



# TRANSLATING TARGETS INTO NUMBERS: QUANTIFYING THE GREENHOUSE GAS TARGETS OF THE G20 COUNTRIES

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## 1. INTRODUCTION

Governments around the world have adopted national greenhouse gas (GHG) targets to address climate change. In 2009, under the Copenhagen Accord, developed countries set quantified economy-wide emissions targets for 2020, while developing countries put forward nationally appropriate mitigation actions (NAMAs). These targets and actions were formalized at the Cancun climate change negotiations in 2010. Then, in 2015, countries announced new GHG emissions reduction targets and actions in the lead-up to the Paris Agreement. Also known as Intended Nationally Determined Contributions, or INDCs, these plans include targets and actions for reducing GHG emissions by 2025 or 2030.

Countries' GHG targets<sup>1</sup> have taken different forms, from reductions from historical base year levels to reductions relative to projected baseline scenarios and levels of emissions intensity of the economy. This paper translates these heterogeneous targets set by members of the G20 into emissions levels for future years and compares those future emissions levels to the most recent official country-reported emissions data. Doing so enables us to understand each country's intended emissions pathway. It also enables us to understand the gap between countries' current levels of emissions and where emissions need to be in order to meet national goals.<sup>2</sup>

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While attention has recently been focused on countries' INDCs in the context of the Paris Agreement, it is important not to lose sight of countries' Cancun pledges for 2020. Now that 2020 is only a few years away, it is important to understand the gap between countries' current emissions and their intended levels of emissions in 2020 in order to highlight the need for countries to enhance action to meet or exceed their 2020 goals. There is still a significant global gap between where emissions are and where they need to be to avoid the worst impacts of climate change (UNEP 2016). The next few years are critical if we are to get on the right track—meeting or exceeding the Cancun pledges in 2020 will be an important milestone on the pathway to a long-term low-carbon economy.

## 2. SCOPE OF THIS PAPER

This paper focuses on the GHG targets of 15 members of the G20: Argentina, Australia, Brazil, Canada, China, the European Union (EU), India, Indonesia, Japan, Mexico, Russia, South Africa, the Republic of Korea, Turkey, and the United States. The GHG targets are examined for only 15 members of the G20 for the following reasons:

- The EU has submitted GHG targets for 2020 and 2030 on behalf of its 28 member states. Because France, Germany, Italy, and the United Kingdom are included in these joint pledges, we assessed only the collective GHG targets of the EU, and not those of the individual countries, which are also members of the G20. In June 2016, UK citizens voted to leave the EU, but the UK government has not yet formally left the union. Therefore, for the purposes of this analysis, the EU assessment includes the UK.
- This study assesses national GHG targets only, rather than individual actions put forward in the absence of a national target, such as the mitigation actions put forward by Argentina for 2020 or by Saudi Arabia for 2030. Saudi Arabia has not put forward a 2020 or a post-2020 GHG target; it is therefore not included in this analysis.

The G20 countries collectively account for 86 percent of the world's GDP, 78 percent of global trade, two thirds of the world's population (including more than half of world's poor), and more than 80 percent of global GHG emissions (Government of Australia 2016a; CAIT 2016). As such, the mitigation goals to which these countries commit and the extent to which the goals are achieved will have a critical impact on the world's GHG emissions trajectory.

## 2.1 What This Paper Does

G20 countries have put forward GHG targets for 2020 in their Cancun pledges, and for 2025 or 2030 in their INDCs. This paper presents the following two analyses:

Calculation of the absolute emissions levels associated with the GHG targets set by the G20 countries

Cancun pledges and INDCs are, by definition, determined by countries in the context of their national priorities, circumstances, and capabilities. As such, countries have chosen to present their GHG targets in different ways. Some have put forward absolute reduction targets relative to a historical base year, while others have set targets relative to a projected baseline scenario or future levels of gross domestic product (GDP). In most cases, countries have not stated the intended level of GHG emissions in future years that would be associated with meeting their targets. Because of the different types of targets and the various approaches taken by each country, it can be difficult to understand what each country's target means for future levels of emissions without further analysis. Accordingly, to improve understanding and transparency of countries' targets, this paper uses the information put forward by countries themselves to calculate the absolute GHG emissions levels in future years that are implied by G20 countries' targets.

Assessment of the emissions gap between the G20 countries' current levels of emissions and target levels of emissions

This paper uses the latest historical GHG emissions data officially communicated by G20 countries and compares them with each country's estimated target level of emissions in future years, highlighting the emissions gap between the two. While this analysis was carried out in 2016, the most recent inventory data for the majority of countries relate to the 2014 calendar year, due to the lag in the availability of countries' historical emissions data. Therefore, "current emissions" refers to the most recent data available, often 2014.

This paper can be used by policymakers, research organizations, non governmental organizations, and advocacy groups to better understand countries' 2020 and 2025/2030 GHG targets in relation to their historical emissions, including how much countries will need to reduce their GHG emissions—or how much emissions can still grow—if they are to reach their stated goals. The analysis presented here could inform further research on assessing countries' untapped GHG mitigation opportunities, ambition gaps, and pathways to meeting or beating their Cancun pledges and INDCs.



## 2.2 What This Paper Does Not Do

The focus of this study is to provide a relatively straightforward analysis of what countries' targets mean for future levels of GHG emissions and where countries' recent emissions are in relation to those target levels of emissions. Several topics are not within the scope of this analysis.

First, this study does not assess the ambition, fairness, or appropriateness of countries' GHG targets. The analysis takes countries' targets as given and assesses what further emissions reductions are needed to meet these targets.

Second, this study does not project or forecast countries' emissions under various scenarios, such as business-as-usual scenarios or policy scenarios, which would help shed light on whether countries are on track to meet their goals based on the emissions reductions expected from planned, adopted, and implemented policies.<sup>3</sup> Instead, the focus is on calculating current and future emissions levels, the gap between them, and the annual average rate of change in GHG emissions needed to reach the targets. One possible future direction of this work is to repeat this analysis regularly in the future, using the same methodological approach to provide an update on countries' current emissions and compare them with target levels of emissions.

Third, this paper does not assess the progress of countries toward achieving their GHG targets under the United Nations Framework Convention on Climate Change (UNFCCC). Common principles for accounting for the land sector and accounting for purchases and sales of internationally transferable emissions units through market mechanisms have yet to be agreed under the UNFCCC. Until the accounting approaches are agreed and countries have provided relevant information on the land sector and market mechanisms, tracking progress toward the achievement of targets is not possible. In the absence of this information, this paper focuses on where countries' recent emissions are in relation to future emissions levels associated with meeting their targets.

Finally, this paper does not calculate the impact of the policies, actions, and non-GHG targets (for example, renewable energy goals) included in countries' Cancun pledges and INDCs. For countries with GHG targets, this paper assumes that these actions contribute to meeting the overall GHG reduction target and are therefore reflected in the emissions level associated with meeting the target, rather than representing additional GHG reductions beyond the national GHG target.

## 2.3 How This Paper Relates to the Work of Other Institutions

Other institutions have undertaken similar efforts, with varying degrees of complexity, to quantify the emissions levels implied by countries' GHG targets.

- The UNEP Emissions Gap Report, published annually, provides a scientific assessment of countries' GHG targets and compares the resulting emissions levels in 2030 with what science tells us is required to be on track toward the agreed target of a global average temperature increase below 2°C (UNEP 2016).
- The Climate Action Tracker (CAT) tracks the national climate actions of 32 countries and calculates the global warming consequence and emissions gaps (CAT 2016).
- PBL Netherlands Environmental Assessment Agency calculates the impact of GHG targets and policies on GHG emissions projections for 2020 and 2030 (PBL 2016).
- NewClimate Institute, PBL Netherlands Environmental Assessment Agency, IIASA, and Ecofys project GHG emissions in 13 major emitting countries/regions up to 2030, taking into account the emissions trajectories based on current and planned policies, and selected enhanced mitigation measures (PBL 2016).
- The Australian-German Climate and Energy College at the University of Melbourne quantifies the GHG targets put forward in the INDCs submitted to the UNFCCC before May 16, 2016 (Australian-German Climate and Energy College 2016).

Unlike the efforts above, this paper focuses only on the GHG targets of the G20 countries and uses official information communicated by governments, rather than independent assumptions. The majority of information used in this analysis is sourced from countries' Cancun pledges and INDCs themselves, supported by data from National Communications, National Inventory Reports, Biennial Reports, Biennial Update Reports, and national climate change strategies. This is further described in the research methodology section of this paper.



### 3. RESEARCH METHODOLOGY

Quantifying the GHG targets of the 15 members of the G20 analyzed in this paper involves the following steps:

- Review the Cancun pledges and INDCs of the G20 countries.
- Gather historical emissions data.
- Calculate the target level of emissions.
- Calculate the average annual rate of emissions change required to meet countries' targets.

Each step is described further below.

#### 3.1 Review the Cancun Pledges and INDCs of the G20 Countries

Countries' Cancun pledges and INDCs were reviewed to determine the following aspects of countries' targets:

The GHG target base year/reference point, target type, and time frame

The GHG targets assessed in this paper can be categorized in terms of four target types: a base year target, an intensity target, a baseline scenario target, or a trajectory target (adapted from the Greenhouse Gas Protocol *Mitigation Goal Standard*):

- A base year target is a target that reduces or controls the increase of emissions by a specified quantity relative to a base year.
- An intensity target is a target that reduces the emissions intensity (emissions per unit of another variable, typically GDP) by a specified quantity relative to a base year.
- A baseline scenario target is a target that reduces emissions by a specified quantity relative to a projected emissions baseline scenario. A baseline scenario is a reference case that represents future events or conditions most likely to occur in the absence of activities taken to meet the mitigation goal.
- A trajectory target is a target that specifies an emissions level or range in future years.

The GHG target scope and coverage

*Scope and coverage* refers to the sectors,<sup>4</sup> geographical area, and GHGs that are included in the target.<sup>5</sup> Some countries have specified sector and gas coverage for their targets, while others have not. For those that have not, we have made assumptions about the most likely sector and gas coverage. Section 4 details any assumptions made (if they were needed) to calculate target levels of emissions.

The methodological approach communicated by countries

This includes global warming potential (GWP)<sup>6</sup> values and calculation approaches for estimating GHG emissions. (As explained in section 2.2, because common principles for accounting for the land sector and internationally transferable emissions units are still to be agreed, it is not possible to accurately track progress toward countries' targets.)

These three categories of information were used to calculate countries' target level of emissions, using the equations presented in section 3.3.

#### 3.2 Gather Historical Emissions Data

Official sources—such as countries' latest Biennial Update Reports, Biennial Reports, National Inventory Reports, or National Communications—were used to record countries' historical GHG emissions data.<sup>7</sup> Unofficial sources—such as the IEA's Energy Atlas<sup>8</sup> and the CAIT Climate Data Explorer<sup>9</sup>—were used to fill in data gaps in the historical emissions trajectories of China and India, because these countries communicated incomplete GHG emissions data between 1990 and 2014. China has communicated official national GHG inventories only for 1994 and 2005, while India has communicated official national GHG inventories only for 1994, 2000, 2007, and 2010.

The historical emissions data that were recorded for each country matched the sector and gas coverage of the country's GHG target. For example, China's GHG targets for 2020 and 2030 apply only to carbon dioxide (CO<sub>2</sub>) emissions, and therefore only China's historical CO<sub>2</sub> emissions were recorded, rather than total GHG emissions. India's 2020 and 2030 targets exclude the agriculture sector, and therefore the historical emissions recorded for India exclude this sector.<sup>10</sup>

Where national or regional 2020 and 2025/2030 targets have different coverage—as is the case for Russia and the EU, where the land use, land-use change, and forestry (LULUCF) sector is excluded from the 2020 GHG targets, but included in the 2030 GHG targets—we recorded both sets of historical emissions levels.



Finally, some countries report their historical GHG emissions using one set of GWP values but opt to use other GWP values to track progress toward their stated goals. It is not feasible to adjust countries' historical emissions in line with different GWP values, as this would create additional uncertainty. This is particularly true for HFC and PFC emissions. For example, the emissions source "production and use of alternatives for ozone depleting substances" includes several types of HFC compounds, each with a different GWP. If emissions from this source were adjusted to reflect another set of GWP values, it would involve making assumptions about the percentage share of the various HFC compounds in this emissions source (due to lack of granularity in countries' underlying GHG emissions data). These assumptions would have an impact on the overall emissions estimate because the GWP values for HFC compounds vary significantly, from 138 to 12,400 (over a 100-year time horizon) (IPCC 2013).

### 3.3 Calculate the Target Level of Emissions

The following equations are used to calculate countries' target levels of emissions, depending on the GHG target type. In cases where a country has explicitly stated its target level of emissions in its Cancun pledge or INDC, we have used the target level of emissions as reported.

Calculating the target level of emissions for countries with base year targets

For countries with base year targets (for example, Australia, which aims to reduce its GHG emissions by 26–28 percent by 2030, relative to 2005 levels), the target level of emissions is calculated using the following equation:

$$\begin{aligned} \text{Emissions in the target year (MtCO}_2\text{e)} = \\ \text{Base year emissions (MtCO}_2\text{e)} - \\ [\text{Base year emissions (MtCO}_2\text{e)} \times \text{Percent reduction}] \end{aligned}$$

Calculating the target level of emissions for countries with intensity targets

For countries with intensity targets (for example, India, which aims to reduce its GHG emissions intensity per unit of GDP by 33–35 percent by 2030, relative to 2005 levels), the target level of emissions is calculated according to the following two equations:

$$\begin{aligned} \text{Emissions intensity in the target year (MtCO}_2\text{e/level of output)} = \\ \text{Base year emissions intensity (MtCO}_2\text{e/level of output)} - \\ [\text{Base year emissions intensity (MtCO}_2\text{e/level of output)} \times \\ \text{Percent reduction}] \end{aligned}$$

$$\text{Emissions in the target year (MtCO}_2\text{e)} =$$

$$\begin{aligned} \text{Emissions intensity in the target year (MtCO}_2\text{e/level of output)} \times \\ \text{Level of output in the target year} \end{aligned}$$

Calculating the target level of emissions for countries with baseline scenario targets

For countries with baseline scenario targets (for example, Mexico, which aims to reduce its GHG emissions by 22 percent by 2030, relative to its baseline scenario), the target level of emissions is calculated according to the following equation:

$$\text{Emissions in the target year (MtCO}_2\text{e)} =$$

$$\begin{aligned} \text{Projected baseline scenario emissions in the target year (MtCO}_2\text{e)} - \\ [\text{Projected baseline scenario emissions in the target year (MtCO}_2\text{e)} \times \\ \text{Percent reduction}] \end{aligned}$$

In the case of the G20 countries with baseline scenario targets, all these countries have explicitly stated their projected baseline scenario emissions. These emissions were used as reported.

Calculating the target level of emissions for countries with trajectory targets

For countries with trajectory targets (for example, South Africa, which states that its emissions between 2025 and 2030 will be in a range between 398 and 614 MtCO<sub>2</sub>e), no calculation is required because the country has already communicated its target level emissions in absolute terms.

**Note:** In cases where assumptions are made in calculating countries' target levels of emissions, these assumptions are explicitly stated in section 4 of this paper.

### 3.4 Calculate the Average Annual Change in Emissions Needed to Meet GHG Targets

The following equation is used to calculate the average annual rate of change in GHG emissions required to meet countries' GHG targets:

$$\text{Average annual rate of change in emissions (percent)} =$$

$$\begin{aligned} \text{[Target emissions level in target year (MtCO}_2\text{e)} - \\ \text{Emissions in comparison year (MtCO}_2\text{e)}] / [\text{Number of years between} \\ \text{target year and comparison year} \times \text{Emissions in comparison year} \\ \text{(MtCO}_2\text{e)}] \times 100 \text{ percent} \end{aligned}$$



## 4. COUNTRY ANALYSIS

This section presents the analysis of the GHG targets set by the G20 countries. For each country, a table summarizes the following elements:

- The Cancun pledge and INDC.
- The GHG targets for 2020 and 2025 or 2030 (depending on the target period).
- The type of GHG target, the sector and gas coverage of the target, and the GWP values applied.

- The average annual rate of emissions change required to meet the 2020 and 2025 or 2030 GHG target (depending on the target period).
- Information about an emissions peak year and long-term GHG target, if officially announced by the country.

An emissions trajectory graphic is presented for each country, which shows the historical emissions and target level of emissions in 2020 and in 2025 or 2030 (depending on the target period). Information about the source of historical emissions, and the calculation of target emissions levels, is also included.

### 4.1 Argentina

Table 1 | **Information Related to Argentina's Mitigation Goals**

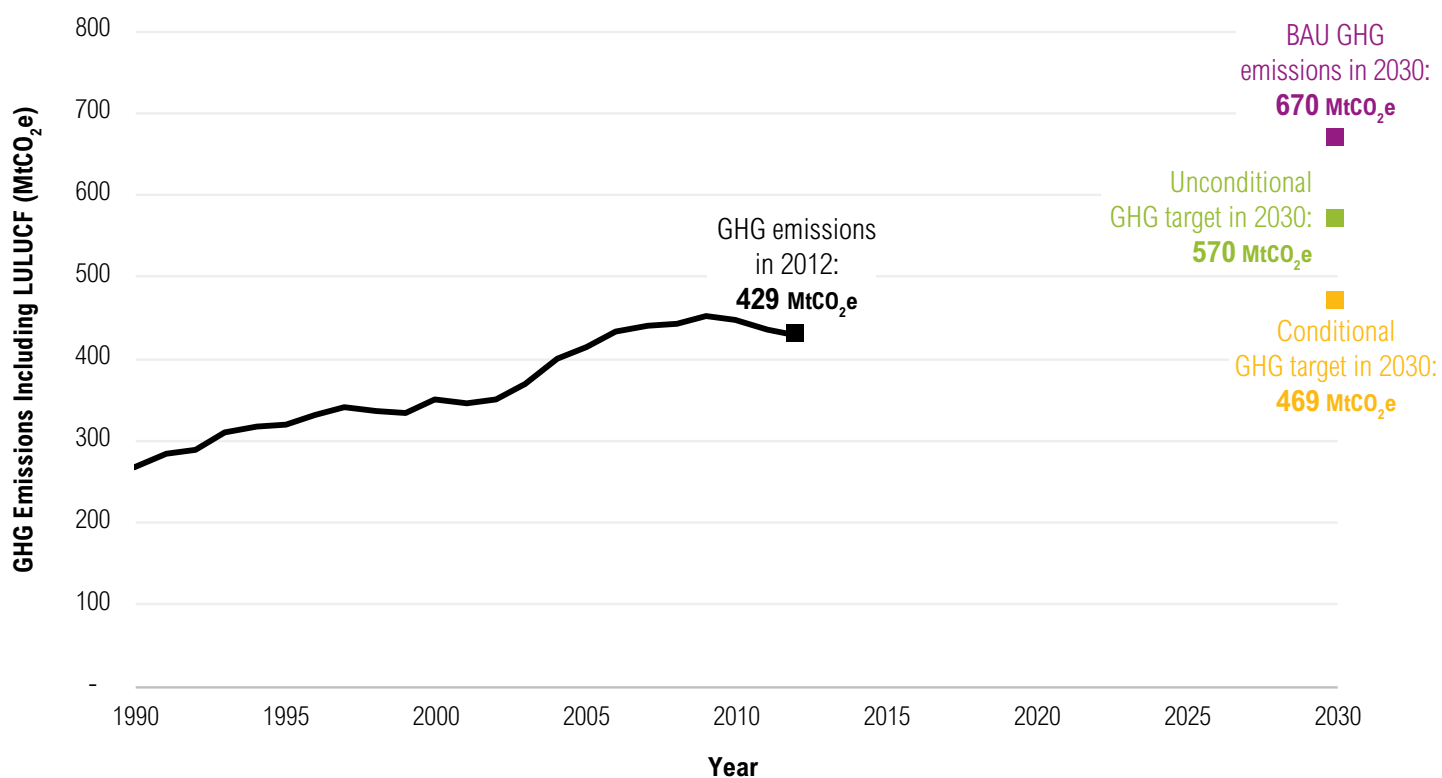
	CANCUN PLEDGE (FOR 2020)	INDC (FOR 2030)
<b>Summary</b>	<p>Argentina communicated that it is currently developing programs and nationally appropriate mitigation actions (NAMAs), and is taking sector-specific actions in energy efficiency, renewable energy, biofuels, forest management, and solid waste management. Argentina did not communicate a GHG target in its Cancun pledge.</p> <p>Argentina also stated that the implementation of NAMAs by developing countries would contribute to the global process of the reduction of emissions, based on the principles of common but differentiated responsibilities and according to the principles and provisions of the Convention, particularly Article 4, paragraphs 1, 7, and 8.</p>	<p>Argentina communicated an unconditional goal to reduce GHG emissions by 15% by 2030 with respect to projected business-as-usual (BAU) emissions for that year. The goal includes, among other things, actions linked to the promotion of sustainable forest management, energy efficiency, biofuels, nuclear power, renewable energy, and transport modal shift.</p> <p>Argentina also communicated a conditional goal to reduce GHG emissions by 30% in 2030 with respect to projected BAU emissions for that year. This goal is contingent on adequate and predictable international financing; support for transfer, innovation, and technology development; and support for capacity building.</p>
<b>GHG target(s)</b>	No GHG target	<p>Unconditional target: Reduce GHG emissions by 15% by 2030, relative to a BAU scenario.</p> <p>Conditional target: Reduce GHG emissions by 30% by 2030, relative to a BAU scenario.</p> <p>Argentina included its BAU emissions for 2030 in its INDC—these values were used to calculate the country's target levels of emissions in 2030.</p>
<b>Type of GHG target(s)</b>	Not applicable	Baseline scenario target
<b>Sector coverage of GHG target(s)</b>	Not applicable	All Intergovernmental Panel on Climate Change (IPCC) sectors
<b>Gas coverage of GHG target(s)</b>	Not applicable	Six gases under the Kyoto Protocol
<b>GWP values applied</b>	Not applicable	100-year values from the IPCC Second Assessment Report (SAR)
<b>Average annual rate of change in emissions to meet<sup>a</sup> GHG target(s)</b>	Not applicable	<ul style="list-style-type: none"> <li>■ Unconditional target: +1.8% per annum between 2012 and 2030</li> <li>■ Conditional target: +0.5% per annum between 2012 and 2030</li> </ul>
<b>Emissions peak year</b>	Argentina has not formally communicated when it anticipates that its GHG emissions will peak.	
<b>Long-term GHG target</b>	Argentina has not formally communicated a long-term GHG target.	

<sup>a</sup> Noting that common principles for accounting for the land sector and internationally transferable emissions units are still to be agreed upon, which will affect how countries meet their GHG targets.



Figure 1 presents Argentina's historical emissions and target levels of emissions. Argentina expects to meet either its unconditional or conditional GHG target while experiencing an increase in absolute GHG emissions (relative to 2012 levels).

Figure 1 | **Argentina's Historical Emissions and Estimated Future Emissions Associated with Targets**



**Notes:**

Argentina's historical GHG emissions between 1990 and 2012 (the latest inventory year) are sourced from the country's third National Communication (Government of Argentina 2015).

