

Stabilizing the climate and averting catastrophe

December 2019

THE SITUATION

[Heat-trapping gases and other climate pollutants](#) emitted since the beginning of the industrial revolution have warmed the planet an average of [1.8° Fahrenheit](#) (1° Celsius) above pre-industrial levels — causing [dangerous and devastating changes](#) for people and communities worldwide. By early in the second half of the 21st century, we must achieve [net zero carbon emissions](#) — taking at least [as much carbon dioxide out of the atmosphere](#) as we put in it.

THE DRIVERS

There are two critical aspects of climate change — short term and long term.

Short term: [Methane](#) is the primary pollutant driving climate change in the short term. Within the first two decades after it is emitted, methane pollution traps 84 times more heat than carbon dioxide. It is responsible for at least a quarter of the warming we experience today.¹

The primary [human causes of methane pollution](#) are oil and gas production and delivery and agriculture (mainly livestock and rice production). Landfills and wastewater are also important sources of methane pollution. Methane emissions [have surged](#) in the past few years, and one likely cause is increased drilling for oil and natural gas.

A [study commissioned by EDF](#) in 2015 found that oil and gas methane pollution comes from every region of the world, with Russia and the United States as top emitters. Most of what we know about this pollution is self-reported by industry and frequently underestimates what is actually happening in the field. New efforts are underway to [study](#) and [monitor](#) methane to pinpoint sources and drive reductions.

Because methane lasts for only a decade or so in the atmosphere, reducing emissions can have a [near-immediate impact](#) on slowing the rate of warming. This is critical for reducing the climate effects that we are already seeing, such as sea level rise and more severe weather events. Cutting methane could also help avoid dangerous [climate tipping points](#).

Other short-lived climate pollutants emitted by humans that drive near-term warming include black carbon from wildfires, cook stoves and diesel engines, and hydrofluorocarbons emitted from refrigeration and air conditioning.

Long term: Carbon dioxide is the primary pollutant driving climate change in the long term. Whereas short-lived drivers control how fast the planet warms, the carbon dioxide we emit now will warm the planet for centuries. Cutting emissions of carbon dioxide is the key to achieving climate stability and preventing more than 3.6°F (2°C) of warming globally over the long term.

The [majority of carbon dioxide](#) emitted from human activities comes from the burning of fossil fuels for electricity, heat and transportation. The geographies that emit the most carbon dioxide are China, the

¹ EDF calculation based on the Intergovernmental Panel on Climate Change Fifth Assessment Report (IPCC AR5), Working Group 1, Chapter 8: <https://www.ipcc.ch/report/ar5/wg1/>

United States and the European Union. Rapid economic development could put [India on the path](#) to being the world's largest climate polluter as soon as 2030.

Industrial processes such as cement production and chemical manufacturing also emit carbon dioxide. Another major source of carbon dioxide is the destruction of forests through cutting and fire, often to clear land for agriculture. Other long-lived climate pollutants include nitrous oxide, primarily from the use of fertilizers.

