).

Provincial governments are also important players in China's climate policy as their rank equals that of the central government ministries (Sandalow, 2018). They also play a key role in the implementation of climate policies because the national targets are allocated to individual provinces under a 'target responsibility system' (Sandalow, 2018).

State-owned enterprises, in particular electric utilities and fossil fuel extraction companies, are important actors in China's climate policy-making as well. CEOs of these companies are generally considered to have rank equivalent to that of national government ministers (Sandalow, 2018).

3.5.4 Civil society

Generally speaking, civil society activities are strictly controlled and regulated in China by the government, and climate change is relatively a new topic for Chinese NGOs (Liu, Wang and Wu, 2017). The four main roles that NGOs play in China's climate change governance were identified by Liu et al. (2017) include: (i) "government partnership with restricted political space", (ii) "organisation development with inadequate professional capacity", (iii) "strong international financial reliance but with growing domestic support" and (iv) "public advocacy with low social recognition" (Liu, Wang and

Wu, 2017). A few pro-climate western NGOs and think tanks, e.g. Energy Foundation, WRI, WWF, and Greenpeace, have offices in Beijing.

3.5.5 Potential NDC review process and historical precedent

In June 2019, at the Osaka G20 Summit, China committed to updating its NDC by 2020. For the 2020 update/revision of the NDC under the Paris Agreement, the Chinese government has already started to review the progress so far and discuss the possibility of a revision. The National Centre for Climate Change Strategy and International Cooperation (NCSC) has already conducted the necessary assessments for the MEE (China Development Observation, 2018). After several stakeholder consultations, the MEE will formulate a draft proposal on whether or not to update the NDC. The proposal will then go through the deliberation process for approval in the Leading Group on Climate Change.

4 The European Union

4.1 Introduction

The European Union (EU) has a long history of ambitious climate action. While its declarations have not always been matched by actions, it has nonetheless managed to reduce its emissions between 1990 and 2017 by 23.5% while its economy grew by 58% during the same period (European Environment Agency, 2019a). The EU's 2020 emissions reduction goal of 20% is thus going to be surpassed significantly.

The picture for 2030 is clearly different: based to the most recent national projections the EU as a whole will need to implement additional policies to reach its emissions reduction goal of "at least 40%" (European Environment Agency, 2018). However, analysis on the impacts of the new 2030 energy goals (adopted in 2018) shows that their full implementation could result in reductions of over 45% (see for example (European Commission, 2018a)). There is thus great promise – but also the need - for additional action in the form of enabling policies.

A host of legislative changes have already been adopted towards this end: the EU Emissions Trading System (ETS) has been reformed for the period post 2020 and numerous policies aiming at increasing energy efficiency especially in the buildings sector and development of renewable sources of energy have been strengthened. However, both the equity and least cost approaches require a much faster and deeper emissions reductions than those currently targeted by the EU for 2030 (-40%) and 2050 (-80-95%). The long-term strategy currently discussed by the EU as well as the potential submission of a new NDC in 2020 both offer an opportunity to decrease this disparity.

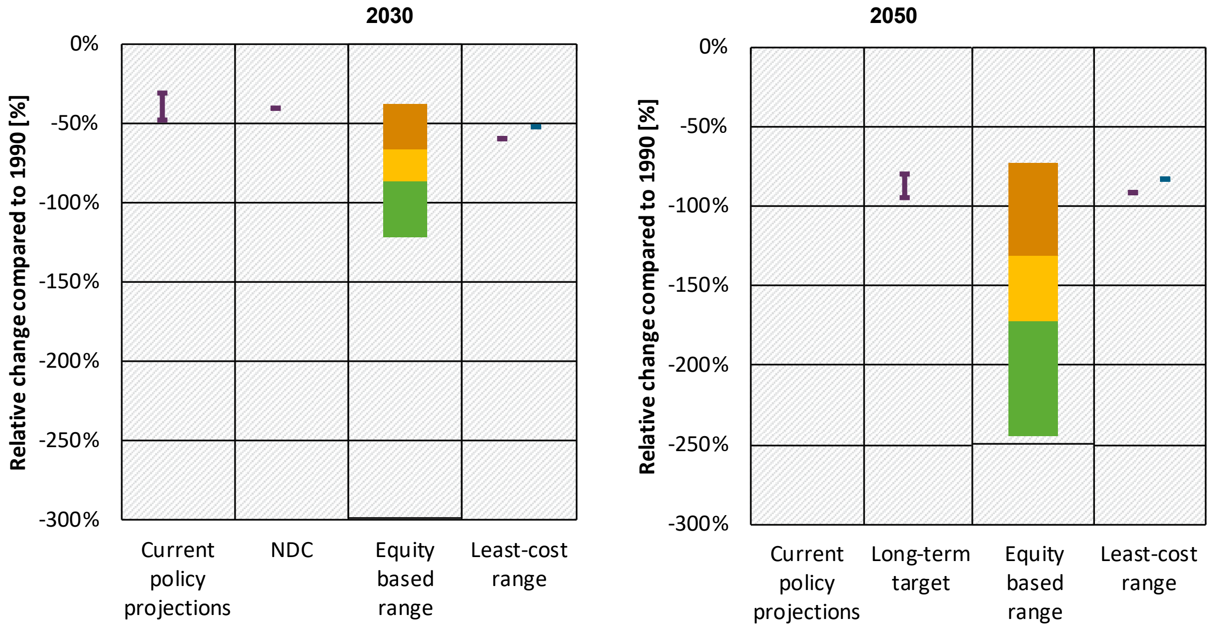


Figure 16: The EU - Relative change in GHG emissions (without LULUCF) to base year for equity and cost-based approaches in 2030 (left) and 2050 (right).

Notes: Current policy projections, NDC, and equity-based emissions reduction range from Climate Action Tracker (equity range from 2018 (December update), other data from 2019 April update). Legend: For equity-based range: orange (upper range)- >2°C consistent, yellow (middle range) – 2°C consistent, green (low range)-1.5°C consistent. For least cost range lower limit for 1.5°C, upper limit for 2°C.

4.2 Socio-economic context for greenhouse gas emissions reductions

The European Union (EU) currently covers 28 member states, amongst which including three G20 economies (Germany, UK, France, Italy)[12]. Socio-economic data varies across the member states. This report shows EU average numbers or the range of all member states (see Table 7). The EU is one of the economically most developed regions: GDP per capita is three times world average, the human development (HDI) index is also above world average in all EU member states. While electrification is at 100%, energy poverty is a topic of increasing awareness (European Commission, 2018d).

4.2.1 Economic and development-related data

Table 7: The EU - Key socio-economic figures

Indicator	Absolute value	World	Year
Population [million]	513	7594	2018
GDP [2018 billion USD]	18749	85791	2018
GDP/Cap [2018 USD/cap]	36532	11297	2018
HDI [0 – 1]	* 0.8 – 0.9	0.73	2018
Electrification rate [%]	100%	89%	2017
GINI index [0 – 100]	* 25.7 – 37.7	n.a.	2014
Urbanization [% of total]	* 75%	55.7%	2019

Data sources: (United Nations Department of Economic and Social Affairs Population Division, 2014; UNDP, 2016a; The World Bank, 2017). *GDP per capita calculated based on World Bank (2017)*

4.2.2 Energy production and consumption

EU's primary energy consumption increased steadily, especially since the late 1990s until it peaked in 2007. Since then, except for a significant fall caused by the economic crisis in 2009 and increase in the subsequent year, energy consumption was decreasing. Altogether, it fells only slightly – by less than 1% - between 1990 and 2017.

However, this overall trend disguises significant difference in the energy consumption trends between different member states. All countries that joined the EU in or after 2004 recorded a significant decrease in energy consumption in the 1990s – by up to 60% in Lithuania and 52% in Estonia. In some western EU member states energy consumption in the 1990s tend to increase, especially in Ireland (+42%), Spain (+39%) and Cyprus (+47%). An exception – due to the reunification and thus accounting for decrease in energy consumption in Eastern Germany – was Germany, were energy consumption decreased by 10% in the 1990s. Since the beginning of the century, the differences in energy consumption trends between the Eastern and Western EU member states is less clear, but the growth continued in the East, with 10 out of 16 countries in which energy consumption increased since 2000 being new member states (Eurostat, 2019).

The energy mix has also changed, with the role of coal and after 2011 nuclear energy decreasing steadily. At the same time energy consumption from renewable source, especially biomass, and since the beginning of the century solar and wind, continued to increase. The increased of the latter accelerated after 2010, however they still constitute and small share of primary energy consumed.

[12] At the time of writing, a decision on future membership of the United Kingdom is still pending.

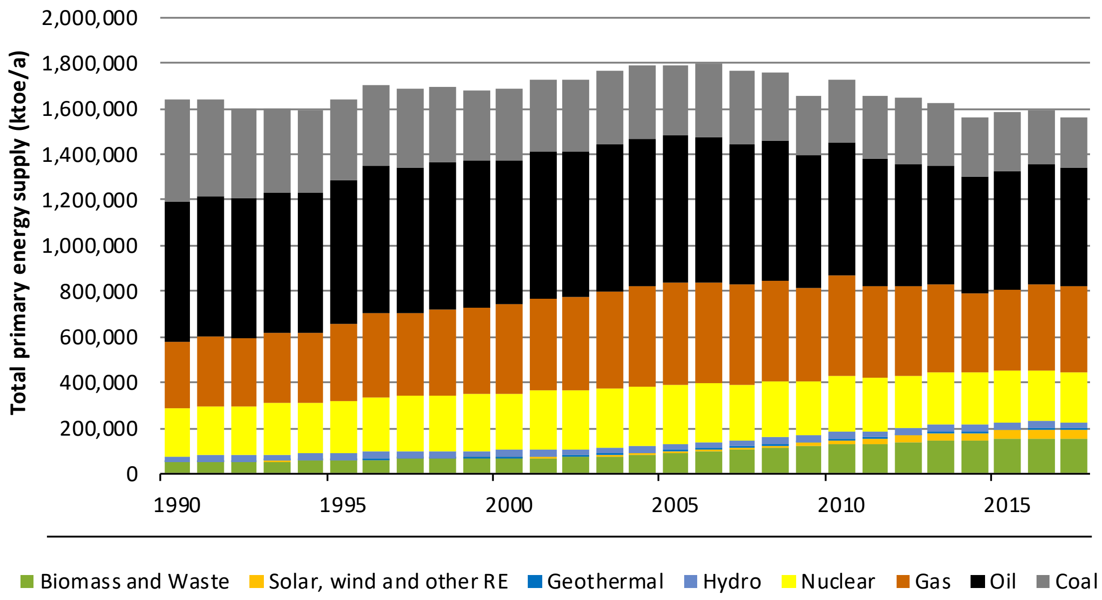


Figure 17: The EU - Primary energy supply by energy carrier between 1990 and 2017

Data source: (IEA, 2018b)

4.3 Greenhouse gas emissions profile

EU's GHGs emissions were decreasing during the whole period between 1990 and 2017, with an overall decrease by almost 24% in this period. The fastest decrease in emissions took place in the first half of the 1990s (by 5.6%) and between 2007 and 2009 (by 9.2%). After recovery in 2010, the emissions continued a decreasing trend until 2014. Since then they remained relatively constant with a slightly increasing trend. Emissions in energy and industry covered by the EU ETS fell by 23% and 27%, respectively, whereas emissions in the transport sector increased by 19%.

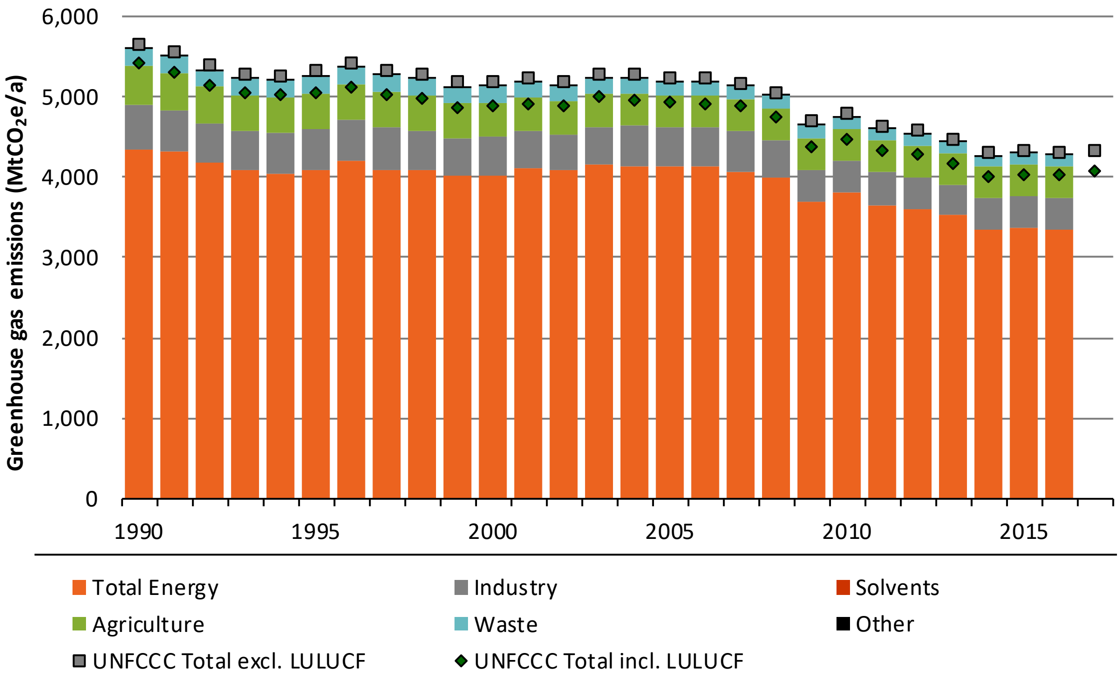


Figure 18: The EU - GHG emissions by sector between 1990 and 2017

Data sources: (Gütschow *et al.*, 2018a; UNFCCC, 2019)

Table 8: The EU – Key GHG emissions data

Indicator	EU	World	Year
GHG/cap [tCO_2e/cap]	8.36	6.15	2016
GHG/GDP [tCO_2e/mln USD]	259	603	2016
Energy/GDP [ktoe/mln USD]	0.09	0.18	2017
Global share of emissions [%]	7.64%	100%	2012

Data sources: (JRC and PBL, 2014; Gütschow *et al.*, 2018a; IEA, 2018b; The World Bank, 2018b). *GHG indicators were calculated using PRIMAP data and exclude contributions from the LULUCF sector.*

4.4 Development of future greenhouse gas emissions

This section illustrates existing targets and projections under current policies, least-cost mitigation pathways consistent with the 2°C and the 1.5°C target, and the "fair share" of emission reduction efforts according to equity-based effort sharing approaches. A comparison of those can provide insights whether or not a country can increase its NDC, for example because it already overachieves it, or because the NDC is much less ambitious as the mitigation potentials or the fair share of the country. The data can also show how large the efforts in the country domestically should be and indicate need for support to or from other countries, if there is a mismatch between the potentials and the fair share.

The range of fair shares was derived from an evaluation of a broad spectrum of equity-based approaches by the Climate Action Tracker. The least-cost mitigation pathways are based on the most recent marginal abatement cost curves (MACCs) from the global energy system model POLES[13], which were used to derive globally cost-effective national pathways for energy- and process-related GHG emissions. The details of the methodology and an in-depth comparison of the results across selected countries can be found in Wachsmuth et al.

4.4.1 Emission reduction targets and current policy projections

With its NDC, the EU aims at reducing total GHG by at least 40% below 1990 by 2030. Under the Copenhagen Accord, the EU has committed to reducing emissions by 20% to 30% below 1990 by 2020. The long-term target is set at 80% to 95% below 1990 by 2050, however this target is currently under discussion.

According to Climate Action Tracker projections, the EU will overachieve its unconditional 2020 pledge, and get close to achieving both the conditional 2020 target and the NDC.

[13] Compare the model documentation at https://ec.europa.eu/jrc/en/publication/poles-jrc-model-documentation

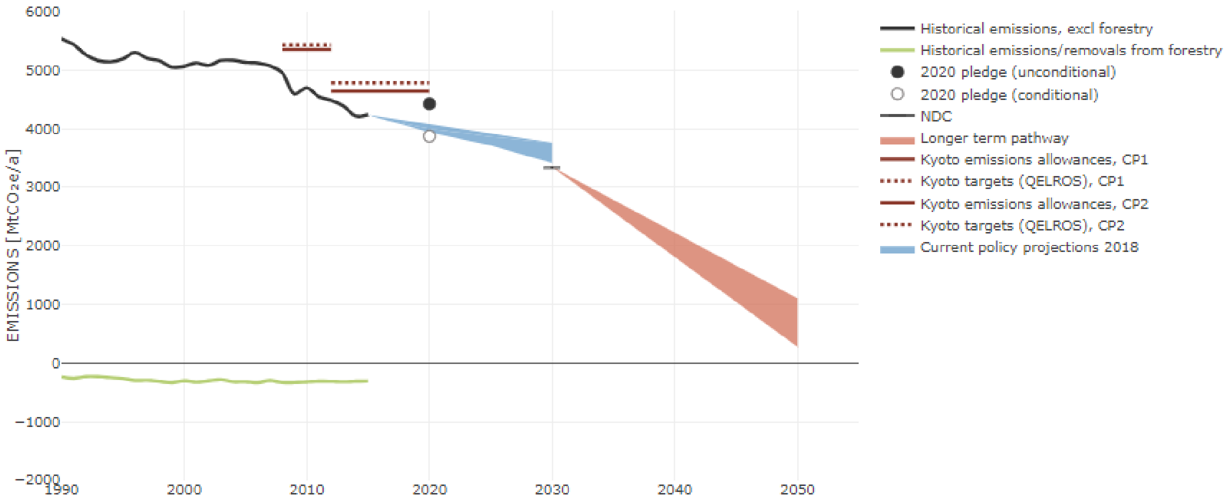


Figure 19: The EU - Historical and projected emissions under current policies and target pathways

Source: Climate Action Tracker 2018

4.4.2 Sectoral mitigation pathways until 2030

In 2015, the highest share of energy- and process-related GHG emissions in the EU occurred in the energy supply sector followed by the transport, industry and buildings sectors (see Figure 20). Emissions in the transport sector are mainly determined by road transport. The energy supply sector comprises the GHG emissions from electricity generation and other transformation (centralized heat, refineries, etc.).

A comparison between global 1.5°C consistent and 2 °C consistent pathways based on recent marginal abatement cost curves (MACCs) for 2030 leads to the conclusion that the potential to reduce energy- and process-related emissions based on the MACC has to be exploited to a much larger extent to achieve 1.5 °C consistency. For the EU, this would amount to a reduction of energy- and process-related emissions in 2030 by -46% compared to 2015 (-58% if compared to the base year 1990 selected for the EU's NDC). The economic mitigation potential would be highest for the energy supply sector with -51% compared to the 2015 emissions of that sector, followed by the buildings sector with -48% and the industry sector with -47%. The transport sector would show the lowest economic potential with reductions of -37% compared to 2015.

When assuming a global least cost pathway compatible with 2 °C until 2030, the economic potential to reduce energy- and process-related emissions in the EU would amount to -37% compared to 2015 and -51% compared to NDC's base year 1990. The order of the GHG reduction potentials changes: reductions in the energy supply sector would amount to -43% compared to the 2015 emissions of the energy supply sector, followed by the buildings sector with -37%, the transport sector with -32%, and the industry with -30%.

In an NDC-compatible reference pathway, the total mitigation amounts to -26% in 2030 compared to 2015 (-42% compared to 1990). The highest emission reduction comes from the energy supply sector with -34% followed by the transport sector with -28%.

The sectoral GHG reduction pathways are summarized in Figure 20.

