

# Understanding the IPCC Special Report on 1.5°C

WEATHER CLIMATE WATER



# Understanding the IPCC Special Report on 1.5°C

The Intergovernmental Panel on Climate Change (IPCC) was established in 1988 by the World Meteorological Organization (WMO) and United Nations Environment Programme (UNEP). Participation is open to all member countries of the WMO and United Nations, and the IPCC currently has 195 members.

In 2015 governments adopted the Paris Agreement to tackle climate change (see below) and invited the IPCC to prepare a special report in 2018 to assess the impacts and related pathways of warming of 1.5°C.

approval, by the Intergovernmental Panel on Climate Change (IPCC) on 8 October 2018. This brief is produced prior to the release of the report and therefore does not contain results from the report itself.

This brief provides context and explanation of key concepts for policymakers, media and others about the Special Report on 1.5°C<sup>1</sup>, scheduled to be published, subject to

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<sup>1</sup> The full title of the 1.5°C Report is “Global Warming of 1.5 °C, an IPCC special report on the impacts of global warming of 1.5 °C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty.”

# What is the 1.5°C Special Report?

During a summit in Paris in December 2015, organized under the United Nations Framework Convention on Climate Change (UNFCCC), 195 countries adopted the Paris Agreement which includes a long-term temperature goal:

“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, recognizing that this would significantly reduce the risks and impacts of climate change;” (Article 2.1.a).

and:

“In order to achieve the long-term temperature goal set out in Article 2, Parties aim to reach global peaking of greenhouse gas emissions as soon as possible, recognizing that peaking will take longer for developing country Parties, and to undertake rapid reductions thereafter in accordance with best available science, so as to achieve a balance between anthropogenic emissions by sources and removals by sinks of greenhouse gases in the second half of this century, on the basis of equity, and in the context of sustainable development and efforts to eradicate poverty.” (Article 4.1).

To inform governments, the Paris meeting invited the IPCC to provide a Special Report on 1.5°C in 2018 to assess the implications of the goal and how it could be achieved.

Ninety-one coordinating lead authors, lead authors and review editors from 40 countries, helped by 133 contributing authors, prepared the Special Report.

The most recent report from the IPCC is the Fifth Assessment Report, published in 2013 and 2014. It assessed more than 30,000 scientific publications.

## The scope of the report

The Special Report on 1.5°C assesses three main themes:

- What would be required to limit warming to 1.5°C (mitigation pathways)
- The impacts of 1.5°C of warming, compared to 2°C and higher
- Strengthening the global response to climate change; mitigation and adaptation options

The connections between climate change and sustainable development and efforts to eradicate poverty are discussed throughout the report and in a dedicated chapter.

(Response options to climate change include mitigation – preventing future climate change by reducing greenhouse gas emissions or concentrations – and adaptation – adjusting to climate change that has already occurred or will occur in the future because of current or past emissions.)

