Sixth Assessment Report
WORKING GROUP III – MITIGATION OF CLIMATE CHANGE

ipcc
INTERGOVERNMENTAL PANEL ON climate change

WMO UNEP

Climate Change 2022

Mitigation of Climate Change

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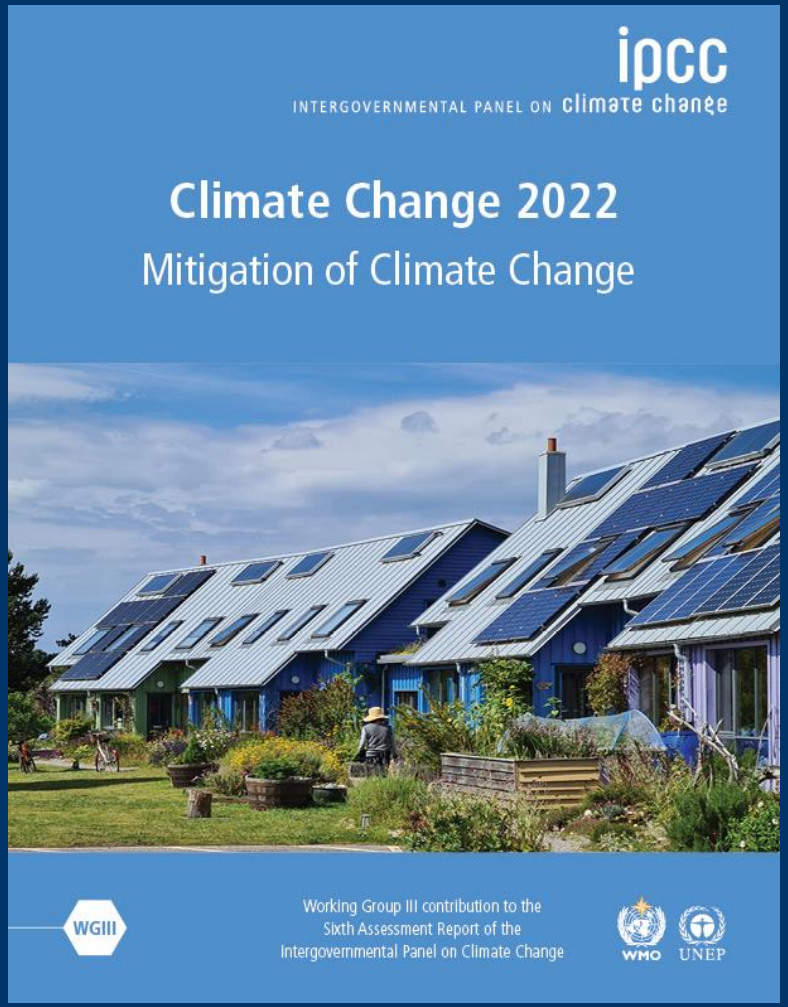
[photo: Matt Bridgestock, Director and Architect at John Gilbert Architects]