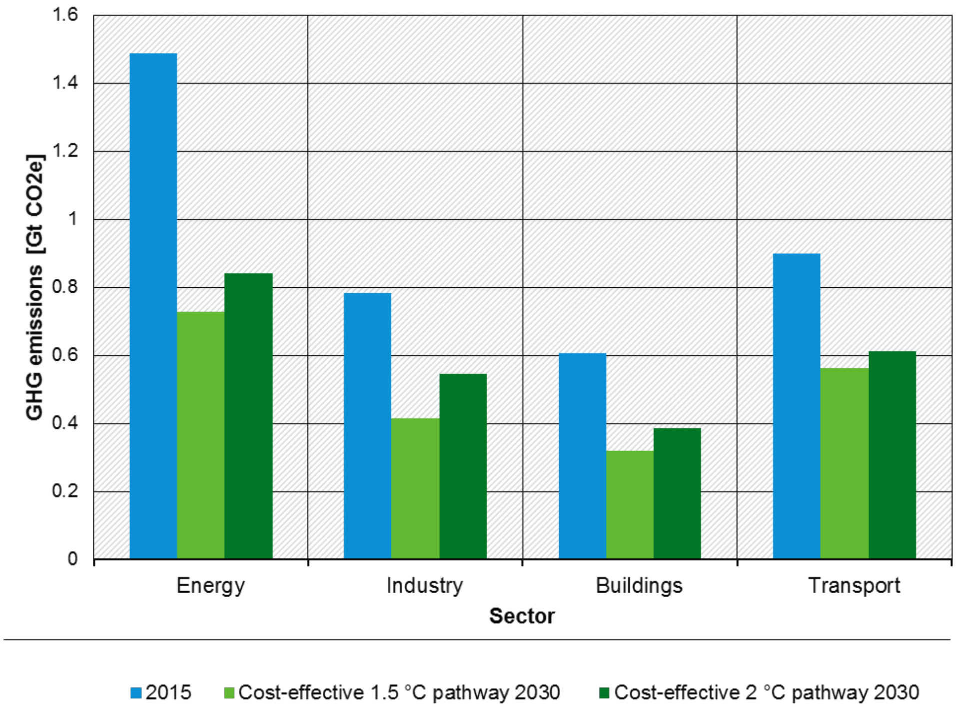


Figure 20: Sectoral GHG reduction pathways in the EU until 2030 compared to 2015

Source: own calculation based on data from the POLES-Enerdata model

4.4.3 Emissions reduction targets suggested by equity considerations

Due to its high level of historic emissions and high capability to reduce emissions determined by the level of economic development, for the EU the equity approaches show much higher levels of emissions reduction than the least cost approaches. To be compatible with the Paris Agreement 1.5°C temperature limit different equity approaches would require emissions in 2030 to decrease by at least 59% in comparison to 1990, and 92% in 2050 thus requiring more ambitious reductions than in the least cost pathway and/or financial support for emissions reductions in developing countries where least cost reductions are higher than equity.

The lower end of the 1.5°C-compatible range for 2030 is defined by approaches using responsibility and capability as the basis for distributing emissions reduction as well as by “staged” approaches which allow countries to take differentiated commitments in various stages. Due to the broad range of results, staged approaches also represent the top of the overall range for this emissions reduction limit. Even more generous equity approaches for the EU are those that would lead to emissions to converge or immediately reach the same level for all countries.

The situation for 2050 looks similar, with the main difference that for the less ambitious 2°C limit the approaches focusing on capability and cost, thus essentially focusing on the combination of mitigation potential and capability, are the most generous.

4.5 Political context

4.5.1 General disposition of the EU towards climate policy

European climate policy is marked by a history of ambitious declarations, targeted actions and leadership in international negotiations. A self-appointed global champion on curbing climate change, the EU has not only enacted the most encompassing set of policies aimed at economy-wide emissions reduction in the world (Delreux and Happaerts, 2017) but has also routinely challenged the international community to keep up, in many cases setting the bar in terms of ambition and framing the negotiations at the international level (Oberthür and Groen, 2016) It is thus helpful to consider the development of EU and international climate action over the last three decades as occurring in “tandem” (Oberthür and Pallemaerts, 2010)

Nevertheless, there is and has been a division between different EU Member States regarding how high to set the bar in terms of EU climate ambition. With other large global players failing to match the degree of action needed worldwide, some EU countries have questioned whether the EU should continue forging ahead unconditionally. Furthermore, domestic interests (e.g. concerning domestic energy resources) and diverse set of powerful incumbent (economic) players at the national level, have opposed further and more ambitious actions. The following two subsections provide a short overview of the historical development of EU climate policy and outline the most relevant ongoing and future processes.

4.5.1.1 Historical developments

As early as 1988, the Commission of the European Communities in a Communication to the Council pointed out the need for urgent action to deal with climate change and suggested increasing energy efficiency, switching to less carbon intensive fuels and promoting renewable and “safe nuclear” sources of energy as alternatives to fossil fuels (Commission of the European Communities, 1988). In October 1990, the Council of Environment and Energy Ministers agreed to stabilise emissions at 1990 levels by 2000 under the condition that “other leading countries undertake similar commitments” (Council of the European Communities, 1993). This was the first time that a major political entity made any form of commitment to engage in climate change mitigation.

After a failed attempt to introduce a carbon tax in 1992, EU climate policy in the 1990s amounted solely to dedicated funding for the deployment of renewable sources of energy and energy efficiency within the framework of the ALTENER and SAVE Programmes (The Council of the European Communities, 1991, 1993). Following its ratification of the Kyoto Protocol, in 2000, the EU launched the first European Climate Change Programme, which encompassed a series of mitigation policies and measures aimed at achieving the block’s declared international target. Two pillars of modern EU climate policy arose out of this period: the Renewable Electricity Directive, which was adopted in 2001 (European Council, 2001) and the EU Emissions Trading Scheme (ETS)(European Council, 2003), established two years later.

4.5.1.2 Development of EU greenhouse gas targets

The EU first aspired to leadership in climate action in international fora during the negotiations preceding the adoption of the Kyoto Protocol in December 1997. During the preceding meeting of the European Council the heads of states adopted a goal of reducing emissions by 15% in 2010 in comparison to 1990 (European Council, 1997). During the negotiations the EU agreed to reduce emissions by 8%, much lower than initially expected, but significantly higher than the average 5% for the industrialized countries (UNFCCC, 1998). After the US withdrawal from the agreement in 2002, the EU played a critical role in ensuring its entry into force in 2005 (Afionis, 2017).

In 2008, the EU adopted a new 20% emissions reduction target for 2020 compared to 1990 levels. Similar to its approach in 1990, it attempted to incentivise higher ambition in other countries by announcing a conditional emissions reduction target of 30% that was contingent on reaching “an ambitious and comprehensive global agreement on climate change” in Copenhagen the following year (Council of the European Union, 2008). The 2020 Energy and Climate Package implemented legislation to achieve the 2020 goal, including directives aimed at the further development of renewable sources of energy, energy efficiency, emissions reduction in the non-ETS sectors and revisions to the EU ETS.

In the last ten years, multiple crises—starting with the Euro crisis following the 2008-2009 global financial meltdown, through the refugee crisis to Brexit—have drawn the EU’s attention away from climate action. Moreover, unlike during the first decade of the century, after 2010, the most influential EU member states, especially Germany, France and the Netherlands, stagnated in their push for a progressive climate agenda (Bals *et al.*, 2014). Simultaneously, a small group of Eastern European countries, led by Poland, began blocking any attempts to significantly increase the level of ambition of EU climate policy and effectively vetoed 2011's 2050 Roadmap, which represented the EU's first long-term climate and energy strategy (Council of the European Union, 2012; Ancygier, 2013).

This division among EU MS has had a lasting influence on EU climate policy. It has been argued that the threat of a veto during discussions of the EU's 2030 emissions reduction goal decreased the overall level of ambition (Scislowska, 2014). Nevertheless, in October 2014, in the lead up to the Paris climate summit, EU member states adopted a goal of reducing EU's emissions by "at least 40%" by 2030 compared to 1990 levels. (European Council, 2014). The emissions reduction goal was accompanied by a target of increasing the share of renewables in the energy sector to 27% and improving energy efficiency by 27% in comparison to projections. Adopted at a time of plummeting costs for renewables, the renewable energy target was significantly lower than expected (Vaughan, 2014).

In the meantime, abolished or weakened support for renewable energy in some major EU countries, such as Spain and Germany, combined with an upturn of economic growth, has resulted in a reversal of Europe's long-lasting trend of decreasing emissions. In 2015, emissions increased by 0.7%; and after a slight decrease by 0.4% in 2016, EU's emissions from combustion of fossil fuels increased by 1.8% in 2017—the highest increase since the post-economic crisis year 2010 (European Environment Agency, 2019b).

In late 2016, the Commission presented a package of proposals titled "Clean energy for all Europeans" with measures aimed at achieving the emissions reduction and renewable energy goals adopted by the heads of states in October 2014. The proposal to amend the Energy Efficiency Directive increased the previous 2030 goal from 27% to 30% improvement in efficiency. The Commission justified this by citing positive impacts on employment, economic growth, energy security, health and air quality (European Commission, 2016).

During the interinstitutional negotiations finalised in June 2018, both the renewable energy and energy efficiency goals were increased to 32% and 32.5%, respectively (European Parliament and the Council of the European Union, 2018a, 2018b). If implemented, these goals would lead to emissions reductions of approximately 45% in 2030 (European Commission, 2018a), and other analyses estimate this figure to be even higher (European Environmental Agency, 2018; Climate Action Tracker, 2019c) up to 50% (Sandbag, 2019). Despite these increases, at the time of writing, the emissions reduction goal has not been changed to reflect the more ambitious renewable energy and energy efficiency targets. Still, in its joint position on COP24 (the 2018 UN climate summit in Katowice, Poland) adopted in October 2018 the European Council kept the door open for a possible increase of the GHG target (Council of the European Union, 2018). Two weeks later the European Parliament (EP) called for the adoption of a more ambitious emissions reduction target of 55% (European Parliament, 2018; Government of the Netherlands, 2018) – which it repeated again in March 2019, prior to the EP elections.

4.5.1.3 Other aspects of the UN-EU interactions on climate policy

The "in tandem" development of EU and UN climate policy is also visible in other aspects. The EU has taken the lead on operationalising the UNFCCC's objective of preventing "dangerous anthropogenic interference with the climate system". As early as 1996, it agreed that global warming shouldn't exceed 2°C above pre-industrial levels (The Council of Ministers for Environment, 1996) and it was also instrumental in including a reference to this temperature limit in the Copenhagen Accord and Cancun Agreements (UNFCCC, 2009, 2011). Before the negotiations in Paris in 2015, the EU was one of the leading members of the High Ambition Coalition and thus helped to ensure that mention of 1.5°C made it into the Paris Agreement (European Commission, 2015).

At the same time, the Paris Agreement's combination of a clear long-term perspective with its procedural mechanisms has served as a major impulse for the climate policy landscape in the EU, effectively refocusing and revamping the block's primary governance mechanism. The new "Regulation for the Governance of the Energy Union and Climate Action" or Governance Regulation, which entered into force in December 2018 (European Council, 2018), established an iterative system of integrated National Energy and Climate Plans (NECP) that cover 10 year periods beginning in 2021. While chiefly focused on the 2030 targets, the regulation puts these in context of long-term strategic planning (2050 and beyond) by mandating the development of long-term climate strategies (LTS) at the EU and MS level and further requires the EU to explore net-zero scenarios for 2050. The EU was already called on to produce a long-term vision for climate policy by heads of state and government in March 2018.

The regulation also implements a five-year review and revision process akin to the ambition mechanism for NDCs under the Paris Agreement as well as a direct link to the global stocktaking provision of the international agreement (see Article 45).

4.5.2 Relevant political processes in the foreseeable future

The impulses taken from the Paris Agreement for the future framework of the EU's energy and climate policy are continuing into ongoing processes that are relevant to the potential raising of the EU's NDC.

A key input to this is the **draft EU 2050 strategy**, published by the European Commission on November 28, 2018, four months earlier than the April 2019 deadline stipulated in the Governance Regulation. The document was entitled "A Clean Planet for all. A European strategic long-term vision for a prosperous, modern, competitive and climate neutral economy" and published in conjunction with an underlying in-depth analysis of emissions pathways (European Commission, 2018c). It spells out a vision of a net-zero emissions future for Europe by 2050 (which would be a new target) and identifies possible areas for joint EU initiatives towards this goal (see also UBA, 2018 for a summary).

At the time of writing, the EU is thus in the process of adopting its vision for 2050, but an agreement may not be found before December 2019. Many observers remain cautiously optimistic regarding the 2050 net-zero target. Discussions could extend into 2020 due to the influence of national election cycles and negotiations on other major issues, such as the EU budget. The European Commission has explicitly stated that it did not intend to propose new targets with the draft strategy – however, the eight long-term scenarios explored in the analysis all take as their starting point a 2030 reference point that implies a reduction of 45% in emissions from 1990 levels (due to the aforementioned increase in the energy targets). There is thus an undeniable connection between the draft strategy, the new 2050 goal and the 2030 greenhouse gas target.

A closely related process is the implementation of the **short-term NECPs**, which is central to the realisation of the 2030 targets. At the time of writing, Member States are in the process of finalising their plans, taking as input, among other things, recommendations from the Eropean Commission. These were published in June 2018 in a Commission communication, which included an EU-wide assessment of the draft plans submitted by all countries (European Commission, 2019b). EU MS have until the end of 2019 to submit finalised NECPs to the Commission. The Commission analysis and other evaluations (Duwe *et al.*, 2019) show that the draft plans fall short on many accounts. This also includes the collective achievement of the EU's energy targets. However, the assessments also show that some countries have gone for national contributions that are above what they were required to communicate or expected to commit to (these are: Luxembourg, Sweden, Spain). There is thus both a need to make improvements to the plans (which could connect to a debate on the EU 2030 target) but there are also signs that individual Member States are moving ahead with doing more than the EU has agreed to.

The implementation of the EU's energy and climate framework also connects to the ongoing discussions surrounding the **EU budget for the period 2021-2027**, otherwise known as the Multi-Annual Financial Framework (MFF). In May 2018, the Commission presented a proposal for the future MFF and subsequently published drafts for all legislative instruments required for its implementation. The proposed budget for the period covering the EU NDC foresees 25% of all EU funding directed towards climate actions—up from 20% under the current MFF. Pending the final structure of the MFF, including the strength of monitoring and how well it syncs up with the review schedule of the 2030 NDC, EU budget programming has the potential to act as an incentive for climate action, leverage private investment and, at the very least, align MS ambition by leveling the playing field with dedicated support mechanisms through the Cohesion Fund (Duwe, 2018). On the other hand, there is a chance that these windows of opportunity will be missed.

Finally, the impending **withdrawal of the UK from the EU** in October 2019, if it takes place, is expected to have an impact on the direction and speed of EU climate policy for the foreseeable time and by extension any chance of an upwards revision of the EU NDC. The UK has historically been a strong advocate for robust climate action and its absence from policy-making in the immediate future will inevitably affect near-term processes and may hamper ambition.

4.5.3 Prospects for a review and increase of EU climate ambition

The ongoing debate on the 2050 target of climate neutrality and the underlying Commission analysis could serve as a springboard to galvanize interest in an upwards revision of the EU NDC target for 2030 already for 2020 (Duwe and Iwaszuk, 2019). However, similar to the EU's experience with the 2050 Roadmap in 2011 outlined above, the issue is highly politically sensitive. Now, like then, long-term planning emphasises the need for greater ambition in the medium term, but with a net-zero target on the table the need is even more pronounced. At the June 2019 European Council meeting a vast majority of MS back the net-zero by 2050 goal—only Czech Republic, Estonia, Hungary and Poland were opposed—signaling far-reaching support for an unprecedented climate target at the EU level. As the group of opponents is growing smaller, the likelihood of an eventual agreement increases. Should EU MS adopt net-zero emissions, it will be harder for those same heads of state and government to turn around months later and argue against a revised 2030 GHG target. Indeed, iincreased ambition in the short-term is needed to meet the EU's proposed and lofty 2050 goal (I4CE and Enerdata, 2018).

Nevertheless, at the **Member State level** support for an NDC update is uncertain. An impulse for change is the growing attention to the long-term objectives and its implications for 2030. For the first time with the Governance Regulation, EU law requires MS to align their medium and long-term goals. And several MS have either already revised their 2050 goals in light of the Paris Agreement, many adopting climate neutrality (i.e., UK, Sweden and Finland) or are in the process of reviewing their long-term climate ambition (Duwe and Iwaszuk, 2019). Sweden has committed to reaching neutrality by 2045 and Finland made the ambitious statement at the start of its turn in taking on the EU's rotating Presidency of wanting to reach this goal even by 2035. The upward revision of domestic long-term targets over and above what is currently the formal EU goal could be considered implied support for more climate ambition by the block as a whole.

Many MS have made their support for a stronger NDC more explicit, with both Sweden and the Netherlands asking for 55% (Climate Action Network Europe (CAN), 2018). And a group of 15 Member States expressed general support for an NDC increase around the discussions on the COP24 Council conclusions in October 2018 (Climate Action Network Europe (CAN), 2018). Most recently, at a meeting with the Dutch Prime Minister on August 23, 2019, German Chancellor, Angela Merkel, hinted at being in favour of a 55% GHG target for 2030 (German Government, 2019). An analysis by environmental umbrella organisation CAN Europe published in June 2019 found that 22 out of th 28 Member States had at some point joined calls for a higher EU NDC (Climate Action Network Europe (CAN), 2019b).

A key player in the debate is of course the European Parliament. In October 2018, it passed a resolution calling for greater climate ambition at the EU level, explicitly outlining the need for a 55% reduction in GHG emissions by 2030 (European Parliament, 2018; Government of the Netherlands, 2018). This was reiterated in another resolution on March 14, 2019, which also expressed support for the European Commission's draft 2050 strategy and the climate neutrality goal (European Parliament, 2019). Several political Parties have renewed the demand since the EP elections, and made it a key issue in their conversations with incoming EC President Von der Leyen (Ferrand, 2019b)

Unlike the Parliament, the European Commission has been careful not to be too outspoken on the matter, in order not to alienate select MS in the middle of negotiations on the 2050 strategy —in June 2019 outgoing Commission President Juncker dispelled any notion a target revision being on the table (Sauer, 2019). Having learned from past experience with the 2011 Roadmap, it is likely that the Commission is waiting to make its move on a possible NDC update until after the 2050 net-zero target is agreed upon. However, ahead of her confirming vote in the Parliament, incoming Commission

President, Von der Leyen, championed a higher target, even mentioning (if not firmly committing to) the 55% 2030 target put forth by the European Parliament (von der Leyen, 2019). She has spelled this out further since, expressing a potential sequence of moving from 50 to 55% if other non-EU countries follow suit. In the mission letter describing the responsibilities designated future Commissioner in charge of the respective portfolio, Frans Timmerman (issued on September 10, 2019), the task is described as follows: "(…) I want you to lead international negotiations to increase the level of ambition of other major emitters by 2021. By then, you should put forward a comprehensive plan to increase the EU's target for 2030 towards 55% in a responsible way. This must be based on social, economic and environmental impact assessments that ensure a level playing field and stimulate competitiveness." (European Commission, 2019c).

Support for an update to the EU NDC is wide-ranging among European stakeholders and civil society groups. The expansive consultation of stakeholders conducted for the draft LTS recently came to a close in the last quarter of 2018, and the resulting report published in November 2018 indicated support by a diversity of civil society groups, governmental bodies and trade organisations, while associations from other sectors were opposed (see section below on civil society).

Each player described above is acting within the context and confines of its own political and economic interests. In the next two sections, we discuss the role of each actor in the EU political system and their relative influence in EU climate policy.

The EU is comprised of numerous governing entities each with different competencies and responsibilities. The European Commission—the executive function of the EU—has historically been the initiator of climate governance but must work within the limits of what would be accepted by the two legislative branches, the European Parliament and Council. The Parliament has historically been an advocate for bolstering the EU's action on climate change, however, following the elections in May 2019 it remains to be seen whether increases for climate-friendly parties will offset gains by right-wing parties. Nevertheless, while the two largest groups no longer command a majority, there is likely still a viable pro-climate faction that can continue to pressure the Commission and Council on climate issues in the immediate future (Schwägerl, 2019).

The dynamics of the Council are dependent on several factors, including national elections, with heads of state and government motivated by domestic political and economic circumstances—such as, existing energy resources and powerful incumbent national interests. Therefore, while the EU represents a united front at international levels and all countries have signed on to the NDC and 2030 framework, there are clear divisions between country governments on the process moving forward, in particular on the highly contentious issue of revising targets early. Historically, the Visegrád countries, spearheaded by Poland have acted to block reference to long-term decarbonisation in EU legislation and, as mentioned above, most notably vetoed the 2011 Roadmap, which as a result was never formally adopted. Pre-Paris, Poland argued that EU targets should not surpass international ambition (Görlach, Duwe and Evans, 2016), a stance that is now difficult to justify given the clear long-term goal of decarbonisation stated in Article 4 of the Paris Agreement.

Economic concerns are a primary driver when it comes to a Member State's willingness to engage in climate mitigation, and thus European funding can be a key lever for additional action at the national level (Duwe 2018). Specific funding schemes could be enacted within the context of the MFF, such as through the Cohesion Fund, to implement incentives and measures to jumpstart climate ambition in countries that are dragging their feet. However, such direct linkages would be most effective if written directly into the budget legislation and implemented in concert with the NECP revision process. Even without dedicated mechanisms in place, the future MFF is an important factor in EU climate ambition. If EU Member States see potential economic co-benefits arising in the form of greater access to EU funds, this could make discussions of target revision more palatable. The use of EU funds has also been touted openly as a way of facilitating agreement among Member States on raising climate targets (Ferrand, 2019a).

4.5.4 Civil Society

Civil society has a long history of influence in EU climate policy (Van den Hove, 2000). The European Commission considers climate-related civil society organisations (CSO) to be all non-state, not-for-profit groups actively pursuing advocacy or research pertaining to climate change and climate policy. This includes but is not limited to academic institutions, think tanks, advocacy groups, religious organisations and other NGOs. The EU views an empowered and engaged civil society to be "a crucial component of any democratic system and is an asset in itself" (European Commission, 2019a). Following the 2008-2009 financial crisis, CSOs saw a decrease in opportunities for political involvement in EU climate policy-making, and many saw their role diminishing compared to industry lobbyists and trade groups (Derman, 2013). Still, public participation is not only a pillar of EU policy-making but the Aarhus Convention and its implementing legislation make it a legal obligation. The Governance Regulation incorporates this obligation by requiring the EU to conduct extensive stakeholder consultation during the development of both the NECPs and the long-term strategies.