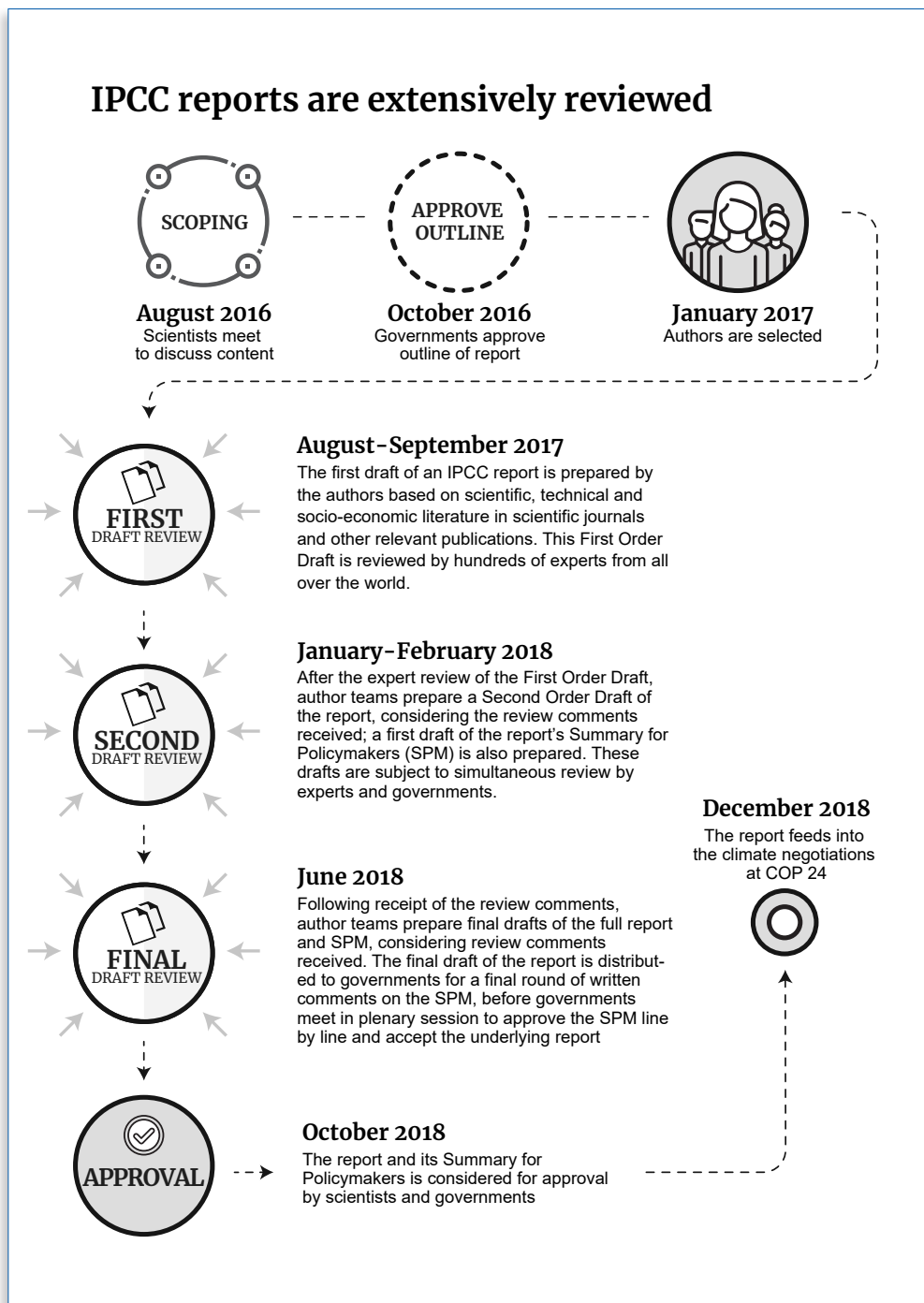
The connections between climate change and sustainable development and efforts to eradicate poverty are discussed throughout the report and in a dedicated chapter.

The 17 UN Sustainable Development Goals (SDGs) are a universal call to action to end poverty, protect the planet and ensure that all people enjoy peace and prosperity. This includes tackling climate change (SDG 13). The SDGs are unique in that they call for action by all countries, – rich, poor, and middle-income – to promote prosperity while protecting the planet. The forthcoming IPCC report is framed in the context of the SDGs.

## Writing and review process

The process of preparing an IPCC report involves both scientists and government representatives. Scientists and governments frame the report and its content at the start of the process. The scientific community

then works independently to undertake and write the full assessment. At the end of the process, input from governments helps shape the Summary for Policymakers and ensures it is policy-relevant and consistent with the underlying report, through line-by-line discussion of the text and figures.





For more information:

- How the IPCC selects its authors:  
[http://www.ipcc.ch/news\\_and\\_events/docs/factsheets/FS\\_select\\_authors.pdf](http://www.ipcc.ch/news_and_events/docs/factsheets/FS_select_authors.pdf)
- How the IPCC review process works:  
[http://www.ipcc.ch/news\\_and\\_events/docs/factsheets/FS\\_review\\_process.pdf](http://www.ipcc.ch/news_and_events/docs/factsheets/FS_review_process.pdf)

### Approval meeting

Approval is the process used for IPCC Summaries for Policymakers (SPMs). Approval signifies that the material has been subject to detailed, line-by-line discussion during the approval meeting, leading to

## The IPCC report on 1.5°C in numbers

Ninety-one authors from 40 countries have been involved in the assessment and writing of the Special Report on 1.5 degrees. Chapter teams comprise three Coordinating Lead Authors (CLAs) and a team of Lead Authors, who are responsible for developing the chapter's content. Review Editors are responsible for ensuring the integrity of the review process. A further 133 Contributing Authors added their expertise to the report. The report has over 6,000 cited references to the scientific literature.