The GHG emissions presented in Figure 1 include the LULUCF sector, in accordance with the sector coverage of Argentina's GHG targets.

Argentina included its BAU emissions for 2030 in its INDC (670 MtCO<sub>2</sub>e); these values are used to calculate the country's target levels of emissions in 2030.



## 4.2 Australia

Table 2 | **Information Related to Australia's Mitigation Goals**

	<b>CANCUN PLEDGE (FOR 2020)</b>	<b>INDC (FOR 2030)</b>
<b>Summary</b>	Australia communicated three GHG targets for 2020: to unconditionally reduce GHG emissions by 5% below 2000 levels by 2020; to conditionally reduce GHG emissions by up to 15% below 2000 levels by 2020 if there is a global agreement that falls short of securing atmospheric stabilization at 450 ppm CO <sub>2</sub> e and under which major developing economies commit to substantially restrain emissions and advanced economies take on commitments comparable to Australia's; and to conditionally reduce GHG emissions by up to 25% below 2000 levels by 2020 if the world agrees to an ambitious global deal capable of stabilizing levels of greenhouse gases in the atmosphere at 450 ppm CO <sub>2</sub> e or lower.	Australia communicated that it will implement an economy-wide target to reduce GHG emissions by 26–28% below 2005 levels by 2030. Australia further states that it will implement the 28% target should circumstances allow, taking into account opportunities to reduce emissions and factors such as the costs of technology.
<b>GHG target(s)</b>	<ul style="list-style-type: none"> <li>■ Unconditional target: Reduce GHG emissions by 5% by 2020, relative to 2000 levels.</li> <li>■ Conditional target: Reduce GHG emissions by 15–25% by 2020 relative to 2000 levels.</li> </ul>	Unconditional target: <sup>b</sup> Reduce GHG emissions by 26–28% below 2005 levels by 2030.
<b>Type of GHG target(s)</b>	Base year target	Base year target
<b>Sector coverage of GHG target(s)</b>	All IPCC sectors	All IPCC sectors
<b>Gas coverage of GHG target(s)</b>	Seven gases under the Kyoto Protocol	Seven gases under the Kyoto Protocol
<b>GWP values applied</b>	100-year values from the IPCC Fourth Assessment Report (AR4)	100-year values from the IPCC Fourth Assessment Report (AR4)
<b>Average annual rate of change in emissions to meet<sup>a</sup> GHG target(s)</b>	<ul style="list-style-type: none"> <li>■ Unconditional target: +0.1% per annum between 2014 and 2020</li> <li>■ Conditional target: Between –1.6 and –2.5% per annum between 2014 and 2020</li> </ul>	Unconditional target: <sup>b</sup> Between –0.9 and –1.1% per annum between 2014 and 2030
<b>Emissions peak year</b>	Australia has not formally communicated a GHG emissions peak year.	
<b>Long-term GHG target</b>	Australia has not formally communicated a long-term GHG target.	

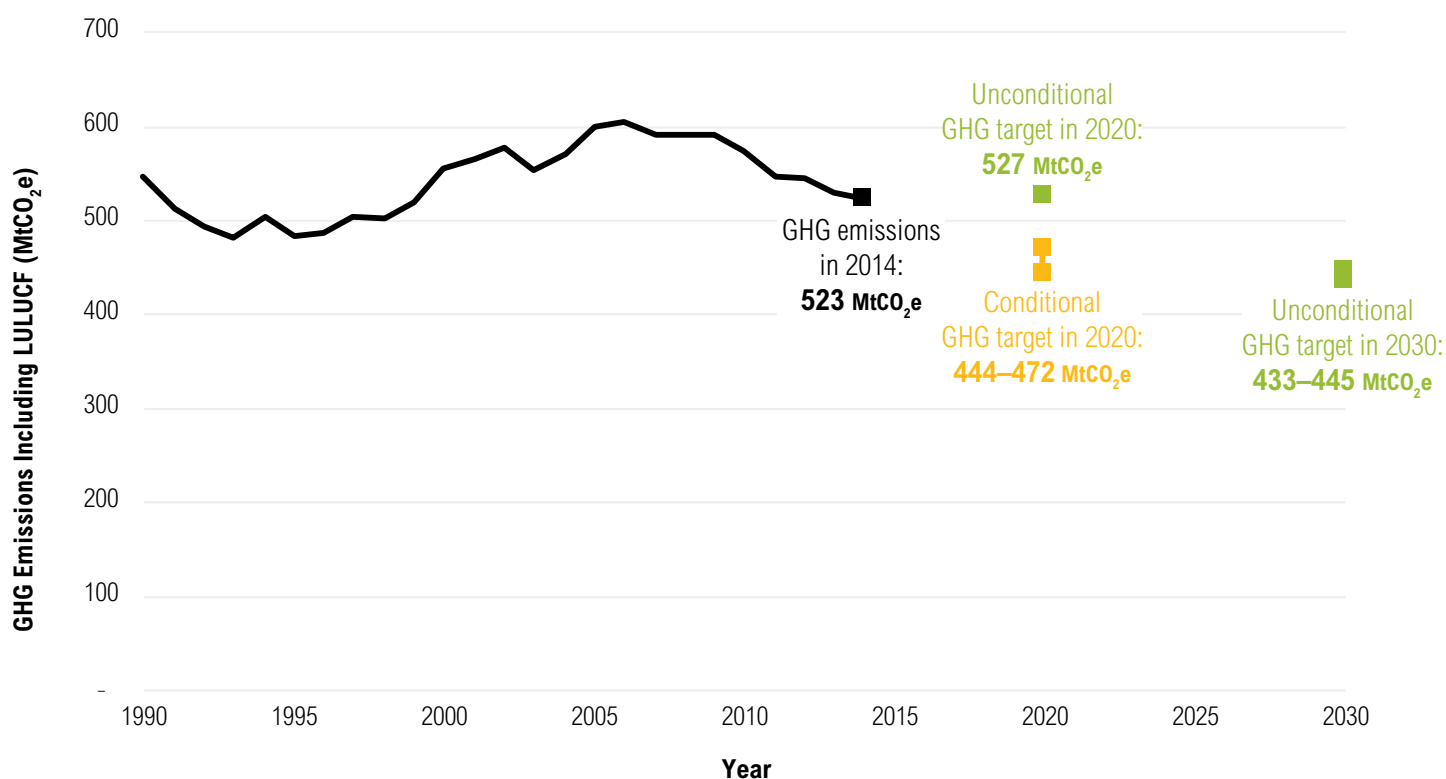
<sup>a</sup> Noting that common principles for accounting for the land sector and internationally transferable emissions units are still to be agreed upon, which will affect how countries meet their GHG targets.

<sup>b</sup> It is assumed that Australia's 2030 GHG target is unconditional as the country has not included any conditionality clauses in its INDC.



Figure 2 presents Australia's historical emissions and target levels of emissions. To meet the 2020 unconditional target, Australia's GHG emissions would slightly increase to 527 MtCO<sub>2</sub>e (relative to 2014 emissions levels), before decreasing to between 433 and 445 MtCO<sub>2</sub>e in order to meet the 2030 unconditional target.

Figure 2 | **Australia's Historical Emissions and Estimated Future Emissions Associated with Targets**



**Notes:**

Australia's historical GHG emissions between 1990 and 2014 (the latest inventory year) are sourced from the country's 2016 National Inventory Report (Government of Australia 2016b).

The GHG emissions presented in Figure 2 include the LULUCF sector, in accordance with the sector coverage of Australia's GHG targets.

Australia's 2020 and 2030 target emissions levels are calculated based on the country's 2000 GHG emissions levels (567 MtCO<sub>2</sub>e) and 2005 GHG emissions levels (601 MtCO<sub>2</sub>e), respectively, sourced from the country's 2016 National Inventory Report (Government of Australia 2016b).



## 4.3 Brazil

Table 3 | **Information Related to Brazil's Mitigation Goals**

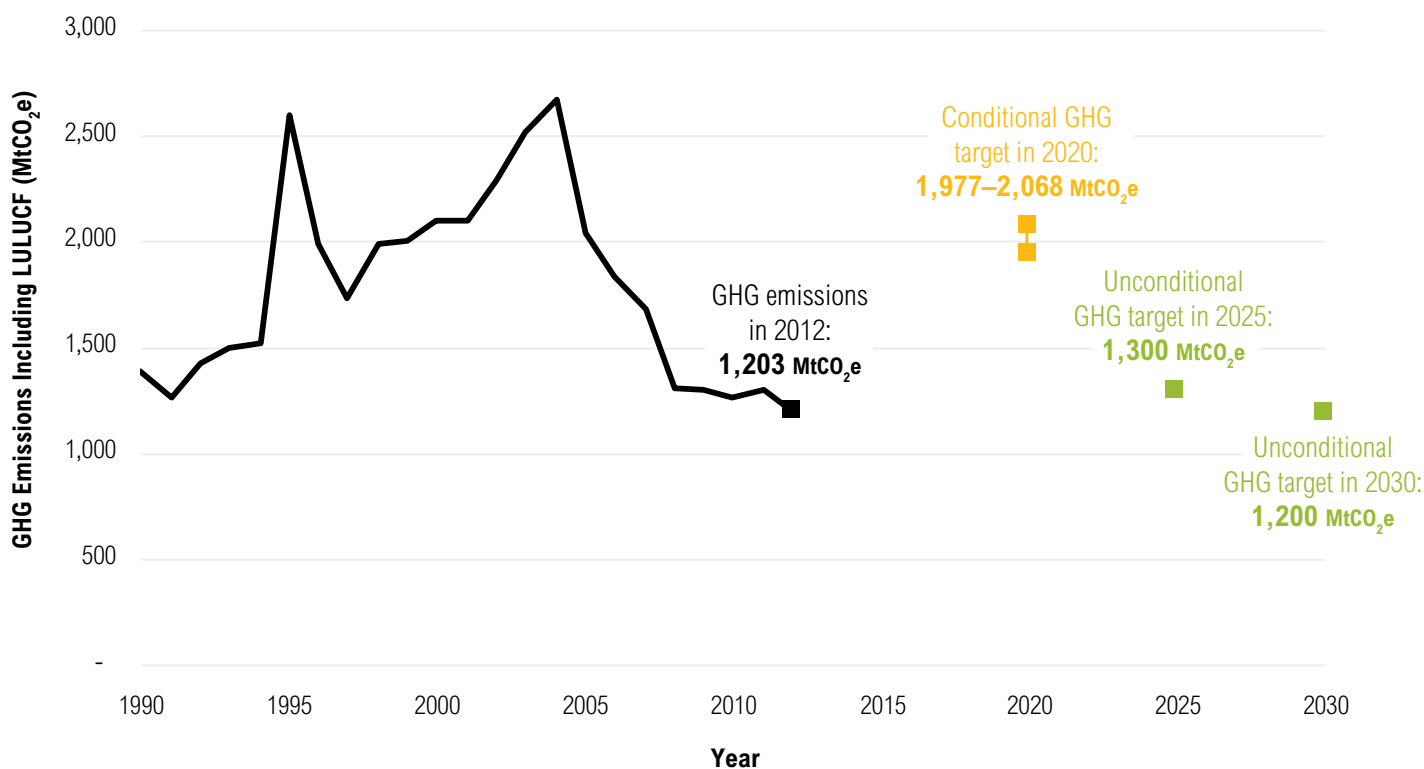
	<b>CANCUN PLEDGE (FOR 2020)</b>	<b>INDC (FOR 2025)</b>
<b>Summary</b>	<p>Brazil communicated that it anticipates its mitigation actions will lead to an expected emissions reduction of between 36.1% and 38.9% below its projected emissions in 2020. The mitigation actions listed in its nationally appropriate mitigation action (NAMA) include reducing deforestation in the Amazon, reducing "cerrado" deforestation, restoring grazing land, an integrated crop-livestock system, no-till farming, biological nitrogen fixation, energy efficiency, increasing use of biofuels, increasing energy supply from hydroelectric power plants, using alternative energy sources, and replacing coal from deforestation with coal from planted forests in the iron and steel sector.</p> <p>Brazil stated that the envisaged domestic actions outlined above are voluntary in nature and that they will be implemented in accordance with the principles and provisions of the Convention, particularly Article 4, paragraphs 1 and 7; Article 10, paragraph 2(a); and Article 12, paragraphs 1(b) and 4.</p>	<p>Brazil communicated that it intends to reduce its GHG emissions by 37% by 2025 relative to 2005 levels. Brazil also communicated a subsequent indicative contribution to reduce its GHG emissions by 43% by 2030 relative to 2005 levels.</p> <p>Brazil clarified that the implementation of its INDC is not contingent upon international support, yet it welcomes support from developed countries with a view to generating global benefits.</p>
<b>GHG target(s)</b>	Conditional target: Reduce GHG emissions by 36.1–38.9% by 2020 relative to projected levels. In its INDC, Brazil communicated the absolute emissions levels that these targets imply—between 1,977 MtCO <sub>2</sub> e and 2,068 MtCO <sub>2</sub> e in 2020.	Unconditional target: Reduce GHG emissions by 37% by 2025 relative to 2005 levels, with a subsequent indicative contribution to reduce its GHG emissions by 43% by 2030 relative to 2005 levels. In its INDC, Brazil communicated the absolute emissions levels that these targets imply—1,300 MtCO <sub>2</sub> e in 2025 and 1,200 MtCO <sub>2</sub> e in 2030.
<b>Type of GHG target(s)</b>	Baseline scenario target	Base year target
<b>Sector coverage of GHG target(s)</b>	All IPCC sectors	All IPCC sectors
<b>Gas coverage of GHG target(s)</b>	Not specified. Assumed to match coverage of 2030 target.	Six gases under the Kyoto Protocol
<b>GWP values applied</b>	100-year values from the IPCC Second Assessment Report (SAR)	100-year values from the IPCC Fifth Assessment Report (AR5)
<b>Average annual rate of change in emissions to meet<sup>a</sup> GHG target(s)</b>	Conditional target: Between +8.0 and +9.0% per annum between 2012 and 2020	<ul style="list-style-type: none"> <li>■ Unconditional target: +0.6% per annum between 2012 and 2025</li> <li>■ Unconditional target: –0.01% per annum between 2012 and 2030</li> </ul>
<b>Emissions peak year</b>	Brazil has not formally communicated a GHG emissions peak year.	
<b>Long-term GHG target</b>	Brazil has not formally communicated a long-term GHG target.	

<sup>a</sup> Noting that common principles for accounting for the land sector and internationally transferable emissions units are still to be agreed upon, which will affect how countries meet their GHG targets.



Figure 3 presents Brazil's historical emissions and target levels of emissions. Brazil's emissions may increase at an average annual rate of between 8 and 9 percent per annum if the country is to reach its 2020 conditional target (relative to 2012 GHG emission levels), before decreasing to meet the 2025 target and indicative 2030 target.

Figure 3 | **Brazil's Historical Emissions and Estimated Future Emissions Associated with Targets**



**Notes:**

Brazil's historical GHG emissions between 1990 and 2012 (the latest inventory year) are sourced from the country's National Inventory Report (Government of Brazil 2014).

The GHG emissions presented in Figure 3 include the LULUCF sector, in accordance with the sector coverage of Brazil's mitigation goals.

Brazil included its absolute GHG emissions levels in 2020 (1,977–2,068 MtCO<sub>2</sub>e), 2025 (1,300 MtCO<sub>2</sub>e), and 2030 (1,200 MtCO<sub>2</sub>e) in its INDC. These values were used as stated.

Brazil's 2020 target is calculated based on GWP values from the IPCC Second Assessment Report. Brazil's 2025 and 2030 targets are calculated based on GWP values from the IPCC Fifth Assessment Report. Due to the reasons outlined in section 3.2, we have not attempted to re-calculate Brazil's 2020 target with GWP values from the IPCC Fifth Assessment Report.



## 4.4 Canada

Table 4 | **Information Related to Canada's Mitigation Goals**

	<b>CANCUN PLEDGE (FOR 2020)</b>	<b>INDC (FOR 2030)</b>
<b>Summary</b>	Canada communicated a target of a 17% emissions reduction by 2020 relative to 2005 levels.	Canada communicated that it intends to achieve an economy-wide target to reduce its GHG emissions by 30% below 2005 levels by 2030.
<b>GHG target(s)</b>	Unconditional target: <sup>b</sup> Reduce GHG emissions by 17% below 2005 levels by 2020.	Unconditional target: <sup>b</sup> Reduce GHG emissions by 30% below 2005 levels by 2030.
<b>Type of GHG target(s)</b>	Base year target	Base year target
<b>Sector coverage of GHG target(s)</b>	All IPCC sectors	All IPCC sectors
<b>Gas coverage of GHG target(s)</b>	Not specified. Assumed to match the coverage of the 2030 target.	Seven gases under the Kyoto Protocol
<b>GWP values applied</b>	100-year values from the IPCC Fourth Assessment Report (AR4)	100-year values from the IPCC Fourth Assessment Report (AR4)
<b>Average annual rate of change in emissions to meet<sup>a</sup> GHG target(s)</b>	Unconditional target: <sup>b</sup> –3.8% per annum between 2014 and 2020.	Unconditional target: <sup>b</sup> –2.2% per annum between 2014 and 2030.
<b>Emissions peak year</b>	Canada has not formally communicated a GHG emissions peak year.	
<b>Long-term GHG target</b>	Canada aims to reduce its GHG emissions by 80% by 2050, relative to 2005 levels.	

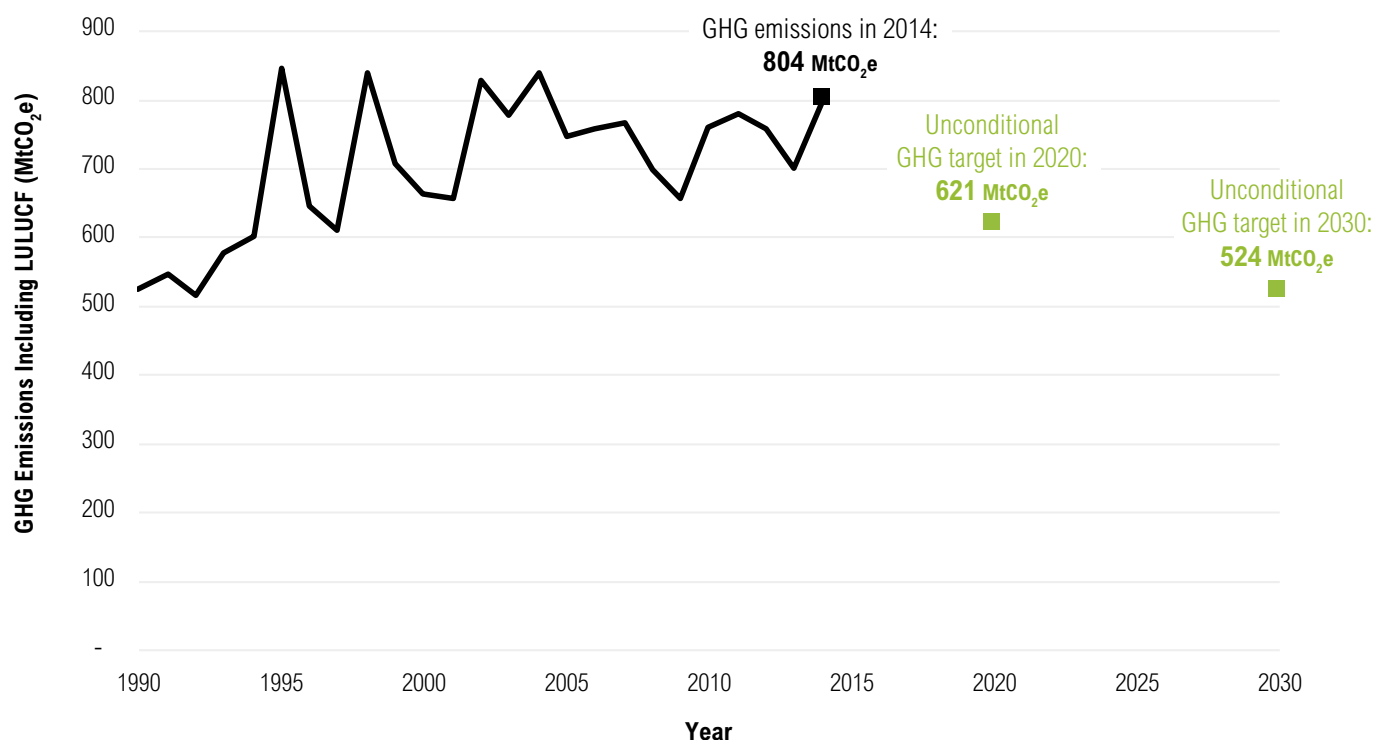
<sup>a</sup> Noting that common principles for accounting for the land sector and internationally transferable emissions units are still to be agreed upon, which will affect how countries meet their GHG targets.

<sup>b</sup> It is assumed that Canada's 2020 and 2030 GHG targets are unconditional as the country has not included any conditionality clauses in its Cancun pledge or INDC.



Figure 4 presents Canada's historical emissions and target levels of emissions. Canada will experience an accelerated emissions reduction rate in the pre-2020 period (relative to the post-2020 period) if the country is to meet both its 2020 and 2030 unconditional GHG targets.

Figure 4 | **Canada's Historical Emissions and Estimated Future Emissions Associated with Targets**



*Notes:*

Canada's historical GHG emissions between 1990 and 2014 (the latest inventory year) are sourced from the country's 2016 National Inventory Report (Environment and Climate Change Canada 2016).

The GHG emissions presented in Figure 4 include the LULUCF sector, in accordance with the sector coverage of Canada's GHG targets.

Canada's target emissions levels are calculated based on the country's 2005 GHG emissions levels (748 MtCO<sub>2</sub>e), sourced from the country's 2016 National Inventory Report (Environment and Climate Change Canada 2016).



## 4.5 China

Table 5 | **Information Related to China's Mitigation Goals**

	<b>CANCUN PLEDGE (FOR 2020)</b>	<b>INDC (FOR 2030)</b>
<b>Summary</b>	China communicated that it will endeavor to lower its CO <sub>2</sub> emissions per unit of GDP by 40–45% by 2020, relative to 2005 levels. It also expressed the intention to increase the share of non fossil fuels in primary energy consumption to around 15% by 2020, and to increase forest coverage by 40 million ha and forest stock volume by 1.3 billion m <sup>3</sup> by 2020 relative to 2005 levels.  China stated that its domestic mitigation actions are voluntary in nature and that they will be implemented in accordance with the principles and provisions of the Convention, in particular Article 4, paragraph 7. China also stated that its communication is made in accordance with the provisions of Article 12, paragraphs 1(b) and 4, and Article 10, paragraph 2(a), of the Convention.	China communicated the following nationally determined actions: to peak CO <sub>2</sub> emissions around 2030, making best efforts to peak earlier; to lower the CO <sub>2</sub> emissions per unit of GDP by 60–65% by 2030, relative to 2005 levels; to increase the share of non fossil fuels in primary energy consumption to around 20% by 2030; and to increase the forest stock volume by around 4.5 billion m <sup>3</sup> by 2030, relative to 2005 levels.
<b>GHG target(s)</b>	Conditional target: Reduce CO <sub>2</sub> emissions intensity (per unit of GDP) by 40–45% by 2020, relative to 2005 levels.	Unconditional target: <sup>b</sup> Reduce CO <sub>2</sub> emissions intensity (per unit of GDP) by 60–65% by 2030, relative to 2005 levels, and peak CO <sub>2</sub> emissions around 2030, making best efforts to peak earlier.
<b>Type of GHG target(s)</b>	Intensity target	Intensity target and peaking target
<b>Sector coverage of GHG target(s)</b>	Not specified. Assumed to cover energy-related activities only. <sup>c</sup>	Not specified. Assumed to match the coverage of the 2020 target (energy-related activities only).
<b>Gas coverage of GHG target(s)</b>	CO <sub>2</sub>	CO <sub>2</sub>
<b>GWP values applied</b>	Not specified	Not specified
<b>Average annual rate of change in emissions to meet<sup>a</sup> GHG target(s)</b>	Conditional target: Between +0.9 and +3.8% between 2013 and 2020	Unconditional target: Between +0.2 and +2.6% between 2013 and 2030
<b>Emissions peak year</b>	China has communicated that it intends to peak its CO <sub>2</sub> emissions by around 2030, and make best efforts to peak earlier.	
<b>Long-term GHG target</b>	China has not formally communicated a long-term GHG target.	