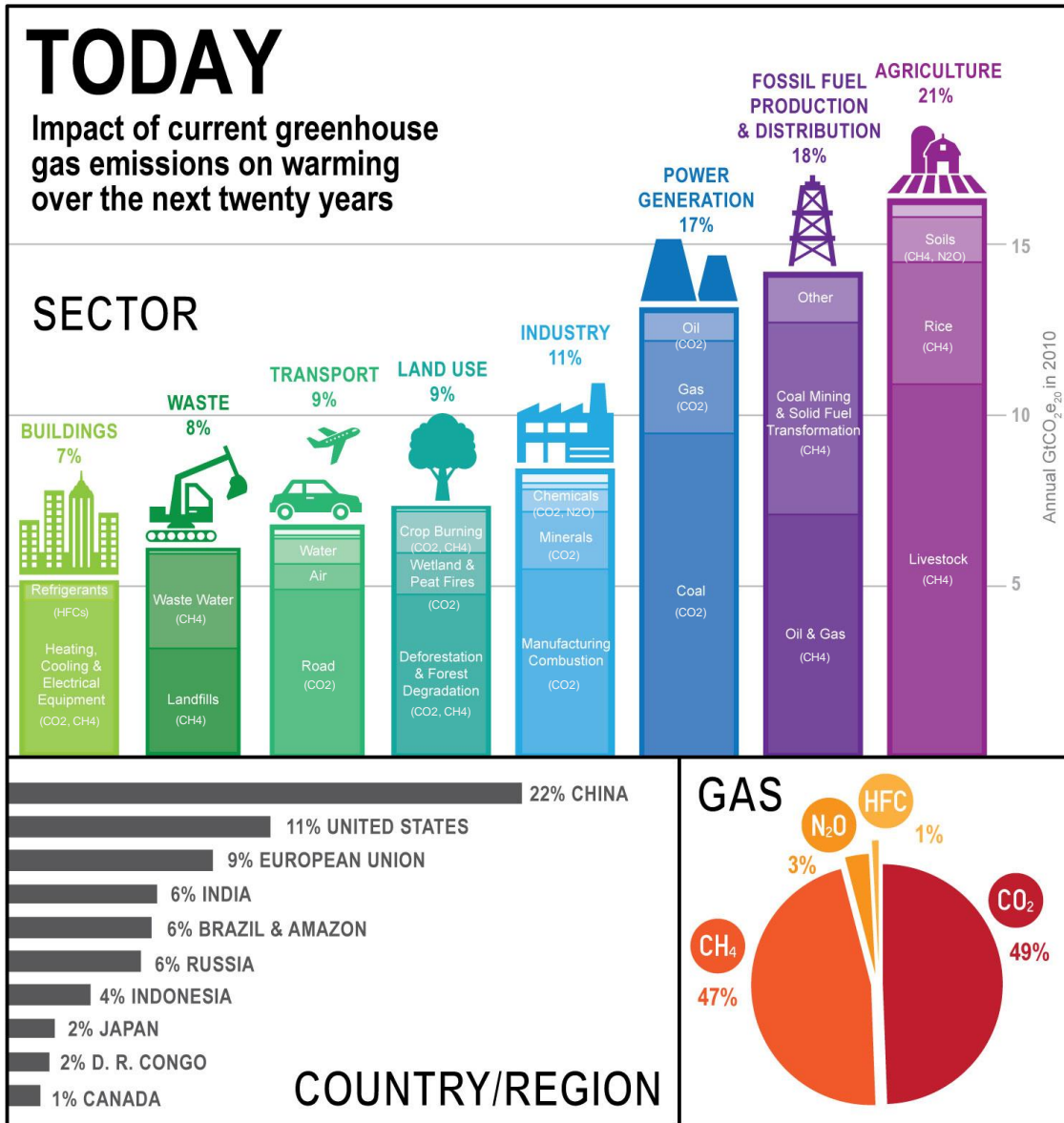
WHAT DOES THIS MEAN?

Global warming is among the greatest challenges humanity has ever faced. We need many solutions and many actors. Our best chance of avoiding the worst consequences of climate change will require [reducing emissions of both](#) short-lived climate pollutants (such as methane) and long-lived climate pollutants (such as carbon dioxide) — simultaneously and immediately.

We also must ensure that natural systems, economies and communities are resilient in the face of the devastating impacts that are already here and will intensify in the future. Proactively helping people and nature be more resilient could [dramatically reduce the damages and costs](#) of climate change — and will save lives.