### Authors



**Coordinating lead authors 14**



**Lead authors 60**



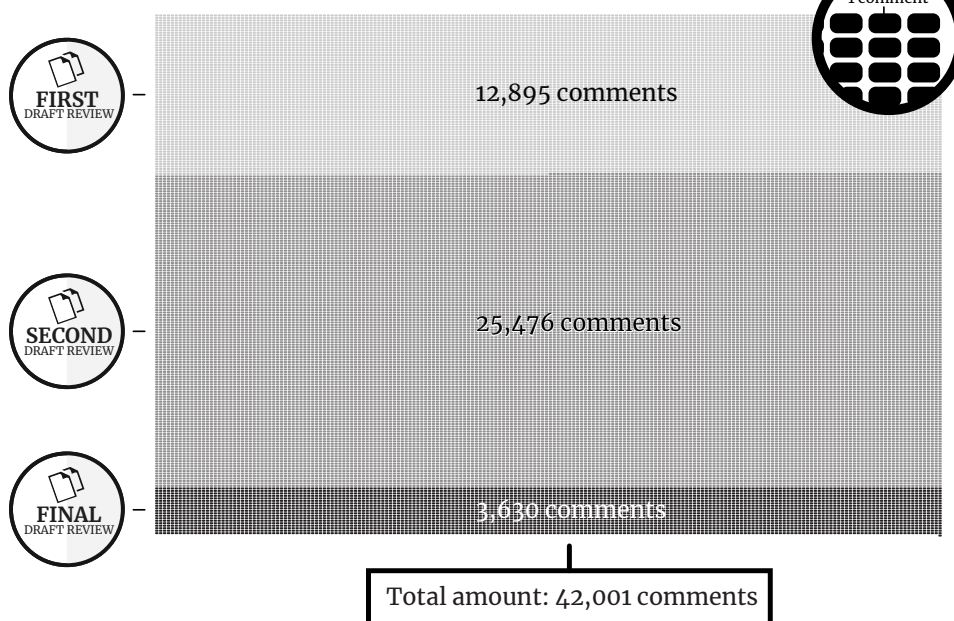
**Review editors 17**



All comments submitted through this review process are addressed by authors, and a written response is provided to each comment.

### Review comments

All comments are made public after the report has been published.



agreement among the participating IPCC member countries, in consultation with the scientists responsible for writing the report. This process strengthens the SPM by ensuring that SPM statements are as direct, clear and unambiguous as possible in summarizing the material contained in the report. Participation of assessment authors ensures that any changes to the SPM are consistent with the underlying report and are scientifically robust. The rest of the report is accepted by the approval meeting, which signifies that the material has not been subject to line-by-line discussion and agreement in plenary, but nevertheless presents a comprehensive, objective and balanced view of the subject matter.

For more information:

- How the IPCC approves reports:  
[http://www.ipcc.ch/news\\_and\\_events/docs/factsheets/FS\\_ipcc\\_approve.pdf](http://www.ipcc.ch/news_and_events/docs/factsheets/FS_ipcc_approve.pdf)

The approval meeting for the Special Report on 1.5°C takes place in Incheon, Republic of Korea, 1–5 October 2018. The report is due to be published on 8 October.





# Key concepts of the Special Report on 1.5°C

The following concepts, which have not or only partially been used in previous IPCC assessments, are discussed by the IPCC in the Special Report on Global Warming of 1.5°C. The descriptions here do not necessarily reflect WMO or UN Environment usage or terminology.

## Emission reduction pledges and Nationally Determined Contributions

In the lead-up to the Paris Agreement in 2015, all Parties were invited to communicate their intended nationally determined contributions as part of the global response to climate change.

