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

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[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.

EDF'S ROLE

EDF is working on solutions in the three primary categories:

1. Cutting emissions of short-lived and long-lived climate pollutants. This is our highest priority, and the focus of most of our efforts. Unless we and others succeed in this, temperatures will keep rising to catastrophic levels.
2. Supporting climate resilience to withstand the impacts of global warming that are here and unavoidable.
3. Removing pollution already emitted. This is an emerging effort, acknowledging that economical ways to do this are not yet available.

EDF focuses on solutions that are practical, cost-effective and have the potential for high impact. We deliver results by deploying our strengths: science; technological innovation; economics and market incentives; nonpartisan policy, law and advocacy; and partnerships with large corporations.

CUTTING CLIMATE POLLUTION

Our approach is to advance strategies that turn the engines of the economy toward low-carbon prosperity — stabilizing the climate while enabling people to thrive. Our strategies:

- Help establish markets, binding agreements and policies that create economic incentives to drive down pollution. Build in the rules and regulations to ensure the measures achieve meaningful and durable results.
- Work with companies and their global supply chains to drive systemic shifts to low-carbon activity, with verification to ensure progress.
- Advance science and technologies to accelerate the transition to a low-carbon economy and hold governments and industries accountable.

We focus on select places, sectors and industries where we can make the greatest impact, achieve meaningful reductions, and advance transformational change.

EDF's priorities for cutting climate pollution:

Slash methane from the global oil and gas industry 45% by 2025, on a path to achieve a 75% reduction no later than 2030. The fastest, most cost-effective way to slow the rate of warming is to cut methane pollution from oil and gas. The International Energy Agency found existing technologies can cut methane pollution from the oil and gas industry by 75%, two thirds of this at no net cost to industry. EDF science helped turn world attention to this problem by quantifying the role methane plays in warming and identifying opportunities for reductions. We are advancing policies and partnerships to cut methane, and our affiliate, MethaneSAT LLC, is building and launching a satellite to identify major sources of global methane pollution. Armed with that data, we will secure additional commitments from corporations and governments to drastically reduce methane emissions and ensure accountability for those commitments.

Spark a global market to drive many billions of dollars into reducing climate pollution. EDF is helping shape an agreement that will create the first global carbon market for an entire industrial sector: aviation, which is one of the fastest-growing sources of carbon pollution worldwide. The world's major airlines and 70 governments support the plan, which could drive investments in reducing climate pollution around the world, spur new technologies and fuels with impacts far beyond aviation, such as in shipping, and serve as a template for other international carbon markets. If it succeeds, the system will force emissions down at a fraction of the projected cost of other techniques, allowing far faster and deeper cuts in pollution.

Move the United States to a 100% clean economy — net zero emissions by 2050. We are working with a wide range of allies to pass federal climate legislation in the U.S. We also are harnessing economic incentives to make low-carbon prosperity possible, while advancing the policies and practical steps to make the transition — for example by modernizing the electricity grid and reforming utility regulations. To build momentum for national action and secure immediate cuts in pollution, we are leading or supporting policy efforts in 22 states. We also defend existing policies and regulations by going to court when necessary, for example to defend the Clean Power Plan, clean car standards and methane regulations.

Ensure that China's carbon emissions peak and start to decline by 2025. China is the world's largest greenhouse gas emitter and consumes half the world's coal. We are building on nearly 30 years in China, working as a trusted advisor to help the government design and implement a national carbon market. It will be the world's largest when it goes into effect in 2020. We also are working to ensure that China's mammoth Belt and Road Initiative channels capital into low-carbon development around the world.

Help India get on a low-carbon, high-growth path. Based on our decade of experience in India, we are working with partners to cut climate and air pollution that kills millions of people in India's cities. In India's rural states we are promoting low-carbon technologies, such as clean cook stoves, to improve health and cut pollution at the state level in India. These state-level initiatives are designed to create a pathway to low carbon development nationally.

Protect tropical forests and build global financial demand for healthy forests. Tropical forests play a critical role in the climate, and no forest is more important than the Amazon, which stores more carbon than any forest on Earth. EDF is helping our Brazilian partners defend the forest from illegal burning. We also are working with global corporations and our partners in Mato Grosso, Brazil's largest beef and soy producing state, to support rural economies, increase agricultural production and protect forests. In Brazil and globally, we are creating economic incentives to ensure tropical forests are worth more alive than dead.

Shift global road transport to zero emissions. Transportation is expected to be one of the fastest growing sources of climate pollution through 2050. Most of this added pollution will come from ships, planes and medium- and heavy-duty trucks carrying freight. Pollution from vehicles also causes hundreds of thousands of premature deaths globally. Our vision: Transform truck fleets in the U.S., China and Europe, which represent two-thirds of the global total, to near zero emissions by 2050. We will launch this new work with pilot projects in cities like Houston, Los Angeles and London, along with policy change and economic incentives to remove the biggest barriers to vehicle electrification.