<sup>a</sup> Noting that common principles for accounting for the land sector and internationally transferable emissions units are still to be agreed upon, which will affect how countries meet their GHG targets.

<sup>b</sup> It is assumed that China's 2030 GHG targets are unconditional as the country has not included any conditionality clauses in its INDC.

<sup>c</sup> In a news conference in November 2009, Xie Zhenhua, deputy head of the National Development and Reform Commission, clarified that China's Cancun pledge covers energy-related CO<sub>2</sub> emissions, stating, "China's reductions are all the emissions reductions from energy intensity" (Buckley 2009).

Figure 5 presents China's historical emissions and estimated target levels of emissions associated with its CO<sub>2</sub> intensity goals. The goal to increase the share of non fossil fuels in primary energy consumption is assumed to be a means of achieving the CO<sub>2</sub> intensity goal and is therefore not separately represented in the graph. The goal to peak CO<sub>2</sub> emissions around 2030 is also not separately represented since the level at which emissions would peak has not been specified. In terms of sector and gas coverage, it is assumed that China's CO<sub>2</sub> target covers only energy-related activities. In 2012, CO<sub>2</sub> emissions from energy-related activities comprised 80 percent of the country's total GHG inventory (CAIT 2016).

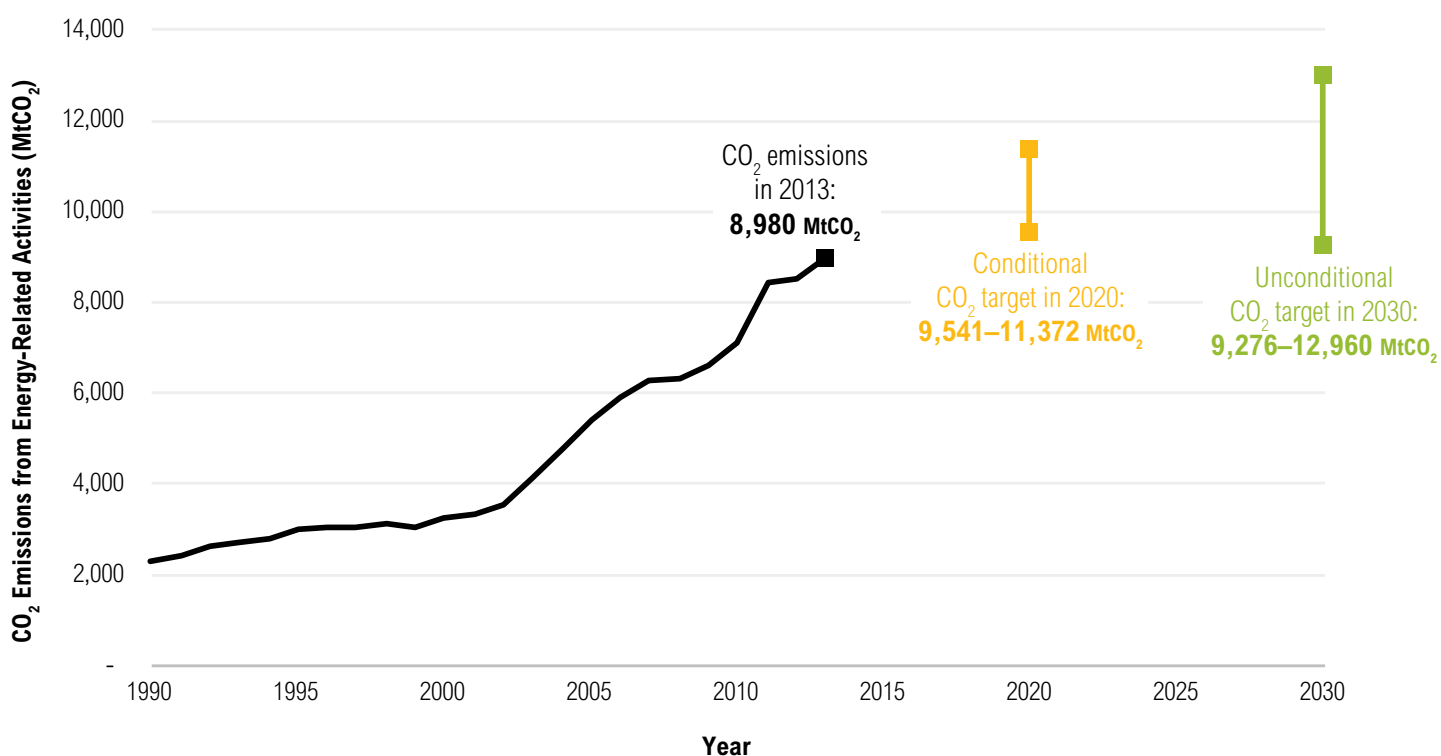
Since China's CO<sub>2</sub> targets for 2020 and 2030 are emissions intensity targets, the expected levels of emissions in 2020 and 2030 consistent with meeting the goals depend on assumptions about future rates of GDP growth. This analysis assumes annual average GDP growth of between 8.1 and 8.7 percent for the period 2005–2020 and 6.6 and 7.4 percent for the period 2005–2030. These GDP growth rates are sourced from several studies published within the last two years. For more information, please refer to the technical appendix.



Due to the range in potential GDP growth rates, and the five percent goal range included in both the 2020 and 2030 targets, China's absolute levels of CO<sub>2</sub> emissions (from energy-related activities) are likely to be between 9,541 MtCO<sub>2</sub> and 11,372 MtCO<sub>2</sub> in 2020, and between 9,276 MtCO<sub>2</sub> and 12,960 MtCO<sub>2</sub> in 2030, if the goals are achieved. Depending on actual GDP growth between now and 2030, and depending on whether China meets the lower or upper bound of its emissions intensity range,

China's CO<sub>2</sub> emissions from energy-related activities could increase at an annual average rate of between 0.2 percent and 2.6 percent between 2013 and 2030 while meeting the country's 2030 CO<sub>2</sub> intensity goal. China's total CO<sub>2</sub> emissions from energy-related activities could be between 3 percent and 44 percent higher in 2030 than in 2013 and still meet the CO<sub>2</sub> intensity goal, based on current forecasts of GDP growth.

Figure 5 | **China's Historical Emissions and Estimated Future Emissions Associated with Targets**



**Notes:**

China's historical GHG emissions for 1994 and 2005 are sourced from the country's first and second National Communications, respectively (Government of People's Republic of China 2004; 2012). GHG inventory data in the other years are sourced from the IEA's Energy Atlas (IEA 2016).

The GHG emissions presented in Figure 5 cover CO<sub>2</sub> emissions from energy-related activities only, in accordance with the assumed sector and gas coverage of China's targets.

China's target emissions levels are calculated based on the country's 2005 GHG emissions intensity levels. For more information on these calculations, please refer to the technical appendix.

China has not stated its peak levels of CO<sub>2</sub> emissions, and therefore this target cannot be represented in absolute terms based on the information that the government has presented. Several studies have attempted to quantify China's peaking emissions level and year. The analysis in this paper is, however, only based on information that national governments have put forward.



## 4.6 European Union

Table 6 | **Information Related to the European Union's Mitigation Goals**

	<b>CANCUN PLEDGE (FOR 2020)</b>	<b>INDC (FOR 2030)</b>
<b>Summary</b>	The European Union and its member states communicated an economy-wide emissions reduction target of 20% by 2020 relative to 1990 levels. The European Union also reiterated its conditional offer to move to a 30% emissions reduction by 2020 compared with 1990 levels, provided that other developed countries commit themselves to comparable emissions reductions and that developing countries contribute adequately according to their responsibilities and respective capabilities.	The European Union and its member states communicated a binding target to reduce GHG emissions by at least 40% by 2030, relative to 1990 levels.
<b>GHG target(s)</b>	<ul style="list-style-type: none"> <li>■ Unconditional target: Reduce GHG emissions by 20% by 2020, relative to 1990 levels.</li> <li>■ Conditional target: Reduce GHG emissions by 30% by 2020 relative to 1990 levels.</li> </ul>	Unconditional target: <sup>b</sup> Reduce GHG emissions by 40% by 2030, relative to 1990 levels.
<b>Type of GHG target(s)</b>	Base year target	Base year target
<b>Sector coverage of GHG target(s)</b>	All IPCC sectors excluding LULUCF	All IPCC sectors (The EU's INDC states that the "policy on how to include LULUCF into the 2030 GHG mitigation framework will be established as soon as technical conditions allow and in any case before 2020.")
<b>Gas coverage of GHG target(s)</b>	Six gases under the Kyoto Protocol	Seven gases under the Kyoto Protocol
<b>GWP values applied</b>	100-year values from the IPCC Fourth Assessment Report (AR4)	100-year values from the IPCC Fourth Assessment Report (AR4)
<b>Average annual rate of change in emissions to meet<sup>a</sup> GHG target(s)</b>	<ul style="list-style-type: none"> <li>■ Unconditional target: +1.0% per annum between 2014 and 2020</li> <li>■ Conditional target: -1.2% per annum between 2014 and 2020</li> </ul>	Unconditional target: <sup>b</sup> -1.2% per annum between 2014 and 2030
<b>Emissions peak year</b>	In its INDC, the European Union stated that its GHG emissions peaked in 1979.	
<b>Long-term GHG target</b>	In its INDC, the European Union stated that its 2030 GHG target is in line with the region's objective to reduce emissions by 80 to 95% by 2050, relative to 1990 levels.	

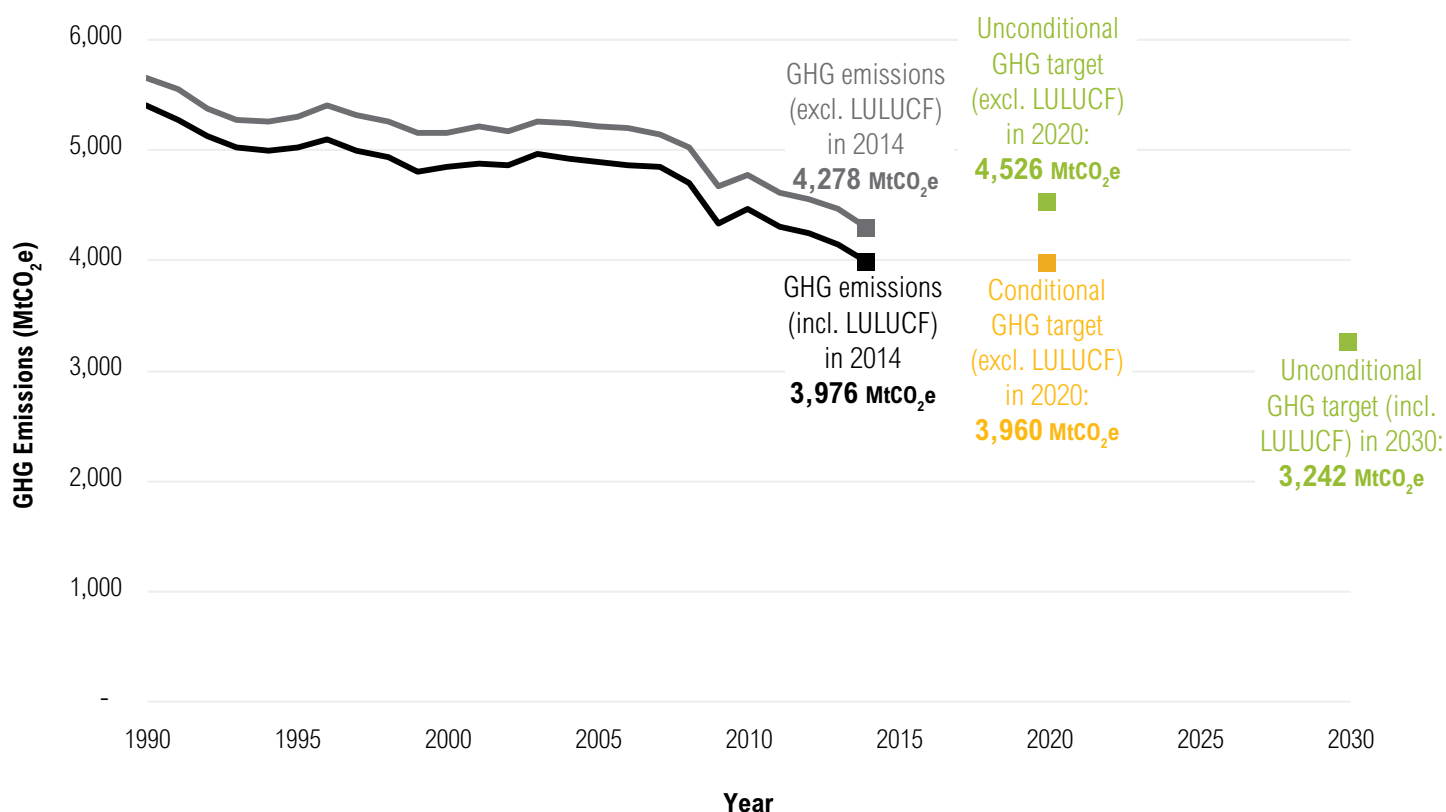
<sup>a</sup> Noting that common principles for accounting for the land sector and internationally transferable emissions units are still to be agreed upon, which will affect how countries meet their GHG targets.

<sup>b</sup> It is assumed that the European Union's 2030 GHG target is unconditional as the region has not included any conditionality clauses in its INDC.



Figure 6 presents the European Union's historical emissions and target levels of emissions. The region's GHG emissions, including the LULUCF sector, need to reduce at an average annual rate of 1.2 percent per annum (relative to 2014 levels) to meet the European Union's 2030 target.

Figure 6 | **The European Union's Historical Emissions and Estimated Future Emissions Associated with Targets**



**Notes:**  
The European Union's historical GHG emissions between 1990 and 2014 (the latest inventory year) are sourced from the region's 2016 National Inventory Report (European Environment Agency 2016).

Two sets of historical GHG emissions are presented in Figure 6: GHG emissions excluding the LULUCF sector to match the coverage of the European Union's 2020 GHG target, and GHG emissions including the LULUCF sector to match the coverage of the European Union's 2030 GHG target (noting that the European Union is still to decide how to include LULUCF in the 2030 GHG mitigation framework). The European Union's LULUCF sector has been historically a net sink.

The target levels of emissions for 2020 and 2030 have been calculated taking into consideration the different sector coverage, that is, the 2020 targets have been calculated using the European Union's 1990 GHG emissions excluding LULUCF (5,658 MtCO<sub>2</sub>e), while the 2030 targets have been calculated using the European Union's 1990 GHG emissions including LULUCF (5,403 MtCO<sub>2</sub>e). The target emissions levels for 2020 and 2030 are calculated based on the EU's 1990 GHG emissions levels, sourced from the EU's 2016 National Inventory Report (European Environment Agency 2016).



## 4.7 India

Table 7 | **Information Related to India's Mitigation Goals**

	<b>CANCUN PLEDGE (FOR 2020)</b>	<b>INDC (FOR 2030)</b>
<b>Summary</b>	<p>India communicated that it will endeavor to reduce the emissions intensity of its GDP by 20–25% by 2020 relative to the 2005 level.</p> <p>India stated that the proposed domestic actions are voluntary in nature and added that these actions will be implemented in accordance with the provisions of relevant national legislation and policies, as well as the principles and provisions of the Convention, in particular Article 4, paragraph 7.</p>	<p>India communicated the following mitigation-based nationally determined contributions for the period 2021–2030: to reduce the emissions intensity of its GDP by 33–35% by 2030 relative to the 2005 level; to achieve about 40% cumulative electric power installed capacity from non fossil based energy resources by 2030, with the help of transfer of technology and low-cost international finance including from the Green Climate Fund (GCF); and to create an additional carbon sink of 2.5 to 3 billion tonnes of CO<sub>2</sub>e through additional forest and tree cover by 2030.</p> <p>India stated that the successful implementation of its INDC is contingent upon an ambitious global agreement including additional means of implementation to be provided by developed country parties, technology transfer, and capacity building following Article 3.1 and 4.7 of the Convention.</p>
<b>GHG target(s)</b>	Conditional target: Reduce the emissions intensity (per unit of GDP) by 20–25% by 2020, relative to 2005 levels.	Conditional target: Reduce the emissions intensity (per unit of GDP) by 33–35% by 2030, relative to 2005 levels.
<b>Type of GHG target(s)</b>	Intensity target	Intensity target
<b>Sector coverage of GHG target(s)</b>	The Cancun pledge explicitly states that the 2020 target excludes agriculture. It is assumed that the target also excludes LULUCF, as implied by a 2014 Planning Commission report (Government of India 2014).	Not specified. Assumed to match the sector coverage of the 2020 GHG target.
<b>Gas coverage of GHG target(s)</b>	Not specified	Not specified
<b>GWP values applied</b>	Not specified	Not specified
<b>Average annual rate of change in emissions to meet<sup>a</sup> GHG target(s)</b>	Conditional target: Between +2.4 and +5.8% per annum between 2012 and 2020	Conditional target: Between +4.5 and +10.1% per annum between 2012 and 2030
<b>Emissions peak year</b>	India has not formally communicated a GHG emissions peak year.	
<b>Long-term GHG target</b>	India has not formally communicated a long-term GHG target.	

<sup>a</sup> Noting that common principles for accounting for the land sector and internationally transferable emissions units are still to be agreed upon, which will affect how countries meet their GHG targets.

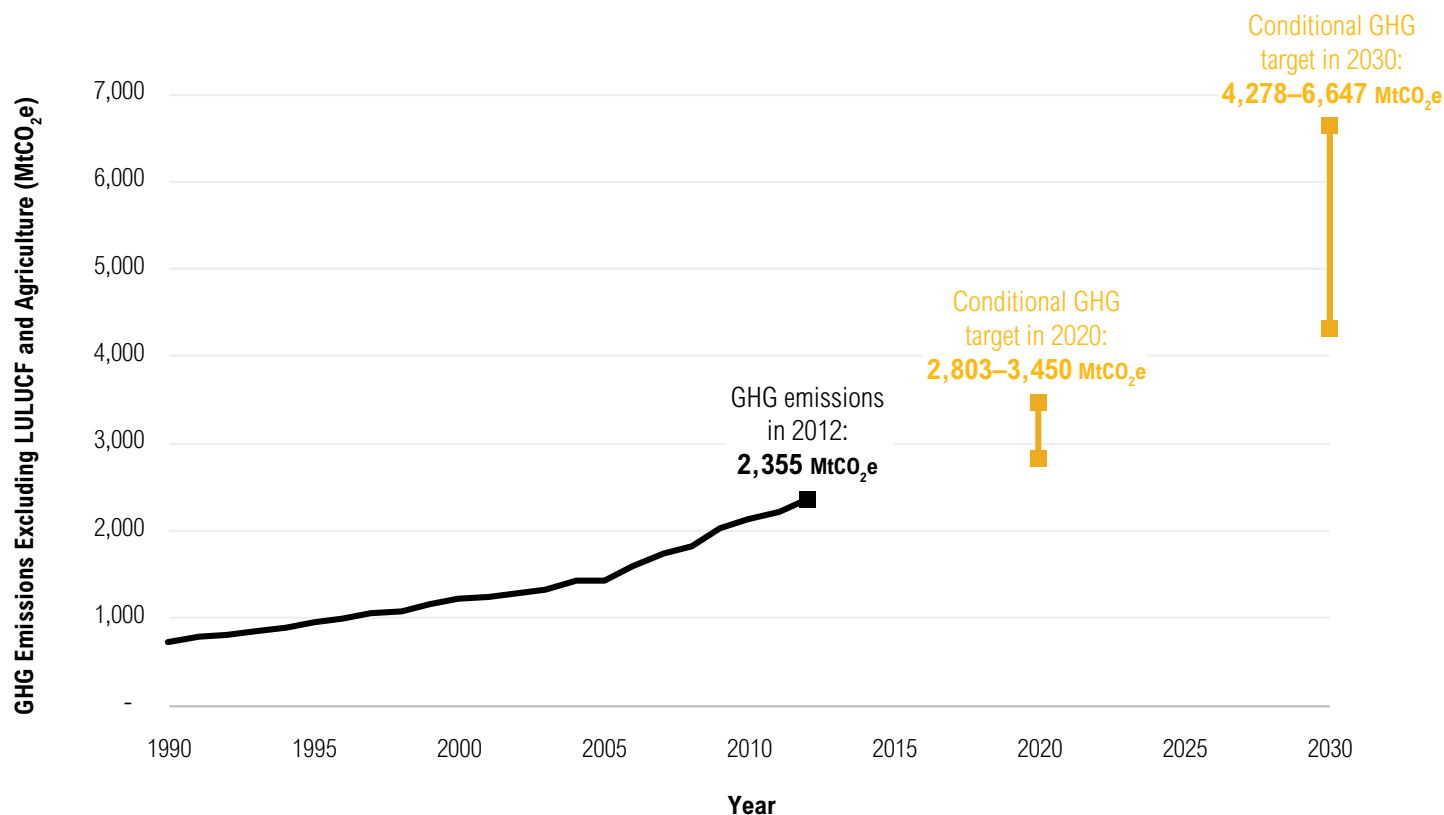


Figure 7 presents India's historical emissions and target levels of emissions. The goal to increase the share of non fossil-based electric capacity is assumed to be a means of achieving the CO<sub>2</sub> intensity goal and is therefore not separately represented in the graph.

Because India's targets are emissions intensity targets, the expected levels of emissions in 2020 and 2030 consistent with meeting the goals depend on assumptions about future rates of GDP growth. This analysis assumes average annual GDP growth of between 6.6 and 7.6 percent for the period 2005–2020 and 6.3 and 8.0 percent for the period 2005–2030. These GDP growth rates are sourced from several studies published within the last two years. For more information, please refer to the technical appendix.

