

CHAPTER 1

Climate Change in 20 Questions and Answers

A lot of ink has been spilled over the past several years already regarding the Paris Climate Change Conference that will take place from November 30 to December 11, 2015. The results of the negotiations at this conference will have a considerable impact on the world energy picture in the coming decades. This chapter is organized as a series of questions and answers intended as a guide to help understand the different aspects of the process and the major issues that will be front and centre during the conference.

1. What is the United Nations Framework Convention on Climate Change?

The United Nations Framework Convention on Climate Change (UNFCCC) is a treaty that “establishes a global framework for intergovernmental efforts to face the challenge posed by climate change.”¹ According to the Framework Convention, governments must collect and make available information on greenhouse gases (GHGs) and on the best policies to adopt in order to cooperate in facilitating adaptation to climate change.

“All countries have a role to play in reducing GHGs, but efforts must take into account the economic and technological capabilities of each country.”

The Framework Convention was adopted in 1992 at the Earth Summit in Rio de Janeiro and came into effect in 1994. Progress in implementing it is measured at a Conference of the Parties (COP) where all the member states have met annually since 1995. Today, 195 states plus the European Union are parties to the Framework Convention.

The Paris Conference is the 21st COP of the UNFCCC and the 11th Conference of the parties participating in the Kyoto Protocol (CMP²), whence the abbreviation COP21/CMP11.³

2. What is the Kyoto Protocol?

The Kyoto Protocol is the first major international climate change agreement. It was adopted in 1997 at COP3 in Kyoto and came into effect in 2005.

The Kyoto Protocol implemented the United Nations Framework Convention’s goal of fighting climate change by legally binding 37 industrialized countries and countries in transition to collectively reduce their average GHG emissions over the 2008-2012 period by 5.2% compared to their 1990 levels.⁴

The protocol respects the principle of “common but differentiated responsibility.” This principle recognizes that all countries have a role to play in reducing GHGs, but that efforts must take into account the economic and technological capabilities of each country. Reduction targets were set only for industrialized and transition countries, whereas poorer countries just had to report their emissions.⁵

The collective target was 5.2%, but it varied from country to country. For example, members of the European Union had a GHG reduction target of 8% compared to 1990 levels, whereas Iceland could increase its GHG emissions by 10% compared to the same reference year.⁶

Since then, international negotiations have failed to produce another binding agreement, and much hope rests on the conclusion of such an agreement at the Paris Conference.

1. United Nations Framework Convention on Climate Change, La Convention, 2015.

2. The acronym CMP refers to the Conference of the parties serving as the meeting of the parties to the Kyoto Protocol.

3. Paris 2015, What Is COP21/CMP11? 2015.

4. *Ibid.*, Kyoto Protocol, 2015.

5. United Nations, *Kyoto Protocol to the United Nations Framework Convention on Climate Change*, article 10, 1998.

6. *Ibid.*, Annex B.

3. What is meant by “climate change”?

According to the Intergovernmental Panel on Climate Change (IPCC), an organization that was set up in 1988 to analyze questions related to climate change, this term refers to “any change in climate over time, whether due to natural variability or as a result of human activity.”⁷

The UNFCCC’s definition is stricter and only includes changes linked directly or indirectly to human activity, therefore excluding natural changes to the climate.⁸

Whether or not the natural variability of the climate is included, climate change is measured by the long-term variation in the Earth’s average temperature and by variations in precipitation and wind patterns.

Although the media use the terms “climate change” and “global warming” interchangeably, there is a difference, since global warming refers solely to long-term increases in the average temperature of the Earth’s surface. The Industrial Revolution is used as a reference period for the measurement of anthropogenic warming (which is to say, warming caused by human beings).

“NASA estimates that the average temperature at the Earth’s surface has risen by 0.8°C since 1889, and that the impact of humans on the climate has surpassed natural changes to the climate.”

As for the term “climate change,” it includes the long-term variability of the Earth’s temperature, as well as that of precipitation and winds. The concept is therefore broader, and is the one generally preferred by the scientific community.⁹

4. Which factors are responsible for climate change?

Climate change is in part a natural phenomenon, influenced by solar energy, volcanic eruptions, changes in the Earth’s orbit, and oceanographic changes, among other things.

Humans are also responsible for climate change through activities like the combustion of fossil fuels, agriculture, and forestry, which emit GHGs. A greater concentration of GHGs in the atmosphere, by allowing sunlight to penetrate but absorbing a certain portion of the infrared radiation that bounces back from the Earth, contributes to an increase in the temperature at the Earth’s surface. The accumulation of GHGs and the corresponding temperature increase are then associated with climate changes like heavier precipitation in certain places.

According to the IPCC, human influence on the climate since 1750 is clear and has contributed to its warming.¹⁰ NASA estimates that the average temperature at the Earth’s surface has risen by 0.8°C since 1889, and that the impact of humans on the climate has surpassed natural changes to the climate. These last have made the temperature vary by an interval of -0.2°C to 0.2°C, according to NASA. Human activity, for its part, has contributed to an increase of 0.8°C.¹¹

5. Which GHG emissions are caused by human activity, and which sectors emit them?

Figure 1-1 shows the proportions of anthropogenic GHG emissions in Canada in 2013 by type of gas. The global proportions are similar. Note that 78% of the total consists of carbon dioxide (CO₂) emissions. These last come mostly from the combustion of fossil fuels. Methane, the second most significant anthropogenic GHG (15%), essentially comes from oil and natural gas systems, as well as domestic livestock and landfills.¹² Global proportions are similar.¹³

In 2013, 726 million tonnes of carbon dioxide equivalent (TCO₂e) were emitted in Canada. Figure 1-2 shows the proportions of GHG emissions attributed to each economic sector according to the IPCC’s classification.

6. What is a carbon footprint?

A carbon footprint is a measure estimating the total contribution of some unit (an activity, a company, a country) to global warming. A carbon footprint not only

7. Intergovernmental Panel on Climate Change (IPCC), *Contribution of Working Group II to the Fourth Assessment Report: Summary for Policymakers*, p. 21.

8. United Nations, *United Nations Framework Convention on Climate Change*, Article 1, 1992.

9. Anthony Leiserowitz et al., *What’s in a Name? Global Warming Versus Climate Change*, Yale Project on Climate Change Communication and George Mason University Center for Climate Change Communication, May 2014, p. 6; NASA, *What Are Climate and Climate Change?* October 26, 2011.

10. Richard B. Alley et al., “Summary for Policymakers,” in S. Solomon et al. (eds.), *Climate Change 2007: The Physical Science Basis, Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*, IPCC, 2007, p. 3.

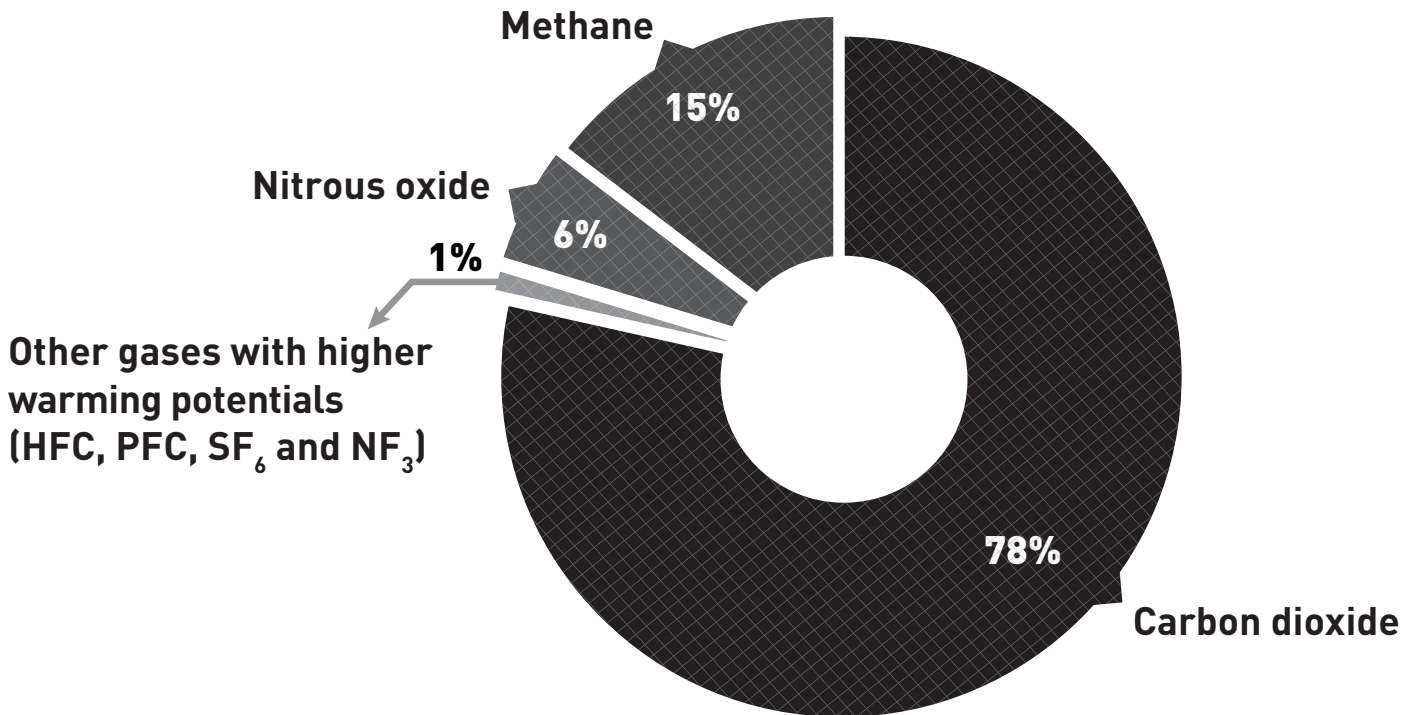
11. NASA Earth observatory, *Is Current Warming Natural?*

12. Environment Canada, *National Inventory Report 1990-2013: Greenhouse Gas Sources and Sinks in Canada – Executive Summary*, The Canadian Government’s Submission to the UN Framework Convention on Climate Change, 2015, p. 2.