Figure 1. Today's greenhouse gas emissions

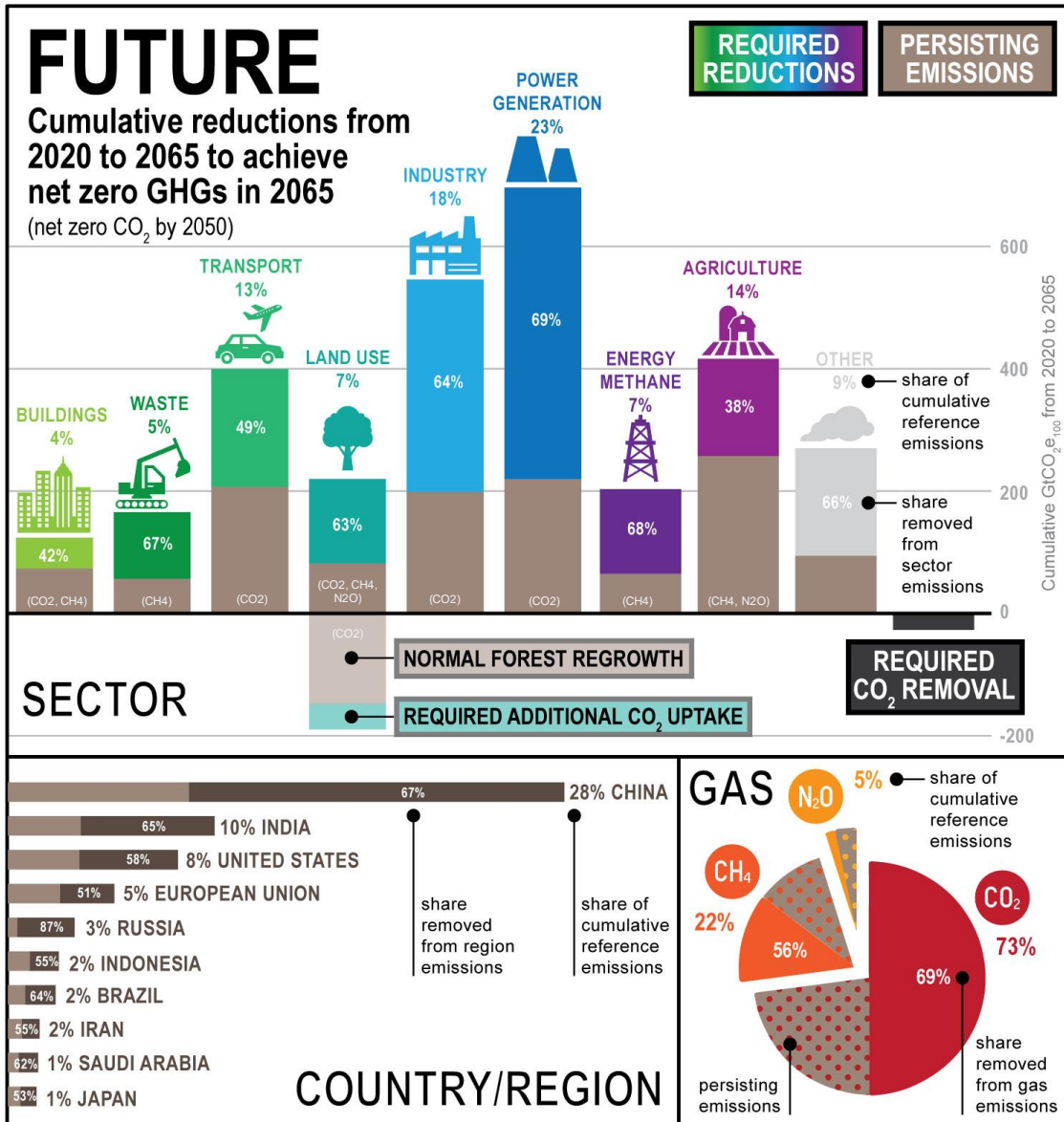
This chart shows the major sources of current greenhouse gas emissions, in terms of their impact on warming over the next two decades. Methane (CH₄) accounts for nearly half of warming in the near term, largely from a handful of sources: rice and livestock agriculture, fossil fuel production and distribution, and waste. Carbon dioxide emissions from electric power generation, manufacturing, deforestation, transport and buildings also represent significant drivers of near-term warming. The five largest geographies, meanwhile, account for more than half of near-term warming. EDF is focused on a handful of the largest emitting sectors and geographies where we can maximize our impact and drive transformational change.



Source: EDF analysis. Emissions data provided for year 2010 from the Joint Research Centre (JRC) EDGAR Database (2019) and converted to carbon dioxide equivalence using 20-year Global Warming Potentials (GWPs) from IPCC AR5 (2013) for N₂O and HFCs, and Etminan et al. (2016) and IPCC AR5 (2013) for direct and indirect GWPs for CH₄, respectively. HFCs are assumed to be HFC-134a, the most dominant HFC in use. Power sector breakdowns are based on 2013 data from IEA WEO 2015. Land use does not include sinks. In the top panel, gases that account for >5% of total GHGs for each sector are listed in parentheses. For more information on sector breakdowns, see JRC EDGAR website.

Figure 2. Future greenhouse gas emissions

The latest science suggests that achieving net zero greenhouse gas emissions globally in the next four decades would be sufficient to limit warming to 2 degrees Celsius above preindustrial levels — the goal of the Paris Climate agreement. This chart shows sources of cumulative emissions and emissions reductions along an illustrative future pathway to meet that goal. In the scenario presented here, power generation, industry and transport provide the major opportunities for emissions reductions. This also requires significant amounts of carbon dioxide removal from new technologies such as direct air capture. In this long-term perspective, carbon dioxide plays a much larger role than methane. China, Europe and the U.S. remain major contributors — but India becomes a top priority as well, given its projected future growth.



Source: EDF analysis. Emissions data from the Joint Research Centre (JRC) GECO Database (2019) reference and 1.5C scenarios, and converted to carbon dioxide equivalence using 100-year Global Warming Potentials (GWPs) from IPCC AR5 (2013) for N₂O, and Etminan et al. (2016) and IPCC AR5 (2013) for direct and indirect GWPs for CH₄, respectively. HFCs are not included here. Energy Methane includes all methane emitted from energy activities – including natural gas end uses in buildings. In the top panel, gases that account for >5% of total GHGs for each sector are listed in parentheses. For more information on sector breakdowns, see JRC GECO website.