Due to the range in potential GDP growth rates, and the goal range included in both the 2020 and 2030 targets, India's absolute levels of GHG emissions (excluding the agriculture and LULUCF sectors) are likely to be between 2,803 MtCO<sub>2</sub>e and 3,450 MtCO<sub>2</sub>e in 2020, and between 4,278 MtCO<sub>2</sub>e and 6,647 MtCO<sub>2</sub>e in 2030, if the goals are achieved. Depending on actual GDP growth between now and 2030, and depending on whether India meets the lower or upper bound of its emissions intensity range, India's GHG emissions could increase at an annual average rate of between 4.5 percent and 10.1 percent between 2012 and 2030 while still meeting its 2030 CO<sub>2</sub> intensity goal. India's total CO<sub>2</sub> emissions from energy-related activities could be between 82 percent and 182 percent higher in 2030 than in 2012 while meeting the GHG target, based on current forecasts of GDP growth.

Figure 7 | **India's Historical Emissions and Estimated Future Emissions Associated with Targets**



**Notes:** India's historical GHG emissions for 2005 are sourced from the country's 2014 Planning Commission report (Government of India 2014). GHG inventory data for the other years are sourced from CAIT Climate Data Explorer (CAIT 2016). The official GHG emissions data that India has communicated for 2005 exclude both the agriculture and LULUCF sectors. Please refer to the technical appendix for more information on the calculation of India's target level of emissions.



## 4.8 Indonesia

Table 8 | **Information Related to Indonesia's Mitigation Goals**

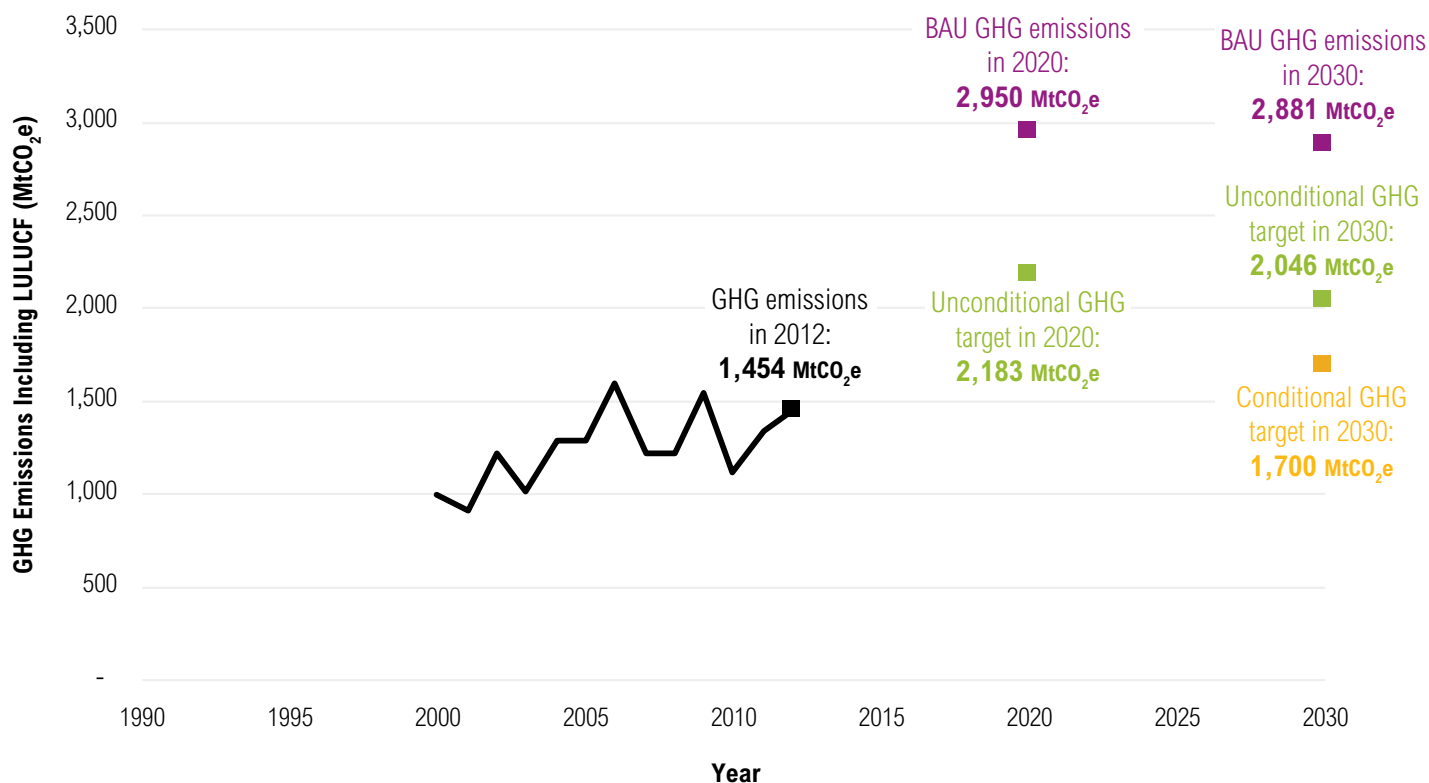
	<b>CANCUN PLEDGE (FOR 2020)</b>	<b>INDC (FOR 2030)</b>
<b>Summary</b>	Indonesia communicated that its voluntary nationally appropriate mitigation actions (NAMAs) will reduce its GHG emissions by 26% by 2020. Indonesia added that this reduction would be achieved through, among other things, sustainable peatland management, a reduction in the rate of deforestation and land degradation, the development of carbon sequestration projects in forestry and agriculture, the promotion of energy efficiency, the development of alternative and renewable energy sources, a reduction in solid and liquid waste, and shifting to low-emission modes of transport.	Indonesia communicated an unconditional target to reduce GHG emissions by 29% by 2030, relative to business-as-usual (BAU) emissions. Indonesia also communicated a conditional target to reduce GHG emissions by 41% by 2030, relative to BAU emissions. The conditional target is contingent on a global agreement that covers, among other things, technology development and transfer, capacity building, technical cooperation, and access to financial resources.
<b>GHG target(s)</b>	Unconditional target: Reduce GHG emissions by 26% by 2020 relative to BAU emissions. (Indonesia clarified the conditionality and reference point of this target in its INDC.) Indonesia included its BAU emissions for 2020 in its first Biennial Update Report—this was used to calculate the country's target level of emissions in 2020.	Unconditional target: Reduce GHG emissions by 29% by 2030 relative to BAU emissions.  Conditional target: Reduce GHG emissions by 41% by 2030 relative to BAU emissions.  Indonesia included its BAU emissions for 2030 in its INDC—this was used to calculate the country's target levels of emissions in 2030.
<b>Type of GHG target(s)</b>	Baseline scenario target	Baseline scenario target
<b>Sector coverage of GHG target(s)</b>	Not specified. Assumed to match the coverage of the 2030 target.	All IPCC sectors
<b>Gas coverage of GHG target(s)</b>	Not specified. Assumed to match the coverage of the 2030 target, a reasonable assumption to make given that Indonesia has historically reported its GHG emissions for only three gases: CO <sub>2</sub> , CH <sub>4</sub> , and N <sub>2</sub> O.	CO <sub>2</sub> , CH <sub>4</sub> , and N <sub>2</sub> O
<b>GWP values applied</b>	Not specified	100-year values from the IPCC Fourth Assessment Report (AR4)
<b>Average annual rate of change in emissions to meet<sup>a</sup> GHG target(s)</b>	Unconditional target: +6.3% per annum between 2012 and 2020	<ul style="list-style-type: none"> <li>■ Unconditional target: +2.3% per annum between 2012 and 2030</li> <li>■ Unconditional target: +0.9% per annum between 2012 and 2030</li> </ul>
<b>Emissions peak year</b>	Indonesia has not formally communicated a GHG emissions peak year.	
<b>Long-term GHG target</b>	Indonesia has not formally communicated a long-term GHG target.	

<sup>a</sup> Noting that common principles for accounting for the land sector and internationally transferable emissions units are still to be agreed upon, which will affect how countries meet their GHG targets.



Figure 8 presents Indonesia's historical emissions and target levels of emissions. Indonesia's 2020 and 2030 GHG targets imply higher absolute GHG emissions levels, when compared to the country's most recently communicated GHG emissions in 2012.

Figure 8 | **Indonesia's Historical Emissions and Estimated Future Emissions Associated with Targets**



**Notes:**

Indonesia's historical GHG emissions between 2000 and 2012 (the latest inventory year) are sourced from the country's first Biennial Update Report (Government of Indonesia 2015).

The GHG emissions presented in Figure 8 include the LULUCF sector, in accordance with the sector coverage of Indonesia's GHG targets.

Indonesia communicated its 2020 BAU emissions in its first Biennial Update Report (2,950 MtCO<sub>2</sub>e), and its 2030 BAU emissions in its INDC (2,881 MtCO<sub>2</sub>e)—these values were used to calculate the country's target levels of emissions in 2020 and 2030.

Indonesia's historical emissions trajectory starts in the year 2000 because the country has not officially reported its emissions data for the years preceding 2000.



## 4.9 Japan

Table 9 | **Information Related to Japan's Mitigation Goals**

	<b>CANCUN PLEDGE (FOR 2020)</b>	<b>INDC (FOR 2030)</b>
<b>Summary</b>	Japan initially communicated a target to reduce its GHG emissions by 25% below 1990 levels by 2020, which was premised on the establishment of a fair and effective international framework. In November 2013, at COP19, Japan announced a revised 2020 GHG emissions reduction target of 3.8% below 2005 levels. This Warsaw target replaced Japan's earlier Cancun pledge (Government of Japan 2013).	Japan communicated a target to reduce its GHG emissions by 26% by 2030, relative to 2013 levels. Japan also stated the target level of emissions that this target implies: 1,042 MtCO <sub>2</sub> e in 2030.
<b>GHG target(s)</b>	Unconditional target: <sup>b</sup> Reduce GHG emissions by 3.8% by 2020, relative to 2005 levels.	Unconditional target: <sup>b</sup> Reduce GHG emissions by 26% by 2030, relative to 2013 levels.
<b>Type of GHG target(s)</b>	Base year target	Base year target
<b>Sector coverage of GHG target(s)</b>	All IPCC sectors	All IPCC sectors
<b>Gas coverage of GHG target(s)</b>	Seven gases under the Kyoto Protocol	Seven gases under the Kyoto Protocol
<b>GWP values applied</b>	100-year values from the IPCC Fourth Assessment Report (AR4)	100-year values from the IPCC Fourth Assessment Report (AR4)
<b>Average annual rate of change in emissions to meet<sup>a</sup> GHG target(s)</b>	Unconditional target: <sup>b</sup> -0.6% per annum between 2014 and 2020	Unconditional target: <sup>b</sup> -1.2% per annum between 2014 and 2030
<b>Emissions peak year</b>	Japan has not formally communicated a GHG emissions peak year.	
<b>Long-term GHG target</b>	In the country's fourth Basic Environmental Plan, Japan communicated a long-term target to reduce GHG emissions by 80% by 2050, relative to 2010 levels (Government of Japan 2012).	

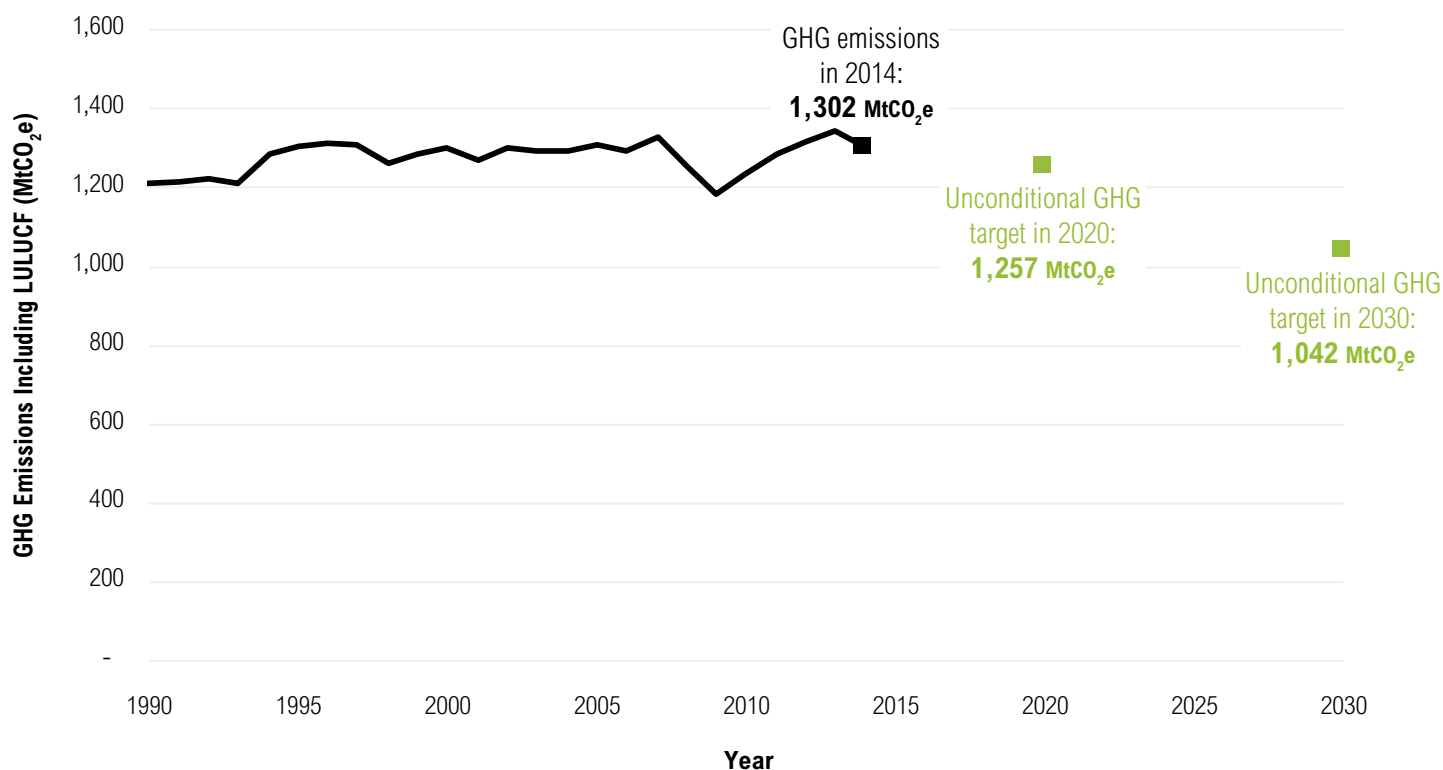
<sup>a</sup> Noting that common principles for accounting for the land sector and internationally transferable emissions units are still to be agreed upon, which will affect how countries meet their GHG targets.

<sup>b</sup> It is assumed that Japan's 2020 and 2030 GHG targets are unconditional as the country has not included any conditionality clauses in its Warsaw announcement or INDC.



Figure 9 presents Japan's historical emissions and target levels of emissions. Japan's GHG emissions will need to decrease in absolute terms from 2014 levels if the country is to reach both its 2020 and 2030 GHG targets.

Figure 9 | **Japan's Historical Emissions and Estimated Future Emissions Associated with Targets**



**Notes:**  
Japan's historical GHG emissions between 1990 and 2014 (the latest inventory year) are sourced from the country's 2016 National Inventory Report (Government of Japan 2016).

The GHG emissions presented in Figure 9 include the LULUCF sector, in accordance with the sector coverage of Japan's GHG targets.

Japan explicitly states its target level of emissions in 2030 (1,042 MtCO<sub>2</sub>e)—this value was used as reported.

Japan's 2020 target emissions levels are calculated based on the country's 2005 GHG emissions levels, sourced from the country's 2016 National Inventory Report (Government of Japan 2016).



## 4.10 Mexico

Table 10 | **Information Related to Mexico's Mitigation Goals**

	<b>CANCUN PLEDGE (FOR 2020)</b>	<b>INDC (FOR 2030)</b>
<b>Summary</b>	Mexico communicated that it aims to reduce its GHG emissions by up to 30% compared with the business-as-usual (BAU) scenario by 2020. Mexico also stated that the achievement of its GHG target would be dependent on the provision of adequate financial and technological support from developed countries as part of a global agreement.	Mexico communicated an unconditional target to reduce its GHG emissions and Short Lived Climate Pollutants (SLCPs) by 25% by 2030, relative to BAU levels. This commitment implies a 22% reduction of GHGs and a 51% reduction of black carbon. Mexico also communicated a conditional target to reduce its GHG emissions and SLCPs by 40% by 2030, relative to BAU levels. This commitment implies a 36% reduction of GHGs and a 70% reduction of black carbon. The conditional target is dependent on a global agreement addressing topics including international carbon price, carbon border adjustments, technical cooperation, access to low-cost financial resources and technology transfer, all at a scale commensurate to the challenge of global climate change
<b>GHG target(s)</b>	Conditional target: Reduce GHG emissions by 30% by 2020, relative to BAU levels. Mexico's BAU emission levels—that relate to the 2020 target—are communicated in the country's first Biennial Update Report.	Unconditional target: Reduce GHG emissions by 22% by 2030, relative to BAU levels.  Conditional target: Reduce GHG emissions by 36% by 2030, relative to BAU levels.  Mexico's BAU emission levels—that relate to this 2030 target—are communicated in the country's INDC. Note that the Mexican government revised its BAU scenario in the time period between communicating its Cancun pledge and INDC.
<b>Type of GHG target(s)</b>	Baseline scenario target	Baseline scenario target
<b>Sector coverage of GHG target(s)</b>	Not specified. Assumed to match the coverage of the 2030 target.	All IPCC sectors
<b>Gas coverage of GHG target(s)</b>	Not specified. Assumed to match the coverage of the 2030 target.	Six gases under the Kyoto Protocol
<b>GWP values applied</b>	Not specified	100-year values from the IPCC Fifth Assessment Report (AR5)
<b>Average annual rate of change in emissions to meet<sup>a</sup> GHG target(s)</b>	Conditional target: +0.3% per annum between 2013 and 2020	<ul style="list-style-type: none"> <li>■ Unconditional target: +0.9% per annum between 2013 and 2030</li> <li>■ Conditional target: -0.3% per annum between 2013 and 2030</li> </ul>
<b>Emissions peak year</b>	In its INDC, Mexico states that its unconditional GHG target implies a net emissions peak starting from 2026.	
<b>Long-term GHG target</b>	Mexico's 2012 General Law on Climate (LGCC in Spanish) sets a long-term target to reduce GHG emissions by 50% by 2050, relative to 2000 levels.	

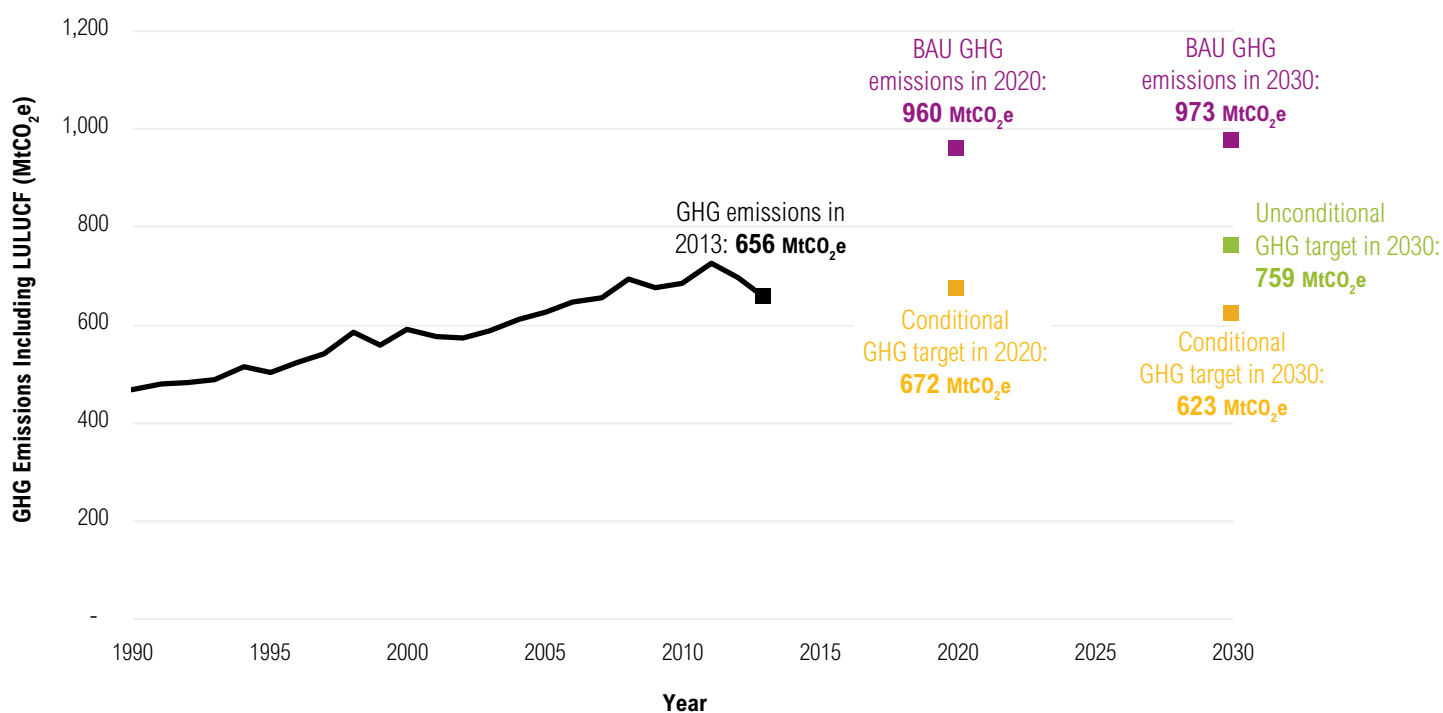
<sup>a</sup> Noting that common principles for accounting for the land sector and internationally transferable emissions units are still to be agreed upon, which will affect how countries meet their GHG targets.



Figure 10 presents Mexico's historical emissions and estimated levels of emissions associated with its targets. Since Mexico's targets are relative to a projected baseline scenario, the expected levels of emissions in 2020 and 2030 depend on the country's communicated projected baseline emissions. In the period between setting its 2020 goal and 2030 goal, Mexico revised its baseline scenario once in 2013. If the country revises its baseline scenario again before 2030, the emissions level in 2030 associated

with meeting the target would change. Assuming that the current baseline scenario remains fixed, Mexico's GHG emissions could continue on an upward trend between 2013 and 2020 while still allowing the country to reach its 2020 target. The rate of emissions growth could then accelerate if the country reaches only its unconditional GHG target. Conversely, to achieve its conditional GHG target, Mexico would need to reduce its GHG emissions at an average rate of 0.3 percent per annum between 2013 and 2030.

Figure 10 | **Mexico's Historical Emissions and Estimated Future Emissions Associated with Targets**



**Notes:**

Mexico's historical GHG emissions between 1990 and 2013 (the latest inventory year) are sourced from the country's first Biennial Update Report (Government of Mexico 2015a).

The GHG emissions presented in Figure 10 include the LULUCF sector, in accordance with the sector coverage of Mexico's GHG targets.

Mexico's 2020 and 2030 GHG targets have been calculated based on two different BAU scenarios because the Mexican government revised its BAU scenario in the time period between setting the country's 2020 and post-2020 goals. Mexico's 2020 target levels of emissions are calculated using the BAU scenario presented in the country's 2013 National Climate Change Strategy (960 MtCO<sub>2</sub>e in 2020) (Government of Mexico 2013), and Mexico's 2030 target levels of emissions are calculated using the BAU scenario presented in the country's INDC (973 MtCO<sub>2</sub>e in 2030) (Government of Mexico 2015b).