13. United States Environmental Protection Agency, *Climate Change Indicators in the United States, Global Greenhouse Gas Emissions*, May 2014.

Figure 1-1

GHG emissions in Canada by type of gas, 2013



Source: Environment Canada, *National Inventory Report 1990-2013: Greenhouse Gas Sources and Sinks in Canada – Executive Summary*, The Canadian Government's Submission to the UN Framework Convention on Climate Change, 2015, p. 2.

includes the impact of carbon on the climate, but also the impact of all other GHGs. It is called a carbon footprint because the effect of each GHG is converted into the equivalent in terms of carbon dioxide, the main GHG emitted.

«Although Canada is not a major emitter compared to China and the United States, it is among the countries with the highest emissions per capita.»

The different greenhouse gases each have a different Global Warming Potential (GWP) calculated in relation to the warming impact of CO₂ over a certain period of time, usually 100 years. Two factors influence the Global Warming Potential of a GHG, namely its energy absorption capacity and the length of time that it remains in the atmosphere. For example, methane (CH₄) has a GWP of 25. This means that each tonne of CH₄ is equivalent to 25 tonnes of CO₂ (see Table 1-1).

7. How are a country's GHGs calculated?

According to the IPCC, "National inventories include greenhouse gas emissions and removals taking place within national territory and offshore areas over which the country has jurisdiction."¹⁴ For practical reasons, the IPCC includes only emissions from production.¹⁵

This is the method that was used for the Kyoto Protocol. There is also an approach based on consumption, which includes emissions from the consumption of imported goods.

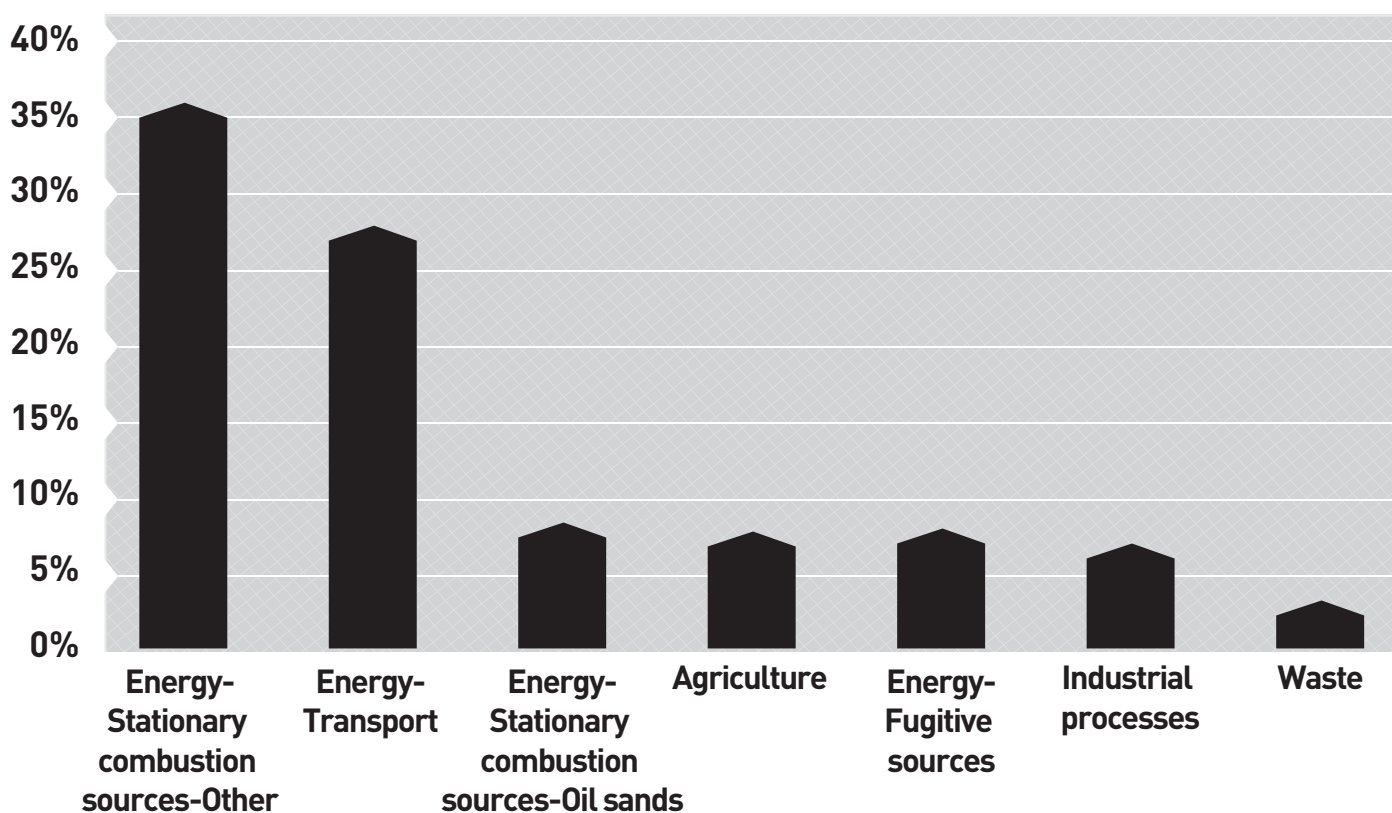
The method used has considerable repercussions on the emissions calculated. For example, the use of the production-based method allows industrialized countries to improve their emissions records by relocating produc-

14. For road transport, emissions are included where the fuel is sold. IPCC, *2006 IPCC Guidelines for National Greenhouse Gas Inventories – Volume 1: General Guidance and Reporting*, 2006, p. 1.4.

15. Baptiste Boitier, "CO₂ emissions production-based accounting vs consumption: Insights from the WIOD databases," Final WIOD Conference: Causes and Consequences of Globalization Groningen, April 2012, p. 2.

Figure 1-2

Proportions of GHG emissions by economic sector in Canada, 2013



Sources: Environnement Canada, "Oil Sands: A Strategic Resource for Canada, North America and the Global Market – GHG Emissions," 2015, p. 1; Environment Canada, *National Inventory Report 1990-2013: Greenhouse Gas Sources and Sinks in Canada – Executive Summary*, The Canadian Government's Submission to the UN Framework Convention on Climate Change, 2015, p. 5.

Table 1-1

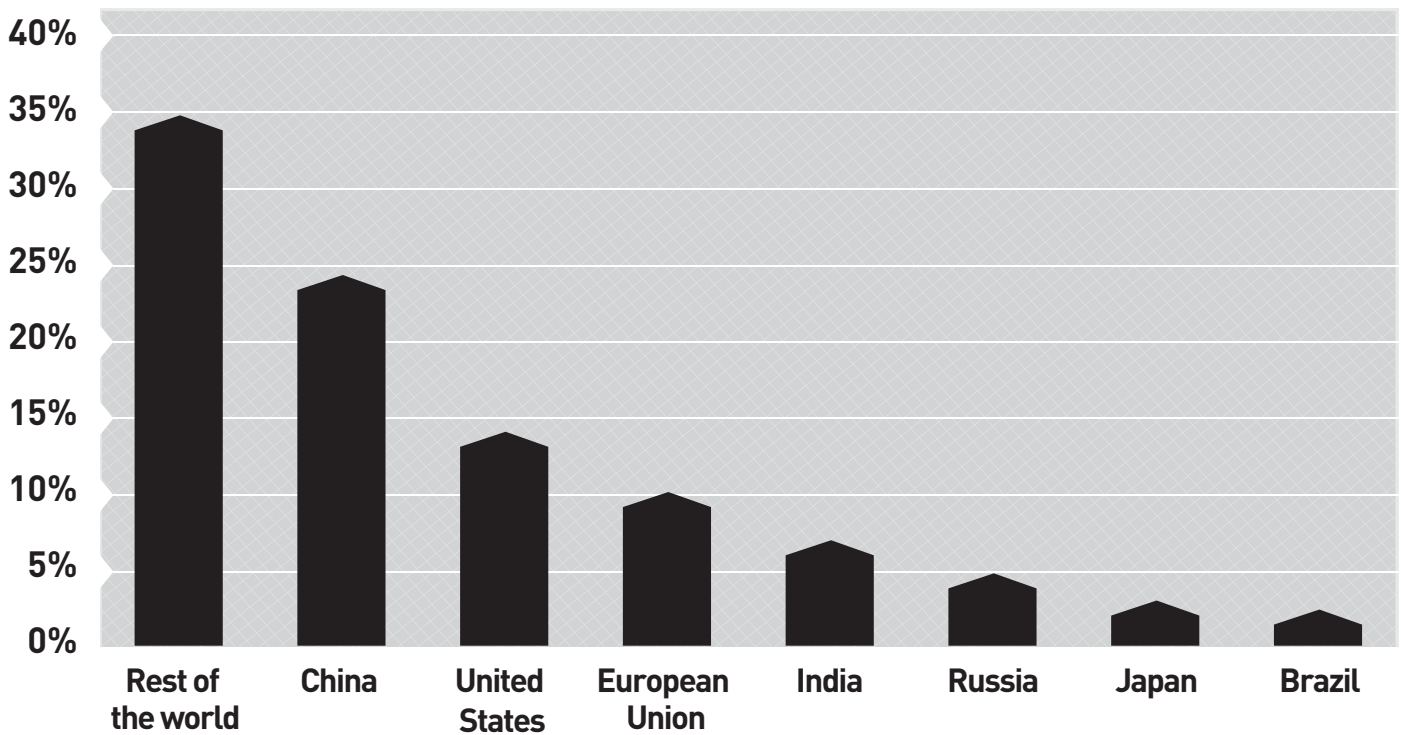
Global Warming Potential for the main GHGs emitted by human activity

GAS	GWP
Carbon dioxide (CO ₂)	1
Methane (CH ₄)	25
Nitrous oxide (N ₂ O)	298
Sulfur hexafluoride (SF ₆)	22,800
Nitrogen trifluoride (NF ₃)	17,200
Hydrofluorocarbons (HFC)	from 12 to 14,800
Perfluorocarbons (PFC)	from 7,390 to 17,340

Source: Environnement Canada, Global Warming Potentials, April 17, 2015.

