



Module 1

Climate Change Toolkit for Health Professionals

Climate Change – Science,
Drivers & Commitments

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Preface

This toolkit consists of eight modules which have been prepared as stand-alone documents that can be read by themselves, but they have also been prepared to complement one another. It has been designed as a tool for health professionals and students in the health care and public health sectors who want to engage more directly on the issue of climate change as educators with their patients, peers and communities, and/or as advocates for the policies, programs and practices needed to mitigate climate change and/or prepare for climate change in their workplaces and communities.

Module 1 – Climate Change – Science, Drivers & Global Response provides an introduction to climate science and discusses the human activities that are contributing to climate change, the international commitments that have been made to address it, and where we are in terms of complying with those commitments.

Module 2 – Global Health Impacts of Climate Change summarizes the direct and indirect health impacts that are occurring, and are predicted to result from, climate change, on a global scale.

Module 3 – Climate Change Health Impacts across Canada summarizes the direct and indirect health impacts that are occurring, and that are predicted to occur, in the different regions of Canada.

Module 4 – Greenhouse Gas Emissions in Canada by Sector and Region discusses the volume of greenhouse gases emitted, and the trends in those emissions, from different sectors in Canada at a national, provincial and territorial scale.

Module 5 – Climate Change Solutions with Immediate Health Benefits discusses climate solutions that can produce fairly immediate health co-benefits for the jurisdictions that implement them.

Module 6 – Taking Action on Climate Change at Health Care Facilities discusses the climate mitigation and adaptation policies, programs and practices that can be adopted and implemented by health care institutions to reduce their greenhouse gas emissions and prepare for climate change.

Module 7 – Preparing for Climate Change in our Communities discusses the climate adaptation policies and programs that can be developed by public health units or municipalities to minimize the health impacts associated with climate change.

Module 8 – Engaging in Climate Change as Health Professionals discusses the different ways in which health professionals can educate and engage their patients, the public, their peers, and their communities on the health impacts of climate change, and the policies and programs needed to mitigate climate change and prepare for it.

Module 1: Climate Change – Science, Drivers & Commitments

Introduction

This module describes the science of climate change – what it is, what causes it, and how human activities contribute to it. It also presents an overview on the global response to climate change. It describes the commitments that have been made by our leaders globally and whether we are on track to meet these obligations. It further depicts the scenarios we will likely face in decades to come if we do not take sufficient action. Based on the most up-to-date evidence, this module outlines what we need to do to achieve our global warming targets. All of this



Air pollution. Photo by Patrick Hendry on Unsplash.

background will help place the action that Canadians are taking on the local and national stage into the global context.

The Greenhouse Effect

The greenhouse effect makes life on Earth possible. Greenhouse gases (GHGs) insulate our planet from the temperature vacuum of space and maintain a stable surface temperature on Earth 32°C warmer than it would otherwise be – a level that is compatible with life.

Solar energy travels through the Earth's atmosphere and surface. This energy is partially reflected back into space and partially absorbed by the surface, some of which is re-radiated as heat into the atmosphere. GHGs absorb a great deal of the re-radiated energy, and over time, release it back into the atmosphere and surface. Atmospheric aerosols (solid particles and liquid droplets suspended in the air) further contribute to the absorption and release of energy. The combined effects of GHGs and aerosols absorbing and releasing energy into the atmosphere that otherwise would be reflected back into space is known as net radiative forcing.

GHGs are the largest contributor to radiative forcing. The most abundant GHGs are carbon dioxide (CO₂), methane (CH₄), nitrous oxide (N₂O), ozone (O₃) and water

vapour (H₂O) (Cleugh et al., 2011). Over the past few centuries, atmospheric concentrations of all of these gases, except for water vapor, have increased as a result of human activity. In addition, human activity has increased the concentration of fluorinated gases (i.e. chlorofluorocarbons and hydrofluorocarbons) in the atmosphere, further increasing the capture of energy cycled through radiative forcing.

Anthropogenic climate change is the result of increased radiative forcing due

Carbon dioxide is the most produced GHG from human activities, however a single CH₄ molecule is around 30 times more effective at trapping heat (known as global warming potential) than a CO₂ molecule (US EPA, 2017).