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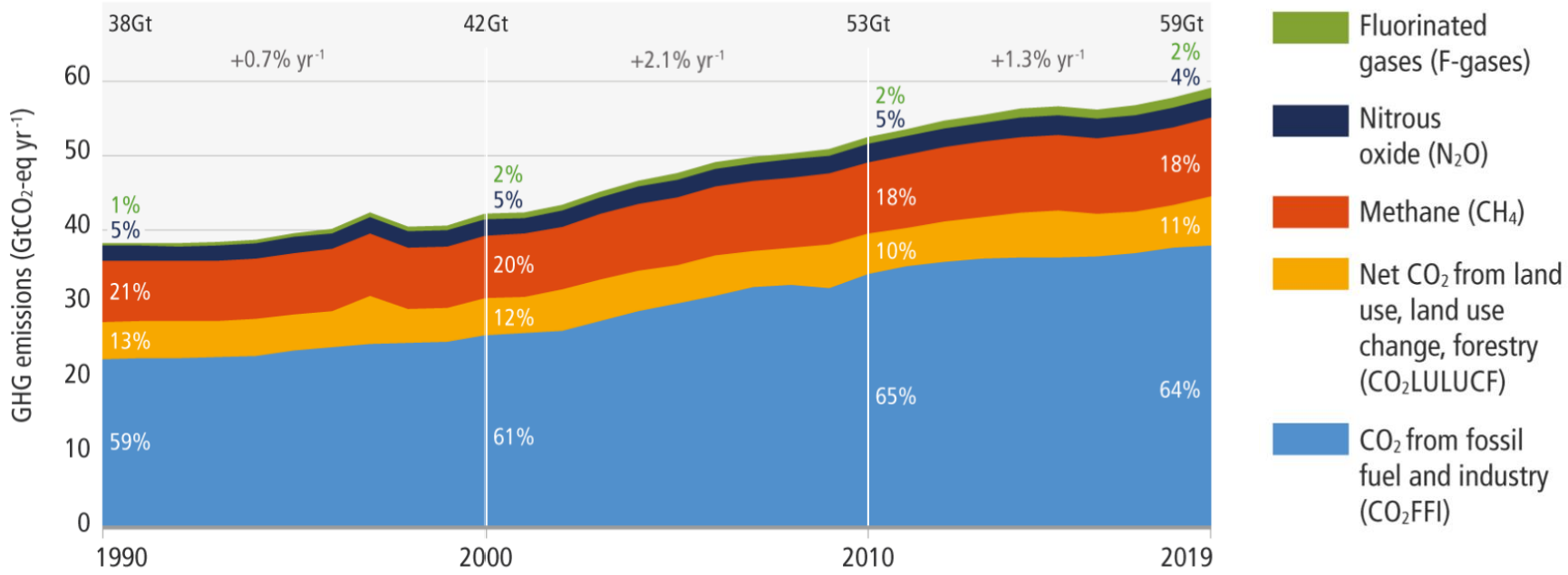
2010-2019: Average annual greenhouse gas emissions at highest levels in human history

We are not on track to limit warming to 1.5 °C.