Figure 1-3

Percentage of global GHG emissions, 2012



Source: World Resources Institute, CAIT – Historical Emissions Data (Countries, U.S. States, UNFCCC), Total GHG Emissions Excluding Land-Use Change and Forestry, June 22, 2015.

tion in emerging countries, without reducing their consumption. This “carbon leakage” decreases the effectiveness of local GHG reduction policies.¹⁶

8. How are global GHG emissions distributed?

The United States, the European Union, Japan, and the BRIC countries (Brazil, Russia, India, and China) are the main emitters of GHGs. Figure 1-3 shows the distribution of GHG emissions by country or region contributing

“Quebec is the province that emits the lowest amounts of GHGs per capita, thanks to its extensive production of hydroelectricity.”

more than 2% of global emissions. Canada, with just 1.59% of global emissions, is included in the “Rest of the world” category.

9. How does Canada compare with other countries in terms of GHG emissions?

Canadian GHG emissions grew by 26% from 1990 to 2012. However, as shown in Figure 1-4, this growth has stagnated since 2003.

Figures 1-5 and 1-6 demonstrate that although Canada is not a major emitter compared to China and the United States, it is among the countries with the highest emissions per capita, ahead of the United States and the European Union, among others.

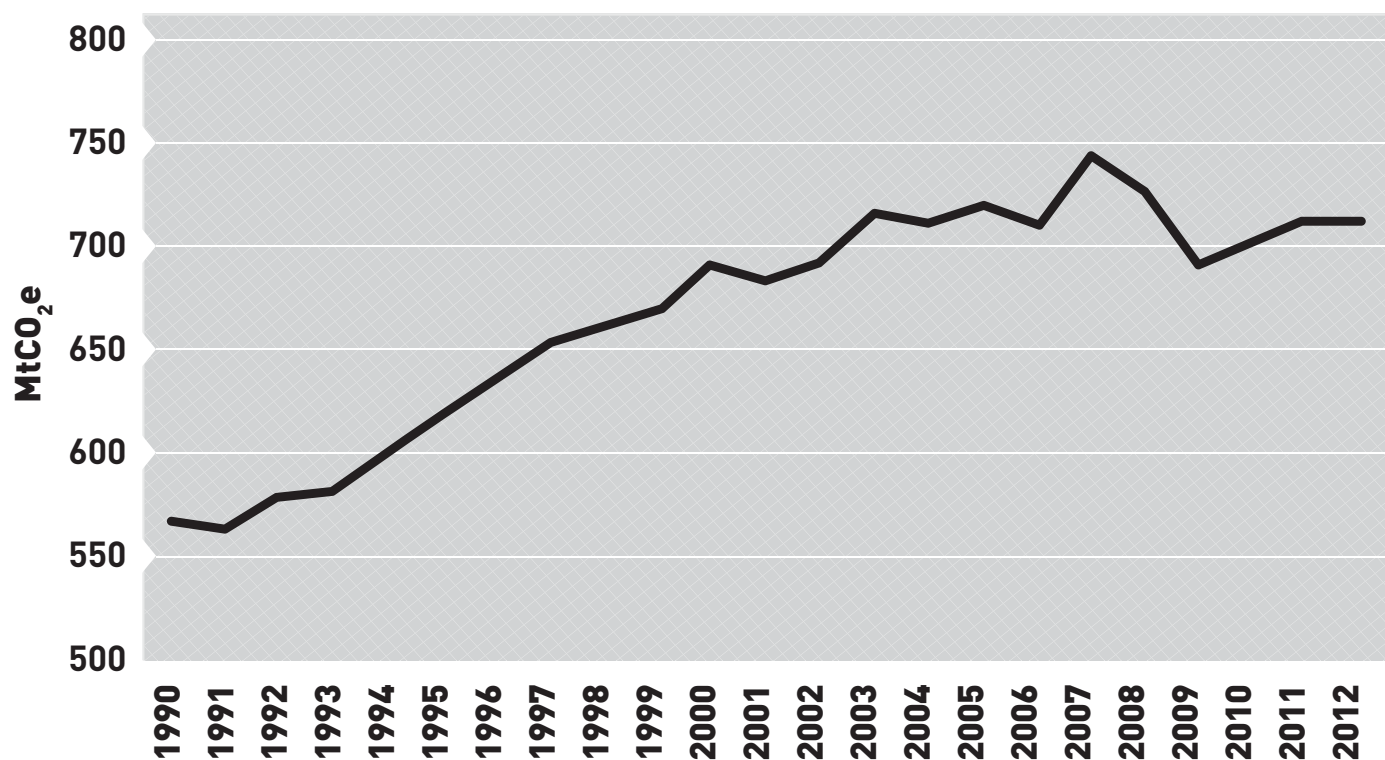
10. How do Canadian provinces fare in terms of GHG emissions per capita?

In 2013, the provinces that emitted the most GHGs per capita were Saskatchewan and Alberta, with 68 and 67 tonnes of CO₂ equivalent respectively. These elevated

16. Glen P. Peters et al., “Growth in emission transfers via international trade from 1990 to 2008,” *Proceedings of the National Academy of Sciences*, Vol. 108, No. 21, May 24, 2011, pp. 8903–8908.

Figure 1-4

GHG emissions in Canada in millions of tonnes of CO₂ equivalent, 1990-2012



Source: World Resources Institute, CAIT – Historical Emissions Data (Countries, U.S. States, UNFCCC), Total GHG Emissions Excluding Land-Use Change and Forestry, June 22, 2015.

figures are essentially due to the substantial amount of oil production in these two provinces. Indeed, 76% of oil produced in Canada is produced in Alberta, whereas Saskatchewan, which represents around 3% of the Canadian population, produces 15% of Canadian crude oil.¹⁷ Quebec is the province that emits the lowest amounts of GHGs per capita, at 10 tonnes of CO₂ equivalent, thanks to its extensive production of hydro-electricity (see Figure 1-7).

11. Why do we need to fight against climate change?

In the long term, higher temperatures entail risks of negative consequences for the environment, and so for human beings as well. Global warming could among other things cause extreme climatic events, more severe

droughts, floods, and rising sea levels. Such changes could in turn generate negative consequences in terms of food production, water supplies, and human health.

The negative impacts of climate change will be felt most acutely in developing countries, since their ability to adapt is much more limited, on account of their more limited wealth. Moreover, a larger proportion of their economic activity is concentrated in sectors like agriculture that are more sensitive to climate.

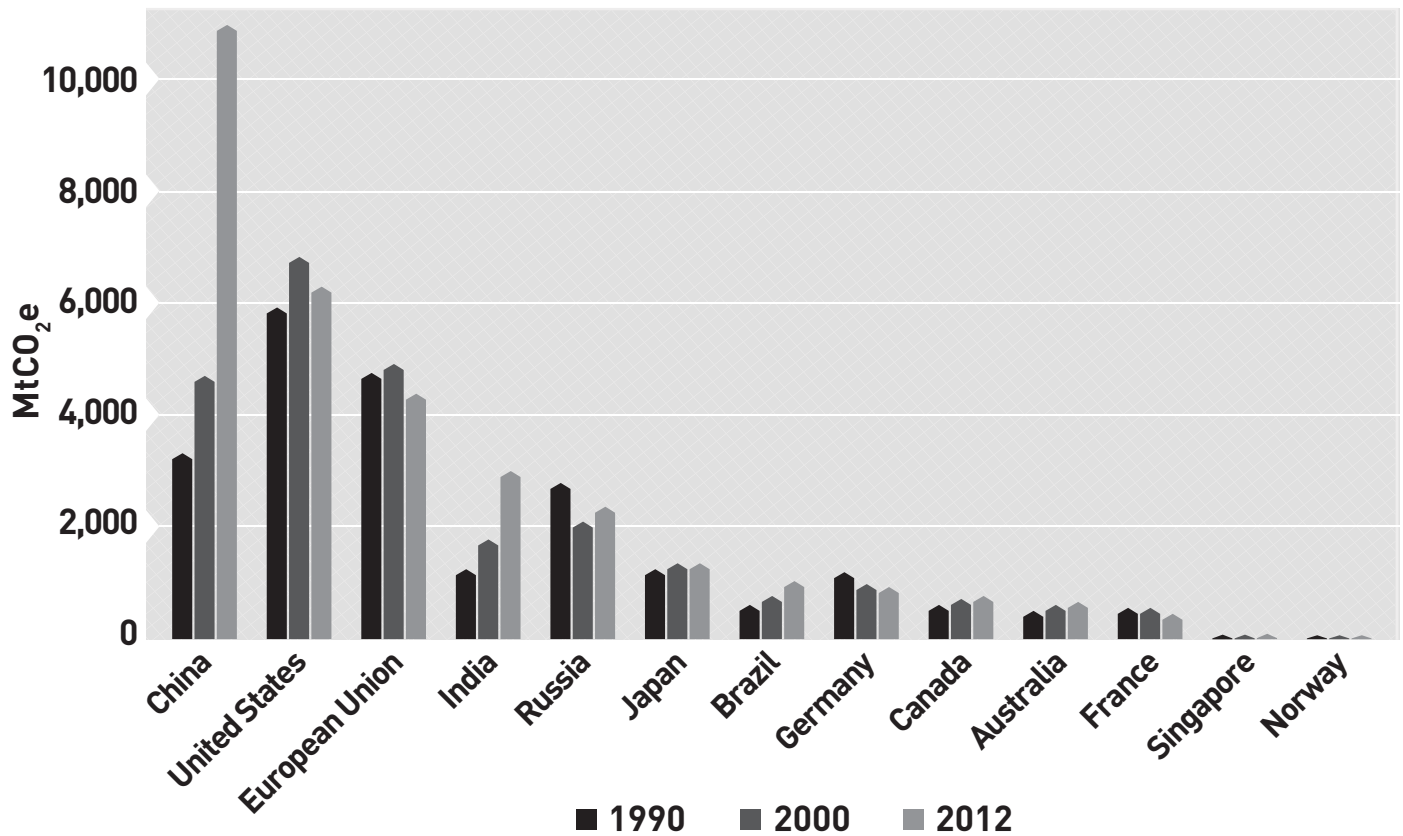
The effects of climate change are not exclusively negative. A higher concentration of CO₂ in the atmosphere reduces the water requirements of plants, thereby allowing for faster growth and increased crop yields. Another benefit is reduced heating costs and cold-related health problems, which entail 17 times more deaths than heat-related health problems.¹⁸

17. Statistics Canada, CANSIM Table 051-0001: Estimates of population, by age group and sex for July 1, Canada, provinces and territories, 2012; Statistics Canada, CANSIM Table 126-0001: Supply and disposition of crude oil and equivalent, annual (cubic metres), 2012.