So, to calculate the overall contribution of each human activity to climate change and to identify the most important mitigation interventions, GHG emissions are often presented as carbon dioxide equivalents (CO₂eq).

to human activity. Cumulatively, human activity has added an estimated 2,220 gigatons of CO₂ to the atmosphere since 1876 (Rogelj et al., 2018). GHGs have increased the concentration of CO₂eq in the atmosphere by almost 100 parts per million (ppm) in 60 years, from 315 ppm in 1958 to around 410 ppm at the end of 2018 (US Dept of Commerce, 2019). So far, climate change has generated, on average, 1°C of global warming since pre-industrial time (Allen et al., 2018).

Anthropogenic Greenhouse Gas Emissions

In terms of human activity increasing the atmospheric concentrations of GHGs, the most common emissions are carbon dioxide (CO₂) from fossil fuel combustion and by-products of industrial processes (76%), methane (CH₄) (16%), nitrous oxide (N₂O) (6.2%) and fluorinated gases (2%) (Blanco et al., 2014).

By sector, the greatest contributors to GHG emissions globally are electricity and heat production (25%); agriculture, forestry, and other land use (24%); industry (21%); and transport (14%):

- Emissions from electricity and heat production come mostly from the combustion of fossil fuels, with coal having the highest carbon intensity.
- GHG emissions from agriculture, forestry and other land use largely come from deforestation as well as methane produced by livestock and nitrous oxide produced from agricultural soils.
- Different types of industries produce emissions at all steps in the supply chain. Extraction industries, materials industries and manufacturing and construction produce GHGs through energy use and also through different processes.
- The transport and storage of products can also produce emissions. The greatest share of emissions from

transport comes from the combustion of gasoline and diesel for fuel in passenger cars and trucks, but aviation is becoming an increasingly important contributor to emissions.

- The contribution of each sector varies for different country income groups. For example, agriculture, forestry and other land use contributes almost all of the global emissions from low-income countries, whereas energy contributes around 40% of global emissions from high-income countries ((IPCC, 2014a).

Observed Changes in our Climate System

The Earth's climate system is comprised of interactions between the atmosphere (air and suspended particles) hydrosphere (oceanic, terrestrial, and atmospheric water), the cryosphere (ice and snow), the biosphere (plants and animals), the pedosphere (soil), and the lithosphere (the upper mantle and crust). Anthropogenic climate change impacts will be felt in all of these spheres, with the exception of the lithosphere (IPCC, 2013).

Over the past two centuries, human-induced climate change has raised the global mean surface temperature on Earth by approximately 1°C. Although natural forces have contributed some uncertainty to climate change estimates, the overall difference between total warming and human-induced warming is demonstra-

bly small, in the range of +/- 0.1°C between 1890 to 2010 (Allen et al., 2018). Currently, the rate of global warming is an increase of 0.2°C average temperature per decade (Allen et al., 2018).

Anthropogenic climate change is having disproportionate effects in populated regions with 20 to 40% of the world's population living in areas which have experienced greater than 1.5°C average warming over at least one set of seasonal temperatures (Allen et al., 2018). Although the global surface temperature of the Earth has warmed by 0.3°C since the early 2000s, temperatures in populated regions have increased by an average of 0.8°C during that time (Watts et al., 2018).

The Intergovernmental Panel on Climate Change (IPCC) has stated with high certainty in its Fifth Assessment Report that the number of cold days and nights has decreased and the number of warm



Storm over a city harbour. Photo by Dejan Zakic on Unsplash.

days and nights has increased on a global scale (IPCC, 2013). Moreover, heatwaves have become more common in large parts of Europe, Asia, and Australia (IPCC, 2013). While the frequency and/or intensity of extreme precipitation events has increased in most regions since the 1970s, in the Mediterranean and West Africa droughts have worsened, and in the North Atlantic the most energetic tropical cyclones have increased in number, strength, and duration (IPCC, 2013).