## 4.11 Republic of Korea

Table 11 | **Information Related to the Republic of Korea's Mitigation Goals**

	<b>CANCUN PLEDGE (FOR 2020)</b>	<b>INDC (FOR 2030)</b>
<b>Summary</b>	The Republic of Korea communicated that it aims to reduce its national GHG emissions by 30% by 2020 relative to business-as-usual (BAU) levels.	The Republic of Korea communicated that it aims to reduce its national GHG emissions by 37% by 2030 relative to BAU levels.
<b>GHG target(s)</b>	Unconditional target: <sup>b</sup> Reduce GHG emissions by 30% by 2020, relative to BAU levels. The Republic of Korea communicated its BAU emissions levels in 2020 in its INDC.	Unconditional target: <sup>b</sup> Reduce GHG emissions by 37% by 2030, relative to BAU levels. The Republic of Korea communicated its BAU emissions levels in 2030 in its INDC.
<b>Type of GHG target(s)</b>	Baseline scenario target	Baseline scenario target
<b>Sector coverage of GHG target(s)</b>	Not specified. Assumed to match coverage of 2030 target.	All IPCC sectors excluding LULUCF
<b>Gas coverage of GHG target(s)</b>	Not specified. Assumed to match coverage of 2030 target.	Six gases under the Kyoto Protocol
<b>GWP values applied</b>	Not specified	100-year values from the IPCC Second Assessment Report (SAR)
<b>Average annual rate of change in emissions to meet<sup>a</sup> GHG target(s)</b>	Unconditional target: <sup>b</sup> –2.6% per annum between 2012 and 2020	Unconditional target: <sup>b</sup> –1.2% per annum between 2012 and 2030
<b>Emissions peak year</b>	The Republic of Korea has not formally communicated a GHG emissions peak year.	
<b>Long-term GHG target</b>	The Republic of Korea has not formally communicated a long-term GHG target.	

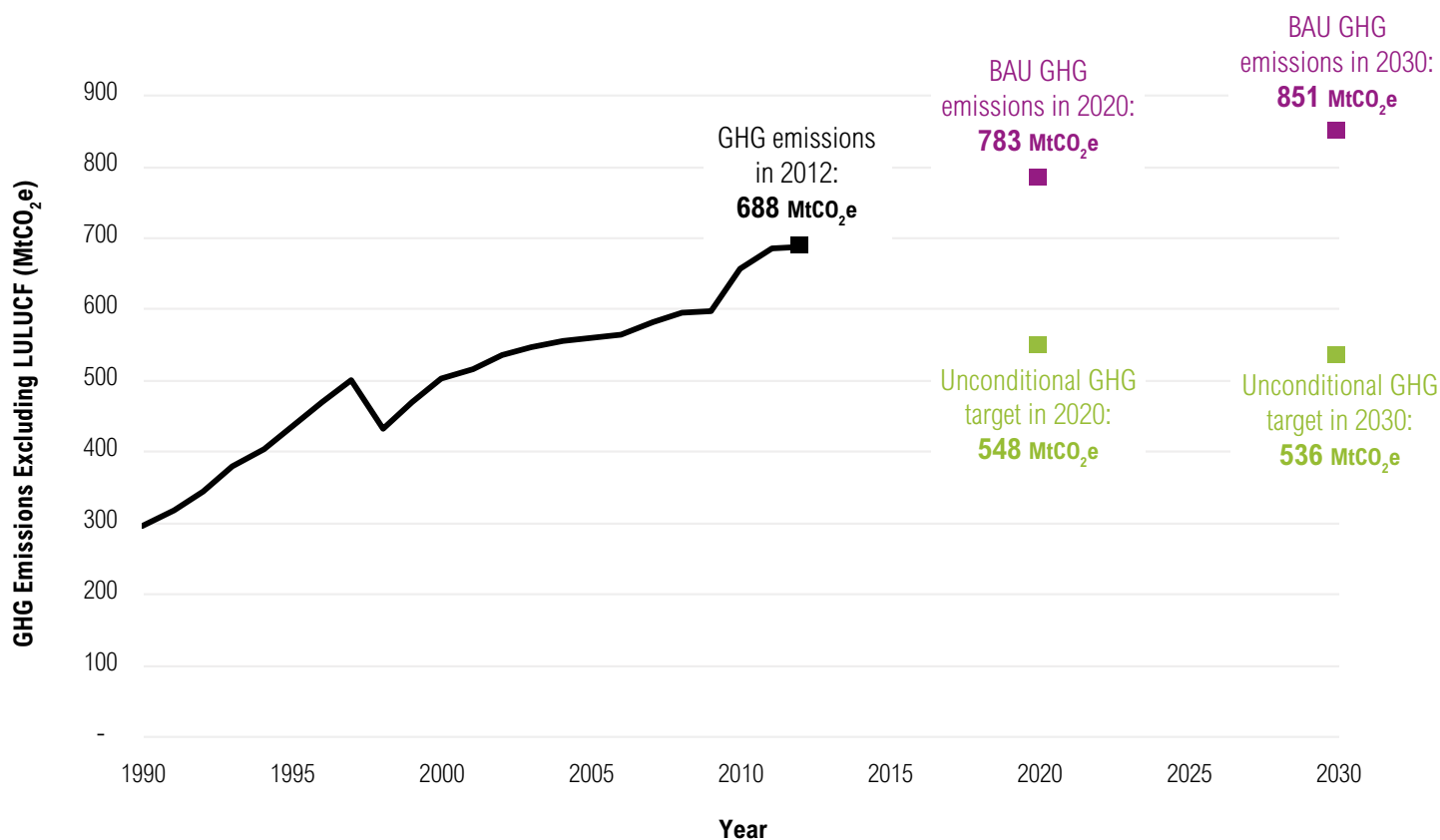
<sup>a</sup> Noting that common principles for accounting for the land sector and internationally transferable emissions units are still to be agreed upon, which will affect how countries meet their GHG targets.

<sup>b</sup> It is assumed that the Republic of Korea's 2020 and 2030 GHG targets are unconditional as the country has not included any conditionality clauses in its Cancun pledge or INDC.



Figure 11 presents the Republic of Korea's historical emissions and target levels of emissions. The country will need to reduce its GHG emissions at an average rate of 2.6 percent per annum to meet the country's 2020 target, and continue reducing its absolute GHG emissions levels (albeit at a much lower rate) to meet its 2030 target.

Figure 11 | **The Republic of Korea's Historical Emissions and Estimated Future Emissions Associated with Targets**



**Notes:**  
The Republic of Korea's historical GHG emissions between 1990 and 2012 (the latest inventory year) are sourced from the country's first Biennial Update Report (Government of the Republic of Korea 2014).

The GHG emissions presented in Figure 11 exclude the LULUCF sector, in accordance with the sector coverage of the Republic of Korea's targets.

The Republic of Korea included its BAU emissions for 2020 and 2030 in its INDC (783 MtCO<sub>2</sub>e and 851 MtCO<sub>2</sub>e, respectively)—these values were used to calculate the country's target levels of emissions in 2020 and 2030.



## 4.12 Russian Federation

Table 12 | **Information Related to the Russian Federation's Mitigation Goals**

	<b>CANCUN PLEDGE (FOR 2020)</b>	<b>INDC (FOR 2030)</b>
<b>Summary</b>	The Russian Federation communicated a target within the range of a 15–25% emissions reduction by 2020 relative to 1990 levels. This target is conditional upon an undertaking by all major emitters with legally binding obligations to reduce anthropogenic GHG emissions.	The Russian Federation communicated its plans to limit anthropogenic GHGs to 70–75% of 1990 levels by the year 2030, subject to the maximum possible account of absorbing capacity of forests.
<b>GHG target(s)</b>	Conditional target: Reduce GHG emissions by 15–25% by 2020, relative to 1990 levels.	Unconditional target: <sup>b</sup> Reduce GHG emissions by 25–30% by 2030, relative to 1990 levels.
<b>Type of GHG target(s)</b>	Base year target	Base year target
<b>Sector coverage of GHG target(s)</b>	All IPCC sectors excluding LULUCF	All IPCC sectors
<b>Gas coverage of GHG target(s)</b>	Seven gases under the Kyoto Protocol	Seven gases under the Kyoto Protocol
<b>GWP values applied</b>	100-year values from the IPCC Fourth Assessment Report (AR4)	100-year values from the IPCC Fourth Assessment Report (AR4)
<b>Average annual rate of change in emissions to meet<sup>a</sup> GHG target(s)</b>	Conditional target: Between +0.8 and +3.2% per annum between 2014 and 2020	Unconditional target: <sup>b</sup> Between +1.6 and +2.1% per annum between 2014 and 2030
<b>Emissions peak year</b>	The Russian Federation has not formally communicated a GHG emissions peak year.	
<b>Long-term GHG target</b>	The Russian Federation has not formally communicated a long-term GHG target.	

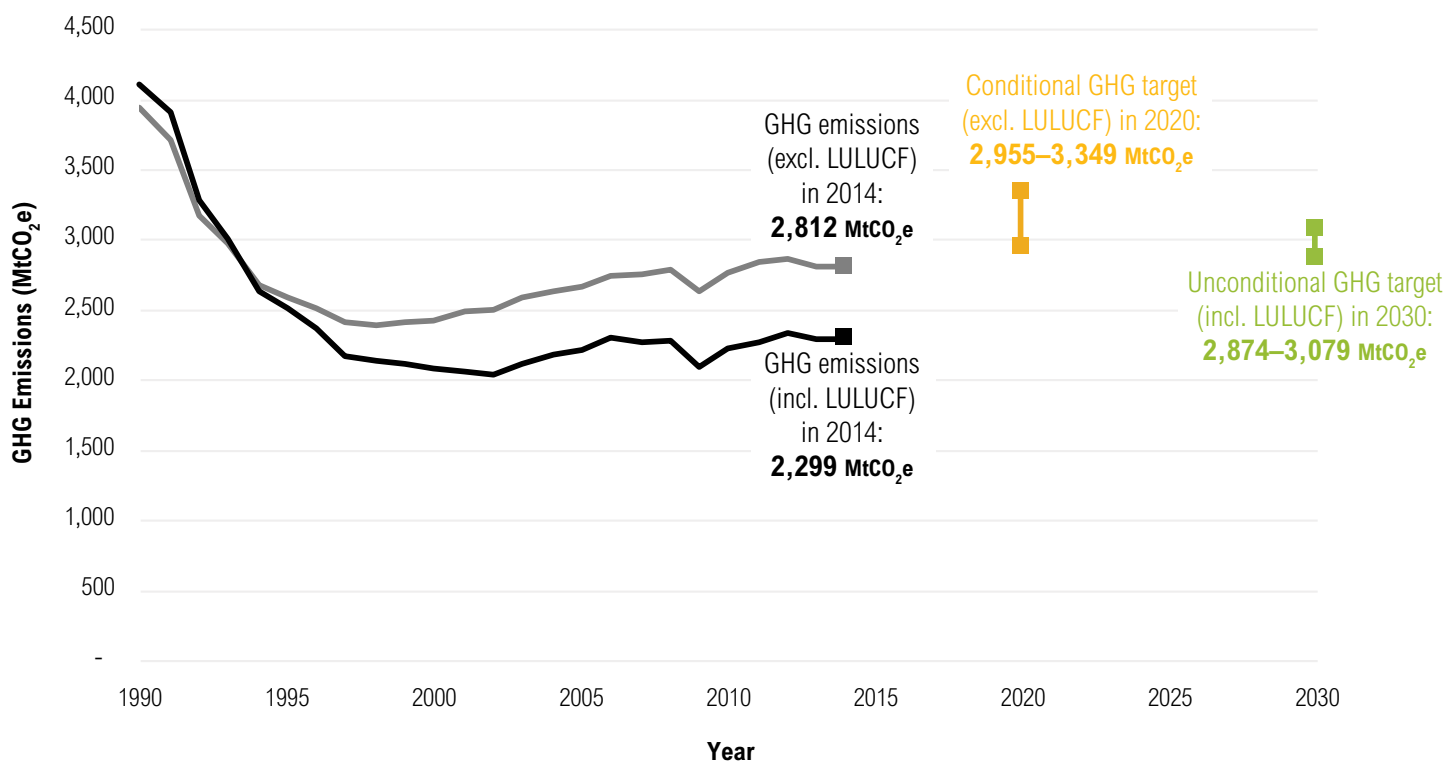
<sup>a</sup> Noting that common principles for accounting for the land sector and internationally transferable emissions units are still to be agreed upon, which will affect how countries meet their GHG targets.

<sup>b</sup> It is assumed that the Russian Federation's 2030 GHG target is unconditional as the country has not included any conditionality clauses in its INDC.



Figure 12 presents the Russian Federation's historical emissions and target levels of emissions. The Russian Federation will be able to increase its GHG emissions between 2014 and 2030 and still reach both its 2020 and 2030 GHG targets.

Figure 12 | **The Russian Federation's Historical Emissions and Estimated Future Emissions Associated with Targets**



**Notes:**

The Russian Federation's historical GHG emissions between 1990 and 2014 (the latest inventory year) are sourced from the country's 2016 National Inventory Report (Government of the Russian Federation 2016).

Two sets of historical GHG emissions are presented in the figure above: GHG emissions excluding the LULUCF sector to match the coverage of the Russian Federation's 2020 GHG target, and GHG emissions including the LULUCF sector to match the coverage of the Russian Federation's 2030 GHG target. The target levels of emissions for 2020 and 2030 have been calculated taking into consideration the different sector coverage, that is, the 2020 targets have been calculated using the Russian Federation's 1990 GHG emissions excluding LULUCF (3,940 MtCO<sub>2</sub>e), while the 2030 targets have been calculated using the Russian Federation's 1990 GHG emissions including LULUCF (4,105 MtCO<sub>2</sub>e).

The Russian Federation's 2020 and 2030 target emissions levels are calculated based on the country's 1990 GHG emissions levels, sourced from the country's 2016 National Inventory Report (Government of the Russian Federation 2016).



## 4.13 South Africa

Table 13 | **Information Related to South Africa's Mitigation Goals**

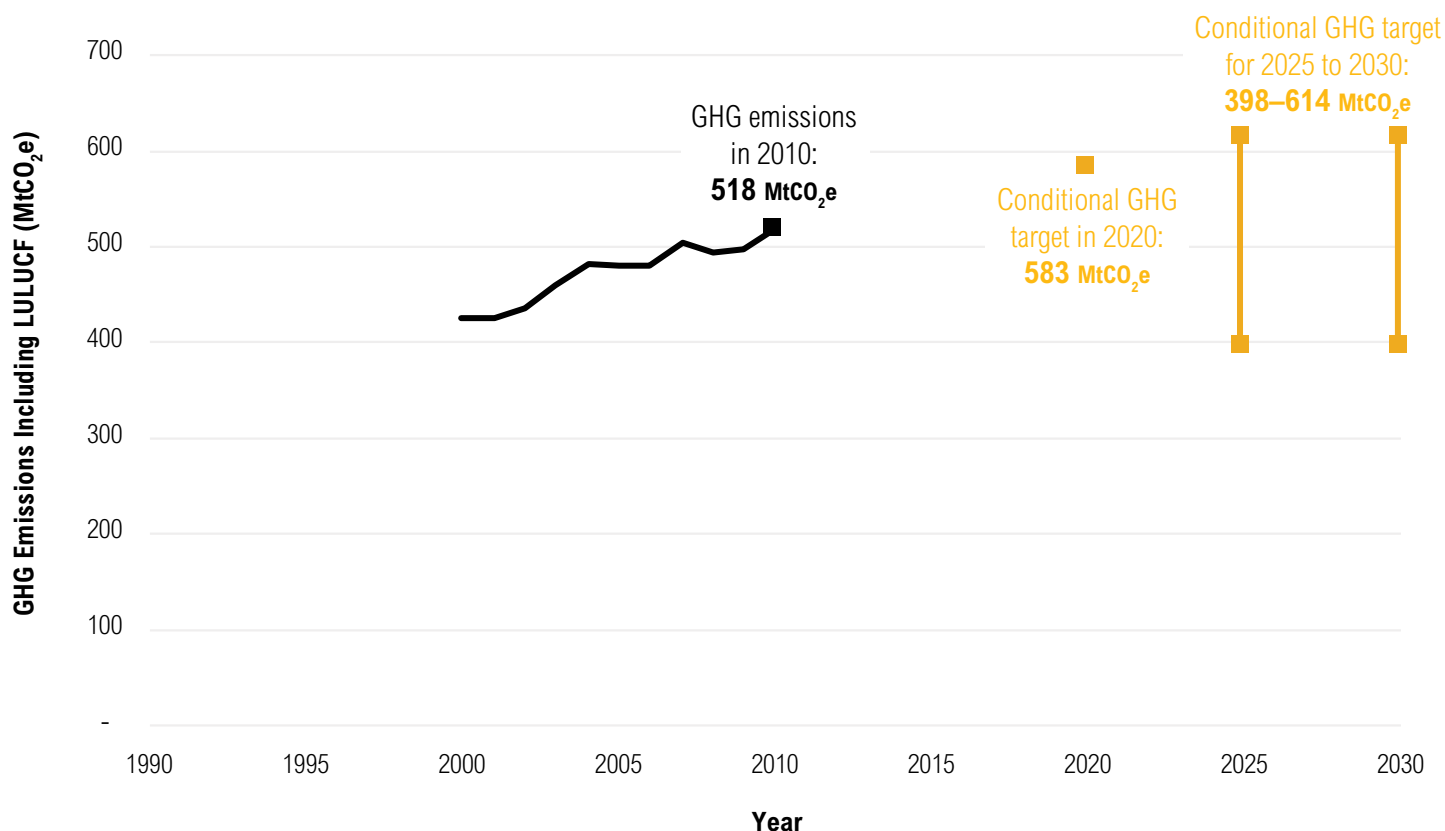
	<b>CANCUN PLEDGE (FOR 2020)</b>	<b>INDC (FOR 2030)</b>
<b>Summary</b>	<p>South Africa communicated that it will implement nationally appropriate mitigation actions (NAMAs) to enable a 34% deviation below the business-as-usual (BAU) emissions growth trajectory by 2020 and a 42% deviation below the BAU emissions growth trajectory by 2025.</p> <p>South Africa stated that the extent to which its target will be implemented would depend on the provision of financial resources, the transfer of technology, and the capacity-building support provided by developed countries.</p>	<p>South Africa communicated that the mitigation component of its INDC moves from a "deviation from business-as-usual" form of commitment and takes the form of a peak, plateau, and decline GHG emissions trajectory range. South Africa states that its emissions by 2025 and 2030 will be in a range between 398 and 614 MtCO<sub>2</sub>e, as defined in national policy.</p> <p>South Africa stated that, in accordance with the Convention, it is assumed that the extent to which developing country Parties will effectively implement their commitments will depend on the effective implementation by developed country Parties of their commitments under the Convention relating to financial resources, development and transfer of technology, and capacity building.</p>
<b>GHG target(s)</b>	Conditional target: Reduce GHG emissions by 34% by 2020, relative to BAU levels, and by 42% by 2025, relative to BAU levels. The BAU values for 2020 and 2025 are sourced from the country's 2009 "Peak, Plateau, and Decline" scenario, which was developed as part of the country's long-term mitigation scenarios (Government of South Africa 2007).	Conditional target: GHG emissions will be in a range of 398 and 614 MtCO <sub>2</sub> e between 2025 and 2030.
<b>Type of GHG target(s)</b>	Baseline scenario target	Trajectory target
<b>Sector coverage of GHG target(s)</b>	Not specified. Assumed to match the coverage of the 2030 target.	All IPCC sectors
<b>Gas coverage of GHG target(s)</b>	Not specified. Assumed to match the coverage of the 2030 target.	Six gases under the Kyoto Protocol
<b>GWP values applied</b>	Not specified	100-year values from the IPCC Fourth Assessment Report (AR4)
<b>Average annual rate of change in emissions to meet<sup>a</sup> GHG target(s)</b>	Conditional target: +1.2% per annum between 2010 and 2020	Conditional target: Between -1.5 and +1.2% per annum between 2010 and 2030
<b>Emissions peak year</b>	In its INDC, South Africa states that its GHG emissions will peak between 2020 and 2025, plateau for approximately a decade, and decline in absolute terms thereafter.	
<b>Long-term GHG target</b>	South Africa has not formally communicated a long-term GHG target.	

<sup>a</sup> Noting that common principles for accounting for the land sector and internationally transferable emissions units are still to be agreed upon, which will affect how countries meet their GHG targets.



Figure 13 presents South Africa's historical emissions and target levels of emissions. As stated in the country's INDC, South Africa's target level of emissions could be 398 MtCO<sub>2</sub>e in 2030, or nearly 65 percent higher, at 614 MtCO<sub>2</sub>e in 2030.

Figure 13 | **South Africa's Historical Emissions and Estimated Future Emissions Associated with Targets**



**Notes:**

South Africa's historical GHG emissions between 2000 and 2010 (the latest inventory year) are sourced from the country's National Inventory Report (Government of South Africa 2014).

The GHG emissions presented in Figure 13 include the LULUCF sector, in accordance with the sector coverage of South Africa's targets.

South Africa has communicated its target levels of emissions for 2025 and 2030 in its INDC—these values were used as reported (between 398 and 614 MtCO<sub>2</sub>e). The country's 2020 target emissions levels are calculated using the 2020 BAU emissions levels reported in the country's long-term mitigation scenarios (Government of South Africa 2007).

South Africa's historical emissions trajectory starts in the year 2000, as the country has only two reported data points in the period before the year 2000: 1990 GHG emissions including LULUCF = 330 MtCO<sub>2</sub>e and 1994 GHG emissions including LULUCF = 361 MtCO<sub>2</sub>e.

South Africa set a 2025 target in both its Cancun pledge and INDC. Figure 13 uses the updated 2025 target communicated in the country's INDC.



## 4.14 Turkey

Table 14 | **Information Related to Turkey's Mitigation Goals**

	<b>CANCUN PLEDGE (FOR 2020)</b>	<b>INDC (FOR 2030)</b>
<b>Summary</b>	Turkey did not communicate a Cancun pledge.	Turkey communicated a nationally determined contribution to reduce its GHG emissions by up to 21% below business-as-usual (BAU) levels by 2030.  Turkey states that to successfully implement its INDC, it will use domestic sources and receive international financial, technological, technical, and capacity-building support, including finance from the Green Climate Fund.
<b>GHG target(s)</b>	No GHG target	Unconditional target: <sup>b</sup> Reduce GHG emissions by 21% by 2030, relative to BAU levels.  Turkey included its BAU emissions and target level of emissions for 2030 in its INDC.
<b>Type of GHG target(s)</b>	Not applicable	Baseline scenario target
<b>Sector coverage of GHG target(s)</b>	Not applicable	All IPCC sectors
<b>Gas coverage of GHG target(s)</b>	Not applicable	Seven gases under the Kyoto Protocol
<b>GWP values applied</b>	Not applicable	100-year values from the IPCC Fourth Assessment Report (AR4)
<b>Average annual rate of change in emissions to meet<sup>a</sup> GHG target(s)</b>	Not applicable	Unconditional target: <sup>b</sup> +8.0% per annum between 2014 and 2030
<b>Emissions peak year</b>	Turkey has not formally communicated a GHG emissions peak year.	
<b>Long-term GHG target</b>	Turkey has not formally communicated a long-term GHG target.	