In Paris, the countries:

[Noted] with concern that the estimated aggregate greenhouse gas emission levels in 2025 and 2030 resulting from the intended nationally determined contributions do not fall within least-cost 2°C scenarios but rather lead to a projected level of 55 gigatonnes in 2030, and also [noted] that much greater emission reduction efforts will be required than those associated with the intended nationally determined contributions in order to hold the increase in the global average temperature to below 2°C above pre-industrial levels by reducing emissions to 40 gigatonnes or to 1.5°C above pre-industrial levels by reducing to a level to be identified in the [IPCC special report on 1.5°C] referred to in paragraph 21 below;

The Paris Agreement introduced the term “nationally determined contributions” (NDCs), of which the intended nationally determined contributions mentioned above count as the first example. NDCs embody efforts by each country to reduce national emissions and adapt to the impacts of climate change. Scientists often use the term “current pledges” when referring to the emissions reduction in the first NDCs.

The IPCC report will assess development pathways and greenhouse gas emission pathways consistent with 1.5°C compared with 2°C, helping policymakers determine whether current pledges are consistent with the temperature goal, and is expected to provide scientific knowledge relevant to the preparation of successive NDCs.

## Net zero emissions

To hold global average temperature steady, emissions need to reach ‘net zero’. Net zero emissions are achieved when emissions of greenhouse gases to the atmosphere are balanced by anthropogenic removals. This requires at least the same amount of CO<sub>2</sub> to be removed from the atmosphere as is emitted. Formally, in the words of the Paris Agreement, net zero emissions are “a balance between anthropogenic emissions by sources and removals by sinks of greenhouse gases in the second half of this century”.

## Carbon Budget

This term refers to at least two concepts in scientific literature.

Each year since 2005, a community of researchers for the Global Carbon Project produce and report a global carbon budget quantifying CO<sub>2</sub> emissions for the prior year, then apportioning that carbon to the atmosphere, the ocean or the land. This careful accounting of human disturbance of the natural carbon cycle, accompanied by quantification of uncertainties in each source and sink term, allows the research community to understand and monitor major components of and processes within the global carbon cycle.

This annual carbon budget also provides a highly valuable resource within a climate policy framework, providing a definitive record of recent trends as well as quantitative

updates on permissible emissions for given climate stabilization targets.<sup>2</sup>

CO<sub>2</sub> remains in the atmosphere for centuries and its natural degradation due to uptake by land and ocean is slow. This means that CO<sub>2</sub> accumulates in the atmosphere, leading to a corresponding temperature rise. 'Net emissions' refers to emissions by sources, minus removals by sinks. An increase in global average temperature of e.g. 1.5°C corresponds to a limited net amount of CO<sub>2</sub> being emitted. This amount of CO<sub>2</sub> is usually referred to as the carbon budget for 1.5°C. See the forthcoming IPCC report for the exact definition; the term has not been used in previous IPCC reports.

The rate at which CO<sub>2</sub> will be emitted determines how many years remain until emissions must reach 'net-zero'. Scientists often operate with different probabilities of reaching a certain temperature target due to the uncertainties in the climate system.

The carbon budget has some limitations:

- It can only tell us about cumulative net CO<sub>2</sub> emissions. Scientists must make assumptions about the reduction of emissions of other greenhouse gases such as methane, which also contribute to climate change. If emissions of other climate drivers are curbed, there could be room for more CO<sub>2</sub>, and vice versa.
- To assess the timing of emission reductions needed, it is useful to combine information from carbon budgets and from greenhouse gas emission pathways.

Limiting warming to 1.5°C or 2°C without overspending the corresponding carbon budget would require very fast changes in electricity production, transport, construction,

agriculture and industry. The longer CO<sub>2</sub> is emitted at today's rate, the faster this decarbonization will need to be. More details are expected to come in the IPCC report.

### Temperature overshoot

Temperature overshoot is the temporary exceedance of a specified level of global warming, returning to that level before 2100 through carbon dioxide removal (CDR) and/or reductions in emissions of other greenhouse gases.

The larger the temperature overshoot and the longer it persists, the harder it will be to return to the original temperature target. Faster and stronger emission reductions may reduce the need for negative emission technologies.

### Carbon dioxide removal (CDR)

Carbon dioxide removal or negative emissions technologies and practices are anthropogenic activities removing CO<sub>2</sub> from the atmosphere and transferring it to geological, terrestrial, product or ocean storage. It includes anthropogenic enhancement of biological or geochemical sinks and direct chemical air capture and storage, but it excludes natural CO<sub>2</sub> sinks.