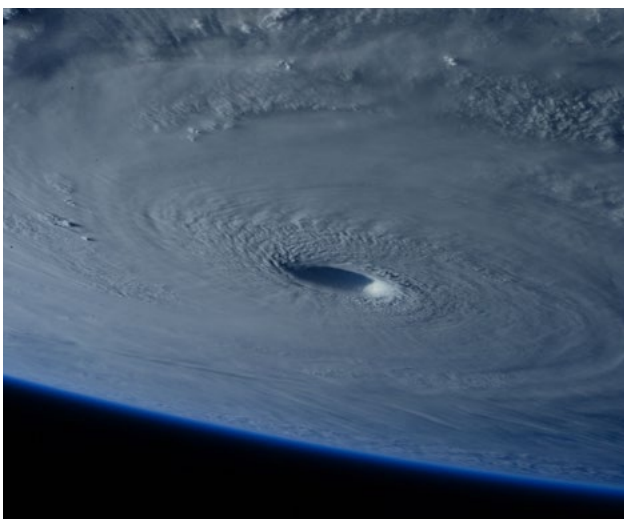
Future Changes Predicted

The IPCC described the scientific consensus on projected impacts of 1.5°C and 2°C warming from pre-industrial baselines to 2100 in its Special Report on Global Warming of 1.5°C released in October 2018. The values of 1.5°C and 2°C were chosen as depicting two temperature scenarios to

which all nations committed in the 2015 Paris Agreement. The IPCC found impacts associated with 1°C, 1.5°C and 2°C global warming will not necessarily present a linear gradation of impacts from one mean temperature scenario to the next.

The IPCC found that global warming of 1.5°C by 2100 would result in:

- approximately 13.8% of the world's population being exposed to severe heatwaves at least once every five years;
- a global increase in the frequency and intensity of hot days and nights, and a similar decrease in cold days and nights, with the largest changes occurring in the hot temperature extremes experienced in tropical regions;
- a global increase in the frequency and intensity of heavy precipitation, strong tropical cyclones, and flood hazards, but also a higher prevalence of droughts in some regions.
- It further found that global warming of 2°C by 2100 would result in:
- over a third of the world's population being exposed to severe heatwaves at least once every five years; nearly three times the population exposed in the 1.5°C scenario;
- a greater risk for drought, heavy precipitation events, and strong tropical cyclones, as well as more land area exposed to flood hazards;
- a global mean sea level rise of 0.1 m greater than expected in the 1.5°C scenario, affecting 10.4 million more



Hurricane from space. Photo by Nasa.

people by the end of the century.

Future Impacts on Ecosystems and Humans

The IPCC found that both 1.5°C and 2°C of warming would increase the number of species at risk of extinction, but 2°C of warming could be expected to nearly double the proportion of insect, plant, and vertebrate species losing half their geographic range, relative to the 1.5°C scenario. It further predicted great risks to our planetary oceans, with 70 to 90% of warm water coral reefs disappearing with 1.5°C of warming, and ecosystem damage, reduced fisheries production, and higher levels of acidification, hypoxia, and dead zones accompanying warming of 2°C. The IPCC also concluded that 2°C compared to 1.5°C of global warming would be associated with greater risks of food and water scarcity, including smaller yields of maize, rice, and wheat, and an up to 50%



Community on Hudson Strait-Nunavik.
Photo by Dan Tobias.

increase in climate-induced water stress.

As discussed in Module 2, the climate change risks to human health, including poverty and disadvantage, under-nutrition, vector-borne diseases, heat-related morbidity and mortality, and ozone-related mortality are all greater in the 2°C as compared to 1.5°C scenario. Climate change is also anticipated to impact several economic sectors and services, particularly energy, transport, and tourism. The IPCC projects a doubling of risk from the 1.5°C to 2°C scenarios, with impacts on energy industries, changing land use, water scarcity, drought, and stress, exposure to heatwaves, species habitat degradation, and lower crop yields accumulating across multiple segments of the economy (Hasegawa and Slade, 2018) (**See Figure 1**).

Regional Tipping Points

Regional “tipping points” – key events that can be associated with major shifts in the climate system – are also at a greater risk with 2°C versus 1.5°C of warming. Ice-free Arctic passages in the summer, reduction in permafrost, and loss of rainforests and boreal forests, may contribute to accelerating concentration of GHGs in the atmosphere as less solar energy is reflected or absorbed at the surface. Even with the stabilization of global mean surface temperatures, some changes will continue beyond 2100, specifically rising sea levels and thawing per-

mafrost (Hasegawa and Slade, 2018).

Previously, the IPCC has issued reports projecting the likely impacts of additional scenarios, including global warming of greater than 4°C by 2100. It predicted that warming of 3°C to 4°C would severely threaten humanity and ecosystems. Anticipated impacts would include the loss of infrastructure, livelihoods, and economic stability in many different regions of the world, destruction of coastal settlements, large risks to regional and global food security, spread of vector-borne diseases, heat-related human mortality, greater frequency and intensity of wildfires, increased risk of heavy precipitation and floods, worsening of drought in dry regions, and greater habitat fragmentation and loss of geographic range for more species (IPCC, 2014b)(**See Figure 1**).