Arguably the most active CSO network for climate and energy related matters is the Climate Action Network Europe (CAN Europe), which has over 160 members from 35 different European countries. CAN Europe's extensive network (as part of the international Climate Action Network) plays a critical role in holding the EU accountable also at international negotiations. Other climate-relevant CSOs active in Brussels include Greenpeace, WWF (and WWF's European Policy Office), Friends of the Earth, E3G and Client Earth as well as hundreds of smaller national organisations working on EU issues. CAN Europe's public position on the EU's NDC is the demand to raise the current figure of a 40% reduction from 1990 levels by 2030 to at least 65% emissions reductions (Climate Action Network Europe (CAN), 2019a); This is thus more ambitious than the calls from the European Parliament and progressive Member States to go to -55%.

The public consultation conducted for the EU's draft long-term climate strategy (July to October 2018) collected nearly 3000 responses from individuals and organisations across Europe. There were many different views on the current NDC, and while many CSO respondents supported an upward revision of the GHG target, others (especially positions offered by trade organisations and business associations) were directly opposed to any change or saw little need to discuss a potential revision until the scheduled review in 2023 (European Commission, 2018e).

4.5.5 Potential NDC review process and historical precedent

Since the Parties to the UNFCCC are expected to submit their updated NDCs in 2020, the EU institutions are expected to discuss a review of the NDC—but no formal process for this currently exists. In fact, while the Paris Agreement's five-year review cycle has been incorporated in and is referenced by several relevant EU laws, there is no dedicated process described for the review of the EU target as a whole that would lead to revised NDCs every five years—a gap in the new EU governance system (see also Meyer-Ohlendorf and Meinecke, 2018) . This is even more true for the NDC submission in 2020—a time-frame that the new laws do not consider (their review processes are geared towards the next five-year interval).

The EU's internal review process for the 2020 NDC will thus need to emerge from the developments of the relevant political processes described above, and still needs to be decided by the EU institutions.

It is important to note that while the normal process to adopt legislation in the EU requires majority voting in the Parliament and Council following a proposal by the Commission, the headline GHG targets could be decided de facto absent any Parliament involvement by heads of state and government, if they explicitly state their position in Council conclusions. However, because a consensus is required in the Council, individual countries hold veto power. This explains why no policy path toward full decarbonisation has materialised from the Council, despite a more active role in climate policy recently. While this approach can be argued to result in broader overall political acceptance because it builds on agreement by all Member States current governments, it also disempowers the directly elected Members of the European Parliament and undermines the standard legislative procedure (Meyer-Ohlendorf, 2017). While there is historical precedent (in 2008 (2020 targets) and in 2014 (2030 targets), respectively) for the Council having weighed in heavily on the EU targets, recent experience with the energy targets adopted through legislation in 2018 has again shown that agreement through the negotiations between Council and Parliament can result in politically acceptable decisions that are more ambitious than what the Heads of State and Government can agree on in consensus.

Against the backdrop of lack of a prescribed process and the historic precedence of the strong role of the EU heads of state and government, the outgoing European Commission was unlikely to push for a 2030 target revision until the impacts of new EU legislation, the aggregate effect of current MS climate policies and the cumulative projected effect of MS NECPs had been accounted for (Marcu 2019).

As stated above, assessments of the more ambitious RES and EE target revisions projects EU-wide emission reductions of 45%, which is itself a strong argument for revising the 2030 GHG target. Furthermore, in June 2019 the Commission completed its assessment of draft NECPs, concluding that planned measures by national governments are already in line with the 40% target (European Commission, 2019b).[14] These encouraging data points are now accompanied by the momentum created through the election of future Commission President von der Leyen, which is already showing in the mission letters issued to her incoming Commissioners. A proposed increase to at least 50% and a plan for how to get to 55% are now publicly stated elements of the agenda for the Commission's work programme. The Commission has organised the debate on targets in the past and is now set to put forward a whole new framing for future climate action via a "green new deal" to be put on the table within the first 100 days of von der Leyen taking office. The conversation on a higher 2030 target will thus likely be framed in a context of an economic opportunity for Europe and its Member States, which may lend itself to finding compromise – with the help of financial incentives, also.

In summary, the following picture of the EU's potential for an increased NDC emerges: Support among Member States is growing, but a significant minority remains opposed to the idea – and the decision on a new 2050 target for the EU is on the agenda to be decided first (and does take up political capital and space). The European Parliament has a clear position in favour of a 55% reduction – and has extracted promises from incoming Commission President Ursula von der Leyen to put forward a higher target. Calls for more EU climate action from climate activists and from environmental CSOs are clear and strong – and while they are joined by progressive businesses and some trade unions certain business associations remain opposed. The actual process for a decision on the NDC is unclear and does matter– as the EP could be side-lined by Heads of States and Government, if a political agreement is sought outside of the standard legislative procedure, as has been the case in 2008 and 2014. There is thus significant momentum towards and potential for a decision to increase the EU's NDC in 2020, but timing and likely elements of a compromise are still uncertain. A final decision could well be delayed to the second half of 2020.

[14] However, the report emphasised that existing measures by EU MS do not meet the non-ETS target of 30%, instead reducing emissions in ESR sectors by 28%.

5 Germany

5.1 Introduction

Germany is represented through the EU in international climate negotiations; thus, it does not have an NDC or 2020 pledge. However, it has set itself national targets guided by UN climate convention and EU legislation. According to official projections, Germany will not achieve its 2020 target of a 40% reduction compared to 1990 and also beyond 2020 emissions are currently projected to be above the 2030 target (BMU, 2018). Germany has already developed its long-term climate strategy for 2050. The strategy contains sectoral targets for 2030, which are designed to meet the current 2030 target of reducing GHG emissions by 55% compared to 1990 and are expected to be part of the planned Climate Protection Act.

The German government has agreed with others to consider increasing the EU NDC target in the light of the IPCC SR on 1.5. While the German chancellor was opposed to raising the EU 2030 target in the beginning, she has recently started to show support for an increase of this target to a 55% reduction (see Section 4). However, the German government has not shown the ambition to modify its 2030 target yet. The Climate Package agreed on by the Climate Cabinet in September 2019 aims at the current 2030 target of -55% GHG reduction. Given its failure to meet the 2020 GHG reduction target, it seems unlikely that Germany will increase the ambition of its 2030 climate target in the near future unless it is driven to do so by a revision to the EU 2030 target.

This is in contrast with equity and least-cost approaches, which both suggest that Germany should increase its ambition for a globally fair solution to limit temperature increase to 1.5 °C in line with the Paris Agreement. Even a globally cost-efficient pathway would imply a more stringent reduction (amounting to 61%, see Section 5.4.2). The equity-based approaches indicate that the reductions in global least-cost pathways are only at the lower end of the range of fair contributions, in particular for 2050, meaning that Germany needs to support developing countries in addition to increasing domestic climate change mitigation efforts.

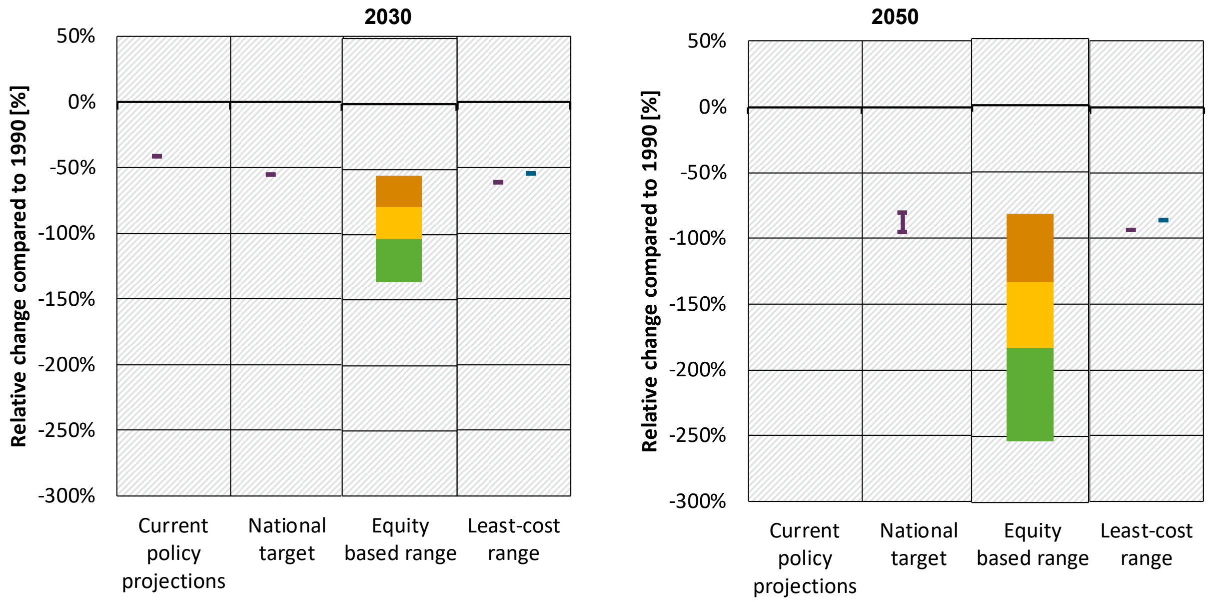


Figure 21: Germany – Relative change in GHG emissions excl. LULUCF compared to base year for equity and cost-based approaches

Notes: Equity-based emissions reduction range from Climate Action Tracker (2018 update), other data from (Federal government of Germany, 2019a). Legend: For equity-based range: orange (upper range) is >2°C consistent, yellow (middle range) is 2°C consistent, green (low range) is 1.5°C consistent. For least-cost range: lower limit for 1.5°C, upper limit for 2°C.

5.2 Socio-economic context for greenhouse gas emissions reductions

Germany is the world's fourth largest economy in terms of nominal GDP and the largest economy in Europe. It continues to be a manufacturing hub and is among the top global net exporters. After a slump in 2015, the German economy showed strong economic growth in 2016 and 2017 (IMF, 2018a). This economic momentum is expected to have been sustained in 2018 although its pace may be effected in 2019 due to geopolitical issues within Europe and with trade partners such as the US (IMF, 2018b). The German state lays a strong focus on social welfare and has been able to achieve and maintain very high levels of development (HDI-0.93), with high per capita income and comparatively fairer income distribution. However, Germany faces demographic challenges due to continued low fertility rates.

5.2.1 Economic and development-related data

Table 9: Germany – Key socioeconomic figures

Indicator	Value	World	Year	Source
Population [million]	83	7 594	2018	The World Bank
GDP [bn USD at current prices]	3 997	85 791	2018	The World Bank
GDP/cap [USD/cap]	48 196	11 297	2018	The World Bank
HDI [0 – 1]	0.94	Rank 5	2018	UNDP
GINI index [0 – 100]	31.7	n.a.	2015	The World Bank
Electrification rate [%]	100%	88.9%	2017	The World Bank
Corruption index	Score: 80/100	Rank: 11/180	2018	Transparency International
Urbanization [% of total]	77.4%	55.7%	2019	United Nations Population Division

Data sources: (Transparency International, 2018; United Nations Department of Economic and Social Affairs: Population Division, 2018; United Nations Development Programme (UNDP), 2018; Statista, 2019; The World Bank, 2019b, 2019a, 2019c).

5.2.2 Energy production and consumption

Germany's current primary energy mix is comprised of high shares of oil (32%), coal (22%) and gas (24%), followed by biomass and waste (10%), nuclear (6%), and solar, wind and other renewables (4%). The primary energy supply has been decreasing over the last three decades and in 2017 showed a reduction of nearly 9% since 1990. In terms of energy carriers, the share of biomass and waste and other renewables is increasing. In parallel, oil and coal use has seen a steady decline, although in part because of increased use of natural gas. Nuclear power's role has declined in accordance with the agreed phase out of nuclear energy by 2022. Since the Fukushima accident in 2011 and Germany's subsequent decision to accelerate its nuclear phase out, electricity from nuclear power has reduced from a quarter of Germany's electricity to about 12%. Roughly 42% of Germany's electricity comes from fossil fuels. As renewables are prioritised for power dispatch, a significant portion of power is exported to neighbouring countries. Most oil-based power has been crowded out by cheaper renewables. However, oil continues to be prominent in the transportation sector. Germany continues to be the largest importer of oil and natural gas in the EU (Eurostat, 2018).

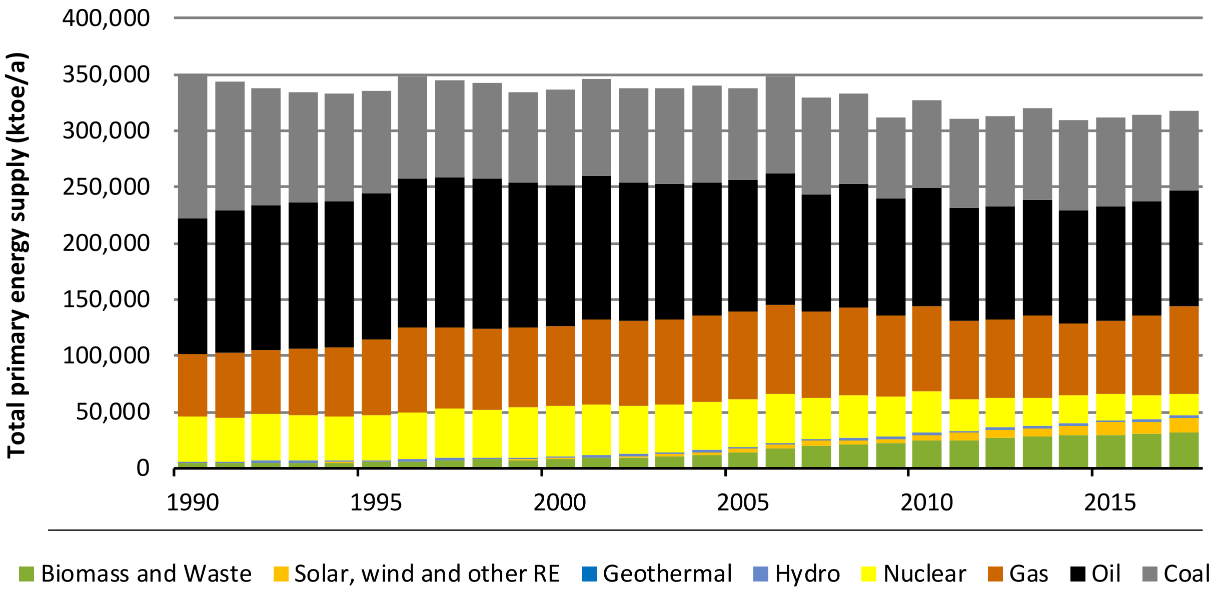


Figure 22: Germany – Primary energy supply by energy carrier between 1990 and 2017

Data source: (IEA, 2018b)

5.3 Greenhouse gas emissions profile

Germany's emissions declined by 28% between 1990 and 2017. However, emissions reductions have stalled during the last decade. Energy combustion constituted the largest share of emissions (85%) in 2015, followed by agriculture (7%) and industry (7%). The emission intensity of the economy stood at 262 tCO_2e/mln USD in 2016—this was 13% higher than in 2014 mainly due to the slump in economic growth that year. Overall, Germany emits 1.76% of global emissions.

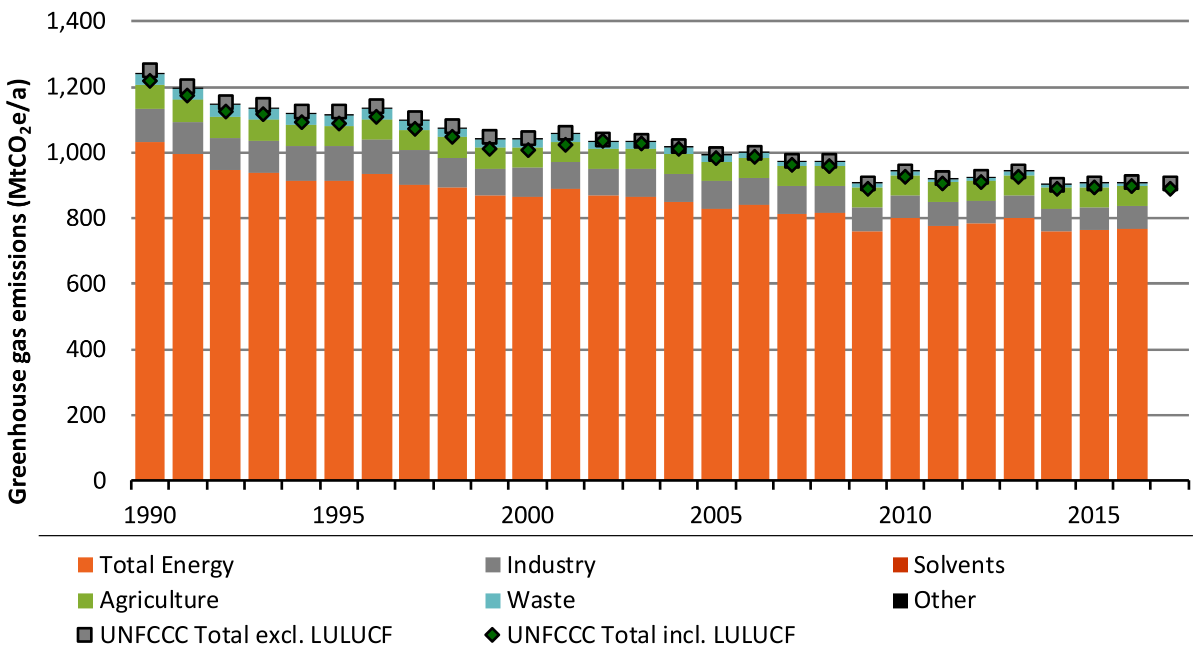


Figure 23: Germany – Sectoral GHG emissions between 1990 and 2017

Data sources: (Gütschow *et al.*, 2018a; UNFCCC, 2019)

Table 10: Germany – Key GHG emissions data

Indicator	Germany	World	Year
GHG/cap [tCO_2e/cap]	11.05	6.15	2016
GHG/GDP [tCO_2e/mln USD]	262	603	2016
Energy/GDP [ktoe/mln USD]	0.09	0.18	2017 (World: 2016)
Global share of emissions [%]	1.76%	100%	2012

Data sources: (JRC and PBL, 2014; Gütschow *et al.*, 2018a; IEA, 2018b; The World Bank, 2018b). *GHG indicators were calculated using PRIMAP data and exclude contributions from the LULUCF sector.*

5.4 Development of future greenhouse gas emissions

5.4.1 Emissions reduction targets and current policy projections

Germany is represented through the EU in the international climate negotiations, and thus, it does not have an NDC or 2020 pledge. However, it has set itself national targets, guided by the UN climate convention and EU legislation (Umweltbundesamt, 2018b). Germany's 2020 target is a 40% reduction in GHG emissions below 1990. For 2050, the German government has committed, through the Climate Action Plan 2050, to become "largely GHG neutral"—according to the accompanying data provided this translates to a relative reduction below 1990 levels of 80-95%. In addition, the German government has set various interim targets (i.e., 55% below 1990 in 2030, 70% below 1990 in 2040).

According to official projections, Germany will not achieve its 2020 pledge, and beyond 2020 emissions are above the target pathway (BMU, 2018).

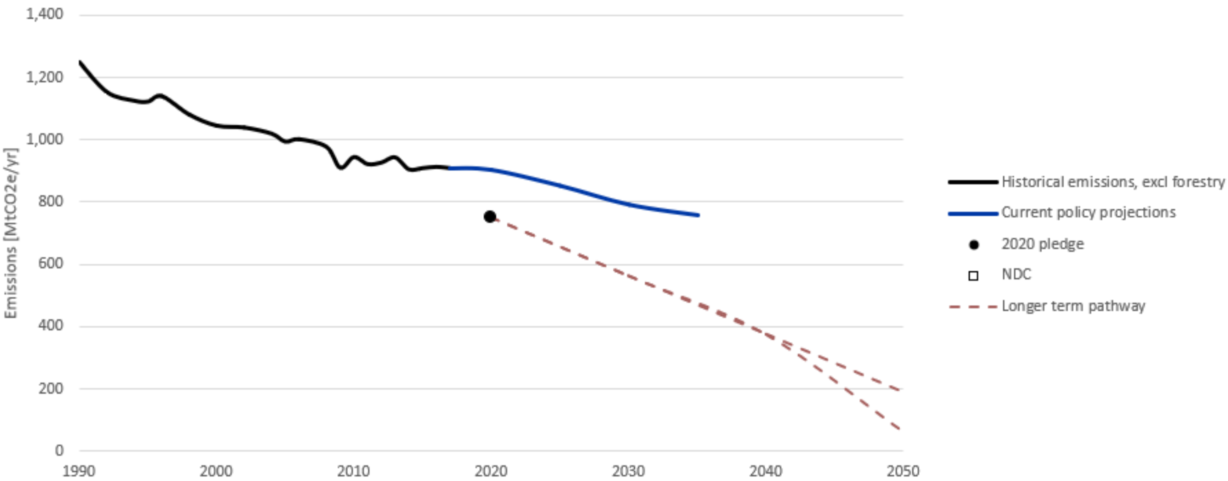


Figure 24: Germany – Historical and projected emissions under current policies and target pathways

Data source: (Federal government of Germany, 2019b; Umweltbundesamt, 2019)

5.4.2 Sectoral mitigation pathways until 2030

In 2015, the highest share of energy- and process-related GHG emissions in Germany occurred in the energy supply sector (43%), followed by the industry, transport and buildings sectors, which were all three almost on the same level (~20%). The energy supply sector is composed of GHG emissions from electricity generation and other transformation (centralized heat, refineries, etc.). Emissions in the transport sector are mainly determined by road transport.