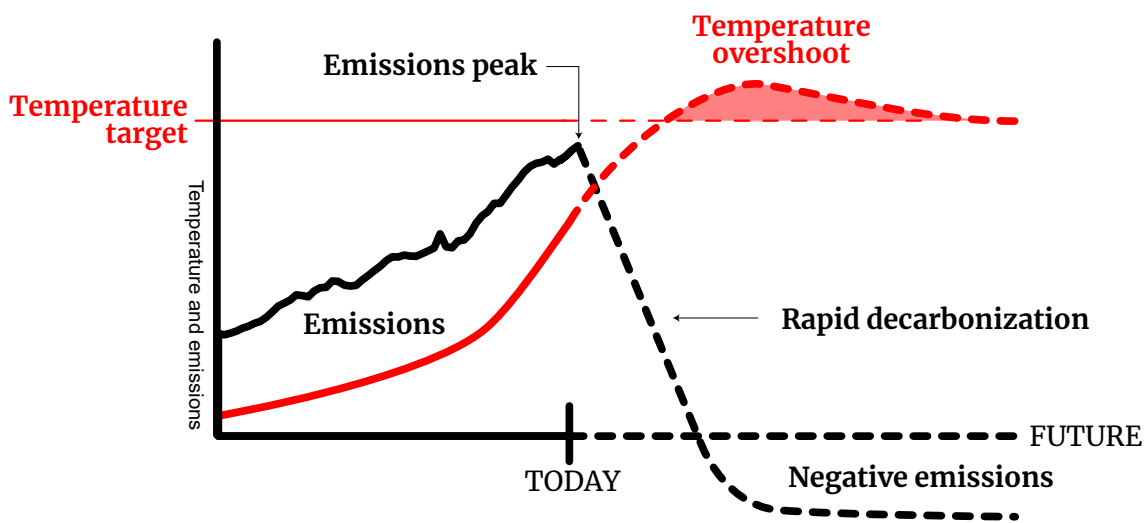
### Carbon capture and storage (CCS)

A process in which a relatively pure stream of carbon dioxide (CO<sub>2</sub>) from industrial and energy-related sources is separated (captured), conditioned, compressed and transported to a storage location for long-term isolation from the atmosphere.

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<sup>2</sup> <https://public.wmo.int/en/resources/bulletin/annual-global-carbon-budget>





*Illustration of temperature overshoot*

## Emission pathways

A pathway of global emissions of greenhouse gases consistent with a given level of global warming.

## Decarbonization

Limiting warming to 1.5°C or 2°C without overspending the corresponding carbon budget would require very fast changes in electricity production, transport, construction, agriculture and industry. The longer CO<sub>2</sub> is emitted at today's rate, the faster this decarbonization will need to be. More details are expected to come in the IPCC report.

## Scenarios

Scenarios are used to explore how emissions evolve under different plausible conditions of future population growth, economic development, and development of new technologies. The purpose of using scenarios is not to predict the future, but to explore both the scientific and real-world implications of different plausible futures.

# Key concepts of climate change research

## Climate change and global warming

**Climate** is defined as the long-term average of weather (temperature, precipitation etc.), often defined as at least a 30-year period. The climate system includes many domains besides the atmosphere, such as the ocean, the cryosphere (frozen world) and biosphere. Over many decades, human-caused emissions of greenhouse gases such as CO<sub>2</sub> and changes to natural carbon sinks through deforestation have been changing the climate by increasing the temperature, altering precipitation patterns, changing the water balance etc.

**Global warming** describes the 20<sup>th</sup> and 21<sup>st</sup> century increase in global average temperature. Both observations and models are used to estimate temperature changes.

Global temperature is calculated by combining measurements across most parts of the globe by satellites, weather stations, ships and buoys. Several large international climate research centres analyse and combine these data to estimate average global temperature and how it is changing. The number of readings has increased over the past decades, which improves the certainty of present-day estimates.