United Nations Framework Convention on Climate Change

Over three decades have passed since the world began to first formulate its response to the global threat of climate change. Negotiations to create a Framework Convention on Climate Change in December 1990. Between then and 1992 when the United Nations Framework Convention on Climate Change was finalised and opened for signature at the Rio Earth Summit, over 150 states negotiated what such a convention would involve: binding commitments, targets



Flooding in an urban area. Photo by jim gade on Unsplash.

and timetables for emissions reductions, financial mechanisms, technology transfer, and 'common but differentiated responsibilities of developed and developing countries (UNFCCC, 2019c).

The United Nations Framework Convention on Climate Change (UNFCCC) entered into force in 1994, with 196 countries signing on as Parties. The annual Conference of the Parties (COP), where Parties of the UNFCCC meet to negotiate multi-lateral responses to climate change, began in Berlin, Germany in 1995, with the most recent, COP23, concluding in Katowice, Poland in 2018.

Kyoto Protocol

The Kyoto Protocol, as the world's first emissions reduction treaty, was adopted in 1997. The fifteen then-members of the European Union and ten other countries

committed to changing the trajectory of their GHG emissions with targets ranging from -8% (then European Union) to -6% (Canada) +10% (Iceland) of 1990 levels compared with the first commitment period of 2008 to 2012 (UNFCCC, 2019a). These targets were not considered to be enough to mitigate climate change, nor did they include two of the world's biggest emitters (China and India) or other low- and middle-income countries. Although it agreed to a commitment of -7%, the United States did not ratify the Kyoto Protocol domestically. Canada with-

drew from the Kyoto Protocol in 2011.

In 2009, the Copenhagen Accord was adopted at COP15. The Copenhagen Accord included provisions to incorporate emissions reporting from developing countries; however, unlike the Kyoto Protocol, it was not considered to be legally binding, and did not have the ambitious objective of limiting global warming to 2°C, let alone 1.5°C, this century (Meyer, 2010).

In 2011 at COP17 in Durban, South Africa, the Parties committed to establishing a new universal climate change agreement