18. Antonio Gasparri et al., "Mortality Risk Attributable to High and Low Ambient Temperature: A Multicountry Observational Study," *The Lancet*, Vol. 386, No. 9991, 2015, pp. 369-375.

Figure 1-5

GHG emissions by country, millions of tonnes of CO₂ equivalent



Source: World Resources Institute, CAIT – Historical Emissions Data (Countries, U.S. States, UNFCCC), Total GHG Emissions Excluding Land-Use Change and Forestry, June 22, 2015.

Certain cost-benefit analyses estimate that global warming on the order of 1°C to 2°C would be beneficial to humanity. In the long term, the negative effects of warming greater than this interval, however, would exceed the benefits.¹⁹

“The negative impacts of climate change will be felt most acutely in developing countries, since their ability to adapt is much more limited, on account of their more limited wealth.”

In order to avoid the potential negative long-term effects of climate change, the UNFCCC member states determined that global warming would have to be limited to 2°C.²⁰

12. What is the objective of the Paris Conference?

The goal of the Paris Conference is “to achieve a new international agreement on the climate, applicable to all countries, with the aim of keeping global warming below 2°C.”²¹

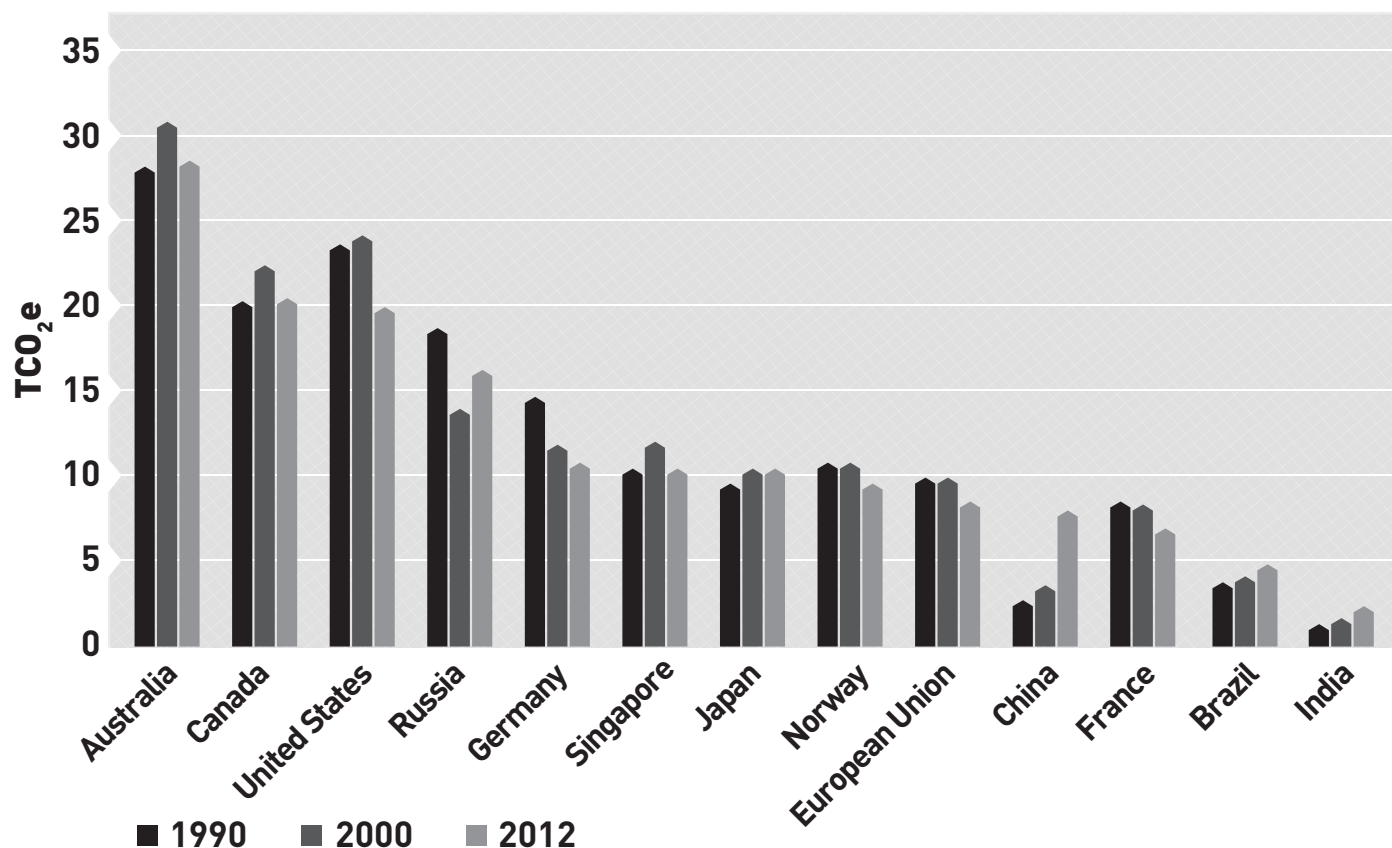
According to existing climate models, the attainment of this objective depends on substantially modifying the composition of the energy used around the world. The International Energy Agency estimates that in 2012, oil,

19. Richard S. J. Tol, “The Economic Effects of Climate Change,” *Journal of Economic Perspectives*, Vol. 23, No. 2, 2009, p. 35; Richard S. J. Tol, *Economic Impacts of Climate Change*, Economics Department, University of Sussex, Working Paper Series, No. 75-2015, 2015.

20. Paris 2015, *op. cit.*, footnote 3.
21. *Idem.*

Figure 1-6

GHG emissions per capita, tonnes of CO₂ equivalent



Sources: World Resources Institute, CAIT – Historical Emissions Data (Countries, U.S. States, UNFCCC), Total GHG Emissions Excluding Land-Use Change and Forestry, June 22, 2015; World Bank, Data, Total Population, September 24, 2015.

coal, and natural gas represented nearly 82% of primary energy produced.²² The global economy will need to have a negative carbon balance by the year 2100 if we want to achieve the 2°C goal, which means that more CO₂ will need to be absorbed by carbon sinks (like the oceans), and removed from the atmosphere using various technologies, than the amount of CO₂ that is emitted.

According to the IPCC, the concentration of GHGs in the atmosphere will need to stabilize between 430 and 480 parts per million of CO₂ equivalent by the year 2100.²³ Excluding the other GHGs, this means around

400 parts per million of CO₂.²⁴ In August 2015, the atmospheric concentration of CO₂ was already close to this limit, at 396.86 parts per million.²⁵ Figure 1-8 shows the progression of the world’s atmospheric CO₂ since 1980, as compiled by the Earth System Research Laboratory.

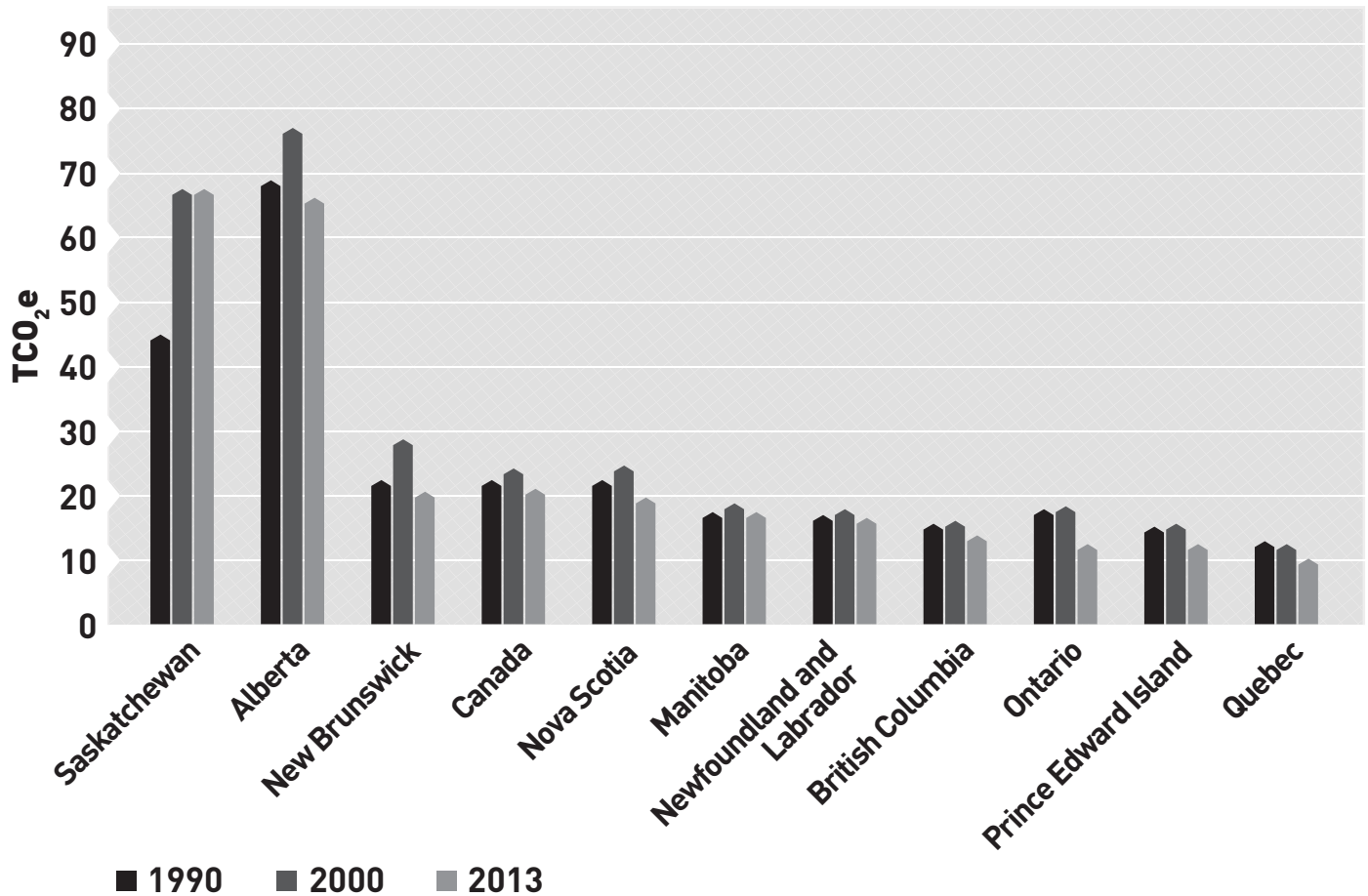
“Certain cost-benefit analyses estimate that global warming on the order of 1°C to 2°C would be beneficial to humanity.”