…but there is increased evidence of climate action

[Charlie Chesvick/IStock.com]

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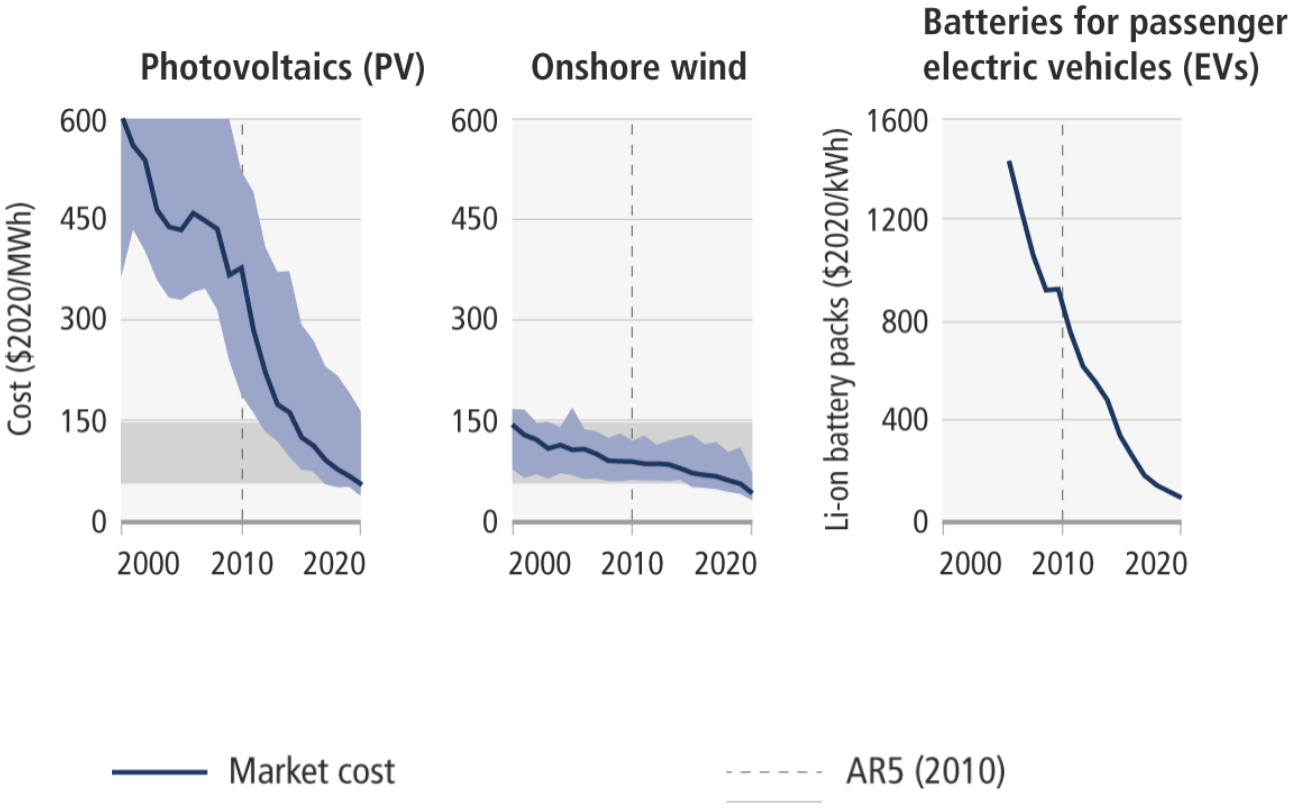
> **Unless there are immediate and deep emissions reductions across all sectors, 1.5°C is beyond reach.**