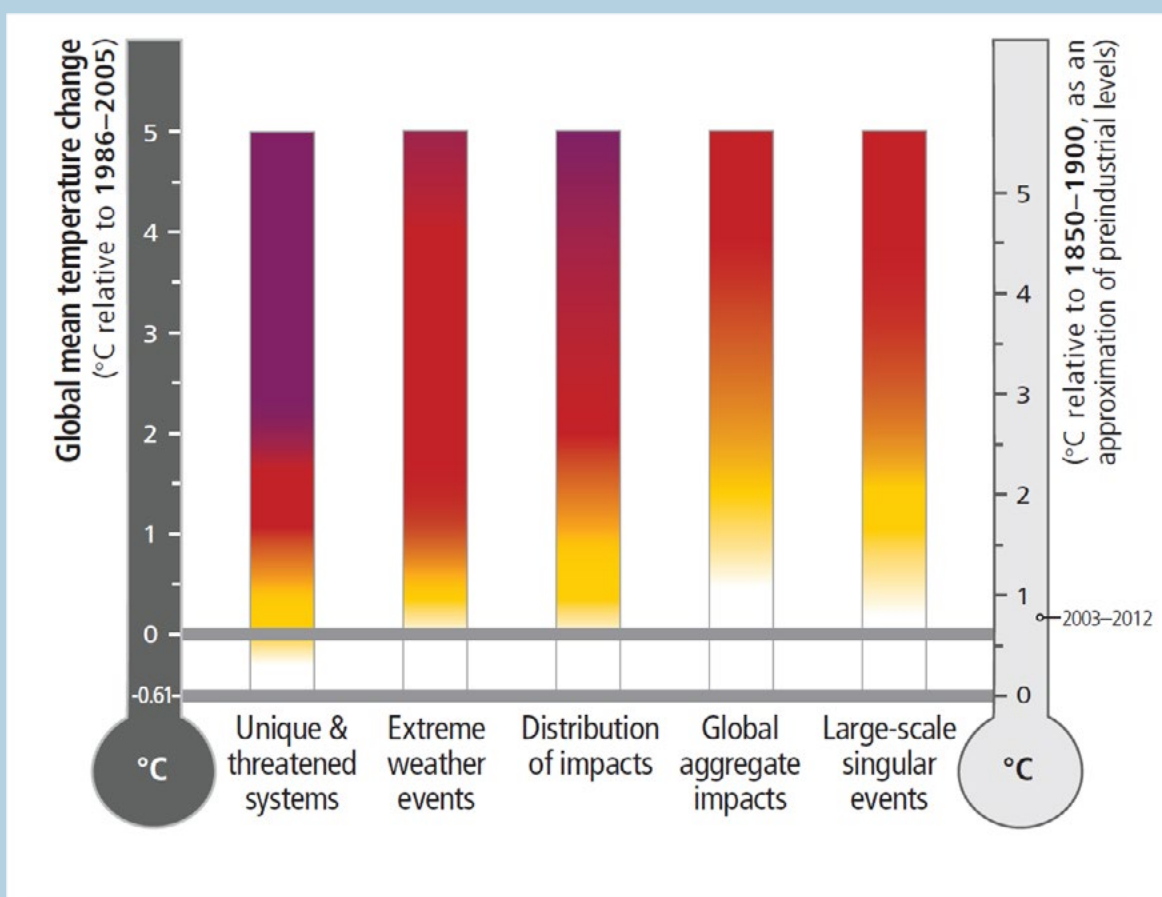


Figure 1: Risks associated with reasons of concern for increasing levels of climate change. Figure taken from (IPCC, 2014b)



A dead zone. Photo by redcharlie on Unsplash.

for the period beyond 2020 by 2015. In 2012 at COP18 in Doha, Qatar the parties adopted the Doha Amendment to the Kyoto Protocol, providing space for the Parties to signify their commitments in the period up until 2020. Following up on the commitment to a new agreement established in 2011 at COP17 in Durban, in 2015 the Parties adopted the Paris Agreement at COP21 in Paris, France.

The Paris Agreement

The Paris Agreement is the first climate change agreement including all nations as signatories, requiring them to commit to climate change mitigation and adaptation. By the start of 2019, 184 of the 197 parties to the UNFCCC have domestically ratified the Paris Agreement (UNFCCC, 2019b). In terms of its provisions, Parties to the Paris Agreement have committed to:

“holding the increase in the global average temperature to well below 2°C above pre-industrial levels and pursuing efforts to limit the temperature increase to 1.5°C above pre-industrial levels” with the peaking of GHG emissions as soon as possible and achieve “a balance between anthropogenic emissions by sources and removals by sinks of greenhouse gases in the second half of this century” (UNFCCC, 2015).

In order to achieve its stated goals, the Paris Agreement requires each Party to submit Nationally Determined Contributions (NDCs), which include each Party’s commitments to emissions reductions targets that contribute to the global goals of the Paris Agreement. The Parties are required to report on their progress in achieving these NDCs every five years, with an option for Parties to increase the scope of their ambitions with regard to reducing GHG emissions within their NDCs. The Paris Agreement stipulates that a “Global Stocktake” will occur in 2023 and every five years thereafter, in order to review whether Parties’ actions are consistent with achieving their NDC goals.

Parties also committed to support developing country efforts to mitigate and adapt to climate change, by financing a Green Climate Fund comprising US \$100 billion in annual contributions by 2020. Other key provisions in the Paris Agreement include statements on fostering sustainable development through adaptation, minimizing risk and mech-

anisms of compensation for losses and damages, developed country leadership in climate finance, facilitating technology transfer and capacity-building support, cooperation in providing education and training, as well as affirming the importance of public awareness, participation, and access to information, aligning with various movements within global climate negotiations (UNFCCC, 2019c).

The Nationally Determined Contributions

As of April 2016, 161 strategies for achieving Nationally Determined Contributions (NDCs) had been submitted by key stakeholders to the Paris Agreement, covering 189 Parties to the Convention and representing 99% of global GHG emissions (UNFCCC, 2016). Each NDC submission includes emissions reduction targets (with some including conditional as well as unconditional targets) presenting a significant progression in commitments beyond current undertakings.