A comparison between global 1.5°C consistent and 2 °C consistent pathways based on recent MACCs for 2030 leads to the conclusion that the potential to reduce energy- and process-related emissions has to be exploited to a much larger extent to achieve 1.5 °C consistency. For Germany, this would amount to a 46% reduction of energy- and process-related emissions by 2030 compared to 2015 (61% compared to 1990, the NDC's base year). For the year 2030, the highest economic mitigation potential would lie in the buildings sector—compared to 2015, this reduction amounts to 56%. The next highest GHG emission reductions would be achieved by the industry sector (52%). The GHG emissions in the energy supply sector would be reduced by 42% and in the transport sector by 41% compared to 2015.

The cost-effective pathway compatible with the 2°C target results in a similar distribution of emission reductions among the sectors for 2030. The total reduction of energy- and process-related emissions by 2030 amounts to 37% compared to 2015 (55% with regard to 1990). With regard to an NDC-compatible reference pathway the order of the mitigation potential among the sectors is changed. Here, the highest emission reduction would still be achieved in the buildings sector with 45%. The industry sector would follow next with a mitigation potential of 38% compared to 2015. The GHG emissions in the energy supply sector and the transport sector would be reduced by 35%.

The sectoral GHG reduction pathways are summarized in Figure 25.

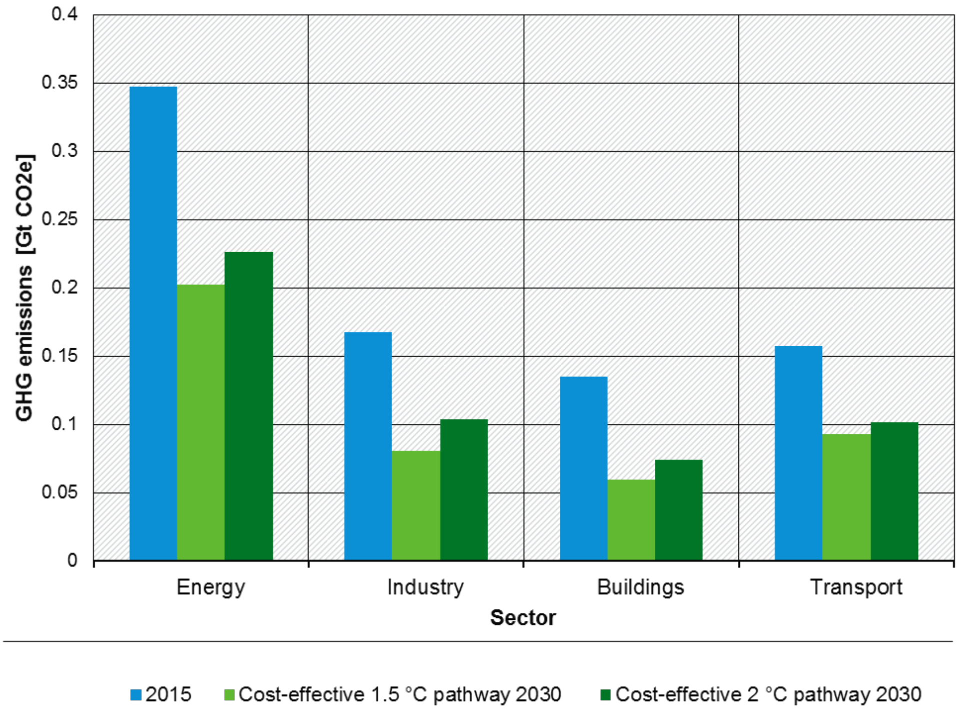


Figure 25: Germany – Sectoral GHG reduction potentials until 2030 compared to 2015

Source: own calculation based on data from the POLES-Enerdata model

5.4.3 Emissions reduction targets suggested by equity considerations

The equity approaches for Germany result in a broad range of emission reductions in 2030 and 2050. To remain within a range compatible with the Paris Agreement, German emissions would have to decrease by at least 104% by 2030 compared to 2015 levels (103% below 2005). To stay within the 1.5°C limit of the Paris Agreement in 2050, Germany would have to reduce its emissions at least by 215% below 2015 levels (205% below 2005). Emissions reductions compatible with the old 2°C limit would be at least 71% for 2030 and 146% for 2050, both below 2015 levels (74% and 142% below 2005).

The most stringent approaches are staged approaches both for 2030 and 2050. Most staged approaches, as well as some considering capability and historical responsibility, would require negative emissions even as early as 2030. This indicates the prominent role Germany should play in international climate cooperation on top of its domestic efforts to reduce emissions. In contrast, the categories of approaches focusing on equality and equal cumulative emissions per capita are less stringent for Germany, both in 2030 and in 2050, with only a few observations pointing to negative emissions in 2050.

5.5 Political context

This section provides the political context for climate action in Germany. It is structured as follows. After a description of the general disposition, the basic political timelines and dimensions that affect mitigation policies are described. After turning to historical precedents and the strength of the civil society, the section ends with a conclusion on the likely direction of the 2020 NDC submission.

5.5.1 General disposition

Germany is a member state of the EU. For this reason, its climate policy is highly interlinked with EU climate policy. Hence, in its 2010 energy concept, the German government adopted the EU's long-term climate target of reducing GHG emissions up to 2050 by 80-95% with regard to 1990. The energy concept also includes milestone targets for GHG reductions in 2020 (-40%) and 2030 (-55%) as well as targets for energy efficiency and renewable energy both in total and partly on a sectoral level. In 2016, Germany submitted its Climate Action Plan 2050 to the UNFCCC — this constitutes the country's long-term GHG reduction strategy. In particular, the Climate Action Plan 2050 includes sectoral mitigation targets for 2030 in line with Germany's 2030 GHG reduction target as well as a more ambitious qualification of the long-term target range of near greenhouse gas neutrality, and a commitment to revise the pathway and in particular the 2030 target in the timeframe of the Paris Agreement (BMU, 2016)

As a member state of the EU, Germany takes part in the EU-wide emission trading system (EU-ETS) established in 2008, which covers GHG emissions from the energy sector and the energy-intensive industry sectors. Furthermore, under the EU's Effort-Sharing Decision, Germany is required to reduce GHG emissions in the sectors not covered by the EU-ETS by 14% until 2020 and by 38% until 2030 both compared to 2005, with yearly emissions budgets. Currently, like seven other MS, it is not in compliance with its obligation for 2020, which means Germany will have to compensate by buying emission allowance units from other MS (EEA, 2018).

5.5.2 Basic political timelines that affect mitigation policies

In the last national elections in September 2017, the centre-right Union parties (CDU/CSU), who have led the government since 2005, again received the highest number of votes. After the formation of a coalition with the Green Party (Bündnis90/Die Grünen) and the Liberal Democrats (FDP) failed, the former coalition between the Union parties and the centre-left Social Democrats (SPD) was re-established. The current government confirmed the long-term strategy adopted in 2016 by the previous coalition government, with all its targets and policies. However, the government expects that Germany will largely fail to meet its 2020 climate target (BMU, 2018).

One of the first steps of the coalition was to install a new commission on growth, structural change and employment ("Coal Commission"), which was meant to recommend measures for closing the gap to the 2020 climate target and agree on a timeline for the phase-out of coal-fired power plants in order to ensure that Germany meets its 2030 climate target for the energy sector. In this regard, the commission was meant to find a balance between climate mitigation needs and its impacts on economic growth and employment in the affected regions. The Coal Commission presented its final report to the public in January 2019. In this report, the Coal Commission suggests to phase out coal power in Germany by 2038, with intermediary steps in 2020 and 2030. The report includes the suggestion to re-assess an earlier phase-out in the early 2030s. The suggestions are not binding to the German government, but the government has announced to establish regulations that follow the suggestions by the Coal Commission, which at the time of writing still needs to be done (Schulz, 2019b).

In addition, the coalition agreed to adopt a Climate Protection Act in the coalition treaty by which Germany's current 2030 climate targets shall become binding. To support this process, Chancellor Merkel announced the formation of a climate cabinet in early 2019, consisting of the ministers responsible for Germany's emissions reduction record and chaired by herself. On 20 September 2019, the climate cabinet approved a package of policy instruments ("climate package") that are meant to ensure that Germany will reach its 2030 targets (BMU, 2019). Besides a variety of measures across all relevant sectors, the package includes an annual monitoring of the progress towards 2030 targets to be established by the planned Climate Protection Act. The climate package may see substantial changes throughout the legislation process, as opposition has been announced by various actors (Schulz, 2019a).

The next regular national elections will take place in 2021. This is after the 2020 NDC submission and the concurrent timetable outlined in the long-term strategy to review the national targets. It is also after the adoption of the EU's revised long-term climate strategy. Currently, the political development in Germany appears to be highly dynamic, with both CDU and SPD losing votes in the most recent federal elections and gains for both the Green Party, which has shown continuous support for an ambitious climate policy, and the right-wing populist AFD, which currently opposes an increase of ambition. This makes it difficult to anticipate outcomes with regard to both winning parties and their attitude towards climate policy.

5.5.3 Dimensions of the political system that affect mitigation ambition

While the German Ministry for the Environment and Nuclear Safety is in charge of climate policy, the Germany Mistry for Economic Affairs and Energy is responsible for the energy transition. Other ministries such as the Ministry for Transport and Digital Infrastructure and the Ministry for Agriculture also play important roles for climate policy. This has led to conflicts in the past, among others in the context of the Climate Action Plan 2050 and the planned Climate Protection Act. In turn, Chancellor Merkel has formed the Climate Cabinet that integrates all relevant ministers in the decision-making process.

Due to Germany's federal political system, the national government is in charge of energy and climate policy, but a lot of the mitigation measures are strongly influenced by the governments of the federal states as well as municipalities. In the past, some of the federal states have shown higher ambition with regard to climate policy and especially the expansion of renewable energy sources, while some federal states are afraid of job losses in existing industries, especially coal mining (Appunn, 2016).

In addition, there are relationships with the private sector that may affect mitigation ambition. First, German energy suppliers who operate fossil power plants are partially owned by municipalities. As a consequence, some municipalities' budgets significantly depend on the dividends from the energy suppliers. Second, there are strong links between the German car industry and the political area. The German car industry, which includes not only five of the largest manufacturers in the world but also numerous SMEs along the supply-chain, plays a key role for the German economy as a whole. Therefore, there are high hurdles to setting ambitious targets for the transport sector due to the risk of de-growth and job losses along the supply chain. The industry lobby has also been able to secure generous exemptions from feed-in tariff and other levies (Egenter, Russell and Wettengel, 2017).

5.5.4 Historical precedent

Germany has proven its ability to transform its energy sector by implementing a nuclear phase-out in spite of strong opposition—at least initially—and ambitious policies in support of renewable energy, such as feed-in tariffs. In former times, Germany was also a frontrunner with regard to international climate governance. Germany was one of first countries to ratify the Kyoto Protocol and was also one of the early actors to set ambitious energy and climate targets both in the shorter (2020 target decided in 2007) and the longer run (2030 and 2050 targets set in 2010). Finally, Germany was among the first countries to develop a long term 2050 climate strategy (in 2016).

Recently, however, Germany has slowed with regard to both ambition and implementation. This has become visible in the expectation that Germany will largely fail to meet its 2020 climate target (BMU, 2018). Furthermore, the German government has watered down more ambitious fuel standards for vehicles several times. The unofficial proposal at the EU level to increase the GHG target to 45% has not received support from the German government in the beginning (Stam, 2018). Latest announcements by Chancellor Merkel suggest that she aims at higher ambition again, e.g. raising the EU 2030 target to even 55% GHG reduction, although Germany still needs to prove this on a more formal level (Tagesspiegel and DPA, 2019).

5.5.5 Strength of civil society

In the past, the civil society has played an important role in environmental issues. In particular, German civil society organisations were a major driver for initiating the ongoing nuclear phase-out. With regard to energy and climate, the current direction of civil society's push is less clear. On the one hand, the majority of the population supports the climate targets and the energy transition as well as the expansion of renewable energies in general (Amelang, Wehrmann and Wettengel, 2019). Moreover, there is also significant support for the phase-out of coal power plants in combination with increasing opposition to the continued extraction of lignite or brown coal. In particular, the protests organised by Fridays For Futures have received strong support by the German youth. As a consequence, their role for driving politics was acknowledged by the German government recently (Egenter, Sven and Wehrmann, 2019).

On the other hand, there are numerous local initiatives, which are against certain measures important for the energy transition, in particular the expansion of certain renewable energy sources such as onshore wind power and the expansion of the electricity grid. The lack of support for grid expansion is a major reason for delays to upgrading Germany's electricity infrastructure, which could hamper the expansion of renewable power due to grid limitations (Mcintosh, 2019).

5.5.6 Likely position with regard to the 2020 NDC submission

Germany will not submit an NDC itself, but may play an important role in the revision of the EU NDC. While Chancellor Merkel was opposed to raising the EU 2030 target in the beginning, she has recently started to show support for an increase of this target to a 55% reduction (see Section 5.5.4). Moreover, Germany's 2050 strategy envisages a review process for the German targets in line with the Paris Agreement ratcheting up mechanism and recognises that the 2030 target will need to be updated accordingly (see Section 5.5.1).

However, the German government has not shown the ambition to modify its 2030 target yet. The Climate Package agreed on by the Climate Cabinet aims at the current 2030 target of -55% GHG reduction (see Section 5.5.2). Moreover, the corresponding sectoral 2030 targets are expected to be part of the Climate Protection Act planned for 2019 as well. Given its failure to meet the 2020 GHG reduction target (see Section 5.5.1), it seems unlikely that Germany will increase the ambition of its 2030 climate target in the near future unless it is driven to do so by a revision to the EU 2030 target.

6 India

6.1 Introduction

Current analyses project that India will overachieve its 2020 targets as well as its conditional and unconditional NDC targets. This alone indicates the need to revise the level of the NDC for the round of 2020 submissions to the UNFCCC. Least-cost approaches show that a cost-effective global pathway in line with limiting temperature increase to 1.5°C suggests an emissions level below 2005 for India in 2030 already. This is at the most ambitious end of the range of equity-based results. The 2050 data show much deeper reductions, and similarly show least-cost approaches demanding reductions beyond the lower end of the equity range. Some effort sharing approaches still assign increasing emissions allowances until the middle of this century to India. It is important to note that these are allowances based on equity considerations. Physical global CO_2 emissions have to become net-zero around 2050, and total GHG emissions shortly thereafter (IPCC, 2018). This means that developed countries should support India in reducing emissions to whatever extent is necessary for a globally cost-efficient and fair solution.

Recent discussions in India about increasing the country's renewable energy targets serve as a promising sign. The process of a potential NDC revision is unlikely to start before 2020.

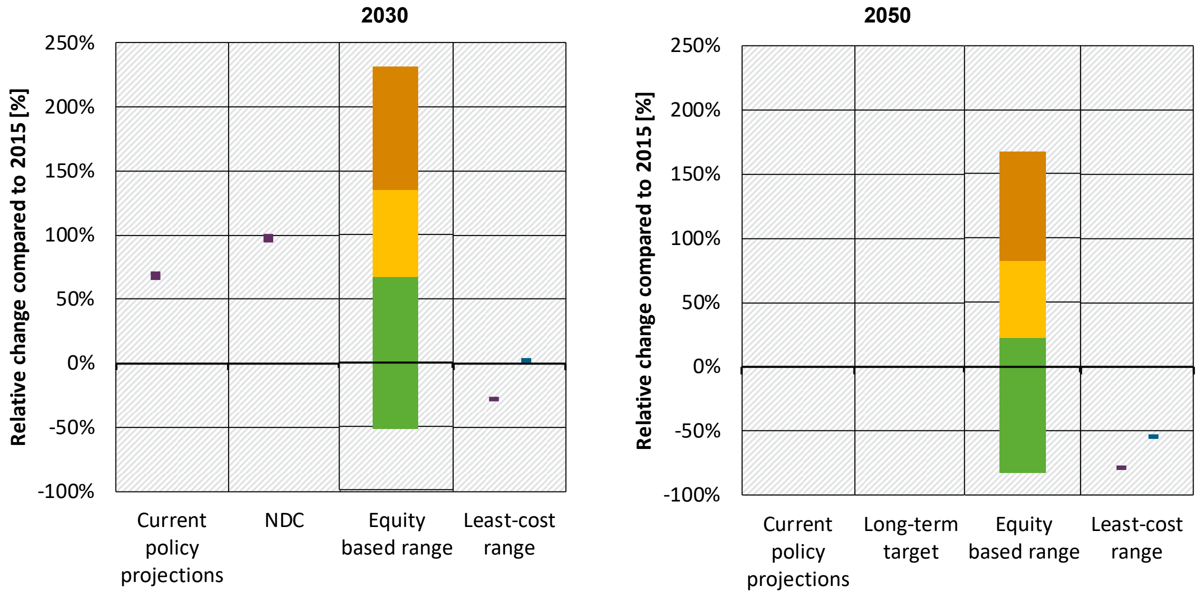


Figure 26: India – Relative change in GHG emissions excl. LULUCF to base year for equity and cost-based approaches

Notes: Current policy projections, NDC and equity-based emissions reduction ranges from Climate Action Tracker—equity range from 2018 (December update), other data from (2019 April update). Legend: For equity-based range: orange (upper range) is >2°C consistent, yellow (middle range) is 2°C consistent, green (low range) is 1.5°C consistent. For least-cost range: lower limit for 1.5°C, upper limit for 2°C.

6.2 Socio-economic context for greenhouse gas emissions reductions

6.2.1 Economic and development-related data

India's growth accelerated after the first economic liberalisation in the early 1990s. In 2016, India was the sixth largest economy in the world with a nominal GDP of 2.26 trillion USD. The services sector is the largest and growing contributor to economic output, followed by industry and agriculture, although the latter continues to be a major employer. This trend of high growth is expected to continue, despite major indirect tax reforms in 2017 (Economic Times, 2018).

Yet, huge economic challenges lie ahead for the country. India's GDP per capita is one-sixth of the global average and income inequality is on the rise. There is also a high degree of informality in the economy. Indian government's 2018 economic survey showed that 87% firms (accounting for a 21% share of the total economic turnover) fall in the informal sector, i.e., are outside any regulatory oversight (Ministry of Finance India, 2018). It must be noted that the informal manufacturing sector is a growing consumer of fossil fuels. Beyond economic challenges, India also faces pronounced human development challenges. It falls in the group of countries with a *medium* level of human development and ranks 131 out of the 188 countries assessed. Despite announcements of major improvements in rural electrification in early 2018, the electrification rate stands at 93% (in 2017). Air pollution, migration and unplanned urbanisation are rapidly becoming issues of great concern.

India's socio-economic context is the defining feature of the country's approach in tackling climate change.

Table 11: India – Key socioeconomic figures

Indicator	Value	World	Year	Source
Population [million]	1 353	7 594	2018	The World Bank
GDP [bn USD at current prices]	2 726	85 791	2018	The World Bank
GDP/cap [USD/cap]	2 016	11 297	2018	The World Bank
HDI [0 – 1]	0.64	Rank 130	2018	UNDP
GINI index [0 – 100]	35.7	n.a.	2011	The World Bank
Electrification rate [%]	93%	88.9%	2017	The World Bank
Corruption index	Score: 41/100	Rank: 78/180	2018	Transparency International
Urbanization [% of total]	34.5%	55.7%	2019	United Nations Population Division

Data sources: (Transparency International, 2018; United Nations Department of Economic and Social Affairs: Population Division, 2018; United Nations Development Programme (UNDP), 2018; Statista, 2019; The World Bank, 2019b, 2019a, 2019c).