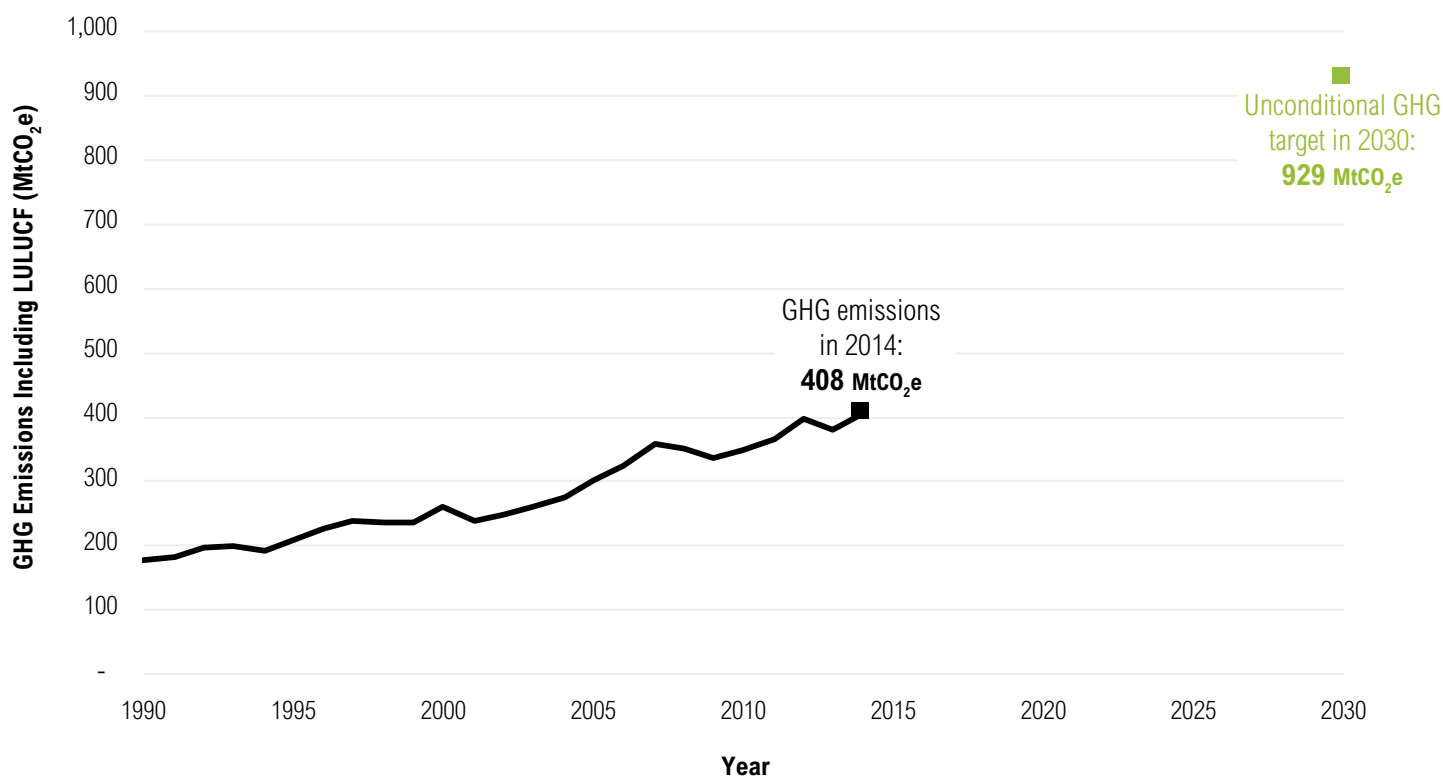
<sup>a</sup> Noting that common principles for accounting for the land sector and internationally transferable emissions units are still to be agreed upon, which will affect how countries meet their GHG targets.

<sup>b</sup> It is assumed that Turkey's 2030 GHG target is unconditional as the country has not included any conditionality clauses in its INDC.



Figure 14 presents Turkey's historical emissions and target levels of emissions. Turkey's emissions may increase by an average rate of no more than 8 percent per annum if the country's 2030 target is to be met.

Figure 14 | **Turkey's Historical Emissions and Estimated Future Emissions Associated with Targets**



*Notes:*

Turkey's historical GHG emissions between 1990 and 2014 (the latest inventory year) are sourced from the country's National Inventory Report (Turkish Statistical Institute 2016).

The GHG emissions presented in Figure 14 include the LULUCF sector, in accordance with the sector coverage of Turkey's GHG targets.

Turkey included its BAU emissions and target level of emissions for 2030 in its INDC (target emissions level = 929 MtCO<sub>2</sub>e).



## 4.15 United States

Table 15 | **Information Related to the United States' Mitigation Goals**

	<b>CANCUN PLEDGE (FOR 2020)</b>	<b>INDC (FOR 2025)</b>
<b>Summary</b>	The United States communicated a target in the range of a 17% emissions reduction by 2020 relative to 2005 levels.	The United States communicated that it intends to achieve an economy-wide target of reducing its GHG emissions by 26–28% by 2025 relative to 2005 levels, and to make best efforts to reduce its emissions by 28%.
<b>GHG target(s)</b>	Unconditional target: <sup>b</sup> Reduce GHG emissions by 17% by 2020 relative to 2005 levels.	Unconditional target: <sup>b</sup> Reduce GHG emissions by 26–28% by 2025 relative to 2005 levels.
<b>Type of GHG target(s)</b>	Base year target	Base year target
<b>Sector coverage of GHG target(s)</b>	All IPCC sectors	All IPCC sectors
<b>Gas coverage of GHG target(s)</b>	Seven gases under the Kyoto Protocol	Seven gases under the Kyoto Protocol
<b>GWP values applied</b>	100-year values from the IPCC Fourth Assessment Report (AR4)	100-year values from the IPCC Fourth Assessment Report (AR4)
<b>Average annual rate of change in emissions to meet<sup>a</sup> GHG target(s)</b>	Unconditional target: <sup>b</sup> –1.5% per annum between 2014 and 2020	Unconditional target: <sup>b</sup> Between –1.7 and –1.9% per annum between 2014 and 2025
<b>Emissions peak year</b>	The United States has not formally communicated a GHG emissions peak year.	
<b>Long-term GHG target</b>	In its INDC, the United States stated that its 2025 target is consistent with a straight-line emissions reduction pathway from 2020 to deep, economy-wide emissions reductions of 80% or more by 2050.	

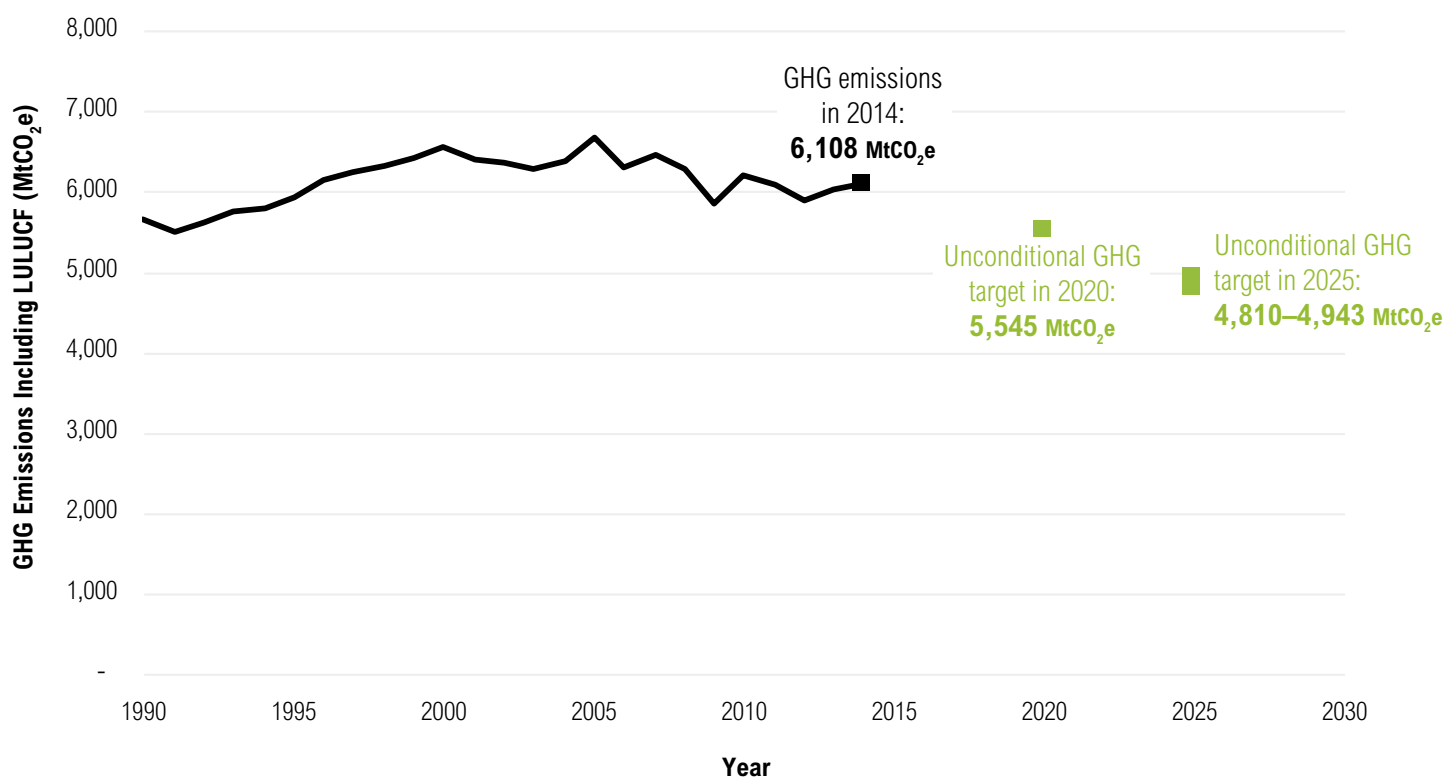
<sup>a</sup> Noting that common principles for accounting for the land sector and internationally transferable emissions units are still to be agreed upon, which will affect how countries meet their GHG targets.

<sup>b</sup> It is assumed that the United States' 2020 and 2025 GHG targets are unconditional as the country has not included any conditionality clauses in its Cancun pledge or INDC.



Figure 15 presents the United States' historical emissions and target levels of emissions. The United States will need to decrease its GHG emissions in absolute terms between 2014 and 2025 if it is to reach its 2020 and 2025 GHG targets.

Figure 15 | **The United States' Historical Emissions and Estimated Future Emissions Associated with Targets**



**Notes:**

The United States' historical GHG emissions between 1990 and 2014 (the latest inventory year) are sourced from the country's 2016 National Inventory Report (USEPA 2016).

The GHG emissions presented in Figure 15 include the LULUCF sector, in accordance with the sector coverage of the United States' GHG targets.

The United States' target emissions levels in 2020 and 2025 are calculated based on the country's 2005 GHG emissions levels (6,680 MtCO<sub>2</sub>e), sourced from the country's 2016 National Inventory Report (USEPA 2016).



## 5. OVERALL RESULTS

The previous sections have shown the estimated emissions associated with the 2020 and 2025/2030 GHG targets set by each of the 15 G20 member countries analyzed in this paper. This section presents the results for all 15 countries together in the following areas:

- The 15 countries' historical emissions and estimated future emissions associated with their targets (section 5.1)
- The 15 countries' historical emissions intensity and estimated future emissions intensity associated with their GHG targets (section 5.2)
- The percentage change in emissions over time (section 5.3)

### 5.1 GHG Emissions

Figure 16 presents an overview of the G20 countries' historical emissions and estimated future emissions associated with their targets. (Please refer to the technical appendix for the underlying data.) This figure does not represent projections of future emissions; rather, it is an estimate of the future emissions that are likely to be associated with countries' targets. All countries' GHG emissions include the LULUCF sector and cover six or seven GHGs, unless otherwise stated in the legend. The dotted lines connecting each country's historical level of emissions with its target levels of emissions do not depict a proposed emissions pathway or a projection of future emissions; instead they represent a linear average rate of change in GHG emissions required to reach the country's stated goals. The larger dots included in the graph represent absolute emissions levels associated with countries' communicated targets.

Because China's and India's targets for 2020 and 2030 are emissions intensity targets, the expected levels of emissions in 2020 and 2030 consistent with meeting the goals depend on assumptions about future rates of GDP growth.

The range in potential GDP growth rates, and the goal range included in both countries' 2020 and 2030 targets means that there is a wide range in these countries' target levels of emissions. China's absolute levels of CO<sub>2</sub> emissions (from energy-related activities) could be between 9,276 MtCO<sub>2</sub> and 12,960 MtCO<sub>2</sub> in 2030 if its goals are achieved, while India's absolute levels of GHG emissions (excluding the agriculture and LULUCF sectors) could be between 4,278 MtCO<sub>2</sub>e and 6,647 MtCO<sub>2</sub>e in 2030 if its goals are achieved.

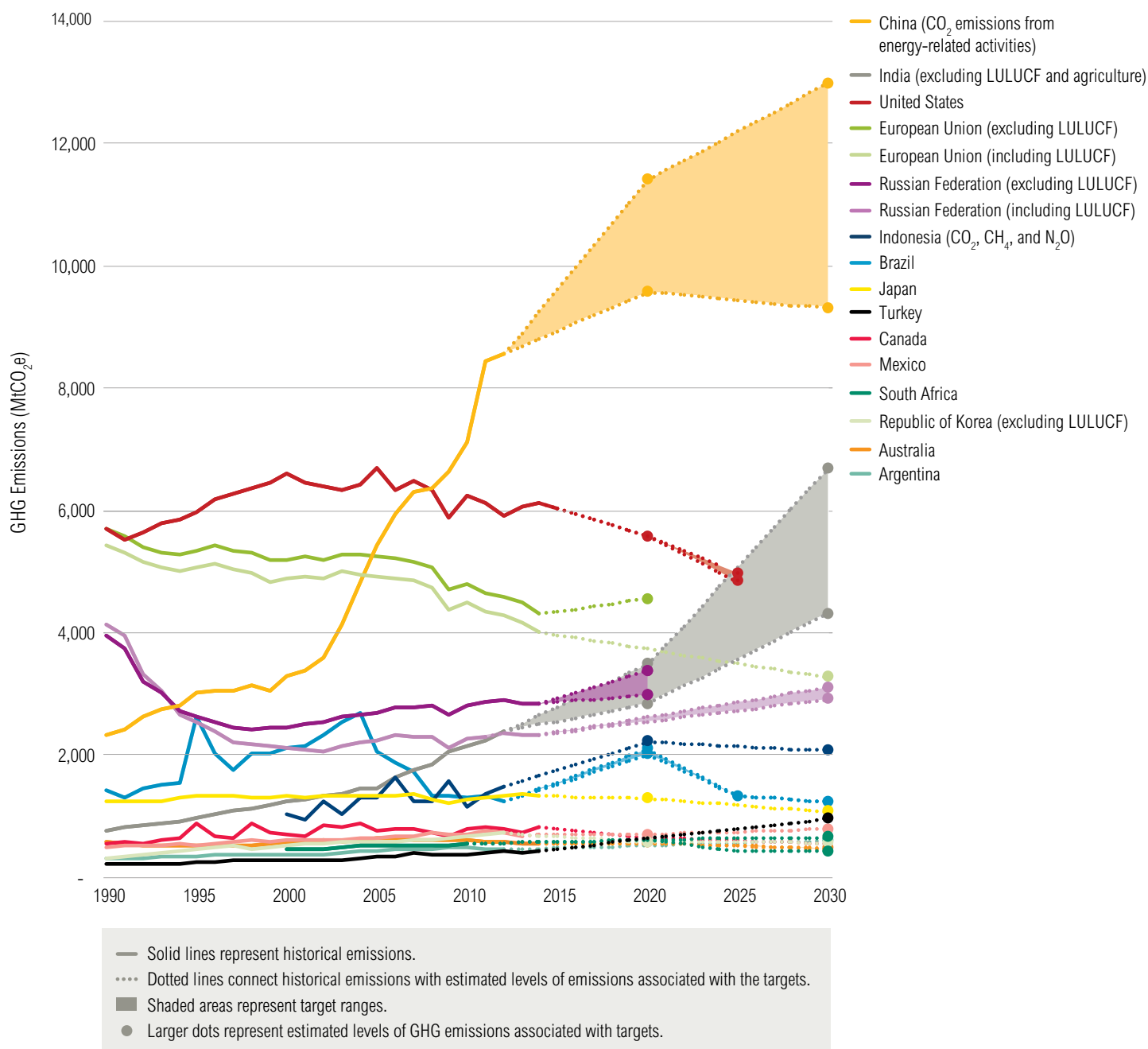
### 5.2 GHG Emissions Intensity

Figure 17 illustrates the G20 countries' historical emissions intensity (GHG emissions per unit of GDP) and future levels of emissions intensity associated with their targets, to show how countries' GHG targets are expected to translate to changes in emissions intensity (please refer to the technical appendix for the underlying data). GHG emissions intensity levels between 1990 and 2030 are calculated by dividing the country's absolute GHG emissions levels in each year by the country's respective GDP in that year. Most countries' GDP data, in million U.S. dollars, were sourced from the Organisation for Economic Co-operation and Development (OECD). The data reflect actual GDP for the period 1990–2015 and forecast GDP for the period 2016–2030. In the case of China and India, Figure 17 presents the range of possible GHG emissions intensities in 2020 and 2030 based on the countries' communicated targets and the respective range of GDP forecasts. For more information of the calculation of China's and India's emissions intensity forecasts, please refer to the technical appendix.

Countries' GHG emissions intensity levels include the LULUCF sector and cover six or seven GHGs, unless otherwise stated in the legend. The dotted lines do not depict a proposed emissions pathway or a projection of future emissions; instead they represent a likely linear average rate of change in GHG emissions intensity required to reach the country's stated goals.



**Figure 16 | G20 Countries' Historical Emissions and Estimated Future Emissions Associated with Targets**  
(Note: This graph does not represent projections of future emissions)



#### Notes:

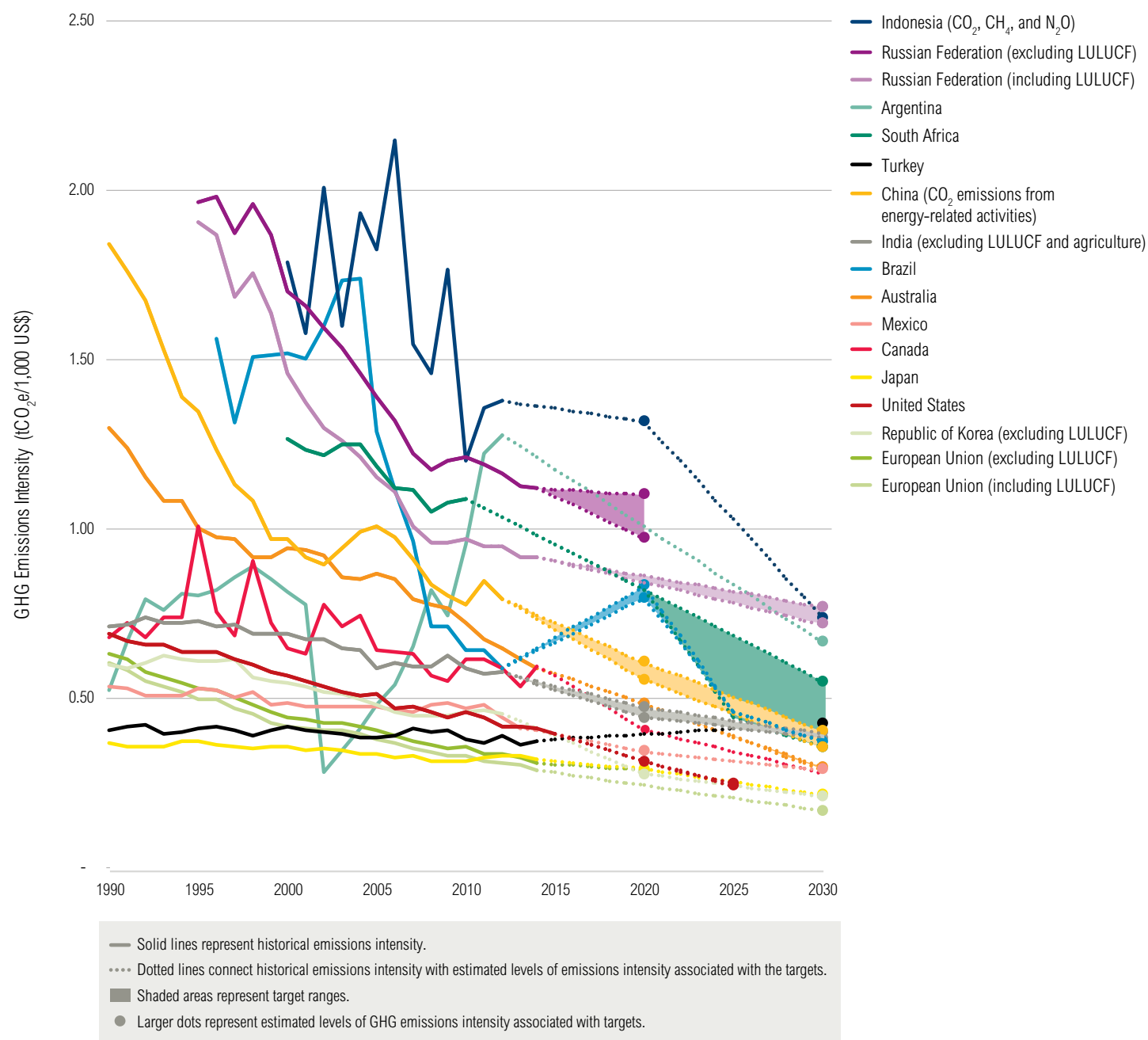
The dotted lines connect each country's historical level of emissions with its target level of emissions. They do not present a proposed emissions pathway or a projection of future emissions; instead they represent a linear average rate of change in GHG emissions required to reach the country's stated goals.

For simplicity, if a country has a conditional and an unconditional GHG target, only the unconditional target is shown in the graph.

The level of each country's emissions represented in the graph reflects the scope and coverage of its GHG target, not necessarily its total GHG emissions. Countries without parentheses in the legend represent full coverage based on the national GHG inventory (covering all sectors including the LULUCF sector and covering all GHGs: CO<sub>2</sub>, CH<sub>4</sub>, N<sub>2</sub>O, HFCs, PFCs, SF<sub>6</sub>, and in some cases NF<sub>3</sub>). Countries with parentheses in the legend are represented by partial GHG emissions rather than total GHG emissions, as explained in the parentheses.



**Figure 17 | G20 Countries' Historical GHG Emissions Intensity and Estimated Future GHG Emissions Intensity Associated with GHG Targets** (Note: This graph does not represent projections of future emissions intensity)



#### Notes:

The dotted lines connect each country's historical level of emissions intensity with its target levels of emissions intensity. They do not present a projection of future emissions or proposed emissions pathway; instead they represent a linear average rate of change in GHG emissions intensity required to reach the GHG emissions levels associated with the country's GHG targets.