Additionally, the majority of NDC contributions include an adaptation component, commonly featuring human health as a

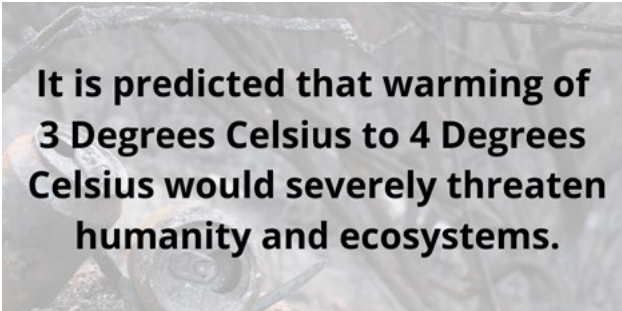
priority, in conjunction with strategies to address water security and impacts in the agriculture sector. Further, many Parties discuss the impacts of climate change in areas that cannot be avoided as loss and damages in both economic and non-economic terms, such as the percentage of land or agricultural production lost, or the proportion of a population affected.

The Carbon Budget and Necessary Steps to Achieve 1.5°C

With global temperatures increasing by about 0.2°C per decade, human-induced climate change reached 1.0°C above pre-industrial levels around 2017, and at the current rate of emissions, is expected to reach 1.5°C by 2040 (IPCC, FAQs, 2018). (See Figure 2).

In the IPCC Special Report on Global Warming of 1.5°C, the authors modelled over 200 possible pathways that global warming might take over the course of the 21st century (Rogelj et al., 2018). These pathways included limiting warming to below 1.5°C throughout the century, temporarily overshooting 1.5°C but returning to 1.5°C by 2100, and limiting warming to below 2°C throughout the century.

Translating these pathways into targets that are consistent with the strategies and timelines set out in the Paris Agreement and operationalized in the NDCs, global annual CO₂ emissions must



It is predicted that warming of 3 Degrees Celsius to 4 Degrees Celsius would severely threaten humanity and ecosystems.

The Different Paths to Action on Climate Change (Babiker et al., 2018)

Climate Mitigation- Climate change requires a multi-pronged approach necessitating many different paths to action. Firstly, measures to minimize climate change and global warming primarily require mitigation, that is reducing anthropogenic GHG emissions through concerted action to enact systemic transformation of industrial and consumer behaviour across all sectors.

Carbon Dioxide Removal Measures - Another set of measures to offset GHG emissions and associated global warming are defined by the IPCC as CO₂ removal (CDR) measures. These CDRs can include activities such as bioenergy produced by living organisms ingesting CO₂, carbon capture and storage technologies, and planting trees to achieve reforestation and afforestation. CO₂ removal can also be undertaken remedially to temporarily reduce or offset warming, including measures like solar radiation modification to increase the amount of solar energy reflected from Earth's surface back into space.

Climate Adaptation - Third, adaptation measures are intended to minimise the exposure and effects of unavoidable impacts due to climate change we cannot prevent. One such adaptation measure is disaster risk management, which involves understanding disaster risk and improving disaster preparedness, response and recovery. Sharing and spreading financial risk can help serve as a financial buffer against impacts from climate hazards. Building awareness and educating communities on the risks of climate change, as well as learning from Indigenous knowledge of agro-ecological and forest management systems, social memory and experience are also important adaptation measures. And health adaptation measures, such as improving access to safe water and improved sanitation, strengthening health systems and strengthening surveillance and early warning systems are very important and will be discussed in detail in Module 6 and Module 7.

Respond and Recover - Finally, measures have been developed to respond and recover from losses and damages – addressing climate change impacts that cannot be avoided through mitigation and adaptation. Losses and damages are largely considered in economic terms; however, there are many situations in which remedies may need to address consequences that extend beyond the reach of financial compensation. Climate change can result in loss of good health, loss of life, loss of livelihood, loss of home, loss of country and loss of culture. Working to ensure equitable processes for public awareness, participation, and access to information is one way to help vulnerable populations facing climate change losses and damages to respond and recover, by promoting their voice in decision-making for arenas impacting their health.

To attempt to address the financial and non-financial losses and damage resulting from climate change, the Warsaw International Mechanism for Loss and Damage was formed in 2013. The Loss and Damage Mechanism promotes implementation of approaches to address loss and damage, including enhancing knowledge and understanding of comprehensive risk management approaches, strengthening dialogue and coordination among relevant stakeholders, and enhancing action and support to address loss and damage through finance, technology and capacity-building (UNFCCC, 2019d).