6.2.2 Energy production and consumption

India's energy mix has traditionally been dominated by fossil fuels. These provide a little short of three-quarters of the country's primary energy needs. Coal fulfils a majority share of 44%, followed by oil (25%), biomass and waste (22%), gas (5%) and a minor share of 2% is covered by renewables including hydro. The share of coal and oil have increased by 20% since the economic liberalisation of 1990, while that of biomass and waste has reduced as improvements in energy access have reduced the use of traditional biomass. Coal based power continues to dominate India's generation capacity (57%). Gas has a share of 7%. Recent years have seen a massive policy push for the uptake of renewables to address energy security considerations. The share of renewable capacity has now reached 20% (Ministry of Power, 2018). However, India continues to be a net importer of crude oil and natural gas. While coal imports are considerable, they are on a declining trend. In 2016, India was still the second largest importer of coal in the world (World Coal Association, 2018). Considering its reliance on fossil fuels, the energy intensity of Indian economy is high—at 0.38 ktoe/mln USD in 2016, more than double of the world average (see Table 12).

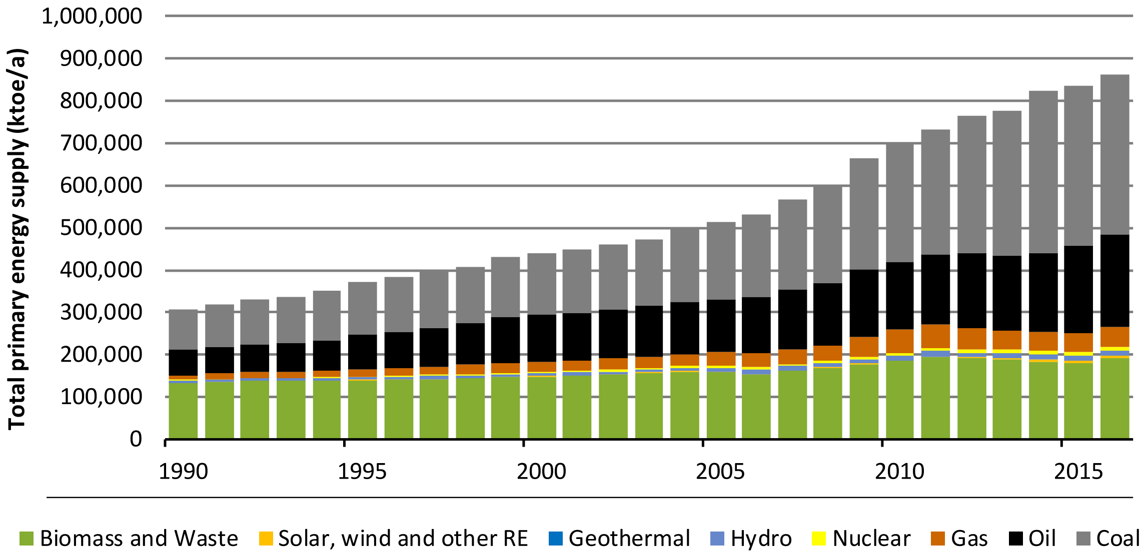


Figure 27: India – Primary energy supply by energy carrier between 1990 and 2016

Data source: (IEA, 2018b)

6.3 Greenhouse gas emissions profile

India's emissions have been on a steady rise. In 2016, GHG emissions excluding LULUCF stood at 2.8 $GtCO_2e$. Energy combustion contributes to three-quarters of the total emissions. Agriculture (14%) is the second largest contributor. The majority of energy combustion emissions are from power generation, manufacturing industries and transport, which reflects the increase in economic activity and prosperity in the last decades.

Yet signs of a partial decoupling of emissions and economic activity are visible. Emissions per unit of economic output has been on a declining trend and stood at 1227 tCO_2e/mln USD in 2016. India's GDP per capita has been increasing at a higher rate than its per capita emissions. An average Indian emits three times less than the world average. Yet the socio-economic inequity in India makes a lower per capita emission also an indicator of the future need for energy, which will likely be accompanied by an increase in emissions.

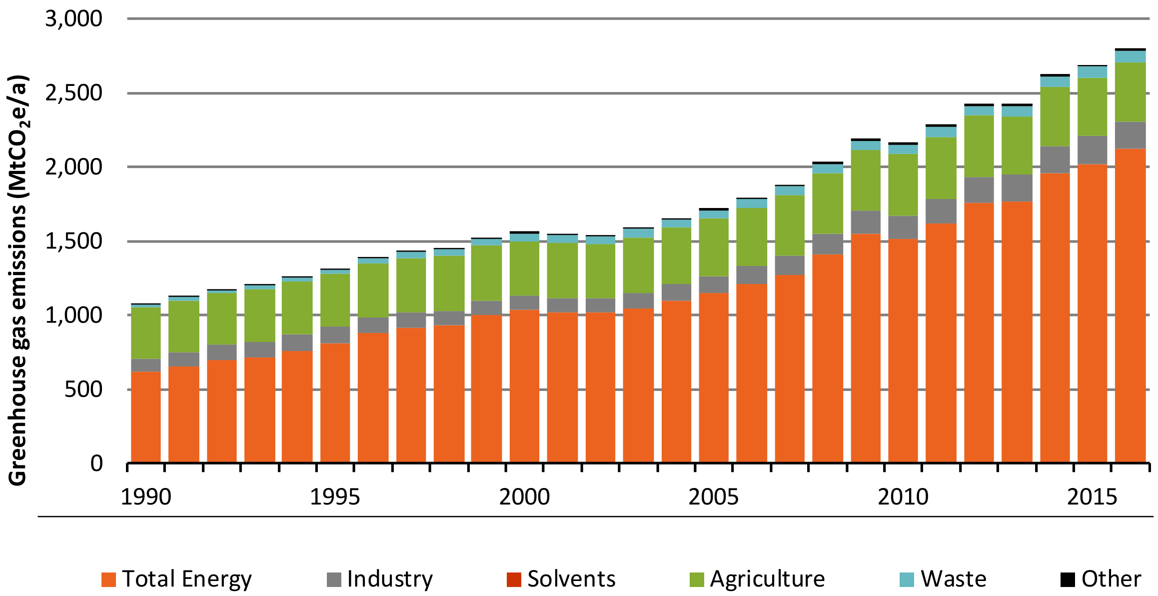


Figure 28: India – Sectoral GHG emissions between 1990 and 2016

Data source: (Gütschow *et al.*, 2018a)

Table 12: India – Key GHG emissions data

Indicator	India	World	Year
GHG/cap [tCO_2e/cap]	2.11	6.15	2016
GHG/GDP [tCO_2e/mln USD]	1,227	603	2016
Energy/GDP [ktoe/mln USD]	0.38	0.18	2016
Global share of emissions [%]	5.57%	100%	2012

Data sources: (JRC and PBL, 2014; Gütschow *et al.*, 2018a; IEA, 2018b; The World Bank, 2018b) *GHG indicators were calculated using PRIMAP data and exclude contributions from the LULUCF sector.*

6.4 Development of future greenhouse gas emissions

6.4.1 Emission reduction targets and current policy projections

Tackling the dual objectives of fighting climate change, while continuing to grow and develop is therefore the centrepiece of India's efforts on climate change. In particular, in recent years, providing energy security to the population has been a fundamental objective of developmental policy-making in the country. The concrete actions proposed in India's first NDC reflect these priorities (Government of India, 2015b):

- to reduce the emissions intensity of GDP by 33%–35% by 2030 below 2005 levels;
- to increase the share of non-fossil-based energy resources to 40% of installed electric power capacity by 2030, with help of transfer of technology and low-cost international finance including from Green Climate Fund (GCF);
- to create an additional (cumulative) carbon sink of 2.5–3 $GtCO_2e$ through additional forest and tree cover by 2030.

The Climate Action Tracker (CAT) analysis shows that India can achieve both its 40% non-fossil target and its emissions intensity target with currently implemented policies. The CAT assessment highlights that the share of non-fossil power generation capacity will reach 60-65% in 2030 as compared to the 40% target. This capacity addition will correspond to a 45-50% share of renewable electricity generation compared to 20% today. Furthermore, India's emissions intensity in 2030 will be ~50% below 2005 levels (see Figure 29).

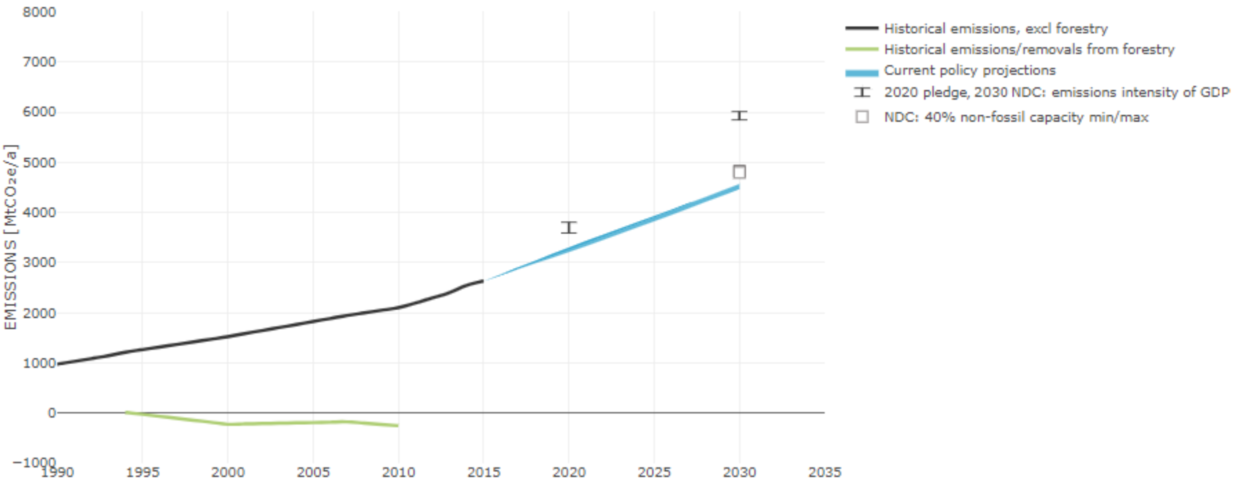


Figure 29: India – Historical and projected emissions under current policies and target pathways

Data source: (Climate Action Tracker, 2018a)

6.4.2 Sectoral mitigation potential until 2030

The highest share of India's energy- and process-related emissions in 2015 came from the energy supply sector, amounting to 1.45 GtCO2-eq (see Figure 30). This sector is comprised of electricity generation as well as other transformation processes (centralized heat, refineries, etc.). The emission level of the industry sector is about half as high while the buildings and the transport sectors each have a share of about 18% of the total emissions.

A comparison between global 1.5°C consistent and 2 °C consistent pathways based on recent MACCs for 2030 leads to the conclusion that the potential to reduce energy- and process-related emissions has to be exploited to a much larger extent to achieve 1.5 °C consistency. For India, this would amount to an 18% reduction of energy- and process-related emissions by 2030 by (or an increase by 29% if compared to the base year 2005 selected for India's NDC). As the evaluation of the MACCs for 2030 shows, the highest reductions can be achieved in the buildings (50%) and the energy supply sectors 51%). The emission reduction potential in the industry sector amounts to 4%, while in the transport sector the emissions increase can at best be limited to 79% compared to the level of 2015.

In the cost-effective pathway compatible with 2°C, reductions would not be achieved in the industry and the transport sector. The emissions in the industry sector would increase by 35% compared to 2015, while the energy- and process-related emissions from the transport sector would see an increase of 116%. The highest economic mitigation potential (about 25%) occurs in the energy and the buildings sectors. The total emissions would increase by 2% if compared to the emission levels in 2015. For the NDC's base year 2005, this would correspond to an increase of 79%.

In an NDC-consistent pathway, emissions in all sectors increase compared to the emission levels of 2015. At 145%, the rise is the highest in the transport sector. The increase in emissions in the industry sector amounts to 98%, and in the energy sector to 55%.

For India, the sectoral mitigation pathways until 2030 are summarized in Figure 30.

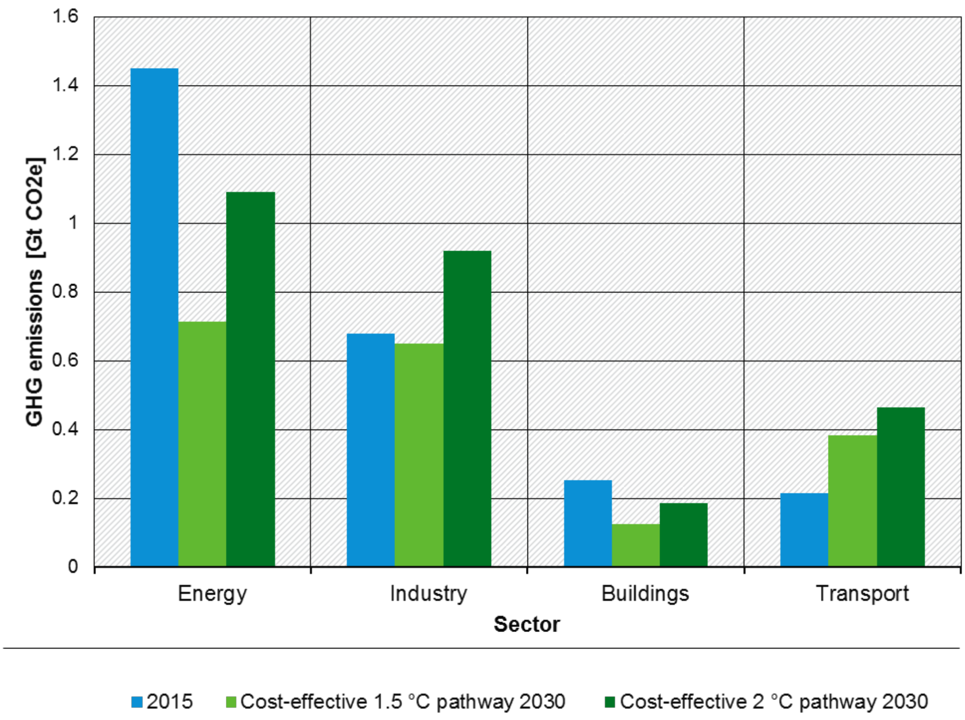


Figure 30: India – Sectoral GHG reduction potentials until 2030 compared to 2015

Source: own calculation based on data from the POLES-Enerdata model

6.4.3 Emissions reduction targets suggested by equity considerations

According to different equity-based approaches, to stay within the Paris Agreement's 1.5°C limit compatibility ranges, India's emissions (excluding LULUCF) in 2030 could increase by 67% above 2015 levels (137% 2005 levels). Compatibility with the former 2°C goal would even allow for higher emissions increase—135% above 2015 levels (234% above 2005 levels).

These emissions allowance ranges stand in stark contrast with the cost-effective reduction ranges in 2030 (28-52% below 2015 levels), which show the big domestic mitigation potential India has compared with the emissions allowances that it would get if only equity considerations were to be considered. This reflects India´s low emissions and GDP per capita indicators, as well as its relatively low historical responsibility for global emissions. Under these considerations, India could benefit substantially from international cooperation and markets to achieve its full mitigation potential.

In 2050, emissions allowances under equity considerations also allow for emissions increases of 22% and 83% in comparison to 2015, respectively for each of the temperature targets (74% and 160% above 2005 levels).

A more detailed look into India's equity range shows that staged approaches define the lower ends of the equity ranges, while categories focusing on capability, as well as approaches taking into account historical responsibility, lead to less stringent emissions reductions and define the upper ends of the equity ranges for India. However, it must be noted that most of the equity categories for India (in particular when considering the Paris Agreement temperature goal) represent a broad range of emissions reduction covering almost the whole range described above. This is explained mainly by large differences between the studies—their underlying metrics, starting points and the weights given to each factor.

6.5 Political context

6.5.1 General disposition of the country towards climate policy

6.5.1.1 Historical developments

India's political disposition towards climate change mitigation has evolved from defensive to increasing proactive. India is keen on defining its role in global climate governance while remaining cognisant of its domestic developmental concerns.

Narratives of equity have been central to India's diplomatic position on its role in climate action (Dubash, 2013a). For many years, little changed in the Indian position, and the country drew strong criticism from the international community for being rigid, even obstructive at times, in the face of its rising emission profile (Rajamani, 2009). The first shifts in India's diplomatic response on its role were seen before Copenhagen, when then Indian Premier, Manmohan Singh, announced that India's per capita emissions would never exceed that of the developed world (Sengupta, 2011a; Atteridge *et al.*, 2012; Dubash, 2013b). Soon after this announcement, it submitted its Copenhagen pledge and announced the National Action Plan on Climate Change (NAPCC). However, the motivations behind this shift in stance were seen as reactions to international pressure (Sengupta, 2011b; Dubash, 2013a) and fear of isolation among the BASIC countries (Atteridge *et al.*, 2012).

More recently, the Indian position has seemed become an even more 'proactive' approach, targeting developmental objectives via climate action. For instance, in 2015, the Indian government decided to raise its renewable energy capacity to 175 GW by 2022. India also played a facilitative role in the run-up to Paris, including collaborating with France to launch the international solar alliance and supporting the 1.5°C framing (Narlikar, 2017). Political analysts see this flexibility and openness as a systematic shift in India's overall diplomatic approach since Copenhagen and a clear departure from its past engagement with the international community on the issue of climate change (Mohan, 2017; Narlikar, 2017; Mohan and Wehnert, 2018).

6.5.1.2 Relevant political processes in the foreseeable future

Government changes in India are not likely to have a negative impact on India's mitigation ambition as there is high consensus among political parties on climate and energy policies (Tewari *et al.*, 2017). Until recently, the implementation of national missions and state-budgets was embedded in 5-year planning cycles (called National Five-Year Plans). However, the government announced that it would replace these with a three-tiered strategic planning system involving a 15-year vision document, 7-year strategies and 3-year action plans geared towards the vision and strategy document. The Action Agenda 2018-2020 was launched in August 2017 (NITI Aayog, 2017). While the economics of renewables are already making coal-based plants unattractive, the document seems to give conventional power a priority over renewables.[15]

In tandem with the planning changes, the share of union taxes transferred to states was increased from 32% to 42% in 2017 (PRS Legal, 2018). As the next section will discuss, dependence of sub-national governments on the union government for financial resources is a key barrier to implementation in India. While financial devolution is a step in the right direction, it may increase uncertainty in the short-term due to low capacity and awareness on environmental planning at the sub-national level.

6.5.2 Prospects for a review and increase of the national climate ambition

There is no separate climate change law to enforce India's NDC. Instead, climate actions have legal foundations under existing sectoral legislations. For instance, most actions relating to the uptake of renewables are embedded in the Electricity Act of 2003. The Government is currently amending the National Forest Policy to support implementation of forestry targets under the NDC. Concrete actions are typically defined under a range of executive directives commonly phrased as 'missions' and 'action plans.' The 2008 NAPCC, the first concrete climate policy effort by India, identified eight thematic national missions based on consultations in a multi-stakeholder committee chaired by the Prime Minister. Line ministries were then tasked to elaborate missions into concrete actions. National agencies coordinate with state agencies to implement and enforce actions.

Two peculiarities of the Indian political system stand out in terms of their impact on implementation.

First is the division of legislative powers among the central government and states. Both central government and states have the power to legislate and administer crucial mitigation sectors such as electricity (Jörgensen, Mishra and Sarangi, 2015a). This means that the centre can only provide model guidance to states in many concrete areas of regulation such as setting Renewable Purchase Obligations, electricity tariffs, policies for grid balancing and forecasting. Execution is uneven, with few ambitious states taking the lead in implementing (and sometimes exceeding) centrally driven policies.

The second peculiarity relates to the sub-national capacities to implement mitigation actions. While states are empowered to legislate on matters of relevance to climate, their implementation capacities are limited by dependence on the central government for funds (Jörgensen, Mishra and Sarangi, 2015b). Therefore, the top-down political mandates need state-level enforcement. In practice, undertaking more ambition mitigation actions will require a systematic collaboration between central and sub-national governments. This is particularly true for the power sector, where state nodal agencies and state-level policies play a critical role in successful implementation of actions. In fact, evidence points towards the

[15] The document defines a 61.6 GW of conventional power capacity between 2018-2020. The targets for solar (53 GW) and wind (15.8 GW) are lower than those defined by the Ministry of New and Renewable Energy to reach the 2022 target of 100 GW solar and 60 GW wind.

crucial role of state policies in generating confidence among business actors to invest (Krishna, Sagar and Spratt, 2015).

Fiscal dependency is most noticeable for local governments in India. The administrative portfolios of urban governance bodies typically include crucial mitigation sectors such as urban planning and waste management. State governments have the power to define the devolution of powers to local governance bodies. However, in practice, most states have devolved several administrative responsibilities to local governments but not equivalent financial and decision-making autonomy.

6.5.3 Role of civil society

Local think tanks have played a formative role as opinion shapers in Indian climate policy and diplomatic positions. The earliest examples of their influence is seen from the widely quoted report from the non-governmental organisation, Center for Science and Environment, titled 'Global Warming in an Unequal World', which framed the Indian position on equity (Dubash, 2013a). The Environment Ministry regularly consults influential think tanks such as The Energy and Resources Institute (TERI) for conducting modelling exercises, which form inputs to target setting. Civil society is also part of the Prime Ministers Council on Climate Change, the multi-stakeholder body tasked with recommending climate actions, including NAPCC, and for the NDC.