PROTECTING PEOPLE AND ECOSYSTEMS THROUGH CLIMATE RESILIENCE

A certain amount of warming is locked in and already harming people and communities. We need to make sure natural systems, economies and communities can withstand the changes. EDF focuses on improving climate resilience in some of the most threatened and important areas: coastal communities, densely populated arid regions, and farms and fisheries that supply the world with food.

EDF's priorities for climate resilience:

Secure a food source for 3.5 billion people. Internationally, we are leading an effort to protect fisheries, which provide a key source of food for nearly half the world's population. Building on our decades of work on sustainable fishing, we are advancing climate-resilient fishing practices, which adapt as fish shift their ranges with warming waters.

Prepare for drought-stressed systems. In the U.S. West, EDF is advancing technologies such as satellite data on crop irrigation needs, groundbreaking agreements, and market approaches like water trading to help communities meet their water needs during drought.

Use natural solutions to protect threatened communities. The Mississippi River Delta is one of the largest deltas on Earth and loses a football field worth of land every 100 minutes. We are demonstrating how to use the Mississippi River's natural processes to rebuild the coastline and protect communities from storms and flooding, as a model for coastal communities. We are launching similar work in North Carolina.

Support climate-resilient farming. With farmers and major food and agriculture companies like Tyson and Smithfield, we are working to create more resilient food systems and reduce climate pollution from agriculture using new technologies and market incentives.

Advance resilient energy systems: We are working with community partners in Puerto Rico to build resilient microgrids — small electricity networks that can run independently of the main grid. Success in Puerto Rico can be a model for creating clean, reliable and affordable power that communities can rely on even after storms.

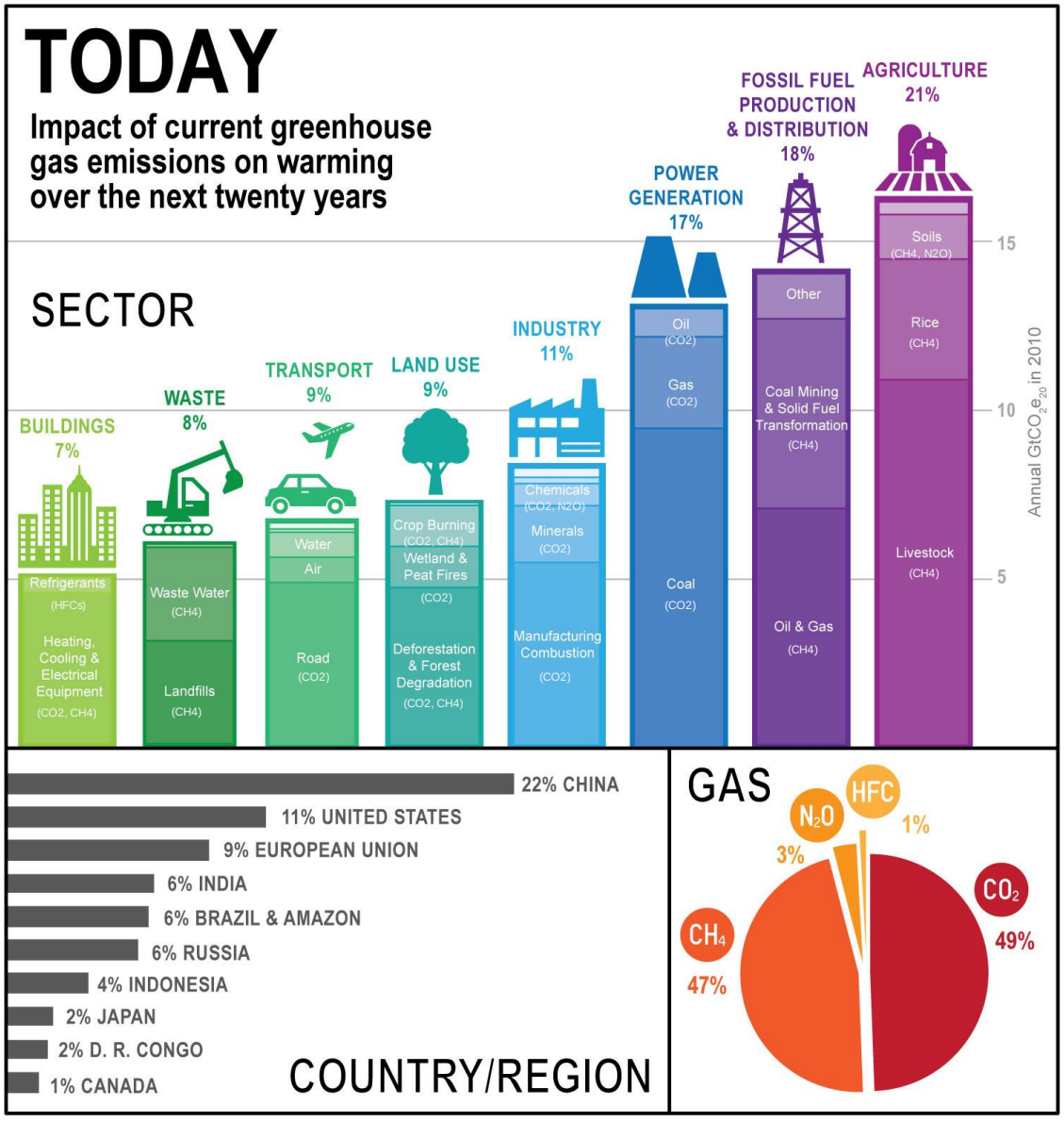
REMOVING POLLUTION ALREADY EMITTED

Long-lived climate pollutants like carbon dioxide build up and stay in the atmosphere for hundreds of years. Scientists have concluded that removing climate pollution from the atmosphere is a necessary component of the global effort to stabilize the climate.