FAQ1.2: How close are we to 1.5°C?

Human-induced warming reached approximately 1°C above pre-industrial levels in 2017

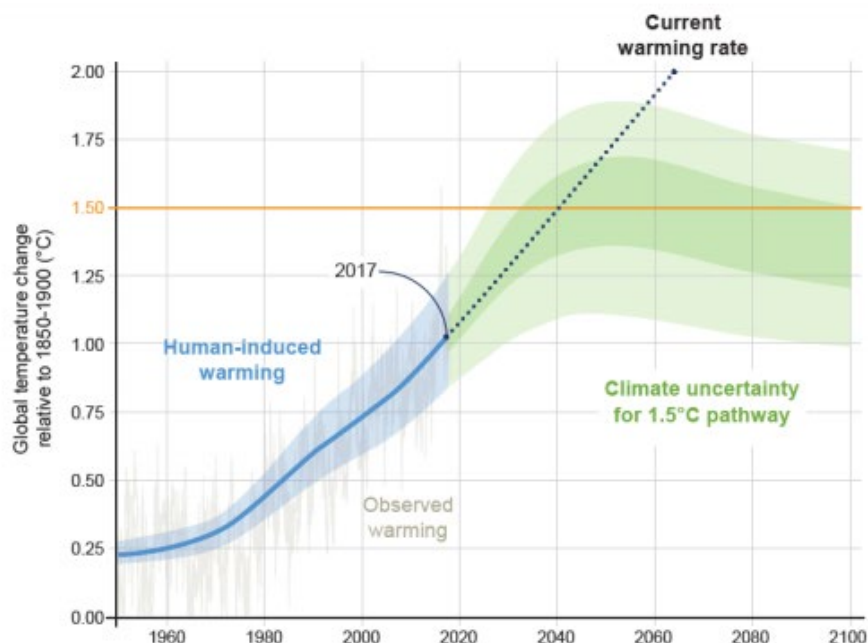


Figure 2: Human-induced climate change reached 1.0°C above pre-industrial levels around 2017, and at the current rate of emissions, is expected to reach 1.5°C by 2040. Figure taken from (IPCC, FAQs, 2018).

be reduced to 25 to 30 Gt CO₂ per year by 2030, corresponding with a 45% reduction from 2010 levels. By 2050, the target for CO₂ emissions would need to be net zero. Achieving a limit of 1.5°C warming would further require reductions in non-CO₂ emissions. While some of these non-CO₂ targets would simultaneously be tackled alongside CO₂ reduction measures in sectors such as energy and transport, others would require sector-specific measures, such as targeting agricultural nitrous oxide (N₂O) and methane (CH₄) emissions (Rogelj et al., 2018).

To limit global warming to 1.5°C, we need transformative systemic change to

occur alongside of sustainable development. In order to limit global warming to 1.5°C, a detailed analysis of the changes required across all sectors, within all levels of government, and for every non-state actor is provided in Chapter 4 of the IPCC's Special Report on Global Warming of 1.5°C (Babiker et al., 2018).

The Pathway to 1.5°C

All pathways for achieving the 1.5°C global warming scenario model a large change in the energy mix:

- By 2050, renewable energy should account for 52 to 67% of primary energy production and coal-fired generation

- should account for only 1 to 7% of production, with much of that production combined with carbon capture and storage technologies to offset emissions;
- From 2020 to 2050, oil consumption should decline by 39 to 77%, and gas consumption by 13 to 62%;
 - The agricultural sector would require improved food production efficiency and closure of yield gaps; changes in consumer behaviours are needed to minimize food loss and waste; and consumption of meat and other livestock products would have to be decreased (particularly in excess of national food guidelines);
 - Carbon dioxide removal (CDR) technologies will be required in all pathways with little or no overshoot of 1.5°C global warming in order to offset any remaining CO₂ emissions and achieve carbon neutrality (Babiker et al., 2018); however, most of these technologies remain largely unproven (particularly at scale) and pose concern for their impacts on environmental and social sustainability.