6.5.4 Potential NDC review process and historical precedent for ambition raising

With regards to the process of NDC revision, India's approach to a NDC revision will be similar to that of NDC definition. The NDC targets were defined based on modelling exercises conducted by domestic think tanks, followed by consultations with sectoral ministries and non-governmental stakeholders (private sector, civil society). The final proposal is approved by the cabinet. The Ministry of Environment, Forests and Climate Change (MOEFCC) facilitates this process.

With general elections approaching in 7-8 months, revising the 2020 target may not be an urgent priority for the current government. Local experts hold the opinion that even if a discussion on ambition raising happens, it will take place only after the new government is in office, i.e., in 2020. MOEFCC recently floated tenders for defining the implementation roadmaps for the current NDC (MOEFCC, 2018), signalling the government's intention to move forward with the existing targets. Furthermore, local experts following the negotiations state that India will look to how discussions on the effective meaning of a 'progressive revision' of NDCs and the stock-taking process will evolve in negotiations.

However, some developments give reasons for optimism that India may raise its contributions. For instance, based on the positive experiences with renewable energy deployment in the past, the Ministry of New and Renewable Energy (MNRE) has recently supported raising the 2022 renewable energy capacity target to 225 GW (from 175 GW). No formal announcements and updates can be found in the Ministry's website suggesting the formalisation of a new target. However, the union cabinet decided to include large hydro as a renewable energy source in March 2019 (Press Information Bureau, 2019). This change results in an increase in renewable installed capacity of 45 GW (end of 2018). With this changed definition, if the 175 GW target is met and all large hydro expansions up to 2022 are considered, India's renewable installed capacity by 2022 will reach 225 GW.

Considering India's diplomatic inclination to play a 'proactive, value-creating and agenda-setting role in global climate governance' (Narlikar, 2017), it will be prudent for the international community to positively engage with India on the prospects of ambition raising in climate and non-climate multilateral forums in the coming years to keep the possibility afloat, especially when the new government is in place in 2019.

7 Japan

7.1 Introduction

The currently implemented policies will result in Japan missing its 2030 NDC target by around 5 percentage points. However, Japan's NDC target as it stands is far from what the country should contribute to the climate change mitigation according to least-cost and equity-based approaches. The least cost approach would require Japanese emissions to be cut in half by 2030 in comparison to 2015 in order to meet the 1.5°C limit set forth in the Paris Agreement. By 2050, emissions should decrease by 88%. Due to Japan's high level of economic development, equity-based emissions reductions are much more ambitious: compatibility with the 1.5°C pathway would require reducing emissions by at least 113% by 2030 in comparison to 2015. Meeting the older 2°C goal would require an emissions reduction of 77%. By 2050, apart from emissions neutrality domestically, Japan should contribute either negative emissions or fund emissions reductions corresponding to 64% (for 2°C-compatibility) or 127% (for 1.5°C-compatibility), both compared to its 2015 emissions.

Despite the significant discrepancies between Japan's current pledge for 2030 and the necessary contributions under different approaches, there is currently no clear sign that the country will make meaningful improvements in climate change mitigation. In addition to lacking ambition domestically, Japanese companies, with the support of the government, are funding the construction of new coal-fired power plants abroad.

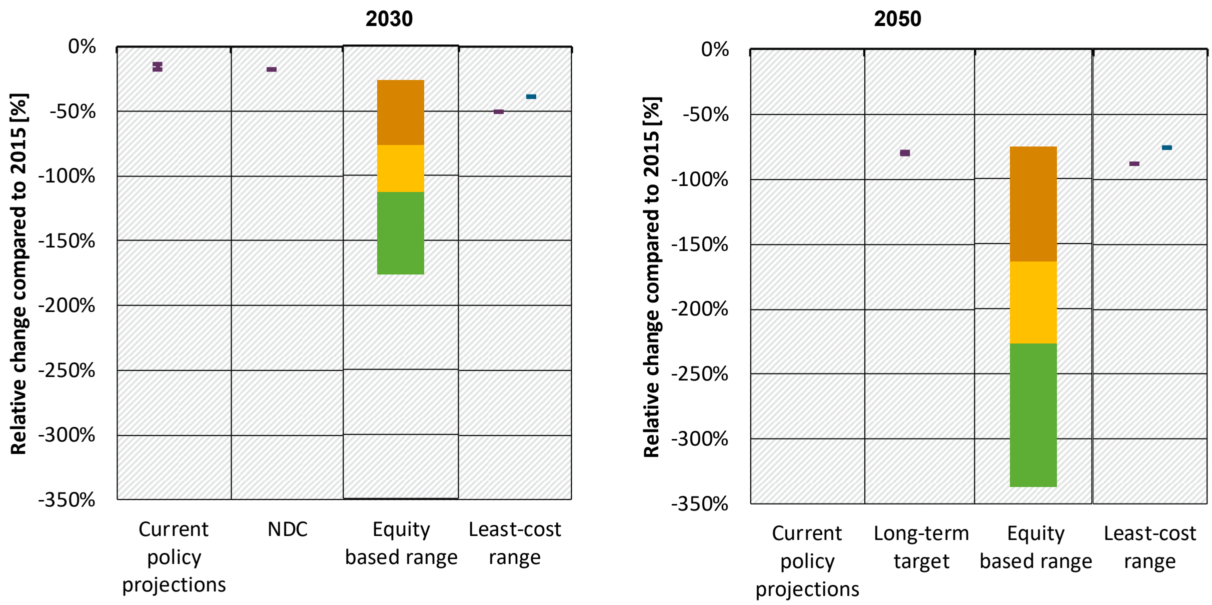


Figure 31: Japan – Relative change in GHG emissions excl. LULUCF compared to base year for equity and cost-based approaches

Notes: Current policy projections, NDC and equity-based emissions reduction ranges from Climate Action Tracker—equity range from 2018 (December update), other data from (2019 April update). Legend: For equity-based range: orange (upper range) is >2°C consistent, yellow (middle range) is 2°C consistent, green (low range) is 1.5°C consistent. For least-cost range: lower limit for 1.5°C, upper limit for 2°C.

7.2 Socio-economic context for greenhouse gas emissions reductions

Following three decades of unprecedented growth, Japan's economy has experienced a wave of slowdowns, recessions and modest recoveries since the 1990s, a period also referred to as the "Lost Decades". Since 2000, the nominal growth of the Japanese GDP has only once exceeded 4%—when recovering from the financial crisis in 2009—and has mostly remained under 2% (World Bank, 2019). According to an International Monetary Fund (IMF) forecast, Japanese economic growth will decrease from 0.9% in 2019 to 0.4% in 2020 (IMF, 2019b). Despite the decreasing rate of growth, due to its current GDP level Japan is expected to remain the world's third largest economy—behind China and the United States, and just ahead of Germany until at least 2023 (Focus Economies, 2019). Japan is a major exporter of motor vehicles and auto parts, quality power generation equipment and semiconductors, whereas its imports are mainly fossil fuels (CIA, 2019). Demographically, it is already among one of the most aged societies in the world. It has experienced lower fertility rates for the last decades, which means that the current population (~127 million) will further shrink in the coming decades and fall below 100 million around 2060 (United Nations Population Division, 2019).

7.2.1 Economic and development-related data

Table 13: Japan – Key socioeconomic figures

Indicator	Value	World	Year	Source
Population [million]	127	7 594	2018	The World Bank
GDP [bn USD at current prices]	4 971	85 791	2018	The World Bank
GDP/cap [USD/cap]	39 287	11 297	2018	The World Bank
HDI [0 – 1]	0.91	Rank 19	2018	UNDP
GINI index [0 – 100]	32.1	n.a.	2008	The World Bank
Electrification rate [%]	100%	88.9%	2017	The World Bank
Corruption index	Score: 73/100	Rank: 18/180	2018	Transparency International
Urbanization [% of total]	91.7%	55.7%	2019	United Nations Population Division

Data sources: (Transparency International, 2018; United Nations Department of Economic and Social Affairs: Population Division, 2018; United Nations Development Programme (UNDP), 2018; Statista, 2019; The World Bank, 2019b, 2019a, 2019c).

7.2.2 Energy production and consumption

Japan occupies a unique position globally as it has had to almost fundamentally rethink its energy strategy. Before the Fukushima nuclear accident in 2011, nuclear energy was considered a fundamental pillar of Japan's energy mix, and its use a key path towards low-carbon growth and reducing import dependence on fossil fuels. The Fukushima accident led to a sharp decrease in the role of nuclear energy in the Japanese electricity sector, and the difference was made up using mainly fossil fuels. Since then, also the share of renewable energy has increased steadily: from 12.1% in 2014 to 17.4% in 2018. Solar energy contributed significantly to this growth, its share increasing from 1.9% to 6.5% in the same period (ISEP, 2019b). Since the Fukushima nuclear disaster, the total primary energy supply has also reduced by 15%. This is often attributed to the continued impact of the massive efforts soon after Fukushima to enhance energy efficiency. In 2017, oil had a 41% share in Japan's primary energy mix, followed by coal (27%) and gas (24%).

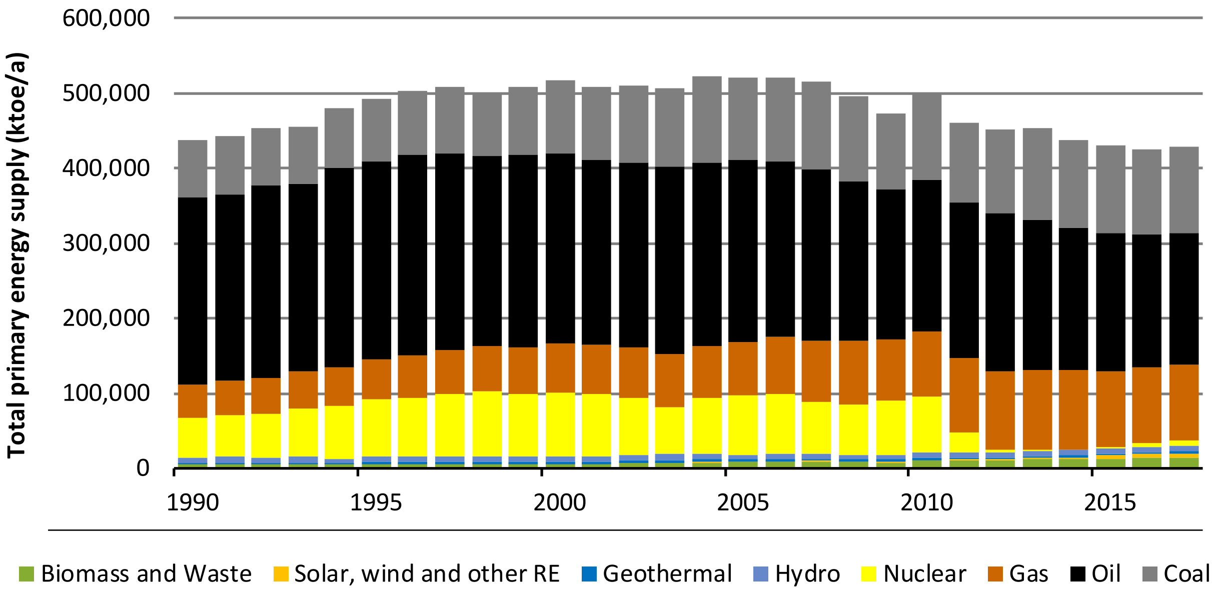


Figure 32: Japan – Primary energy supply by energy carrier between 1990 and 2017

Data source: (IEA, 2018b)

7.3 Greenhouse gas emissions profile

Japan's emissions dipped in 2008 following the financial crisis, grew steadily for the next three years thereafter and receded in 2014, 2015 and 2016. As shown in Figure 33, 91% of Japanese emissions originate from energy combustion. After allocating energy-related emissions from power and steam generation to the final demand sectors, the industrial sector had the largest share (38%), followed by commercial and other buildings (20%), transport (19%), residential buildings (16%) and power plants (7%) (MoEJ, 2018).

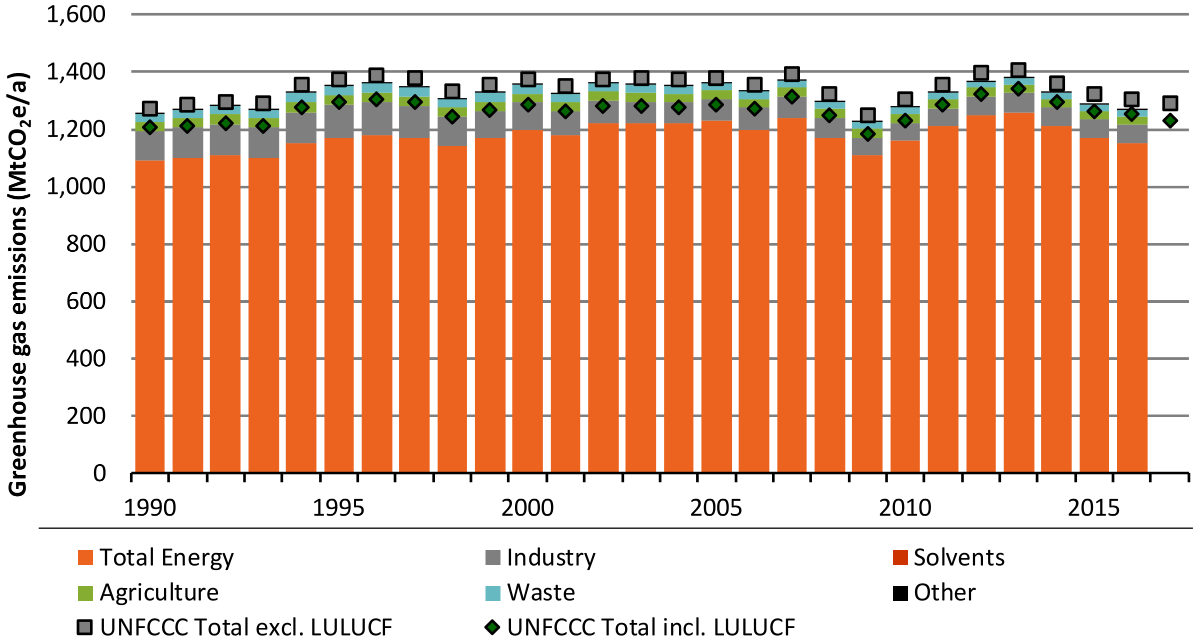


Figure 33: Japan – Sectoral GHG emissions between 1990 and 2016

Data sources: (Gütschow *et al.*, 2018a; UNFCCC, 2019)

Table 14: Japan – Key GHG emissions data

Indicator	Japan	World	Year
GHG/cap [tCO_2e/cap]	10.00	6.15	2016
GHG/GDP [tCO_2e/mln 2017 USD]	257	603	2016
Energy/GDP [ktoe/mln 2017 USD]	0.09	0.18	2017 (World: 2016)
Global share of emissions [%]	2.74	100%	2012

Data sources: (JRC and PBL, 2014; Gütschow *et al.*, 2018a; IEA, 2018b; The World Bank, 2018b) *GHG indicators were calculated using PRIMAP data and exclude contributions from the LULUCF sector.*

7.4 Development of future greenhouse gas emissions

7.4.1 Emission reduction targets and current policy projections

Japan's NDC aims at reducing emissions by 26% below 2013 levels by 2030, including LULUCF. Climate Action Tracker calculates that this means reductions of 18% below 1990 levels excluding LULUCF accounting suggested in the NDC document. Depending on the expectations for the development of nuclear in the future, Japan may or may not meet their NDC, also considering the potential accounting of LULUCF where the rules are not clarified.

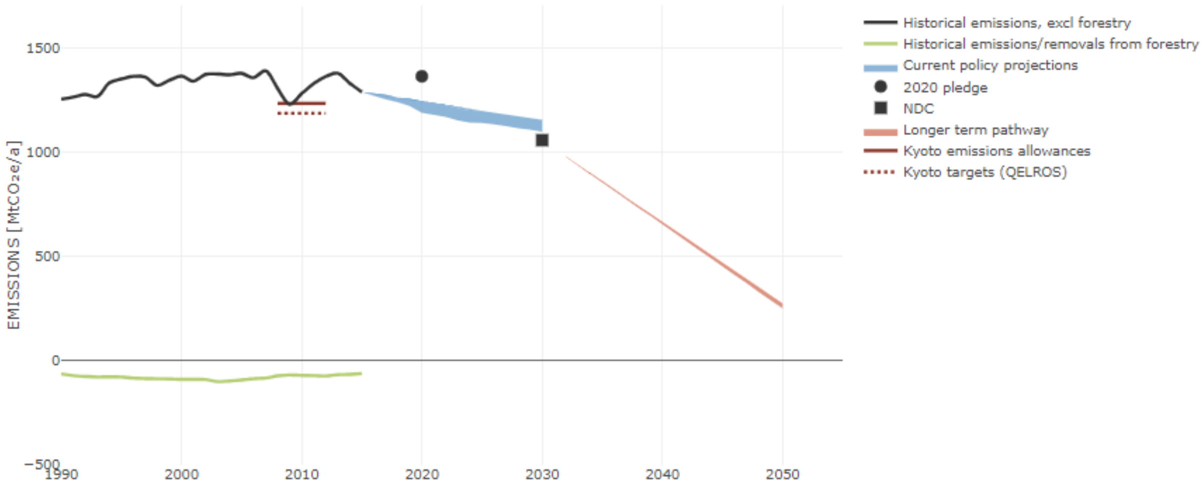


Figure 34: Japan – Historical and projected emissions under current policies and target pathways

Source: Climate Action Tracker 2018

7.4.2 Sectoral mitigation pathways until 2030

In 2016, energy- and process-related GHG emissions from the energy supply sector made up the largest share of total emissions (excl. LULUCF) in Japan (88%) (UNFCCC, 2019). The energy supply sector comprises the majority emissions. It is followed by the industry sector with a share of 26%, the transport sector (17%) and the buildings sector (10%).

A comparison between global 1.5°C consistent and 2°C consistent pathways based on recent MACCs for 2030 leads to the conclusion that the potential to reduce energy- and process-related emissions must be exploited to a much larger extent to achieve 1.5 °C consistency. For Japan, this would amount to a reduction of energy- and process-related emissions in 2030 by 51% compared to 2015 levels (54% compared to 2013 levels, the NDC's base year). The emissions reductions for the energy supply sector would be the highest among all four sectors. In this sector, emissions would be reduced by 60% in comparison to 2015. In addition, lower but still substantial mitigation would be achieved in the transport, industry and buildings sectors (respectively reductions of 42%, 46% and 35%).

The distribution of the mitigation potential among the sectors is similar in the cost-effective pathway compatible with the 2°C limit. In the energy supply sector, emissions would be reduced by 47%. Again, somewhat less mitigation would be achieved in the transport, industry and buildings sectors (respectively 35%, 31% and 23%). In total, this would amount to a 38% reduction of energy- and process-related emissions in 2030 compared to 2015 levels (43% compared to 2013, the NDC's base year).

In the NDC-consistent reference pathway, the highest emission reduction potential of 29% by 2030 is achieved in the transport sector. In the energy sector the mitigation potential amounts to 21% and in the industry and buildings sectors the emission reductions do not exceed 10% when compared to 2015 levels.

The sectoral mitigation pathways until 2030 are summarized in Figure 35.

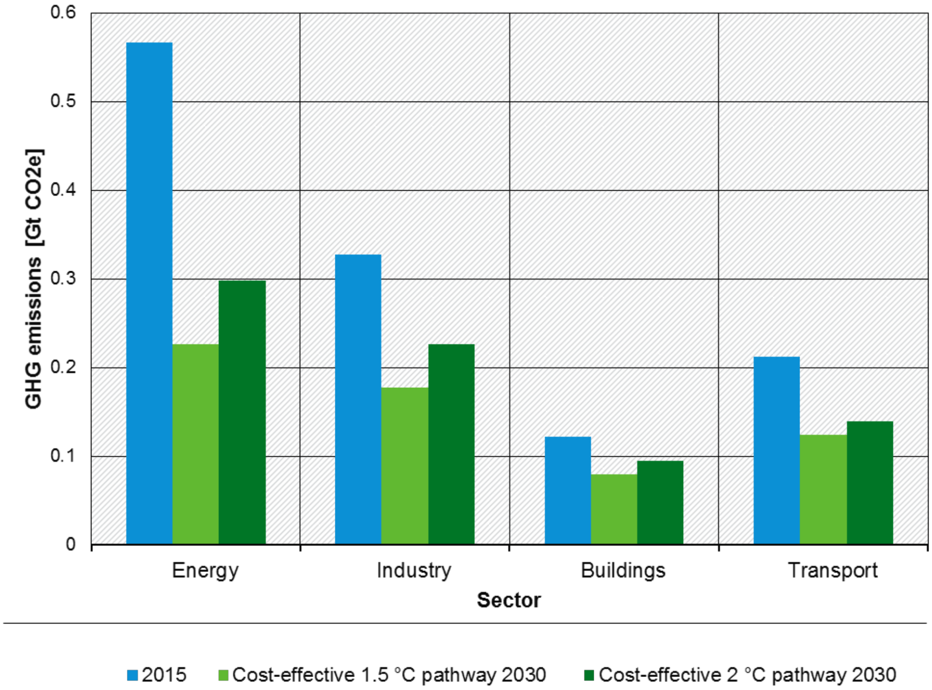


Figure 35: Japan – Sectoral GHG reduction pathways until 2030 compared to 2015

Source: own calculation based on data from the POLES-Enerdata model

7.4.3 Emissions reduction targets suggested by equity considerations

The emissions allowances under different effort sharing approaches for Japan result in a broad range of emissions reductions in 2030 and 2050. To remain within the 1.5°C-compatible range, Japan's emissions would have to decrease by at least 113% below 2015 levels by 2030. To stay within the 1.5°C limit of the Paris Agreement in 2050, Japan would have to reduce its emissions at least by 227% below 2015 levels (221% below 2005). Emissions reduction compatible with the old 2°C limit would be at least 77% for 2030 and 164% for 2050, both below 2015 levels (78% and 161% below 2005). Of all the countries covered in this study, Japan has the strictest emissions reductions under equity considerations. This reflects not only Japan's high capability and relatively high historical responsibility, but also its high current and projected demographic indicators on a per capita basis (given a projected decrease in population, among others).