EDF is leading the way in promoting polices and public investment to remove carbon dioxide from the atmosphere. This includes long-established approaches like reforesting degraded areas; new techniques for using natural climate solutions; and still-nascent technologies for drawing carbon out of the atmosphere. We promote rigorous scientific review, and development of carbon removal strategies that are safe and deliver real climate benefit while being cost effective.

Figure 1. Today's greenhouse gas emissions

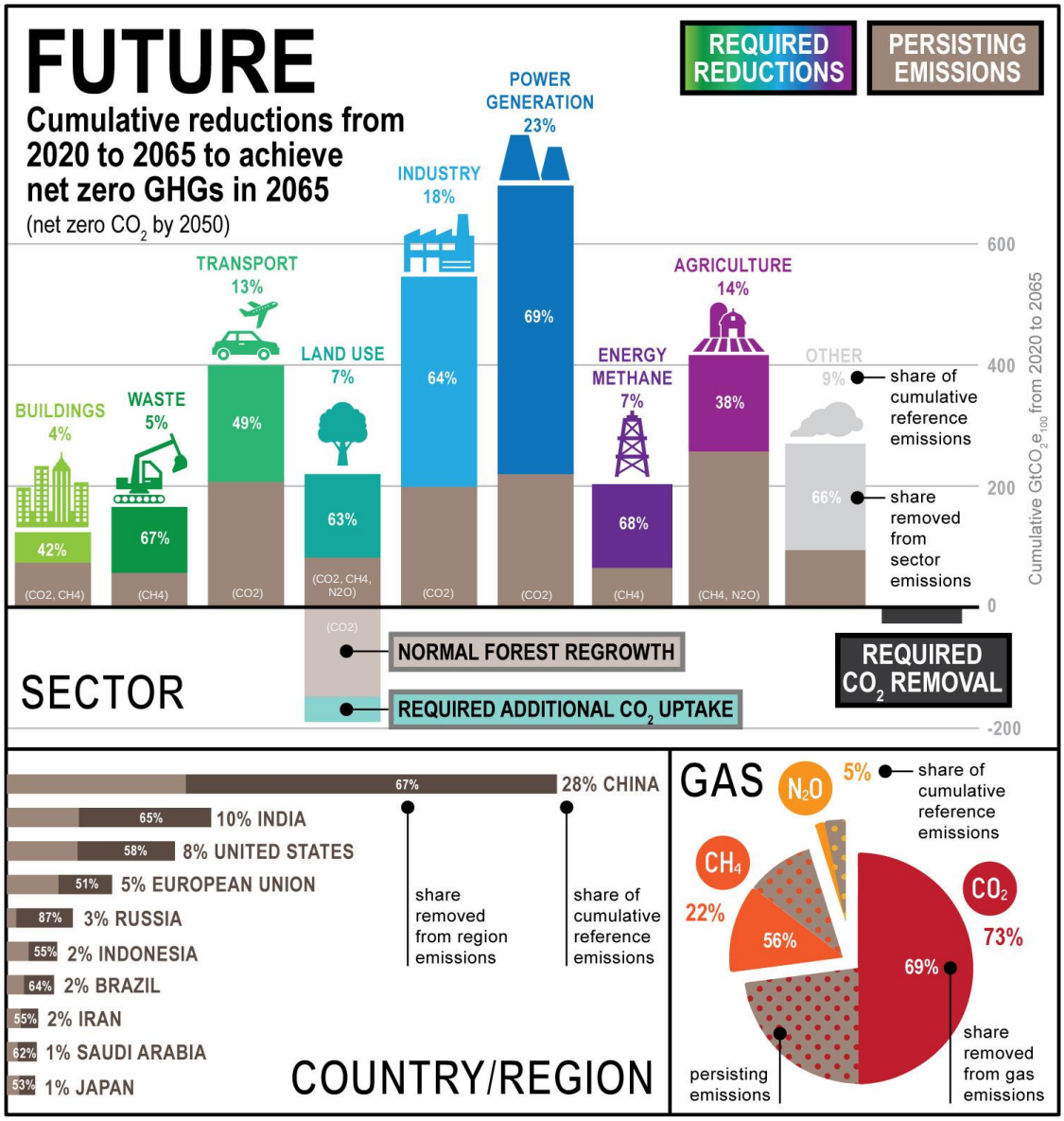
This chart shows the major sources of current greenhouse gas emissions, in terms of their impact on warming over the next two decades. Methane (CH_4) accounts for nearly half of warming in the near term, largely from a handful of sources: rice and livestock agriculture, fossil fuel production and distribution, 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.