**Climate change** refers to changes not only in temperature but also in other properties of the climate system such as precipitation, sea level, extremes and wind speeds. The most recent IPCC assessment, the Fifth Assessment Report (2013/2014), states that warmer global temperatures are already impacting the climate and natural systems. It concluded that:

- atmosphere and oceans have warmed,
- snow and ice have diminished
- precipitation patterns have changed

- sea level has risen
- heat waves are more frequent
- rainfall is more heavy
- Arctic sea ice extent is decreasing
- permafrost temperatures have increased

## Uneven distribution

The rise in global mean surface temperature (GMST) is not evenly distributed across the planet. Land is warming faster than the ocean, which absorbs around 90% of the excess heat, and the Arctic is warming faster than the tropics.<sup>3</sup> Greater warming near the poles is partly due to the loss of reflective sea ice.

## Extremes

The rise in temperature is not evenly distributed from month to month and year to year. As global mean surface temperature rises, we will experience more extremes like heat waves, cold spells, heavy rainfall and drought in some regions.

Although the average global temperature varies significantly from year to year due to e.g. phenomena such as El Niño or volcanic activity, the long-term trend over the past 30 years has shown significant warming. The world's nine warmest years have all occurred since 2005, and the five warmest since 2010.

## Pre-industrial

The multi-century period prior to the onset of large-scale industrial activity. The reference period from 1850–1900 is often used to approximate pre-industrial global mean surface temperature. Earlier temperature records exist but they are fewer and less reliable.

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<sup>3</sup> [http://ipcc.ch/pdf/assessment-report/ar5/wg1/WG1AR5\\_Chapter12\\_FINAL.pdf](http://ipcc.ch/pdf/assessment-report/ar5/wg1/WG1AR5_Chapter12_FINAL.pdf)

## About the IPCC

### Carbon vs. CO<sub>2</sub>

CO<sub>2</sub> emissions are sometimes stated in tonnes of C (carbon) rather than CO<sub>2</sub> (carbon dioxide). To calculate one tonne of carbon dioxide from one tonne of carbon, multiply C by 3.6667.

### Climate Impacts (consequences, outcomes)

Impacts generally refer to effects on lives, livelihoods, health and wellbeing, ecosystems and species, economic, social and cultural assets, services (including ecosystem services), and infrastructure.

Many species have already shifted their geographic range, seasonal behaviour, migration patterns and abundance in response to ongoing climate change. Changing precipitation or melting snow and ice are affecting people's access to fresh water. Negative impacts of climate change on crop yields have been more common than positive impacts. Impacts from recent climate-related extremes, such as heat waves, droughts, floods, cyclones, and wildfires, reveal significant vulnerability and exposure of some ecosystems and many human systems to current climate variability.

The forthcoming IPCC report will assess the impacts of warming of 1.5°C (and to some extent compared with 2°C and higher temperature rises).

### Climate risks

The lower the global average warming, the lower the risks to human and natural systems will be. Much research has been done to identify risks at 2-4°C global warming. When the IPCC was invited to write a special report on 1.5°C, universities and institutions around the world initiated new studies assessing the risks associated with warming of 1.5°C.

The IPCC provides policymakers with assessments of the scientific basis of climate change, its impacts and future risks, and options for adaptation and mitigation. The IPCC assesses published literature – it does not conduct its own scientific research. The assessments are written by hundreds of leading scientists from all over the world who volunteer their time and expertise.

IPCC reports undergo multiple rounds of drafting and review to ensure they are comprehensive and objective, and produced in an open and transparent way. Thousands of other experts contribute to the reports by acting as reviewers, ensuring the reports reflect the full range of views in the scientific community.

The reports are policy-relevant but not policy-prescriptive. They present projections of future climate change based on different scenarios and the risks that climate change poses and discuss the implications of response options, but they do not tell policymakers what actions to take.

### Forthcoming reports

The IPCC Special Report on 1.5°C is due to be released in October 2018, subject to approval. Two other special reports, Climate Change and Land, and the Ocean and Cryosphere in a Changing Climate, will be published in 2019, as will a refinement to the IPCC's 2006 Guidelines on National Greenhouse Gas Inventories. The three Working Group contributions to the Sixth Assessment Report will be published in 2021, with a Synthesis Report in 2022.

Produced in collaboration with CICERO, Norway, with contributions from the Tyndall Centre, UK.

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