The longer that mitigation strategies for curbing CO₂ emissions are delayed, the

Global annual CO₂ emissions must be reduced to 25 to 30 Gt CO₂ per year by 2030, corresponding with a 45% reduction from 2010 levels. By 2050, the target for CO₂ emissions would need to be net zero.

greater will be our reliance on the yet uncertain potential of CDR technologies to try to remain below a 1.5°C threshold of global warming from pre-industrial times to 2100 (Rogelj et al., 2018).

Linking Climate Change to Sustainable Development Agendas

Three months before the adoption of the Paris Agreement, countries committed to the Sustainable Development Goals (SDGs). The SDGs build on the Millennium Development Goals, which aimed to promote a global end to poverty that would help ensure peace, prosperity and protection of the planet (UNDP, 2015).

Sustainable development is most commonly described as “development that meets the needs of the present, without compromising the ability of future generations to meet their own needs” (World Commission on Environment and Development, 1987). As the definition suggests, global action on climate change and sustainable development go hand in hand. Limiting global warming to the 1.5°C as opposed to 2°C scenario would provide a much simpler context for achieving sustainable development, reducing inequalities, and eradicating poverty (Roy et al., 2018). Despite many synergies between climate change action and the SDGs, however, if improperly managed, there could be trade-offs made between prioritizing mitigation and adap-

It's easy to get lost in all the numbers and terms when talking about climate change. Essentially, what the evidence is telling us is that we're already experiencing the impacts of global warming and climate change and every increase in temperature above where we're already at will cause greater impacts. This means, in order to make the impacts as small as possible, we need to stop increasing global emissions (achieving "peak emissions") as soon as possible and from there reduce emissions as quickly as possible.

tation strategies on the one hand, and the SDGs on the other (Roy et al., 2018).

The Emissions Gap

UN Environment publishes an annual Emissions Gap Report immediately prior to the COP each year providing an independent scientific assessment of national progress toward achieving mitigation targets. In its 2018 report, United Nations (UN) Environment stated that in order to achieve the Paris Agreement, global emissions must peak by 2020. However global emissions are not even estimated to peak at 2030 based on current targets.

Indeed, even for those countries that have already peaked, emissions would not decline quickly enough. For example, achieving an 80% reduction in emissions from a 2005 baseline to 2050 would require a constant rate of decline of 3.5% per year, when rates of decline from countries that have peaked range from 0.6% per year in Canada and 2.5% per year in Russia (UN Environment, 2018).

Bridging the Gap

The IPCC's Special Report on Global Warming of 1.5°C has demonstrated that limiting global warming to 1.5°C is still technically feasible. Nevertheless, stronger ambition to take action is required from national and sub-national governments, as well as non-state actors (UN Environment, 2018).

All UNFCCC Parties have the opportunity to strengthen the ambitions of their NDC mitigation targets before 2020. Another opportunity to strengthen mitigation targets will take place after the global stock-taking in 2023. This opportunity might involve strengthening or adding a sectoral CO₂ or non-CO₂ emissions target, and/or developing the addition of new policies and actions within the NDC (UN Environment, 2018).

There is also a huge potential for expanded sub-national government and non-state climate change action. Over 7,000 cities from 133 countries, and some 245

regions and 42 countries have pledged to take action to mitigate their emissions. Additionally, over 6,000 companies have pledged mitigation action, although this represents a small proportion of the more than 500,000 publicly traded companies on global stock exchanges.

Current pledged commitments of non-state actors are consistent with emissions reductions of 0.45 Gt CO₂eq per year, but if these organizations were to achieve their fullest potential, they could reduce emissions by 19 Gt CO₂eq per year by 2030 compared to the status quo (UN Environment, 2018). In order to limit global warming to 1.5°C, all countries, sub-national governments, and non-state actors must increase their ambition for mitigation, as soon as possible.

Summary

Anthropogenic GHG emissions have already resulted in 1°C of global warming since pre-industrial times. This warming has prompted significant changes in our climate system, impacting every region of the world. Further changes will occur with global warming of 1.5°C by 2100, but risks will significantly worsen at 2°C, and at higher temperatures be greater still.

The international response to this issue has been slow. However, the Paris Agreement and the Nationally Determined Contributions (NDC) framework may provide the tools to

achieve global action on climate change.

Limiting global warming to 1.5°C by 2100 is still technically feasible; Moreover it will be necessary to minimise the risks of climate change. Current commitments are far from getting us there. For the best possible chance of limiting global warming, we require rapid and ambitious action from all levels of society; our path is not yet set.

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