The most stringent approaches are the ones that consider capability, need and historical responsibility, as well as staged approaches. Most of these approaches would require negative emissions even as early as by 2030. This indicates the prominent role Japan should play in international climate cooperation on top of its domestic efforts to reduce emissions. In contrast, the categories of approaches focusing on a combination of capability and cost to mitigate suggest less stringent emissions allowances for Japan. However, no studies for this are available for the 1.5°C temperature limit.

7.5 Political context

7.5.1 General disposition of the country towards climate policy

7.5.1.1 Historical developments

Japan's climate policy is largely determined by the two ministries involved in its creation: the Ministry of the Environment (MOE) and the Ministry of Economy, Trade and Industry (METI). Action on climate change has been generally stable with some variations over the last decade due to changes of the government in power. Since the country's mineral resources are negligible, Japan is strongly dependent on fossil fuel imports. This import dependence not only exposes Japan to market dynamics that may threaten its energy security, but its economic growth could also be negatively affected by price volatility.

In the Kyoto Protocol, Japan committed to reduce its emissions by 6% on average for the period 2008-2012 in comparison to 1990 levels (UNFCCC, 1998). However, in the end Japanese emissions increased by 1.4% in comparison to 1990, and therefore Japan was forced to meet its Kyoto target with LULUCF credits and companies purchasing emissions credits abroad (Reuters, 2013).

Before the climate conference in Copenhagen, in June 2009, Japan adopted a goal of reducing emissions by 15% by 2020, compared to 2005 levels. Because Japanese emissions increased by 7% between 1990 and 2005, this 2020 target meant a very modest increase in ambition in comparison to its Kyoto goal and in reality only results in a reduction of 8% compared to 1990 (Adam, 2009).

Following the elections in August 2009 the Liberal Democratic Party (LDP) that had ruled the country since 1993 was replaced by the Democratic Party of Japan (DPJ). In March 2010, the DPJ strengthened Japan's emissions reduction target for 2020, raising the target reduction to 25% compared to 1990 (UNU, 2010). Later the same year the Japanese government also announced its withdrawal from the second commitment period of the Kyoto Protocol, explaining that more focus should be placed on establishing a framework to include "all major economies, including the US and China" (MOFA, 2010).

Yet, following the Fukushima nuclear disaster of 11 March 2011 and the loss of the Democratic Party of Japan in 2012, the new LDP-led government replaced the 2020 target with the substantially less ambitious goal of reducing emissions by 3.8% by 2020 in comparison to 2005—or around 11% in comparison to 1990—explaining that the closure of nuclear power plants would lead to a stronger reliance on combustion plants (Soble and Cienski, 2013).

In its NDC, submitted in July 2015, the Japanese government presented a 2030 emissions reduction target of 26% below 2013 levels. This target foresees the use of credits from the LULUCF sector, and this, according to the Climate Action Tracker, translates into a 15% reduction compared to 1990 levels when the use of LULUCF-related flexibilities are avoided (Climate Action Tracker, 2019e).

In June 2019, Japan submitted its long-term strategy to the UNFCCC reiterating its previous goal of reducing GHG emissions by 80% by 2050. It also defines a "decarbonized society" as its ultimate goal and aims to achieve this "as early as possible in the second half of this century" (Government of Japan, 2019).

Japan remains an outlier in the G7 as the only member still actively seeking to develop new coal power generation. Japan has 45.5 GW of operating coal capacity, and an additional 8.7 GW are under construction with 4.4 GW in pre-construction stage (End Coal, 2019). Furthermore it is proactively exporting coal-fired power generation technology overseas (Climate Analytics & Renewable Energy

Institute, 2018). Over the past three years, E3G's G7 Coal Scorecard reports have consistently found Japan to be one of the worst performer across all six categories of analysis (Littlecott *et al.*, 2018).

7.5.1.2 Relevant political processes in the foreseeable future

As could be seen in the preceding section, the change of the government had a significant impact on the level of climate ambition, with the LDP much less willing to prioritize climate action than the DPJ that ruled Japan for only three years between 2009 and 2012. This helps to explain the overall low level of climate ambition since late 2012, when the LDP's leader, Shinzō Abe became the country's Prime Minister. In the meantime, Abe became the second-longest serving Prime Minister. As a result of the elections in the House of Councillors in July 2019, Abe's position strengthened further (Kyodo News, 2019a). Therefore, no significant change in Japan's climate policy can be expected until the next election for the House of Representatives will be held on 22 October 2021.

It is also worth mentioning that a change in approach to climate and energy policy occurred within the ruling party and the Prime Minister himself. Until the Fukushima disaster in 2011, discussions of decarbonization were closely associated with nuclear energy, with renewables playing only a limited role (Kuramochi, 2015). However, as the cost of renewables decreases and PV generates a higher and higher share of electricity in Japan (currently almost 6.5%) , renewable energy may come to be more widely perceived as a viable and attractive alternative to fossil fuels (ISEP, 2019c).

7.5.2 Role of civil society

A number of environmental NGOs are active on the ground in Japan. Greenpeace Japan, for instance, has pushed the government for years to reduce reliance on coal and gas power and to step up the use of renewable energies. It also strongly criticises the Japanese government's public funding of coal power plants abroad (Greenpeace Southeast Asia & Greenpeace Japan, 2019). In addition, the Kiko Network focuses on decreasing the role of coal by increasing public awareness about the lack of competitiveness and negative environmental impact of existing and new coal power plants and calls for their phase-out by 2030. After the submission of Japan's long-term climate strategy, Kiko published a paper pointing out the risks related to a heavy reliance on carbon capture, utilization and storage, which were indicated in the strategy. The network called on the government to initiate the process of updating Japan's NDC to reflect the Paris Agreement 1.5°C limit (Kiko Network, 2019c, 2019a, 2019b). WWF is also active in Japan, however, climate change is only one of many areas of activity. Its main strategy in this regard is to engage with businesses to reduce carbon emissions (WWF Japan, 2019).

The Institute for Sustainable Energy Policies (ISEP), founded in 2000, focuses on the transformation of the energy sector to 100% renewable energy sources, especially coming from community owned installations. Since its foundation. it developed proposals for different policy instruments that would increase the share of renewables. It is also well connected with other renewable energy organizations and a member of the Global 100% Renewable Energy Platform (ISEP, 2019a).

7.5.3 Prospects for a review and increase of the national climate ambition

7.5.3.1 Relevant dimensions of the political system

Shinzō Abe's LDP has a solid majority in both chambers of the Japanese National Diet. Following the elections in the House of Representatives in 2017, the LDP is represented by 285 members. In addition, LDP's coalition partner, Komeito, holds 29 seats, thus giving the government a safe majority of 314 out of 465 members. The second largest Constitutional Democratic Party of Japan has only 70 representatives (Shugiin, 2019). As a result of the July 2019 elections in the upper chamber of National Diet, the House of Councillors, during which half of the seats were up for grabs, the coalition of LDP and Komeito increased to 141 out of 245 seats (Kyodo News, 2019b).

Shinzō Abe's majority in both chambers of Diet will allow him to soon become the longest-serving Prime Minister in the history of modern Japan. This stability allows his administration to get involved with bureaucratic appointments at a much more granular level, thus strengthening the willingness of the appointees to the party line. Abe has also strengthened the role of policymaking expertise by installing five councils advising him on economic growth strategy (Winter, 2016).

Japanese energy and climate policy is strongly influenced by the METI and MOE, and to a limited extent the Ministry of Foreign Affairs (MOFA). METI tends to be more pro-business, while MOE is more pro-environment. Whereas the balance of power was tilted towards the MOE during the DPJ rule between 2009-2012, METI's position strengthened after LDP came into power (Incerti and Lipscy, 2018).

7.5.3.2 Potential NDC review process and historical precedent

The formulation of the first Japanese INDC was initiated by subcommittees in the MOE's Central Environmental Council and METI's Industrial Structure Council. The joint subcommittee as set up to reconcile the different views and prepare the draft text. This text was subsequently approved in the Global Warming Prevention Headquarters under the Cabinet. It can be expected that a similar process will lead to the adoption of Japan's second NDC. Absent strong signals from abroad or by the public, one can only expect a limited—if any—increase in the level of ambition.

8 United States

8.1 Introduction

The US under the Trump Administration has communicated that it will withdraw from the Paris Agreement and thereby stop the implementation of its NDC. Until this process is closed on November 4, 2020, the NDC remains legally valid (Congressional Research Service, 2019). In the current situation, a positive revision of the NDC is highly unlikely.

This move by the current administration is starkly opposed to equity and least-cost approaches, which suggest the US should increase its ambition for a globally cost-efficient and fair solution to limit the temperature increase to 1.5°C. The equity-based approaches indicate stronger reductions than global least-cost pathways, meaning that the US should support developing countries, in addition to increasing domestic climate change mitigation efforts.

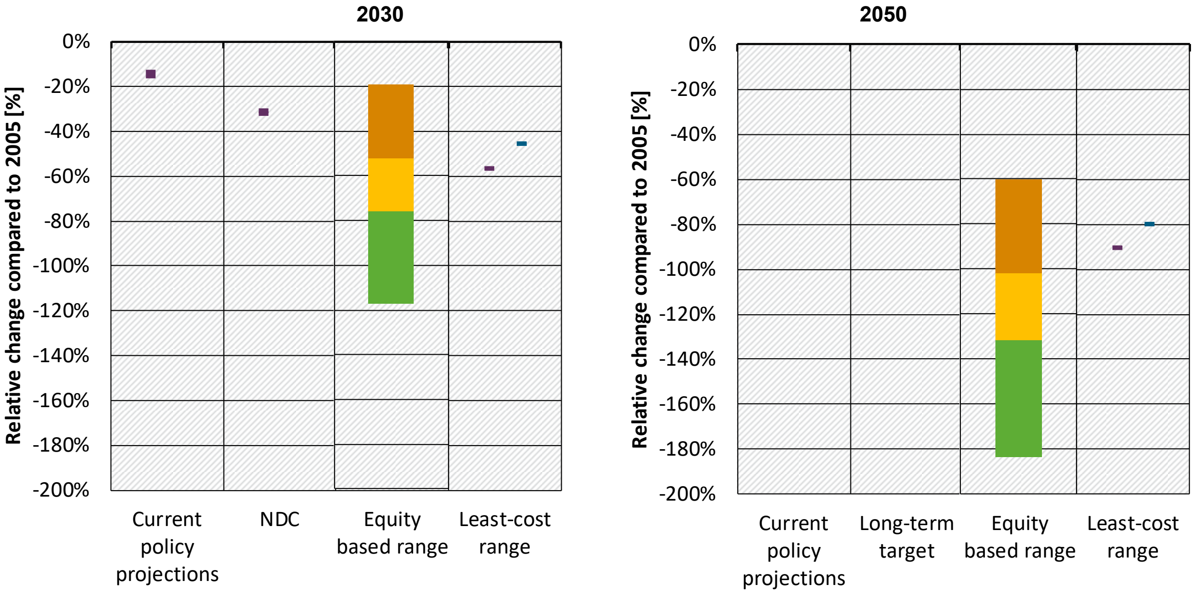


Figure 36: USA – Relative change in GHG emissions excl. LULUCF compared to base year for equity and cost-based approaches

Notes: Current policy projections, NDC, and equity-based emissions reduction range from Climate Action Tracker—equity range from 2018 (December update), other data from 2019 (April update). Legend: For equity-based range: orange (upper range) is >2°C consistent, yellow (middle range) is 2°C consistent, green (low range) is 1.5°C consistent. For least-cost range: lower limit for 1.5°C, upper limit for 2°C.

The United States continues to be the world's largest economy in terms of GDP. Its 20.5 trillion USD economy constitutes a quarter of the global GDP. United States is also the third-most populous country in the world and has a high degree of urbanisation. The state of human development in terms of life expectancy, knowledge and quality of life in the US is *very high* (HDI: 0.92). Although an average American enjoys a standard of living that is five-times better than the global average, the distribution of this income is considerably unequal. The US falls behind many European economies and neighbouring Canada in its GINI index scores. The GINI Index demonstrates the extent of inequality of income in a country—a high score means higher inequality. A concentration of income is said be positively correlated with GHG emissions in high-income economies due to the political and economic power of the wealthy and their emulative influence on society (Grunewald *et al.*, 2017; Jorgenson, Schor and Huang, 2017).

8.1.1 Economic and development-related data

Table 15: USA – Key socioeconomic figures

Indicator	Value	World	Year	Source
Population [million]	327	7 594	2018	The World Bank
GDP [bn USD at current prices]	20 494	85 791	2018	The World Bank
GDP/cap [USD/cap]	62 641	11 297	2018	The World Bank
HDI [0 – 1]	0.92	Rank 13	2018	UNDP
GINI index [0 – 100]	41.5	n.a.	2016	The World Bank
Electrification rate [%]	100%	88.9%	2017	The World Bank
Corruption index	Score: 71/100	Rank: 22/180	2018	Transparency International
Urbanization [% of total]	82.5%	55.7%	2019	United Nations Population Division

Data sources: (Transparency International, 2018; United Nations Department of Economic and Social Affairs: Population Division, 2018; United Nations Development Programme (UNDP), 2018; Statista, 2019; The World Bank, 2019b, 2019a, 2019c).

8.1.2 Energy production and consumption

Oil and gas dominate the US primary energy mix, with the former contributing 37% and the latter 30% in 2017. Coal contributes another 15%. While fossil fuel use has historically been high, 2005 marked a turning point in the US's energy use profile. With the massive uptake of fracking techniques for oil and gas drilling, the role of natural gas in the energy mix has grown post-2005, while that of coal has declined. Indeed, natural gas has replaced coal as the biggest fossil fuel-based power generation source. Nuclear, biomass and waste continue to have a small but consistent contribution. The share of non-hydro renewables has increased in past years with the support of federal tax credits and state level policies but currently stands at only 1% of primary energy.

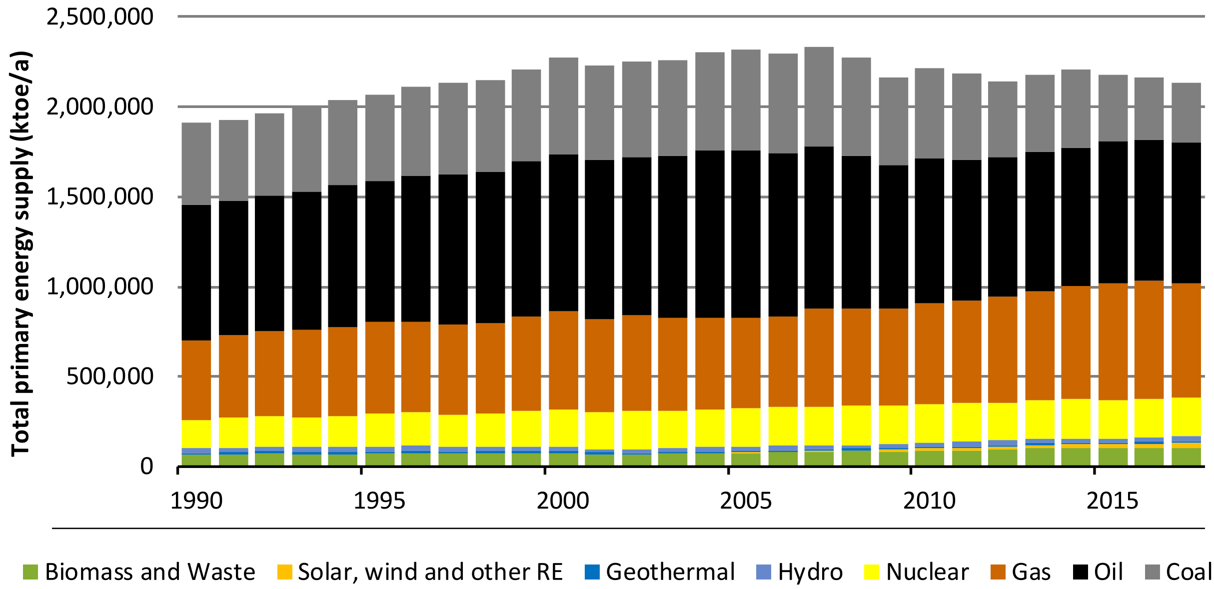


Figure 37: USA – Primary energy supply by energy carrier between 1990 and 2017

Data source: (IEA, 2018b)

8.2 Greenhouse gas emissions profile

The US is the world's second largest emitter and contributed 12% of global emissions in 2012. Energy combustion was responsible for 84% of the US's emissions in 2016, a majority of which are from the fossil fuel-heavy power sector, followed by fuel use in transport sectors. Agriculture and industrial sectors contribute 8% and 6% of total emissions respectively. The land use and forestry sector acts as a net sink. In 2015, the LULUCF sector removed 759 $MtCO_2e$ from the US's emissions.

Per capita emissions stand at about 20 tCO_2e or 3.3 times the world average. Still, the energy and emissions intensity of the US economy declined since the 1990s.

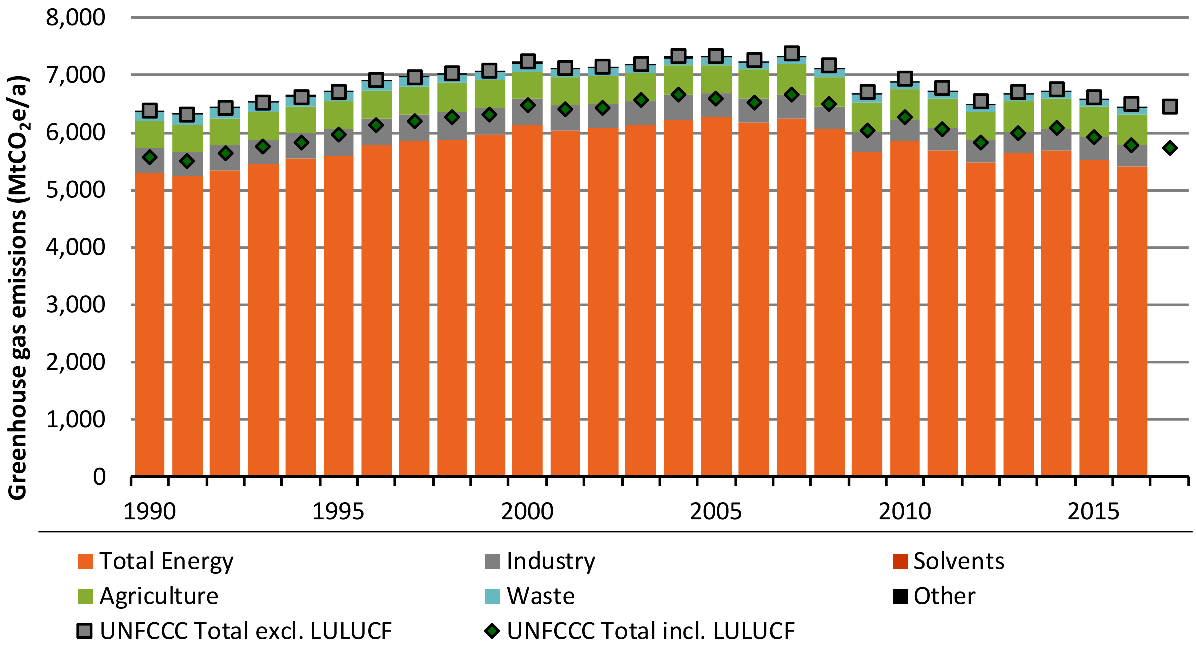


Figure 38: USA – Sectoral GHG emissions between 1990 and 2016

Data sources: (Gütschow *et al.*, 2018a; UNFCCC, 2019)

Table 16: USA – Key GHG emissions data

Indicator	USA	World	Year
GHG/cap [tCO_2e/cap]	19.97	6.15	2016
GHG/GDP [tCO_2e/mln USD]	347	603	2016
Energy/GDP [ktoe/mln USD]	0.11	0.18	2017 (World: 2016)
Global share of emissions [%]	11.76%	100%	2012

Data sources: (JRC and PBL, 2014; Gütschow *et al.*, 2018a; IEA, 2018b; The World Bank, 2018b). *GHG indicators were calculated using PRIMAP data and exclude contributions from the LULUCF sector.*

8.3 Development of future greenhouse gas emissions

8.3.1 Emission reduction targets and current policy projections

The US NDC aims at reducing emissions by 26% to 28% below 2005 levels by 2025, including LULUCF. Climate Action Tracker calculates that this means reductions of 21% to 28% below 2005 excluding

LULUCF, depending on projections for emissions from the sector—or 9 to 17% below 1990. The US has a 2020 pledge of reducing emissions by 17% below 2005 levels (incl. LULUCF). Under the previous administration, headed by President Obama, the US communicated a long-term target of 80% reductions below 2005 by 2050, but it is highly unlikely the current Trump Administration will continue to pursue this long-term ambition.