22. International Energy Agency, *Key World Statistics 2014*, 2014, p. 6.
 23. Ottmar Edenhofer et al., “Summary for Policymakers,” in Ottmar Edenhofer et al. (eds.), *Climate Change 2014: Mitigation of Climate Change, Contribution of Working Group III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*, IPCC, 2014, p. 13.

24. Oceans at MIT, News, 400 ppm CO₂? Add Other GHGs, and it’s Equivalent to 478 ppm, June 6, 2013.
 25. Earth System Research Laboratory, Trends in Atmospheric Carbon Dioxide, Recent Global CO₂, October 9, 2015.

Figure 1-7

GHG emissions per capita, Canadian provinces, tonnes of CO₂ equivalent



Sources: Government of Canada, National and Provincial/Territorial Greenhouse Gas Emission Tables, 1990-2013, August 24, 2015; Statistics Canada, CANSIM Table 051-0001: Estimates of population, by age group and sex for July 1, Canada, provinces and territories, 1990-2013.

13. What reduction in emissions would we need to achieve in order to respect the 2°C target?

On account of the long atmospheric lifetime of CO₂, the level of accumulated CO₂ emissions already in the atmosphere plays an important role in determining the average temperature at the Earth’s surface for decades to come.

The “carbon budget,” or “emissions budget,” represents the threshold of CO₂ emissions accumulated since the pre-industrialized period that must not be exceeded between now and 2100 in order to respect a given target temperature. Of the different models used by the IPCC, most estimate that the carbon budget allowing us

to respect the 2°C limit is 2,900 billion tonnes of CO₂. In 2011, emissions had already used up around two thirds of the carbon budget.²⁶

These models estimate that the cumulative CO₂ emissions remaining if the budget is to be respected for the period from 2012 to 2100 must be limited to between 630 billion and 1,180 billion tonnes of CO₂.²⁷ Given the current rate of reductions of GHG emissions based on existing policies, the carbon budget could be exhausted by around 2034.²⁸

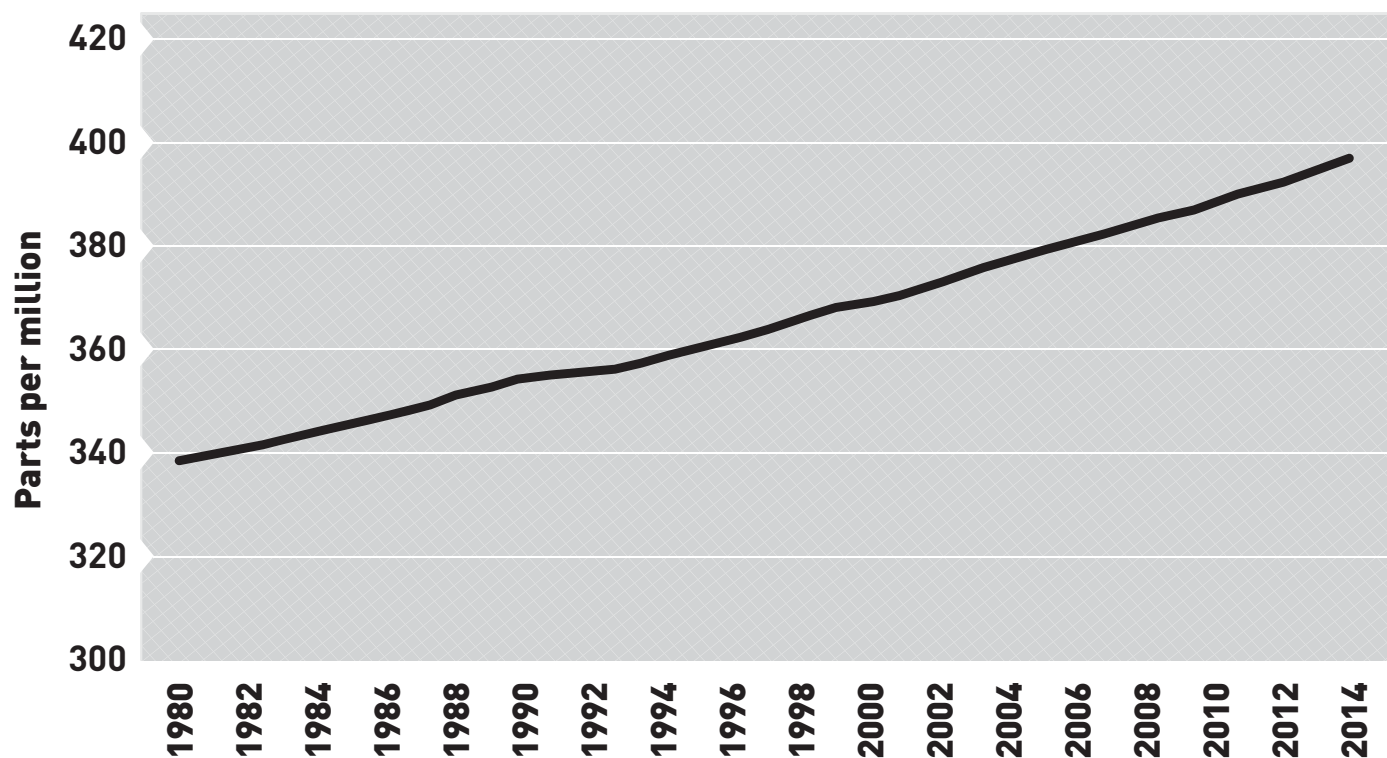
26. United Nations Environment Programme, *The Emissions Gap Report 2014: A UNEP Synthesis Report*, November 2014, p. 2.

27. *Idem*.

28. Price Waterhouse Cooper, IPCC carbon budget to 2100 will be used by 2034 according to PwC analysis, Press release, November 14, 2013.

Figure 1-8

Global atmospheric concentration of CO₂, 1980-2014



Source: Earth System Research Laboratory, Trends in Atmospheric Carbon Dioxide, Globally averaged marine surface annual mean data, October 5, 2015.

It is, however, possible to respect the 2°C limit even while temporarily exceeding the carbon budget in the short run. However, this excess must subsequently be compensated for (sometime around 2065) with a negative global carbon balance. Such a scenario is achievable if anthropogenic GHG emissions are at a certain point more than compensated for by the absorption of carbon associated with reforestation and by the capture and storage of CO₂.

Table 1-2 illustrates the evolution of net emissions through to the end of the 21st century that is required by the carbon budget in order to have a greater than 66% probability of respecting the 2°C limit.

Another method used by the IPCC to illustrate the same goal emphasizes achieving an atmospheric concentration target of 430 to 480 parts per million of CO₂ equivalent by 2100. The different scenarios in which there are no extra efforts on the part of governments to reduce GHG emissions arrive at an atmospheric concen-

tration of 450 parts per million of CO₂ equivalent by 2030, and at concentrations varying from 750 to 1,300 parts per million of CO₂ equivalent by 2100.²⁹

Stabilizing the amount of warming at 2°C implies a substantial reduction in anthropogenic GHG emissions between now and 2050. At that time, in addition to significant energy efficiency gains, we will have to get from three to four times more of our energy from renewable sources, from nuclear power, and from biofuels, or from fossil fuels paired with carbon capture and storage.

“Even though the first global climate conference was held over 35 years ago, CO₂ emissions from the consumption of fossil fuels have not stopped increasing since then.”

29. Ottmar Edenhofer et al., *op. cit.*, footnote 22, p. 8.

Table 1-2

Net emissions required to respect the 2°C limit with a greater than 66% probability, gigatonnes of CO₂

PERIOD	2015-2025	2025-2050	2050-2075	2075-2100
Net emissions for each period	370	506	48	-299

Source: This is a median based on 19 different scenarios. United Nations Environment Programme, *The Emissions Gap Report 2014: A UNEP Synthesis Report*, November 2014, p. 15.

Table 1-3

Maximum annual global emissions and changes compared to emissions in 1990 and 2010 in order to respect the 2°C limit with a greater than 66% probability, gigatonnes of CO₂ equivalent

YEAR	1990	2010	2020	2025	2030	2050	2100
Level (GtCO ₂ e)	37	49	52	47	42	22	-3
Change compared to 1990			+41%	+27%	+14%	-40%	-108%
Change compared to 2010			+6%	-4%	-14%	-55%	-106%

Source: This is a median based on 18 different scenarios. Authors' calculations. United Nations Environment Programme, *The Emissions Gap Report 2014: A UNEP Synthesis Report*, November 2014, pp. xvi and 16.

Between 2040 and 2070, the energy sector's emissions will have to be reduced by 90% compared to the 2010 level.³⁰

Table 1-3 illustrates the GHG reductions required in the 21st century in order to respect the 2°C goal.

14. How have GHG emissions evolved since the first global warming conferences were held?

Even though the first global climate conference was held over 35 years ago, CO₂ emissions from the consumption of fossil fuels have not stopped increasing since then. They rose by 84% from 1980 to 2014. For the 2000-2010 period, they rose twice as fast as they had in any other decade since 1970.³¹

Table 1-4 and Figure 1-9 illustrate the progression of CO₂ emissions from the consumption of fossil fuels.