For simplicity, if a country has a conditional and an unconditional target, only the unconditional target is shown in the graph.

The level of each country's emissions intensity represented in the graph reflects the scope and coverage of its GHG targets, not necessarily the intensity resulting from its total GHG emissions. Countries without parentheses in the legend represent full coverage based on the national GHG inventory (covering all sectors including the LULUCF sector and covering all GHGs: CO<sub>2</sub>, CH<sub>4</sub>, N<sub>2</sub>O, HFCs, PFCs, SF<sub>6</sub>, and in some cases NF<sub>3</sub>). Countries with parentheses in the legend are represented by partial GHG emissions rather than total GHG emissions, as explained in the parentheses.



The achievement of the G20 countries' Cancun pledges and INDCs will likely see a continuing reduction in the emissions intensities of their economies. Moreover, there will be a narrowing range in these emissions intensities over time. For example, in 2006, the emissions intensity of the economies of the G20 countries ranged from 0.33 tCO<sub>2</sub>e/US\$1,000 to 2.15 tCO<sub>2</sub>e/US\$1,000. In 2030, this range will likely be between 0.17 tCO<sub>2</sub>e/US\$1,000 and 0.74 tCO<sub>2</sub>e/US\$1,000. These estimates are based on GDP forecasts, which are likely to be different from countries' actual GDP values between 2016 and 2030.

### 5.3 Percentage Change in GHG Emissions Over Time

The following four figures present the percentage change in GHG emissions between historical years and target years of emissions.

Figure 18 presents, for each of the 15 G20 countries, the percentage change in GHG emissions between their **2010 GHG emissions** and their **Cancun pledges for 2020**.

Figure 19 presents the percentage change in GHG emissions between the countries' **2010 GHG emissions** and their **INDCs for 2025 or 2030**. (Please refer to the technical appendix for the underlying data.)

The purpose of Figures 18 and 19 is to show the relative increase or decrease in emissions associated with countries' targets, with a common reference year, to enable comparison between countries.

Figure 20 presents, for each of the 15 G20 countries, the percentage change in GHG emissions between their **most recently communicated GHG inventory (either 2010, 2012, 2013, or 2014)** and their **Cancun pledge for 2020**.

Figure 21 presents the percentage change in GHG emissions between the countries' **most recently communicated GHG inventory (either 2010, 2012, 2013, or 2014)** and their **INDC for 2025 or 2030**. (Please refer to the technical appendix for the underlying data.)

The purpose of Figures 20 and 21 is to show the relative increase or decrease in emissions associated with countries' targets, relative to their most recently communicated GHG inventories. This is to show the change in emissions needed to meet countries' targets.

The colors used in these figures reflect the type of target that countries have put forward, where green represents an unconditional target and orange represents a conditional target. Several G20 countries have communicated their 2020 and 2025/2030 targets in ranges. If applicable, the upper end of the target range is also shown in the figure. These ranges can have a significant impact on the emissions trajectory that will be necessary to meet the country's stated goals. For example, achieving the low end of South Africa's 2030 GHG target will require an 18 percent decrease in GHG emissions relative to 2010 levels. However, achieving the upper end of the country's target would allow a 42 percent increase in GHG emissions relative to 2010 levels. In the case of India, achieving the 2030 goal could see an emissions increase of anywhere between 82 percent and 182 percent relative to 2012 levels. (Because India's targets are emissions intensity targets, the expected levels of emissions in 2030 consistent with meeting the goals also depend on assumptions about future rates of GDP growth.)

Unsurprisingly, the GHG emissions change required to meet countries' INDCs is far greater than the GHG emissions change required to meet countries' Cancun pledges. This is because countries have an additional 10 years (or 5 years in the case of Brazil and the United States) to reach their stated goals and progressively enhance ambition over time.



Figure 18 | **Percentage Change in GHG Emissions between 2010 GHG Emissions and Cancun Pledges for 2020**

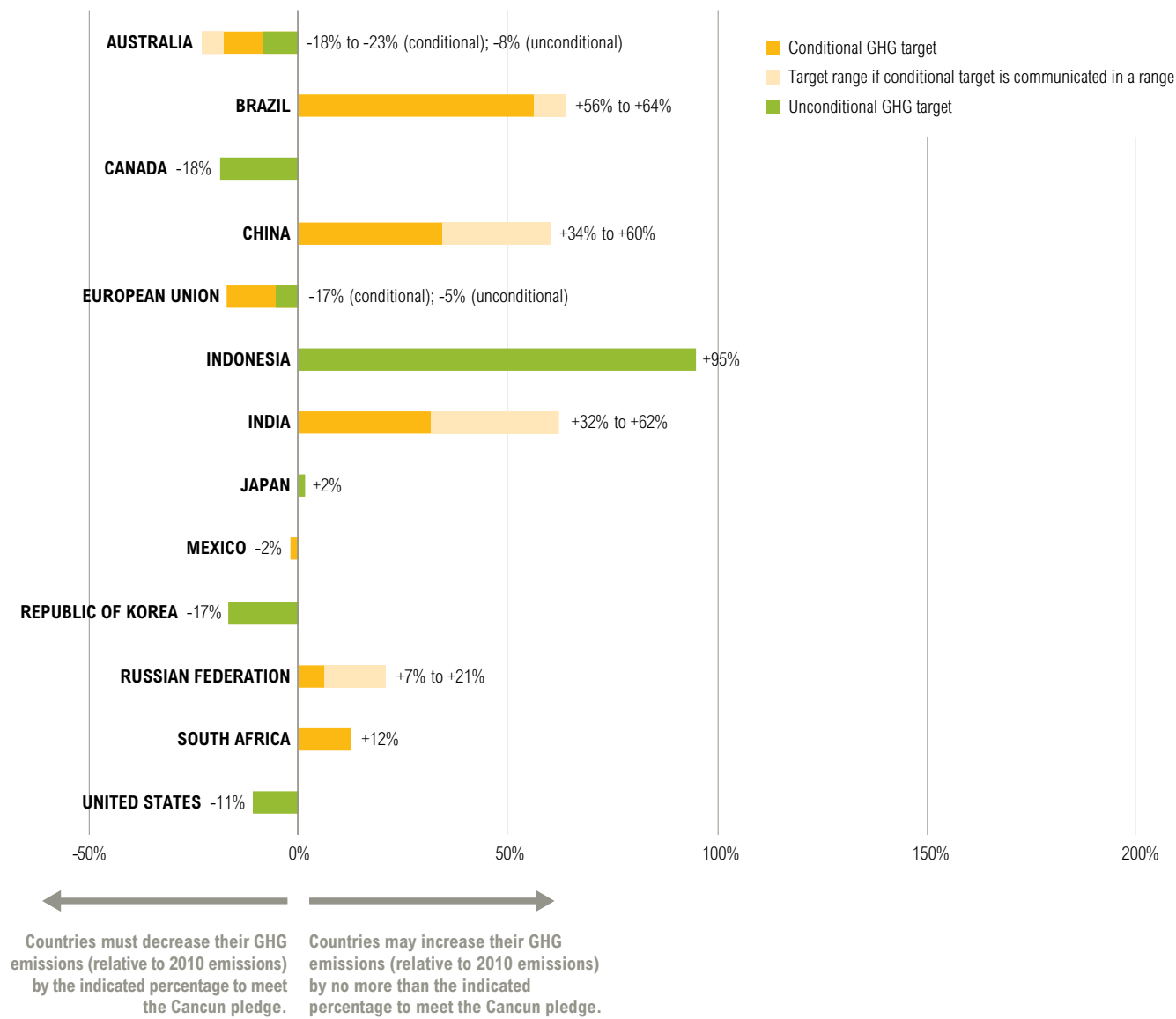
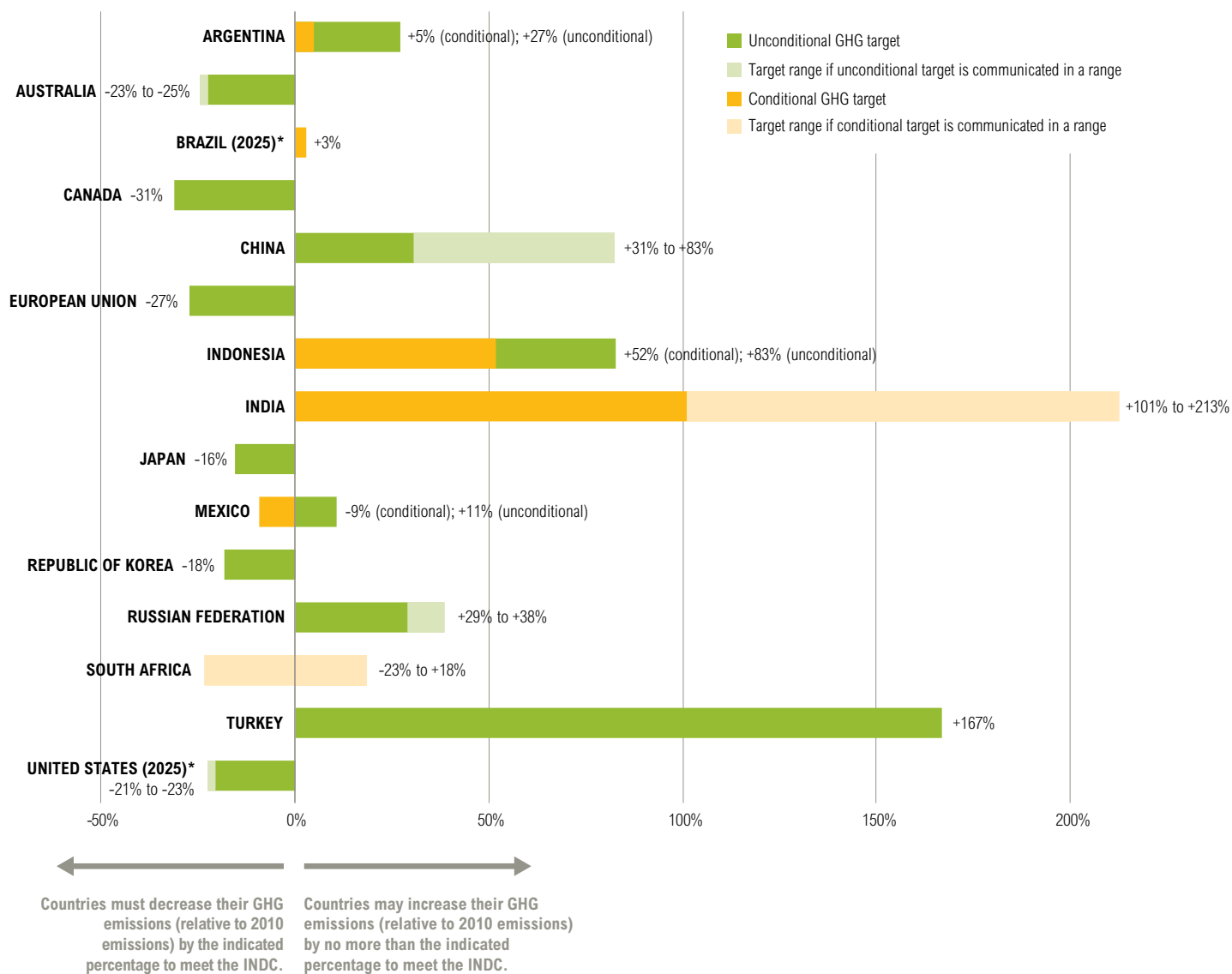




Figure 19 | **Percentage Change in GHG Emissions between 2010 GHG Emissions and INDCs for 2030**



\*Brazil and the United States have communicated GHG targets for 2025 in their INDCs. The other G20 countries have communicated GHG targets for 2030 in their INDCs.



Figure 20 | **Percentage Change in GHG Emissions between Most Recently Communicated GHG Inventories and Cancun Pledges for 2020**

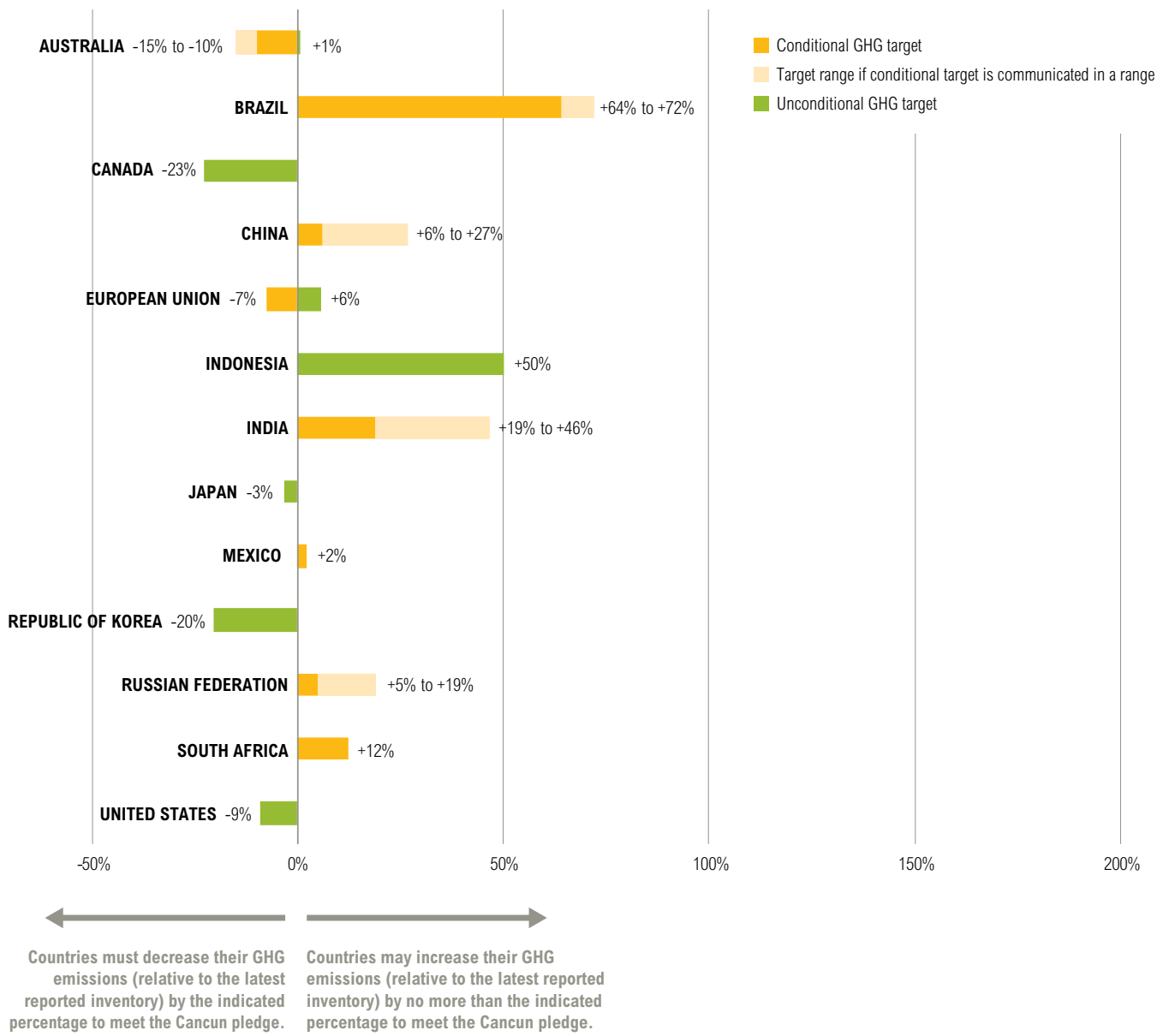
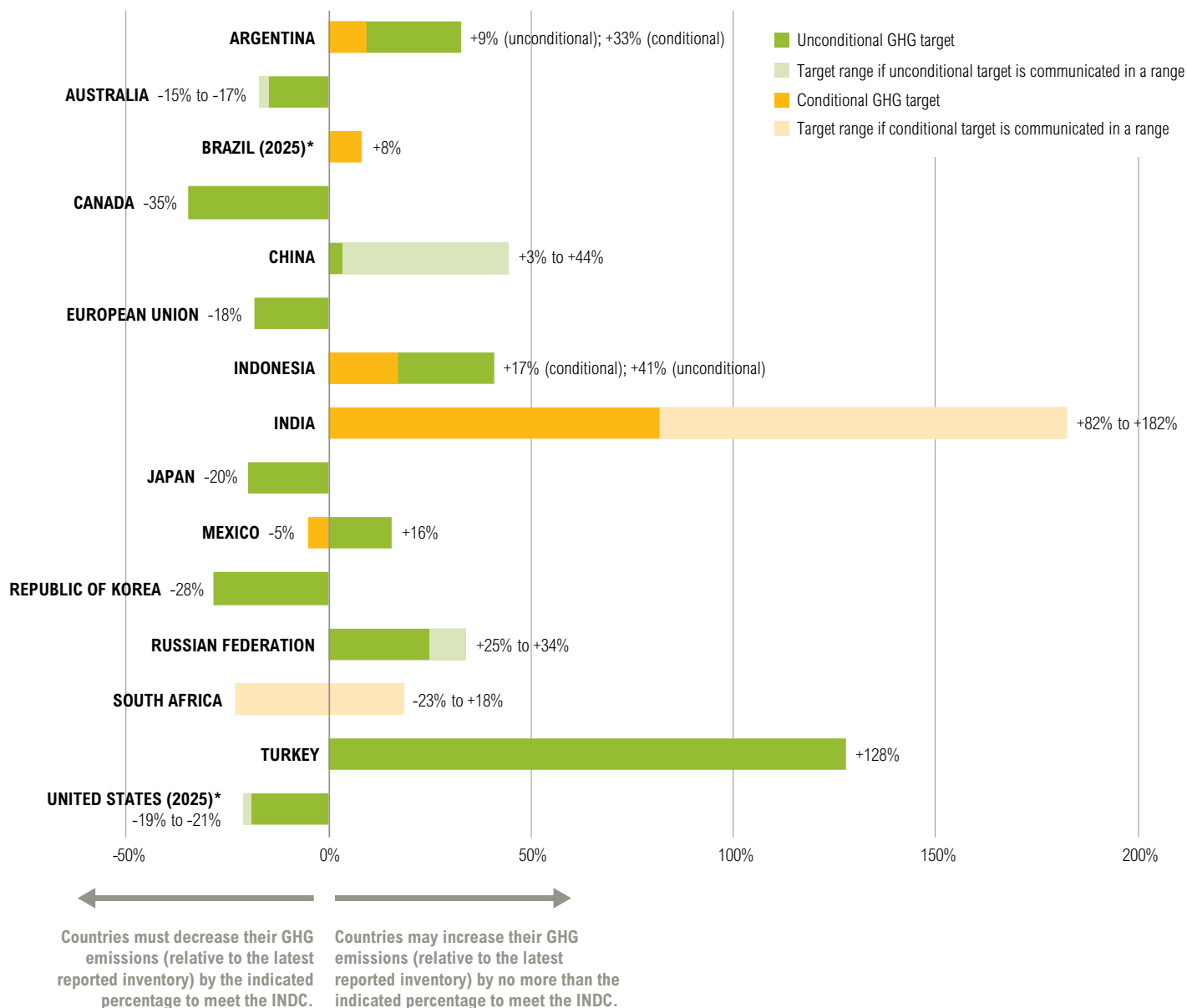




Figure 21 | **Percentage Change in GHG Emissions between Most Recently Communicated GHG Inventories and INDCs for 2030**



\*Brazil and the United States have communicated GHG targets for 2025 in their INDCs. The other G20 countries have communicated GHG targets for 2030 in their INDCs.



## TECHNICAL APPENDIX

### GHG Emissions Changes over Time in the G20 Countries

Table A1 presents an overview of the 15 G20 countries' target coverage and historical emissions.

Table A1 | **Target Coverage and Historical Emissions**

COUNTRY	COVERAGE OF GHG EMISSIONS		HISTORICAL GHG EMISSIONS (MtCO <sub>2</sub> e)			
	Sector coverage	Gas coverage	1990	2000	2010	Latest inventory (year)
<b>Argentina</b>	All IPCC sectors incl. LULUCF	6 gases under the Kyoto Protocol (KP)	269	350	448	429 (2012)
<b>Australia</b>	All IPCC sectors incl. LULUCF	7 gases under the KP	547	555	574	523 (2014)
<b>Brazil</b>	All IPCC sectors incl. LULUCF	6 gases under the KP	1,389	2,100	1,264	1,203 (2012)
<b>Canada</b>	All IPCC sectors incl. LULUCF	7 gases under the KP	526	663	761	804 (2014)
<b>China</b>	Energy-related activities	CO <sub>2</sub>	2,300	3,260	7,100	8,980 (2013)
<b>European Union</b>	All IPCC sectors incl. LULUCF	7 gases under the KP	5,403	4,847	4,461	3,976 (2014)
	All IPCC sectors excl. LULUCF	7 gases under the KP	5,658	5,162	4,778	4,278 (2014)
<b>India</b>	All IPCC sectors excl. agriculture and LULUCF	7 gases under the KP	736	1,216	2,126	2,355 (2012)
<b>Indonesia</b>	All IPCC sectors incl. LULUCF	CO <sub>2</sub> , CH <sub>4</sub> , and N <sub>2</sub> O	No official GHG data	1,001	1,120	1,454 (2012)
<b>Japan</b>	All IPCC sectors incl. LULUCF	7 gases under the KP	1,211	1,300	1,236	1,302 (2014)
<b>Mexico</b>	All IPCC sectors incl. LULUCF	6 gases under the KP	468	591	685	656 (2013)
<b>Republic of Korea</b>	All IPCC sectors excl. LULUCF	6 gases under the KP	295	503	657	688 (2012)
<b>Russian Federation</b>	All IPCC sectors incl. LULUCF	7 gases under the KP	4,105	2,086	2,225	2,299 (2014)
	All IPCC sectors excl. LULUCF	7 gases under the KP	3,940	2,433	2,772	2,812 (2014)
<b>South Africa</b>	All IPCC sectors incl. LULUCF	6 gases under the KP	330	425	518	518 (2010)
<b>Turkey</b>	All IPCC sectors incl. LULUCF	7 gases under the KP	178	261	348	408 (2014)
<b>United States</b>	All IPCC sectors incl. LULUCF	7 gases under the KP	5,659	6,571	6,219	6,108 (2014)



Table A2 presents estimates of the 15 G20 countries' future emissions associated with their targets.