The currently implemented policies are not likely to be sufficient to achieve the current NDC target, according to Climate Action Tracker analysis (see Figure 39).

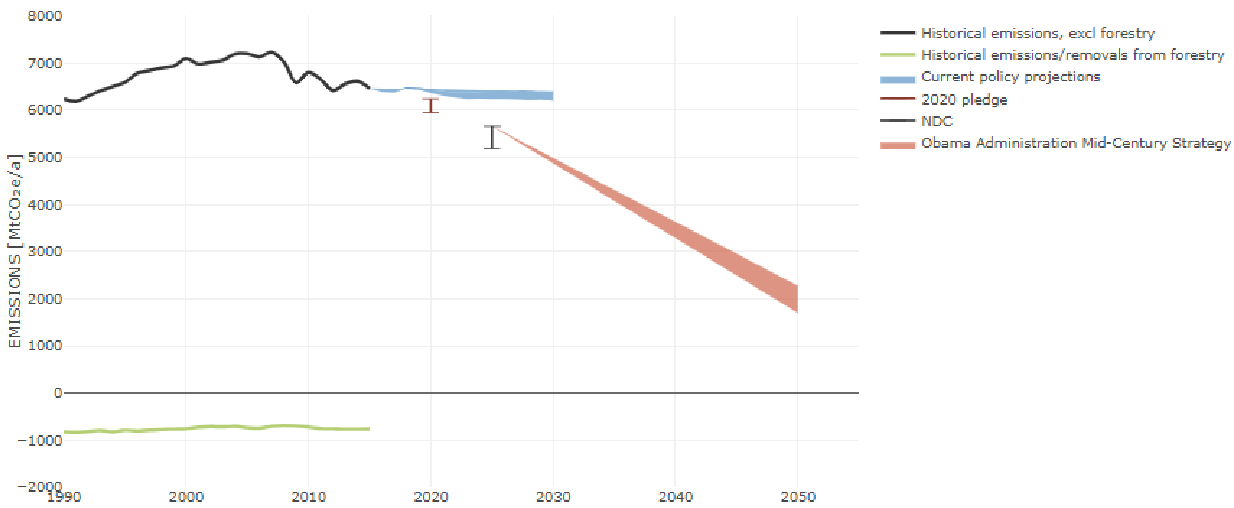


Figure 39: USA – Historical and projected emissions under current policies and target pathways

Source: Climate Action Tracker 2018

8.3.2 Sectoral mitigation pathways until 2030

In 2015, the US's energy supply sector made up the largest share of energy- and process-related GHG emissions at 2.84 $GtCO_2$—which corresponded to 47% of the country's total energy- and process-related GHG emissions. The energy supply sector comprises the GHG emissions from electricity generation and other transformation (refineries, centralized heat, etc.). Emissions from the transport sector, mainly dominated by road transport, make up about one third of total emissions.

A comparison between global 1.5°C consistent and 2°C consistent pathways based on recent MACCs for 2030 leads to the conclusion that the potential to reduce energy- and process-related emissions has to be exploited to a much larger extent to achieve 1.5°C consistency. For the US, this would amount to a reduction of energy- and process-related emissions in 2030 by 52% compared to 2015 (57% when compared to the NDC's base year of 2005). For the year 2030, the highest economic mitigation potential would lie within the energy supply sector. Compared to 2015 emissions in the energy supply sector, the emission reduction in this sector would amount to 61%. Emissions would be reduced by 56% in the industry sector, 42% in the transport sector and 39% in the buildings sector.

When assuming a global cost-effective pathway compatible with 2°C until 2030, the economic potential to reduce energy- and process-related emissions in the US would amount to 40% compared to 2015 (46% compared to 2005). The highest emission reduction potential of 49% would be attributed to the energy supply sector. The economic mitigation potential of the industry sector would be about 37%. The emissions reductions in the transport and building sectors would be the lowest ones with an economic mitigation potential of 31% and 25%, respectively.

Considering an NDC-consistent reference pathway, energy- and process-related GHG emission reductions are the highest in the energy supply sector and the transport sector (both account for 24%), followed by the buildings (8%) and industry sectors (5%). For the US, the sectoral GHG reduction pathways are summarized in Figure 40.

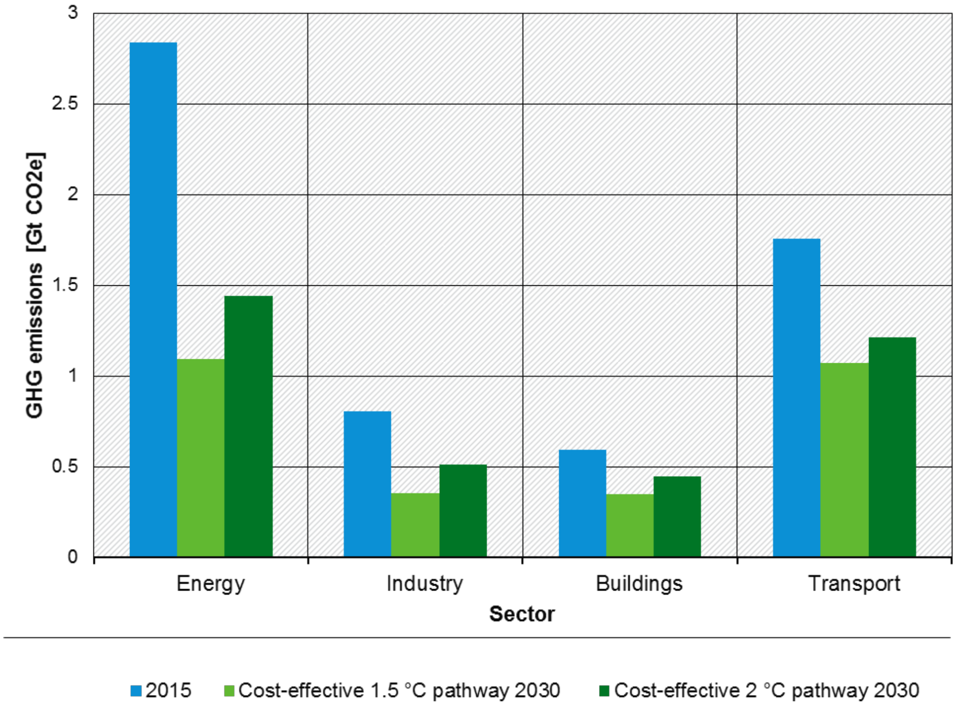


Figure 40: USA – Sectoral GHG reduction pathways until 2030 compared to 2015

Source: own calculation based on data from the POLES-Enerdata model

8.3.3 Emissions reduction targets suggested by equity considerations

In comparison to the division of effort based on the cost-effective approaches, the fairness-based effort-sharing approaches require more stringent emission reductions for the United States, reflecting its high capability to mitigate, as well as its high historical responsibility for global emissions and high per capita indicators. Equity-based emissions allowances consistent with the 2°C target require emission reductions of at least 47% below 2015 levels (52% below 2005 levels), whereas allowances consistent with the 1.5°C goal require emissions reductions of at least 73% below 2015 levels (76% below 2005).

In 2050, emissions allowances under equity considerations show reductions of 102% and 135% in comparison to 2015, respectively for each of the temperature targets (102% and 132% below 2005 levels). This means that the full range of 1.5°C compatible emissions allowances for the US represents negative emissions levels as early as 2030, pointing out the large role that the US should play in international cooperation to global mitigation efforts (including carbon markets and climate finance). This stands in stark contrast with President Trump's views on multilateralism and international cooperation, which resulted in substantial reductions in US contributions to important international cooperation climate organisations, such as the UNFCCC and the Green Climate Fund.

A more detailed look into the US's equity range shows that the most stringent approaches are the ones considering capability, need and historical responsibility. Most of these approaches would require negative emissions even as early as 2030. This indicates the prominent role the US should play in international climate cooperation on top of its domestic efforts to reduce emissions. In contrast, the categories of approaches focusing on a combination of capability and cost to mitigate provide less stringent emissions allowances for the US, however, no studies for this category are available for the 1.5°C temperature limit.

8.4 Political context

8.4.1 General disposition

The disposition of the US toward climate action in the global context over the past quarter century depended largely on the party in power at the national level. Although the UNFCCC was established under Republican President George H.W. Bush—signed by him and ratified by the US Senate at the end of his tenure as president in 1992—the treaty's entry into force (1994) occurred under Democratic President Bill Clinton (1993-2000). The US position on climate change in this early formative period was marked by an *executive branch* (president and relevant agencies/ministries) strongly in favour of action and a *legislative* branch (US Congress) dominated by the opposing party[16]. Thus, both international and domestic federal climate change policies in the late 1990's showed strong ambition in theory (from the executive branch) but not in practice due to opposition from the legislative branch. Exemplary of this was the US experience with the Kyoto Protocol. The Clinton administration urged the US Congress to accept the terms of the agreement following its signing in 1997. However, the Senate did not ratify the Protocol, having unanimously passed a resolution that year that prohibited the US from adopting binding targets without developing countries doing the same (Demand Climate Justice, 2017).

After eight years of limited to no climate change ambition under Republican President, George W. Bush, this permutation occurred again when President Obama's Democratic executive branch collided with Republican majorities in both chambers of the US Congress for nearly Obama's entire time in office. The ambitious climate change action agenda of the administration found little traction in Congress and forced Obama to pursue executive actions that did not require legislative approval. US diplomats to the UNFCCC pushed for a formulation of the Paris Agreement that did not constitute a "treaty" (in the US treaties require approval by 2/3 of the US Senate to be ratified), and federal GHG reduction requirements were enacted using existing statutes (i.e., the Clean Power Plan regulates power sector GHG emissions via the existing Clean Air Act) rather than by attempting to pass new legislation (Farber, 2018).

Since 2017, the US has undertaken no new policy action against climate change under President Trump and the Republican-led Congress. Instead, the few measures enacted under the previous administration (including vehicle emissions standards aimed at cutting carbon output of the country's transport sector) are being actively repealed. Moreover, the Trump administration put forward a weakened replacement of the Clean Power Plan, proposed to freeze vehicle efficiency standards after 2020 and will not enforce regulations to limit highly potent HFC emissions (Climate Action Tracker, 2019f).

The Trump administration is also attempting to dismantle climate science, most prominently by scuttling the National Climate Assessment, a report that has been produced by an interagency task force roughly every four years since 2000. The models used in the most recent report projected that if fossil fuel emissions remain unchecked, the earth's atmosphere could warm by as much as eight degrees Fahrenheit (U.S. Global Change Research Program., 2018). The administration attempted to bury the report by releasing it the day after a major national holiday, and Trump officials have made plans to exclude worst-case or "business-as-usual" scenarios from the next report, which is currently being drafted. In addition, the United States Geological Survey, headed by a Trump appointee, was ordered to only employ models that project the impact of climate change through 2040 instead of the end of the century (Davenport and Landler, 2019).

The Trump administration has also reduced taxes on fossil fuels. Beginning in January 2019, the federal excise tax on coal extraction was lowered (U.S. Department of the Interior, 2019). Similarly, the federal "oil spill" excise tax, which was imposed on crude oil and imported petroleum products, expired at the end of 2018 and was not renewed by the Trump administration (KPMG, 2019). Additionally, in August

[16] Periods of Republican majority in both the US House of Representatives (1996-2006) and the Senate (1995-2001) overlapped with nearly all eight years of Clinton's presidency.

2019, the EPA, under the insistence of the Trump administration, announced it will roll back Obama-era methane regulations in an attempt to boost oil and gas production (Puko, 2019).

The November 2018 midterm elections resulted in the Democratic Party gaining a majority in the House of Representatives, while the Republicans retained control of the Senate. As a result, in May 2019, the House passed the first climate change bill in a decade, which would require the Trump administration to keep the US as a party to the Paris Agreement. However, the bill is mostly symbolic and will not be taken up by the Senate (Volcovici, 2019).

In April 2019, Congress Democrats Alexandra Ocasio-Cortez and Ed Markey proposed the so-called "Green New Deal", a large economic stimulus package to create clean-energy jobs and infrastructure. The plan was quickly defeated in the Senate, but the idea has remained alive in public discourse. Its major goals included achieving carbon neutrality by 2030 (Ocasio-Cortez and Markey, 2019). As a response to the radical measures of the Green New Deal, a different group of House Democrats unveiled a plan with a "more realistic" goal to cut carbon emissions to net zero by 2050 (Friedman, 2019).

At the sub-national level, however, the picture is quite different—some states and regions within the US are pursuing comparatively ambitious climate policies that, given the size of their economies and population, account for significant emission reductions even on a global scale both currently and going forward. The state of California, currently ranked the world's 5th largest economy by GDP,[17] has an emission reduction target that (unlike most of its kind) is a *law*, enacted by a vote of the state legislature in 2006 (California Air Resources Board, 2006). It requires the state to bring its GHG emissions to their 1990 level by 2020 (which is 427 tons greater than France's current annual emissions). Another law passed in 2016 codifies a 2030 target of 40 percent below 1990 levels (California Air Resources Board, 2016). That law also extends operation of the state's emissions trading system (one of the main policies through which the state will meet its target) through 2030, de facto ensuring the existence of the Western Climate Initiative, which is North America's largest carbon market.[18] Other states that are pursuing ambitious targets independent of the federal government include New York, Virginia and Colorado—25 state governors have signed a formal alliance to achieve the US Paris target (26 percent below 2005 emissions levels by 2025) at the state level (United States Climate Alliance, 2019). A wider initiative called "We Are Still In" includes pledges to fulfil emission reduction targets by US cities and counties as well as businesses and investors, universities and cultural institutions (We Are Still In, 2019). According to a report by a privately funded research consortium, if the subnational entities involved continue their current policies under a scenario of no action by the federal government, they will decrease US emissions by 17% below 2005 levels (World Resources Institute, 2019).

8.4.2 Political stability: Basic timelines that affect mitigation policies

The next US federal election is on 3 November 2020. US citizens will vote for the president for the 2021-2025 term, as well as for members of the Senate and House of Representatives. Donald Trump will almost certainly be the Republican candidate for president, and the candidate for the Democratic Party will be decided after the Democratic National Convention in July 2020. Almost all of the over 20 individuals who have publicly declared interest in running for president on the Democratic side support a strong climate change mitigation agenda. In June 2019, partly in response to widespread public support for the Green New Deal, leading candidate Joe Biden released his plan to help the US reach net zero by 2050 with a federal investment of $1.7 trillion over the next ten years. Elizabeth Warren, another leading Democratic candidate, released three separate climate change plans with a goal of

[17] In May 2018, US Commerce Department data revealed California's "gross state product" to be $2.7 billion in 2017. The UK's GDP in that year was $2.6 billion GDP, ranking California the 5th largest economy by GDP after the US, China, Japan and Germany

[18] The Western Climate Initiative is an international emission trading system that covers emitters in California and the Canadian province of Quebec. For the first half of 2018 it also included Canada's largest province, Ontario.

investing $2 trillion over ten years in green manufacturing and calling for a zero-emissions military (Davenport and Glueck, 2019).

The 33 Senate seats up for election in 2020 include Democrats with voting records supporting strong national climate change mitigation actions, such as Massachusetts Senator Ed Markey and Virginia Senator Mark Warner. If these senators are replaced by ones who do not prioritize climate action, the number of mitigation supporters in the senate, already a minority, could dwindle further. On the other hand, some incumbent senators who have a weak voting record on climate change mitigation could be replaced by individuals in favour of emission reduction from either party. Other states where Senate seats are up for election in 2020 include Texas, North and South Carolina, Colorado, Oregon, and New Jersey (Grim, Lacy and Chávez, 2019).

8.4.3 Dimensions of the political system that affect mitigation ambition

With the legislative branch of the US government having been controlled largely by the Republican party during the past decades, the US has few national laws aimed at reducing emissions or addressing climate change. There is no national climate change law, and while renewable energy quotas abound at the state level,[19] there is no renewable electricity requirement that applies to the US as a whole.

The main dimension of the US national political system affecting mitigation ambition is thus the inhabitant of the White House, as his or her prioritization of climate change mitigation determines the rigor with which the US Environmental Protection Agency (EPA) addresses emissions from the sectors it has the authority to regulate (mainly electricity and transport). The primary existing statute under which climate change mitigation action can be taken at the national level is the Clean Air Act, an overarching law on air pollution passed in the 1970s and renewed in the early 1990s. It gives the EPA, which is a federal agency and part of the executive branch under the president, the authority to regulate air pollutants and promulgate emission reduction requirements applicable at the national level (Union of Concerned Scientists, 2010).

The absence of congressionally enacted laws to mitigate climate change renders the US judicial branch extremely influential to climate change mitigation ambition, as the EPA is subject to challenges on its interpretation of the few existing laws. Opponents of climate change action disputed the EPA's authority to regulate greenhouse gases, for instance, as the original legislation was formulated to address criteria pollutants such as sulphur and mercury. In a landmark case in 2007, the US Supreme Court ruled that GHGs constitute pollutants under the Clean Air Act, which in turn meant that the EPA *must* formulate policies to decrease their emission from, e.g., automobiles and power plants (Union of Concerned Scientists, 2010). Had it ruled otherwise (which it may have under its current configuration including newly confirmed, Trump-appointed Justice Kavanaugh), the Obama administration would not have been able to attempt emissions reducing policies.

8.4.4 Historical precedent

Indeed, the EPA under George W. Bush dragged its feet on regulating greenhouse gases even after being essentially required to do so after the 2007 Supreme Court decision. Under Obama, the EPA developed a regulatory framework that increased corporate average fuel economy standards for cars and light trucks through model year 2025 that would have significantly reduced US transport sector greenhouse gas emissions. The Trump EPA is working to roll back these requirements. The Obama EPA also promulgated regulation that would have established limits on GHG emissions from power

[19] At least 38 states have renewable portfolio standards (RPS), requirements that a certain percentage of electricity demand be met with renewably generated power. The percentages (and definitions of what counts as "renewable") vary by state, with California's arguably being most ambitious at 50% by 2030. Whether the requirement is a voluntary goal or a target enacted by the state legislature also varies, with most states' RPS being mandatory. For a searchable database of states' RPS, see http://programs.dsireusa.org/system/program?type=38&category=2.

plants. This measure was challenged in court in 2016 and thus never actually applied to US electricity producers before it was effectively dismantled by the Trump administration. The EPA under Trump interprets its duty to regulate power plant greenhouse gases under the Clean Air Act in a way that allows for states to neglect to set emissions standards, even challenging the right of states to set their own stricter standards. Therefore, the EPA will not have an additional effect on US GHG output from the power sector and is expected to finalize this legal rollback of federal emissions standards in 2019 (Davenport, 2019).

8.4.5 Strength of civil society (pro and contra climate action)

Groups influencing the climate change debate abound in the US, with the country being home to many of the foremost leaders (think tanks, university institutions and private policy institutes) on climate change mitigation policy as well as global environmental advocacy groups like World Wildlife Fund and Greenpeace. The Sierra Club and Union of Concerned Scientists are environmental advocacy groups with only a US presence that share the stances of their international counterparts on the issue of climate change.

Groups explicitly known for their opposition to climate change action include the Heritage Foundation, a right-wing think tank that in 2016 published a report claiming that its proprietary modelling showed the US upholding its Paris commitment would lead to the loss of 400,000 jobs and GDP loss of $2.5 trillion by 2035—as well as increases in household electricity expenditures of up to 20% (Dayaratna, Loris and Kreutzer, 2016). The American Petroleum Institute (API), the US trade association for energy companies that includes over 600 members from oil multinationals to local pipeline repair businesses, actively lobbies at the national level (API, no date) mainly against ambitious mitigation targets. Its advocacy as reflected in public messaging and reports is more nuanced, however, as it represents the interests of the US natural gas industry, to which much of the American power sector's recent GHG emission reductions are due. Messaging on the climate issue emphasises deregulation and touts increased natural gas production and sales (InfluenceMap, 2019).

Unlike most countries profiled in this analysis, the US features dozens of prominent public figures (including President Trump himself) who explicitly deny climate change or explicitly do not attribute it to human action. Several more accept the science but do not prioritize policies that facilitate emission reduction in their legislative agendas.

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