"Non-OECD members were responsible for just 46% of emissions in 1990, compared to a projected share of nearly 70% in 2040."

15. Have the Kyoto Protocol targets been respected?

According to preliminary figures, global greenhouse gas emissions for countries participating in the Kyoto Protocol were reduced by 22.6% compared to the reference year, 1990.³² The overall target was substantially

30. *Ibid.*, pp. 12 and 18.
 31. BP, Data workbook – Statistical Review 2015, Carbon Dioxide Emissions (from 1965), June 2015.

32. United Nations Framework Convention on Climate Change, "The Kyoto Protocol - A Critical Step Forward: Emissions of Countries with Targets Fell Faster than Expected," February 13, 2015, p. 1.

Table 1-4

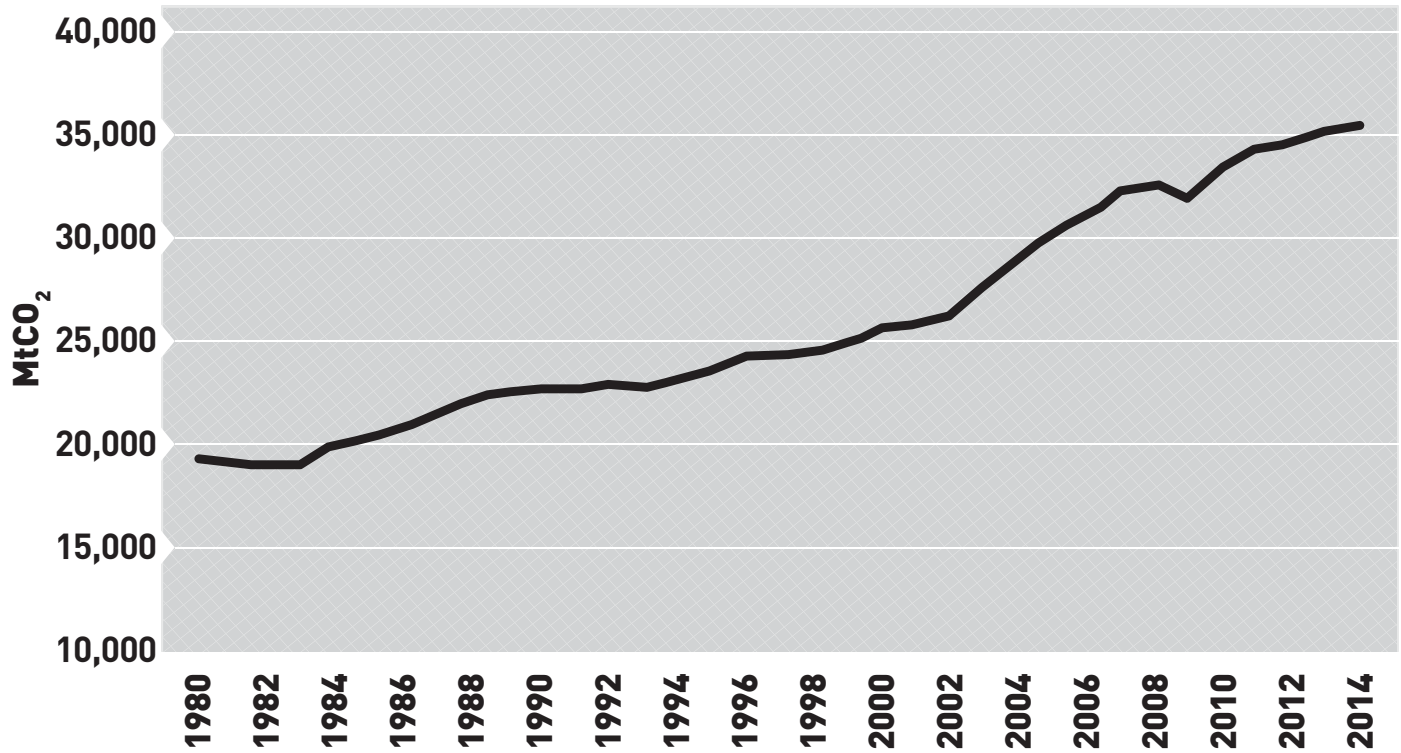
CO₂ emissions from the consumption of fossil fuels

YEAR	UNFCCC	OTHER CONFERENCES AND IMPORTANT EVENTS	CO ₂ EMISSIONS FROM THE CONSUMPTION OF FOSSIL FUELS (MTCO ₂)
1979		1 st global climate conference in Geneva	19,517
1988		Creation of the IPCC	22,154
1989		2 nd global climate conference in The Hague	22,564
1990		1 st IPCC report	22,699
1992		Earth Summit in Rio de Janeiro	22,863
1995	Berlin	2 nd IPCC report	23,564
1996	Geneva		24,185
1997	Kyoto	2 nd Earth Summit in New York: Earth Summit +5	24,423
1998	Buenos Aires		24,510
1999	Bonn		24,853
2000	The Hague		25,501
2001	Bonn and Marrakech	3 rd IPCC report	25,825
2002	New Delhi		26,436
2003	Milan		27,718
2004	Buenos Aires		29,144
2005	Montreal	Kyoto Protocol comes into effect	30,279
2006	Nairobi	1 st meeting of the Asia-Pacific Partnership on Clean Development and Climate in Sydney	31,187
2007	Bali	4 th IPCC report	32,307
2008	Poznan	Adoption of the "climate and energy package" by the European Council	32,597
2009	Copenhagen		32,004
2010	Cancun		33,471
2011	Durban		34,413
2012	Doha	Rio Conference on Sustainable Development or Rio+20	34,819
2013	Warsaw		35,312
2014	Lima (COP20)	New York: Climate Summit 2014 – Catalyzing Action 5 th IPCC report	35,499

Sources: BP, Data workbook – Statistical Review 2015, Carbon Dioxide Emissions (from 1965), June 2015; United Nations Framework Convention on Climate Change, Meetings; United Nations, Climate Summit 2014: Catalyzing Action, FAQs; Intergovernmental Panel on Climate Change, Fifth Assessment Report.

Figure 1-9

Global CO₂ emissions from the consumption of fossil fuels, 1980-2014, millions of tonnes of CO₂



Source: BP, Data workbook – Statistical Review 2015, Carbon Dioxide Emissions (from 1965), June 2015.

surpassed, but this is not the case for each of the participating countries. Figure 1-10 shows the GHG emissions gap in percentages compared to the initial target.

In Canada, none of the provinces has respected the Canadian GHG reduction target, which was 6% below the 1990 level for the 2008-2012 period. Quebec only exceeded the target by 1%, however, whereas Saskatchewan exceeded it by 66% (see Figure 1-11).

16. Was the Kyoto Protocol a success or a failure?

The fact that an agreement involving a large number of parties with diverging interests was concluded at all is itself a success—even more so given that the overall reduction target was respected.³³

However, the impact on total emissions and temperature, which was the ultimate goal, was marginal. Global CO₂ emissions from the consumption of fossil fuels were 53% higher in 2012 than they were in 1990.³⁴ In the hypothetical situation in which all countries had adopted the Kyoto Protocol, it is estimated that the increase in atmospheric temperature would have been just 0.004°C lower by the end of the 21st century.³⁵

The Kyoto Protocol required efforts from industrialized countries only, even though emerging and developing countries are responsible for a growing share of emissions. Non-OECD members were responsible for just 46% of emissions in 1990, compared to a projected share of nearly 70% in 2040 (see Figure 1-12).

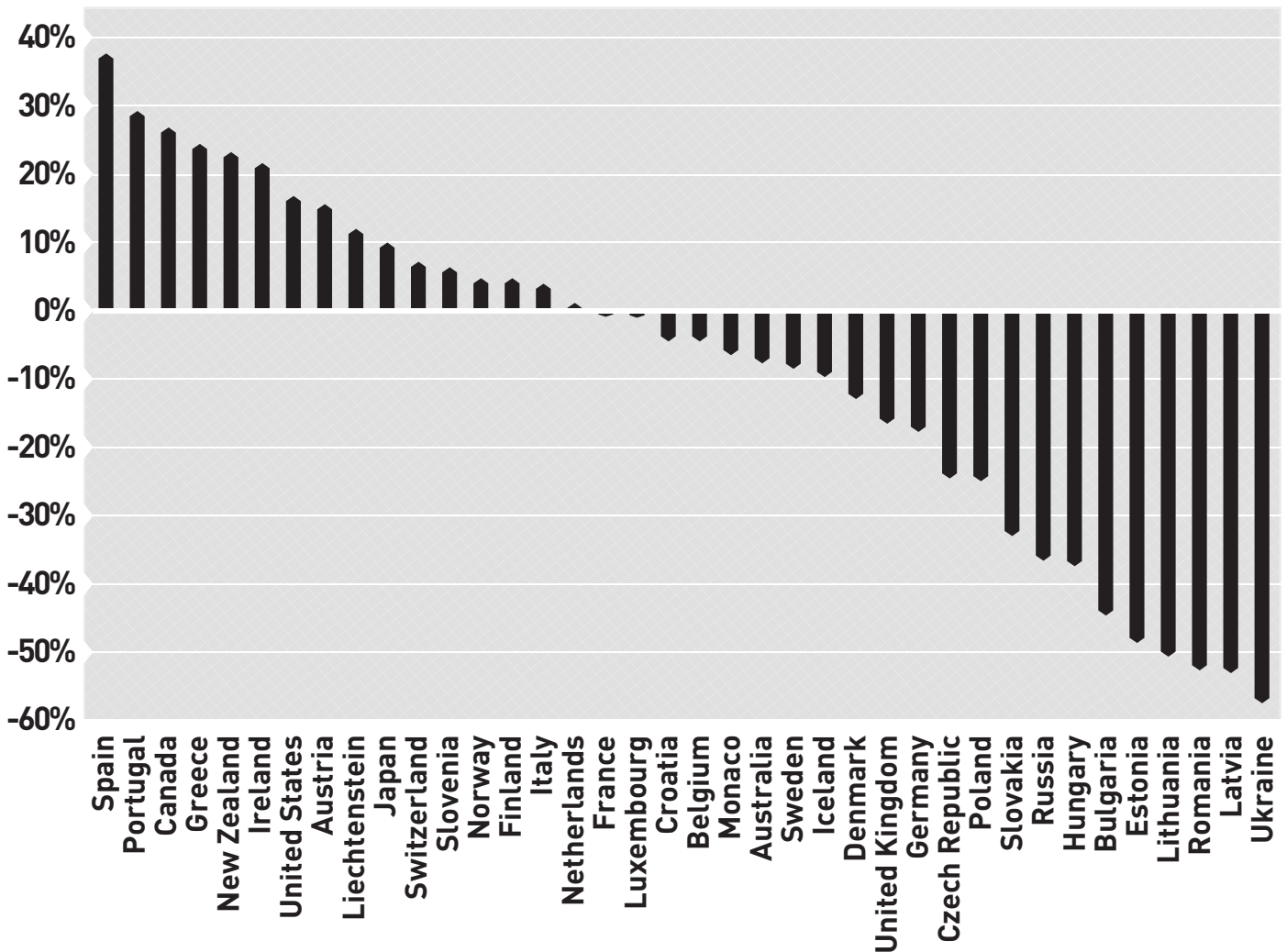
33. In order to evaluate the effectiveness of the Kyoto Protocol in real terms, it would be necessary to determine if it led to the meeting of the targets, or if these would have been met anyway without an agreement. Among other things, one would have to take into account the impact of the 2008-09 economic crisis and the collapse of the Eastern Bloc.