Table A2 | **Estimated Future Emissions Associated with Targets**

COUNTRY	GHG EMISSIONS LEVELS ASSOCIATED WITH TARGETS (MtCO <sub>2</sub> e)		
	2020	2025	2030
<b>Argentina</b>	No 2020 GHG target	No 2025 GHG target	570 (unconditional) 469 (conditional)
<b>Australia</b>	527 (unconditional) 444–472 (conditional)	No 2025 GHG target	433–445 (unconditional)
<b>Brazil</b>	1,977–2,068 (conditional)	1,300 (unconditional)	1,200 (indicative unconditional target)
<b>Canada</b>	621 (unconditional) <sup>a</sup>	No 2025 GHG target	524 (unconditional) <sup>a</sup>
<b>China</b>	9,541–11,372 (conditional)	No 2025 GHG target	9,276–12,960 (unconditional) <sup>a</sup>
<b>European Union</b>	No 2020 GHG target incl. LULUCF	No 2025 GHG target	3,242 (unconditional) <sup>a</sup>
	4,526 (unconditional) 3,960 (conditional)	No 2025 GHG target	No 2030 GHG target excl. LULUCF
<b>India</b>	2,803–3,450 (conditional)	No 2025 GHG target	4,278–6,647 (conditional)
<b>Indonesia</b>	2,183 (unconditional)	No 2025 GHG target	2,046 (unconditional) 1,700 (conditional)
<b>Japan</b>	1,257 (unconditional) <sup>a</sup>	No 2025 GHG target	1,042 (unconditional) <sup>a</sup>
<b>Mexico</b>	672 (conditional)	No 2025 GHG target	759 (unconditional) 623 (conditional)
<b>Republic of Korea</b>	548 (unconditional) <sup>a</sup>	No 2025 GHG target	536 (unconditional) <sup>a</sup>
<b>Russian Federation</b>	No 2020 GHG target incl. LULUCF	No 2025 GHG target	2,874–3,079 (unconditional) <sup>a</sup>
	2,955–3,349 (conditional)	No 2025 GHG target	No 2030 GHG target excl. LULUCF
<b>South Africa</b>	583 (conditional)	398–614 (conditional)	398–614 (conditional)
<b>Turkey</b>	No 2020 GHG target	No 2025 GHG target	929 (unconditional) <sup>a</sup>
<b>United States</b>	5,545 (unconditional) <sup>a</sup>	4,810–4,943 (unconditional) <sup>a</sup>	No 2030 GHG target

<sup>a</sup> The target is assumed to be unconditional since the pledge or INDC does not include a specific conditionality clause associated with the target.



Table A3 presents an overview of the changes in GHG emissions in the 15 G20 countries—both historically and in terms of what is required to meet the countries' targets.

Table A3 | **Absolute (and Percent) Changes in GHG Emissions (Historical Changes and Future Changes Necessary to Meet GHG Targets)**

COUNTRY	CHANGE IN GHG EMISSIONS (MtCO <sub>2</sub> e)				CHANGE IN GHG EMISSIONS (MtCO <sub>2</sub> e)	
	From 1990 to 2000 (historical)	From 2000 to 2010 (historical)	From 2010 to the 2020 GHG target	From the 2020 GHG target to the 2030 GHG target	From the latest reported GHG emissions <sup>c</sup> to the 2020 GHG target	From the latest reported GHG emissions <sup>c</sup> to the INDC GHG target (2025 or 2030)
<b>Argentina</b>	+81 (+30%)	+98 (+28%)	N/A	N/A	N/A	+140 <sup>a</sup> (+33%) +40 <sup>b</sup> (+9%)
<b>Australia</b>	+8 (+1%)	+20 (+4%)	-47 <sup>a</sup> (-8%) -103 to -130 <sup>b</sup> (-18% to -23%)	-82 to -94 <sup>a</sup> (-16% to -18%)	+4 <sup>a</sup> (+1%) -79 to -52 <sup>b</sup> (-10% to -15%)	-78 to -91 <sup>a</sup> (-15% to -17%)
<b>Brazil</b>	+711 (+51%)	-836 (-40%)	+713 to +804 <sup>b</sup> (+56% to +64%)	-777 to -868 <sup>a</sup> (-39% to -42%)	+774 to +865 <sup>b</sup> (64% to 72%)	+97 <sup>a</sup> (+8%) (2025)*
<b>Canada</b>	+137 (+26%)	+98 (+15%)	-140 <sup>a</sup> (-18%)	-97 <sup>a</sup> (-16%)	-183 <sup>a</sup> (-23%)	-281 <sup>a</sup> (-35%)
<b>China</b>	+960 (+42%)	+3,840 (+118%)	+2,441 to +4,272 <sup>b</sup> (+34% to +60%)	-2,096 to +3,418 <sup>a</sup> (-18% to +36%)	+561 to +2,392 <sup>b</sup> (+6% to +27%)	+296 to +3,980 <sup>a</sup> (+3% to +44%)
<b>European Union</b>	-556 (-10%)	-385 (-8%)	N/A	N/A	N/A	-734 <sup>a</sup> (-18%)
	-496 (-9%)	-384 (-7%)	-252 <sup>a</sup> (-5%) -817 <sup>b</sup> (-17%)	N/A	+248 <sup>a</sup> (+6%) -318 <sup>b</sup> (-7%)	N/A
<b>India</b>	+479 (+65%)	+910 (+75%)	+677 to +1,324 <sup>b</sup> (+32% to +64%)	+829 to +3,844 <sup>b</sup> (+30% to +111%)	+448 to 1,095 <sup>b</sup> (+19% to +46%)	+1,923 to 4,292 <sup>b</sup> (+82% to +182%)
<b>Indonesia</b>	N/A	+119 (+12%)	+1,063 (+95%)	-137 <sup>a</sup> (-6%) -483 <sup>b</sup> (-22%)	+729 <sup>a</sup> (+50%)	+592 <sup>a</sup> (+41%) +246 <sup>b</sup> (+17%)
<b>Japan</b>	+88 (+7%)	-64 (-5%)	+22 <sup>a</sup> (+2%)	-215 <sup>a</sup> (-17%)	-45 <sup>a</sup> (-3%)	-260 <sup>a</sup> (-20%)
<b>Mexico</b>	+123 (+26%)	+94 (+16%)	-13 <sup>b</sup> (-2%)	+87 <sup>a</sup> (+13%) -49 <sup>b</sup> (-7%)	+16 <sup>b</sup> (+2%)	+103 <sup>a</sup> (+16%) -34 <sup>b</sup> (-5%)
<b>Republic of Korea</b>	+208 (+70%)	+154 (+31%)	-109 <sup>a</sup> (-17%)	-12 <sup>a</sup> (-2%)	-141 <sup>a</sup> (-20%)	-152 <sup>a</sup> (-28%)
<b>Russian Federation</b>	-2,019 (-49%)	+139 (+7%)	N/A	N/A	N/A	574 to 780 <sup>a</sup> (+25% to +34%)
	-1,507 (-38%)	+340 (+14%)	+183 to +577 <sup>b</sup> (+7% to +21%)	N/A	+143 to +537 <sup>b</sup> (+5% to +19%)	N/A
<b>South Africa</b>	+95 (+29%)	+93 (+22%)	+65 <sup>b</sup> (+12%)	-185 to +31 <sup>b</sup> (-46% to +5%)	+65 <sup>b</sup> (+12%)	-120 to +96 <sup>b</sup> (-23% to +18%)
<b>Turkey</b>	+83 (+47%)	+87 (+34%)	N/A	N/A	N/A	+521 <sup>a</sup> (+128%)
<b>United States</b>	+912 (+16%)	-352 (-5%)	-674 <sup>a</sup> (-11%)	N/A	-563 <sup>a</sup> (-9%)	-1,165 to -1,298 <sup>a</sup> (-19% to -21%) (in 2025)*

<sup>a</sup> GHG emissions change to meet unconditional target, noting that the principles for accounting for land sector and internationally transferable emissions units are still to be agreed upon, and will impact how countries meet their targets.

<sup>b</sup> GHG emissions change to meet conditional target, noting that the principles for accounting for land sector and internationally transferable emissions units are still to be agreed upon, and will impact how countries meet their targets.

<sup>c</sup> Refer to Table A1 for the latest reported GHG emissions from the G20 countries.

\*Brazil and the United States communicated GHG targets for 2025 in their INDCs, while the other countries communicated GHG targets for 2030.

N/A indicates that the country does not have a GHG target that relates to that year, or does not have GHG data that relate to that year.



Table A4 presents an overview of the annual average rate of change in GHG emissions in the 15 G20 countries, both historically and in terms of what is required to meet the countries' targets.

Table A4 | **Annual Average Rates of Change in GHG Emissions**

COUNTRY	ANNUAL AVERAGE RATES OF CHANGE IN GHG EMISSIONS (%)				ANNUAL AVERAGE RATES OF CHANGE IN GHG EMISSIONS (%)	
	From 1990 to 2000 (historical)	From 2000 to 2010 (historical)	From 2010 to 2020 (to meet the 2020 target)	From 2020 to 2030 (to meet the 2030 target)	From the latest reported GHG emissions <sup>c</sup> to the 2020 GHG target	From the latest reported GHG emissions <sup>c</sup> to the INDC GHG target (2025 or 2030)
<b>Argentina</b>	+3.0	+2.8	N/A	N/A	N/A	+1.8 <sup>a</sup> +0.5 <sup>b</sup>
<b>Australia</b>	+0.1	+0.4	-0.8 <sup>a</sup> -2.3 to -1.8 <sup>b</sup>	-1.8 to -1.6 <sup>a</sup>	+0.1 <sup>a</sup> -1.6 to -2.5 <sup>b</sup>	-0.9 to -1.1 <sup>a</sup>
<b>Brazil</b>	+5.1	-4.0	+5.6 to +6.4 <sup>a</sup>	-4.2 to -3.9 <sup>a</sup>	+8.0 to +9.0 <sup>b</sup>	+0.6 <sup>a</sup> (2025)*
<b>Canada</b>	+2.6	+1.5	-1.8 <sup>a</sup>	-1.6 <sup>a</sup>	-3.8 <sup>a</sup>	-2.2 <sup>a</sup>
<b>China</b>	+4.2	+11.8	+3.4 to +4.8 <sup>b</sup>	-1.8 to +3.6 <sup>a</sup>	+0.9 to +3.8 <sup>b</sup>	+0.2 to +2.6 <sup>a</sup>
<b>European Union</b>	-1.0	-0.8	N/A	N/A	N/A	-1.2 <sup>a</sup>
	-0.9	-0.7	-0.5 <sup>a</sup> -1.7 <sup>b</sup>	N/A	+1.0 <sup>a</sup> -1.2 <sup>b</sup>	N/A
<b>India</b>	+6.5	+7.5	+3.2 to +5.6 <sup>b</sup>	+1.6 to +11.1 <sup>b</sup>	+2.4 to +5.8 <sup>b</sup>	+4.5 to +10.1 <sup>b</sup>
<b>Indonesia</b>	N/A	+1.2	+9.5	-0.6 <sup>a</sup> -2.2 <sup>b</sup>	+6.3 <sup>a</sup>	+2.3 <sup>a</sup> +0.9 <sup>b</sup>
<b>Japan</b>	+0.7	-0.5	+0.2 <sup>a</sup>	-1.7 <sup>a</sup>	-0.6 <sup>a</sup>	-1.2 <sup>a</sup>
<b>Mexico</b>	+2.6	+1.6	-0.2 <sup>b</sup>	+1.3 <sup>a</sup> -0.7 <sup>b</sup>	+0.3 <sup>b</sup>	+0.9 <sup>a</sup> -0.3 <sup>b</sup>
<b>Republic of Korea</b>	+7.0	+3.1	-1.7 <sup>a</sup>	-0.2 <sup>a</sup>	-2.6 <sup>a</sup>	-1.2 <sup>a</sup>
<b>Russian Federation</b>	-4.9	+0.7	N/A	N/A	N/A	+1.6 to +2.1 <sup>a</sup>
	-3.8	+1.4	+0.7 to +2.1 <sup>b</sup>	N/A	+0.8 to +3.2 <sup>b</sup>	N/A
<b>South Africa</b>	+2.9	+2.2	+1.2 <sup>b</sup>	-3.2 to +0.5 <sup>b</sup>	+1.2 <sup>b</sup>	-1.5 to +1.2 <sup>b</sup>
<b>Turkey</b>	+4.7	+3.4	N/A	N/A	N/A	+8.0 <sup>a</sup>
<b>United States</b>	+1.6	-0.5	-1.1 <sup>a</sup>	N/A	-1.5 <sup>a</sup>	-1.9 to -1.7 <sup>a</sup> (2025)*

<sup>a</sup> GHG emissions change to meet unconditional target, noting that the principles for accounting for land sector and internationally transferable emissions units are still to be agreed upon, and will impact how countries meet their targets.

<sup>b</sup> GHG emissions change to meet conditional target, noting that the principles for accounting for land sector and internationally transferable emissions units are still to be agreed upon, and will impact how countries meet their targets.

<sup>c</sup> Refer to Table A1 for the latest reported GHG emissions from the 15 G20 countries.

\*Brazil and the United States communicated GHG targets for 2025.

N/A indicates that the country does not have a GHG target that relates to that year, or does not have GHG data that relate to that year.



## GDP Assumptions for China and India

This section details the methodological assumptions that were used in quantifying the estimated future levels of GHG emissions associated with the GHG targets of China and India. Both countries have put forward emissions intensity targets in their Cancun pledges and INDCs; we used an approach adapted from a previous OCN working paper (Damassa et al. 2015), to calculate the level of emissions associated with these intensity targets.

As with other G20 countries assessed in this paper, the quantification of GHG targets involves reviewing the targets, gathering historical emissions data, and calculating the target level of emissions. Section 4 provides detailed country analysis, covering the review of the target and key information such as the reference point, time frame, sector and gas coverage, and methodological approaches. To calculate the target level of emissions for the GHG intensity targets, it is necessary to first estimate the target level of emissions intensity in the target year:

### Emissions intensity in the target year (MtCO<sub>2</sub>e/level of GDP) =

$$\frac{\text{Base year emissions intensity (MtCO}_2\text{e/level of GDP)} - [\text{Base year emissions intensity (MtCO}_2\text{e/level of GDP)} \times \text{Percent reduction}]}{\text{Percent reduction}}$$

Using China as an example, to calculate the emissions intensity in the target year for China, we first calculate an estimate of base year (2005) CO<sub>2</sub> emissions intensity for China, using the 2005 energy CO<sub>2</sub> emissions estimate of 5.404 GtCO<sub>2</sub>e from China's Second National Communication (Government of People's Republic of China 2012) and 2005 GDP data from OECD (OECD 2015). We then calculate CO<sub>2</sub> emissions intensity levels in the target year of 2020, using both 40 percent and 45 percent reductions from 2005 levels. Levels for 2030 are calculated using both a 60 percent and a 65 percent reduction.

The next step is to calculate the estimated level of GHG emissions in 2020 and 2030 associated with the target level of emissions intensity, based on the calculated emissions intensity in the target year and forecasts of GDP in the target year:

### Emissions in the target year (MtCO<sub>2</sub>e) =

$$\text{Emissions intensity in the target year (MtCO}_2\text{e/level of GDP)} \times \text{Level of GDP in the target year}$$

Because the GHG targets of China and India are presented in terms of intensity reductions, assumptions on projected level of GDP in the target year are needed to translate the target into absolute emissions. Historical GDP values are obtained from OECD 2015. For GDP values in the target year, because projections inevitably present uncertainties, and no "official" number can be referred to for either of the two countries, we opt to present a range of GDP projections in 2020 and 2030 taken from recently published studies.

GDP projections are provided in different forms from different sources. Therefore, all reported GDP values (and growth rates) are harmonized by converting them into relative values with respect to 2005 GDP figures to facilitate comparison. If a GDP projection does not include a 2005 value, then the ratio between 2005 and the latest historical GDP value is assumed to be the same as in the OECD GDP long-term forecast estimates, which are in million U.S. dollars (OECD 2015). The maximum and minimum values of relative GDP are used as high GDP and low GDP when estimating emission levels for 2020 and 2030. Absolute emissions values for 2020 and 2030 are then calculated based on the corresponding high and low end of the GDP projection range.

This analysis is meant to present a range of emissions in 2020 and 2030 that would be possible if the countries were to meet their intensity targets, based on different projections of their GDP growth. No interpolations are made for intervening years and this analysis is not intended to reflect any trend of emissions trajectories between historical years and the two data points of 2020 and 2030.

Table A5 below shows the studies used and a summary of harmonization results for GDP projections of China. All of the studies used have been published since 2014. All but one of the studies<sup>11</sup> develop at least one scenario compatible with a low-emissions scenario or a CO<sub>2</sub> peaking in 2030.

We use this same approach to quantify India's GHG intensity target; we estimate the possible range of GDP growth rates in 2020 and 2030 using the publications cited in Table A6. Because no sector or gas coverage is specified in India's INDC, we assume the same coverage as specified in India's 2020 target (i.e., gross emissions excluding agriculture and LULUCF emissions) for both 2020 and 2030 targets. We use a base year GHG emissions estimate of 1,433 MtCO<sub>2</sub>e in 2005, sourced from the Planning Commission report (Government of India 2014).

Again, because of the various units used in different publications, all reported GDP values (and growth rates) are harmonized in terms of the relative values of 2005 GDP, and the compound average annual growth rates between 2005 and 2020, and 2005 and 2030, are also calculated as a reference.



Table A5 | Summary of China's GDP Growth, 2005–2030, Based on Publications Used in This Study

STUDY	RELATIVE GDP (2005=1)				COMPOUND AVERAGE ANNUAL GROWTH RATE	
	2005	2010	2020	2030	2005–20 (%)	2005–30 (%)
Analysis of China's INDC (Fu, Zou, and Liu 2015)	1	1.7	3.2	5.2	8.1	6.8
Continued Emissions Reduction Scenario (Green and Stern 2015)	1	1.7	3.5	5.8	8.7	7.3
Accelerated Emissions Reduction Scenario (Green and Stern 2015)	1	1.7	3.5	6.0	8.7	7.4
GDP Long-term Forecast (OECD 2015)	1	1.7	3.3	4.9	8.3	6.6
World Energy Outlook 2015 (IEA 2015)	1	1.7	3.3	5.5	8.3	7.1
Deep Decarbonization Study (Teng et al. 2015)	1	1.7	3.4	5.7	8.5	7.1
Accelerated Effort Scenario (Zhang et al. 2014)	1	1.7	3.4	5.5	8.5	7.1

Table A6 | Summary of India's GDP Growth, 2005–2030, Based on Publications Used in This Study

STUDY	RELATIVE GDP (2005=1)			COMPOUND AVERAGE ANNUAL GROWTH RATE	
	2005	2020	2030	2005–20 (%)	2005–30 (%)
INDC (Government of India 2015)	1	-	6.9	-	8.0
Deep Decarbonization Study – Conventional scenario (Shukla et al. 2015)	1	-	6.9	-	8.0
Deep Decarbonization Study – Sustainable scenario (Shukla et al. 2015)	1	-	6.4	-	7.7
GDP Long-term Forecast (OECD 2015)	1	2.6	4.6	6.6	6.3
World Energy Outlook 2015 (IEA 2015)	1	2.9	5.7	7.4	7.2
SSP1 – Sustainability (IIASA 2015)	1	2.8	5.5	7.2	7.0
SSP2 – Middle-of-the-Road (IIASA 2015)	1	2.9	5.0	7.3	6.7
SSP3 – Fragmentation (IIASA 2015)	1	2.9	4.6	7.3	6.3
SSP4 – Inequality (IIASA 2015)	1	2.8	4.8	7.2	6.5
SSP5 – Conventional Development (IIASA 2015)	1	2.9	5.9	7.3	7.4
Low-Carbon Strategies – Baseline, Inclusive Growth (BIG) scenario (Government of India 2014)	1	3.0	5.7	7.6	7.2
Low-Carbon Strategies – Low Carbon, Inclusive Growth (LCIG) scenario (Government of India 2014)	1	3.0	5.5	7.5	7.1



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1. This paper uses "targets" to refer to countries' GHG pledges and actions.
2. Meeting goals also depends on how countries account for emissions and removals from the land sector and purchases and sales of transferable emissions units through international market mechanisms.
3. WRI's Open Climate Network has recently published a set of working papers that assess the policy options for achieving India's, Indonesia's, and Mexico's INDCs. See <http://www.wri.org/our-work/project/open-climate-network>.
4. Sectors are classified in accordance with the IPCC guidelines, which include Energy; Industrial Processes and Product Use; Agriculture; Waste; and Land Use, Land-Use Change, and Forestry (LULUCF). In the context of this working paper, "all IPCC sectors" includes all five of the abovementioned sectors.
5. The targets for the first commitment period of the Kyoto Protocol (KP) under the UNFCCC (2008–2012) covered six greenhouse gases: carbon dioxide (CO<sub>2</sub>), methane (CH<sub>4</sub>), nitrous oxide (N<sub>2</sub>O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF<sub>6</sub>). At the start of the second commitment period of the KP in 2013, a seventh gas was included: nitrogen trifluoride (NF<sub>3</sub>). In the context of this working paper, the coverage "six gases under the Kyoto Protocol" includes CO<sub>2</sub>, CH<sub>4</sub>, N<sub>2</sub>O, PFCs, HFCs, and SF<sub>6</sub>; "seven gases under the Kyoto Protocol" includes the six Kyoto gases and NF<sub>3</sub>.
6. This working paper refers to GWP values over a 100-year time horizon, sourced from IPCC reports, including the Second Assessment Report (SAR), Fourth Assessment Report (AR4), and Fifth Assessment Report (AR5).
7. There is a lag in "current" GHG emissions data. In the case of most countries, the latest GHG inventories are for the 2014 calendar year.
8. Historical emissions from the IEA Energy Atlas are accessible at <http://energyatlas.iea.org/#/!tellmap/1378539487>.
9. Historical emissions from CAIT Climate Data Explorer are accessible at <http://cait.wri.org/historical/>. CAIT's historical GHG emissions dataset draws from sources including the International Energy Agency (IEA), U.S. Energy Information Administration (EIA), Carbon Dioxide Information Analysis Center (CDIAC), U.S. Environmental Protection Agency (EPA), and Food and Agriculture Organization of the United Nations (FAO). For a complete list of references and detailed methodology for the CAIT historical GHG emissions dataset, please refer to <http://cait.wri.org/historical/>.
10. India's Cancun pledge states that, "The emissions from agriculture sector will not form part of the assessment of emissions intensity." The sector coverage of India's 2030 target is not specified in its INDC submission. For purposes of this analysis, we assume that the sector coverage remains the same between India's 2020 and 2030 targets.
11. The OECD GDP long-term forecast does not present any emissions analysis along with its GDP forecast.



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## ABOUT THE OPEN CLIMATE NETWORK

The Open Climate Network (OCN) brings together independent research institutes and stakeholder groups to monitor countries' progress on climate change. We seek to accelerate the transition to a low-emission, climate-resilient future by providing consistent, credible information that enhances accountability both among and within countries. [www.openclimatenetwork.org](http://www.openclimatenetwork.org).

## ABOUT WRI

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Natural resources are at the foundation of economic opportunity and human well-being. But today, we are depleting Earth's resources at rates that are not sustainable, endangering economies and people's lives. People depend on clean water, fertile land, healthy forests, and a stable climate. Livable cities and clean energy are essential for a sustainable planet. We must address these urgent, global challenges this decade.

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We start with data. We conduct independent research and draw on the latest technology to develop new insights and recommendations. Our rigorous analysis identifies risks, unveils opportunities, and informs smart strategies. We focus our efforts on influential and emerging economies where the future of sustainability will be determined.

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#### SCALE IT

We don't think small. Once tested, we work with partners to adopt and expand our efforts regionally and globally. We engage with decision-makers to carry out our ideas and elevate our impact. We measure success through government and business actions that improve people's lives and sustain a healthy environment.