34. BP, Data workbook – Statistical Review 2015, Carbon Dioxide Emissions (from 1965), June 2015.

35. Bjørn Lomborg, “Examining the Threats Posed by Climate Change: The Effects of Unchecked Climate Change on Communities and the Economy,” The Senate EPW Committee, Subcommittee on Clean Air and Nuclear Safety, July 29, 2014, p. 15.

Figure 1-10

Gap between actual emissions and Kyoto Protocol GHG reduction objectives



Note: The United States are not part of the Kyoto Protocol, while Canada withdrew from it in 2012. We have included them for purposes of comparison.

Sources: Authors' calculations. United Nations, *Kyoto Protocol to the United Nations Framework Convention on Climate Change*, article 3, 1998; United Nations Framework Convention on Climate Change, *Kyoto Protocol Reference Manual on Accounting of Emissions and Assigned Amount*, 2008, p. 55; United Nations Framework Convention on Climate Change, *Time series - Annex I, Data for greenhouse gas (GHG) total*.

Furthermore, the United States, the biggest emitter through to the middle of the 2000s, did not ratify the Protocol. For its part, Canada officially withdrew from the Protocol in 2012.³⁶

Given that the Kyoto Protocol's objective was reducing overall emissions, these factors substantially qualify its merits.

17. What progress has been made since the Kyoto Protocol?

Since the ratification of the Kyoto Protocol, some small progress has been made in international negotiations. The main ones are:

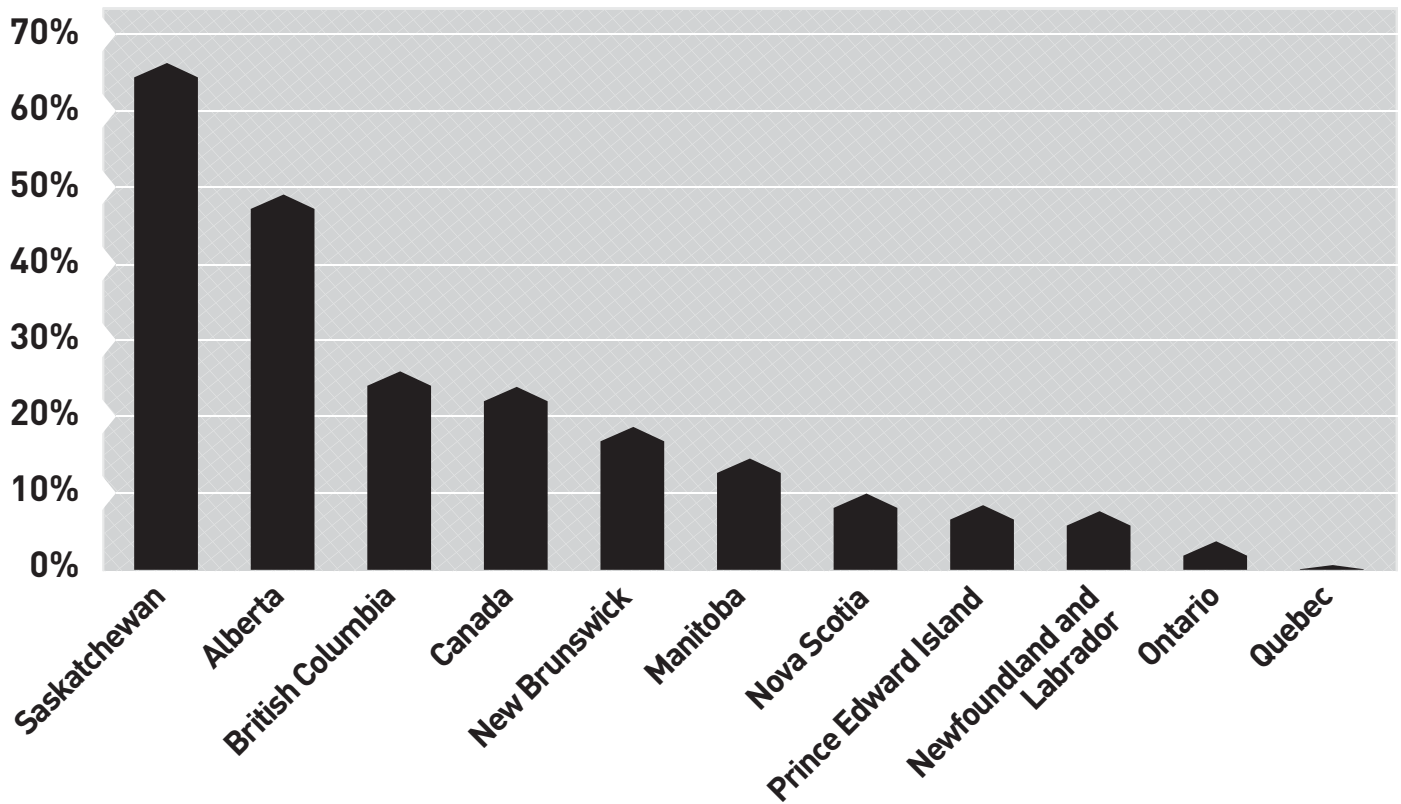
- **The Copenhagen Accord (2009)**

Just as the 2015 Paris Conference seems crucial for reaching an international accord aiming to reduce emissions after 2020, the 2009 Copenhagen Conference

36. United Nations, "C.N.796.2011.TREATIES-1 (Depositary Notification), Canada: Withdrawal," December 16, 2011.

Figure 1-11

Gap between actual emissions and Canada’s Kyoto Protocol GHG reduction objectives



Sources: Government of Canada, National and Provincial/Territorial Greenhouse Gas Emission Tables, 1990-2013, August 24, 2015; United Nations, *Kyoto Protocol to the United Nations Framework Convention on Climate Change*, Annex B, 1998.

represented a cut-off date for reaching an international accord to extend the Kyoto Protocol after its expiration in 2012.

Negotiations did not achieve the hoped-for outcome, since the Copenhagen Accord, approved by 141 parties, is not binding.³⁷ The participants made voluntary commitments to reduce or limit emissions until 2020.

“Without more ambitious GHG emission reductions, the temperature will have climbed 2.6°C by 2100, and 3.5°C over the longer term.”

The conference nonetheless gave rise to two ideas that remain crucial in the context of the negotiations leading up to 2015’s COP21. The first is the precise definition of the objective to be reached, namely limiting long-term global warming to 2°C. The second is the importance of including developing countries in reduction efforts and the financial commitment of industrialized countries to facilitate this transition through the Green Climate Fund.³⁸

• **The Durban Conference (2011)**

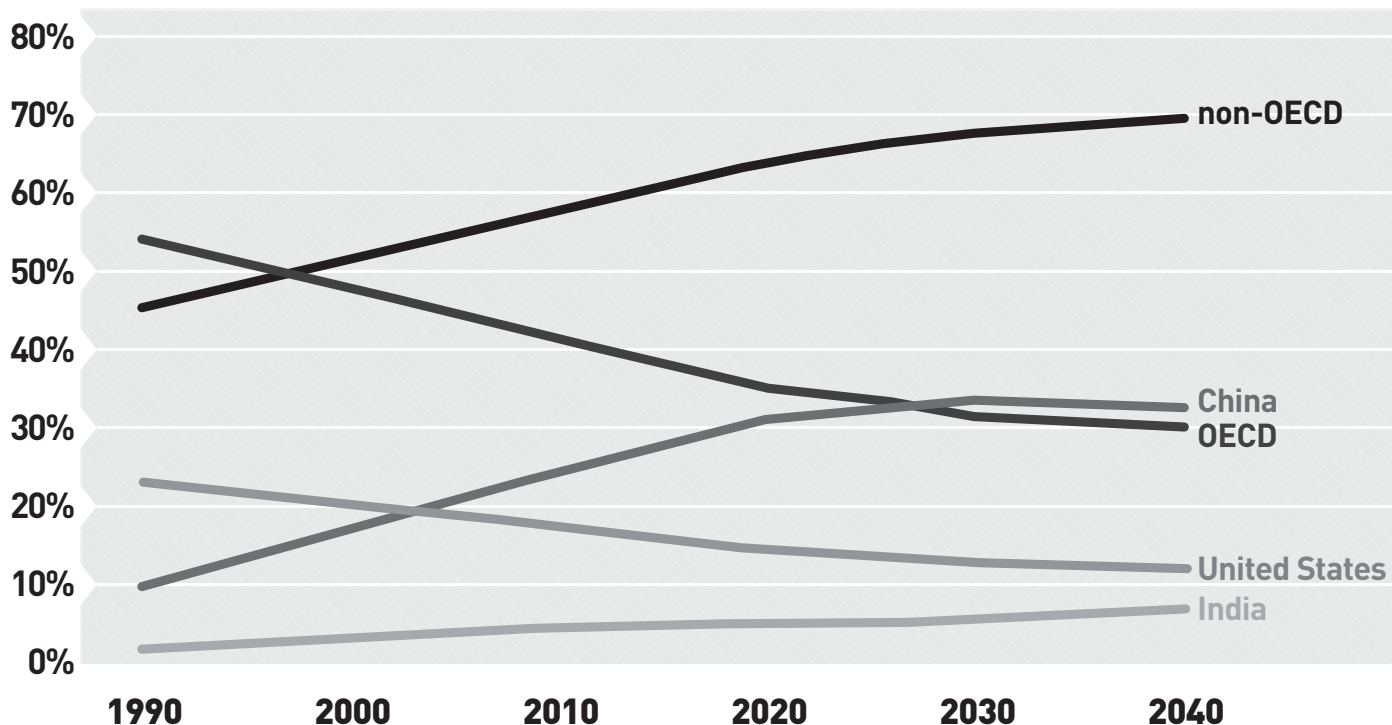
The importance that is accorded to the Paris Conference stems from a decision made during the 2011 Durban Conference to hold international negotiations in order to arrive at a binding agreement by 2015.³⁹

37. United Nations Framework Convention on Climate Change, Copenhagen Accord; United Nations, UN and Climate Change, Towards a climate agreement.

38. United Nations Framework Convention on Climate Change, “Draft decision -/CP.15,” Conference of the Parties: Fifteenth Session, December 18, 2009.
39. United Nations Framework Convention on Climate Change, Ad Hoc Working Group on the Durban Platform for Enhanced Action (ADP).

Figure 1-12

Proportion of emissions for OECD countries, non-OECD countries, the United States, China, and India, 1990-2040



Note: In the absence of compatible data for the year 2000, we extrapolated a linear trend to complete the series.
Source: U.S. Energy Information Administration, *International Energy Outlook 2013: With Projections to 2040*, July 2013, p. 162.

• **The Doha Conference (2012)**

The Doha Conference negotiations led to a commitment by 38 parties to a second round of the Kyoto Protocol, for the 2013-2020 period,⁴⁰ while waiting for a new binding agreement, which would be signed in Paris in 2015, to come into effect. The emissions of the signatories represent just 14% of global emissions.⁴¹

• **The Lima Conference (2014)**

The countries each agreed to submit an Intended Nationally Determined Contribution (INDC) in 2015, before the Paris Conference. INDCs are proposed action plans for each country detailing emission reduction efforts for the post-2020 period.⁴²

18. What are the main national commitments and international accords that will serve as the basis for negotiations at the Paris Conference?

At the end of 2014, China and the United States, the two biggest emitters of carbon on the planet accounting for 40% of total emissions, concluded a climate agreement. The United States committed itself to reduce GHG emissions by 26% to 28% compared to its 2005 level by 2025. China, for its part, committed to having its GHG emissions peak in 2030, and to having the share of its energy not coming from fossil fuels climb to 20%.⁴³

At a G7 meeting in June 2015, the United States, Germany, Japan, France, Canada, Italy, and the United Kingdom committed to transforming their energy sec-

40. United Nations Framework Convention on Climate Change, Kyoto Protocol.
 41. European Commission, Doha Climate Change Conference (COP18/CMP8), December 2012.
 42. United Nations Framework Convention on Climate Change, "Lima Call for Climate Action Puts World on Track to Paris 2015," Press release, December 14, 2015.

43. The White House Office of the Press Secretary, "FACT SHEET: U.S.-China Joint Announcement on Climate Change and Clean Energy Cooperation," Press release, November 11, 2014.

tors by 2050 in order to help reduce global GHG emissions by 40% to 70% compared to 2010 and to achieve carbon neutrality by 2100.⁴⁴

On August 3, 2015, the President of the United States unveiled the “Clean Power Plan,” which is a detailed action plan to allow the country to achieve its GHG reduction goals. The plan essentially rests on the imposition of pollution standards on power plants. New objectives were also announced: By 2030, GHG emissions must have been reduced to 32% below 2005 levels.⁴⁵

In 2014, the European Union had concluded an accord to reduce emissions to 40% below their 1990 level by 2030.⁴⁶ In September 2015, the European Union’s 28 Environment Ministers confirmed their commitment by targeting the year 2020 as a peak for their emissions, and 2050 for a 50% reduction below their 1990 level.⁴⁷

“Governments have an incentive to behave like free riders, to benefit from the GHG reductions of others without themselves contributing to reduction efforts that would impose costs on their citizens.”

While these agreements seem encouraging, they only represent the contributions already proposed, which are insufficient for respecting the 2°C limit, as we shall see at Question 19. Moreover, it is quite possible that the agreements represent trends that the leaders of the various countries think they will be able to achieve with little effort. For instance, a study from the China Academy of Social Sciences estimates that the slowing down of the rate of urbanization in China means that emissions should naturally reach a peak around 2025 or 2030.⁴⁸

19. Will the proposed Intended Nationally Determined Contributions (INDCs) be sufficient?

Climate Action Tracker, a team made up of several independent scientific organizations, analyzed the INDCs submitted as of October 1st, 2015. The countries covered by the analysis represented 71% of global emissions. According to the group, expected GHG emissions in 2030 would need to be reduced by 30% in order to have a 66% probability of respecting the 2°C limit, without which the global temperature will have increased 2.7°C by 2100.⁴⁹

The International Energy Agency came to a similar conclusion, looking at the INDCs that had been submitted as of May 14, 2015 in order to evaluate the impact of the proposed efforts on the climate. Without more ambitious GHG emission reductions, the temperature will have climbed 2.6°C by 2100, and 3.5°C over the longer term. To reach the 2°C target, the Agency estimates that CO₂ emissions would already have to start falling in 2020, whereas it projects that they will still be growing in 2030 according to the proposed INDCs.⁵⁰

The United Nations also deems that the INDCs proposed as of October 1st will be insufficient to respect the two degree target with a probability of 66%. They estimate that global emissions would be 19% higher in 2020 and 35% too high in 2030 if the INDCs were respected to the letter.⁵¹

20. Why is a global agreement so difficult to achieve?

The negative externalities from activities that emit GHGs are not borne solely by the citizens of the countries where they are emitted, since they are exported to neighbouring countries, and to the rest of the planet as well. Similarly, the benefits of reducing GHGs are not enjoyed solely in the country that implements mitigation policies, but by people in all countries. Governments therefore have an incentive to behave like free riders,

44. “Why the G7 is talking about decarbonisation,” *The Economist*, June 10, 2015.

45. The White House, Climate Change and President Obama’s Action Plan.

46. These are the targets they submitted to the UNFCCC as INDCs. See Latvian Presidency of the Council of the European Union, “Submission by Latvia and the European Commission on Behalf of the European Union and its Member States,” March 6, 2015, p. 1; Arthur Neslen, “EU leaders agree to cut greenhouse gas emissions by 40% by 2030,” *The Guardian*, October 24, 2014.

47. Barbara Lewis, “EU ministers unite on climate mandate ahead of Paris summit,” Reuters, September 18, 2015.

48. David Stanway, “UPDATE 3-China, US agree limits on emissions, but experts see little new,” Reuters, November 12, 2014.

49. Johannes Gütschow et al., “INDCs lower projected warming to 2.7°C: significant progress but still above 2°C,” Climate Action Tracker, October 1, pp. 1 and 5.

50. International Energy Agency, *World Energy Outlook Special Report 2015: Energy and Climate Change*, 2015, pp. 12 and 13.

51. United Nations, *Synthesis Report on the Aggregate Effect of the Intended Nationally Determined Contributions*, United Nations Framework Convention on Climate Change, Report of the Ad Hoc Working Group on the Durban Platform for Enhanced Action, October 30, 2015.

which is to say, to benefit from the GHG reductions of others without themselves contributing to reduction efforts that would impose costs on their citizens.

In order to eliminate this incentive and ensure that all countries live up to their commitments, it is logical to try to establish a binding international agreement that would impose penalties for missing targets. The need for an agreement to be binding, however, reduces the chances of signing one, since countries prefer voluntary, non-binding reduction targets.

The differing economic contexts of different countries also make the signing of a binding agreement very difficult. The principle of “common but differentiated responsibility,” which recognizes that all countries have a role to play but which takes into account the particularities of each, is a good illustration of the divergent interests of industrialized and developing countries.

Industrialized countries, which are responsible for the majority of GHG emissions to date, will have less impact in the future since the proportion of emissions from less developed countries is growing. Moreover, the impact of the climate change so far caused by the emissions of industrialized countries will be disproportionately felt in developing countries. Their lower adaptive capacity, which is proportional to wealth levels, makes them more vulnerable.

“Poorer countries demand targets that are adapted to their situation, as well as financial support for their energy transition.”

Industrialized countries will not sign a binding agreement without a non-negligible contribution from those who will have high growth rates in the coming years. For their part, poorer countries demand targets that are adapted to their situation, as well as financial support for their energy transition, since their current wealth levels do not allow them to forgo the affordable energy supplied by fossil fuels.

“Climate finance” is the solution envisioned. It allows for the transfer of financial resources from industrialized to developing countries for the mitigation of, and adaptation to, climate change.

Certain mechanisms, like the Adaptation Fund and the Clean Development Mechanism, created for the parties to the Kyoto Protocol, as well as the Global Environment Facility, already allow for the financing of climate change projects in countries that are in transition.

In the context of the 2015 Paris Conference negotiations, the Green Climate Fund, set up to help meet the UNFCCC’s objectives, will have a determining influence on the signing of a binding agreement that includes developing countries. Industrialized countries promised, in 2009 and 2010, during the Copenhagen and Cancun negotiations, to raise \$30 billion for the 2010-2012 period, and \$100 billion a year starting in 2020, for the energy transition of developing countries.⁵² However, as of October 5, 2015, only \$10.2 billion had been promised for the initial capitalization of the fund.⁵³

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