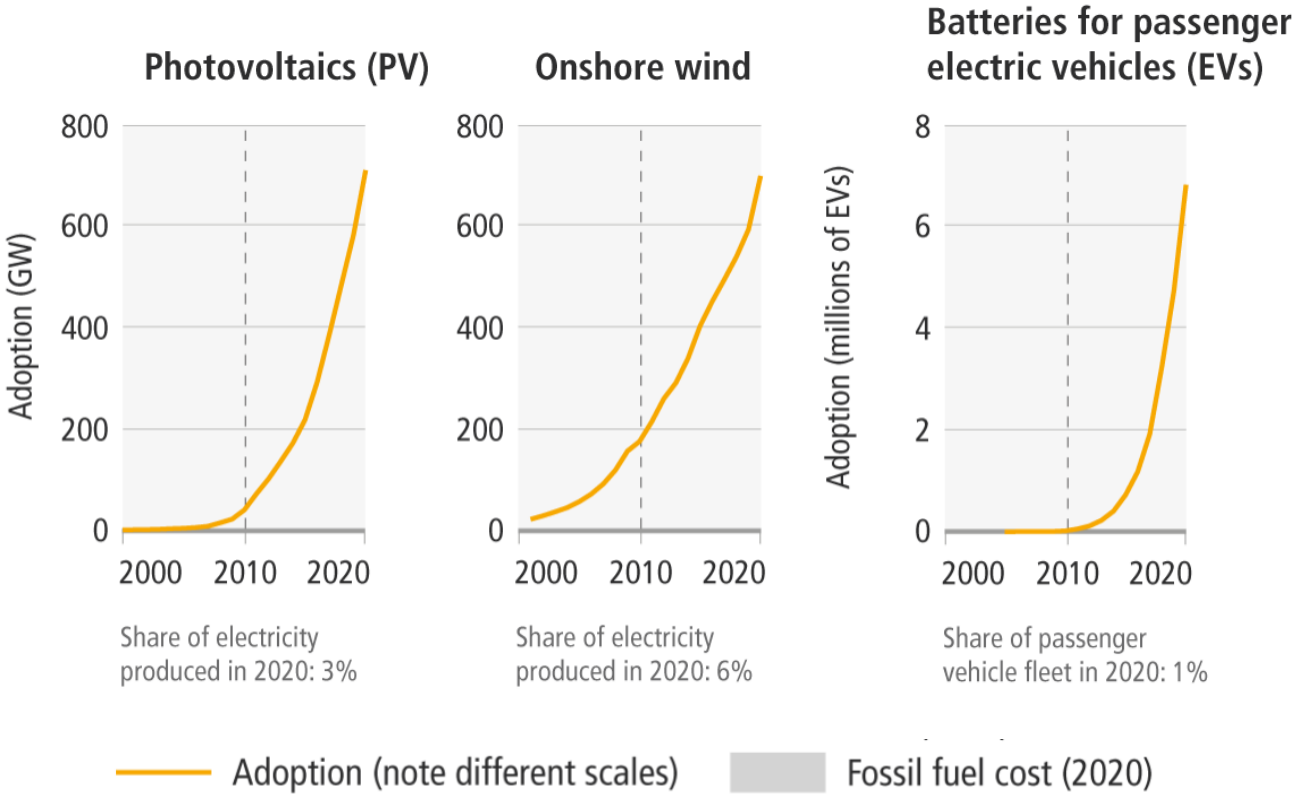
Increased evidence of climate action

Some countries have achieved a **steady decrease** in emissions **consistent** with limiting warming to **2°C.**

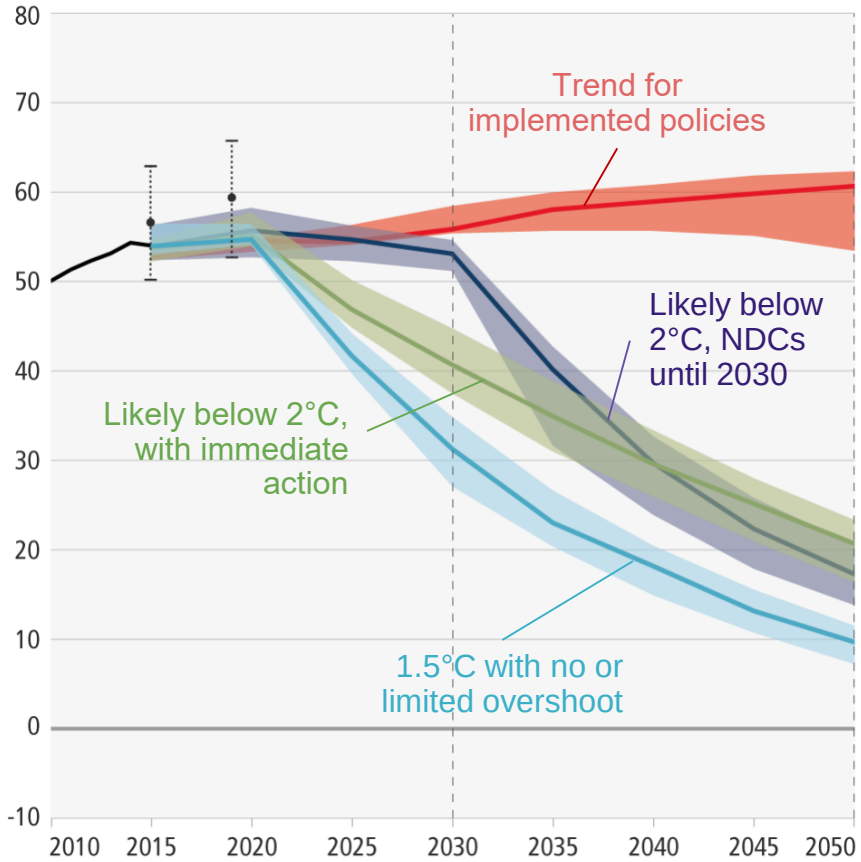
Zero emissions targets have been adopted by at least **826 cities and 103 regions**



In some cases, costs for renewables have fallen below those of fossil fuels.



Electricity systems in some countries and regions are already predominantly powered by renewables.



Limiting warming to 1.5 °C

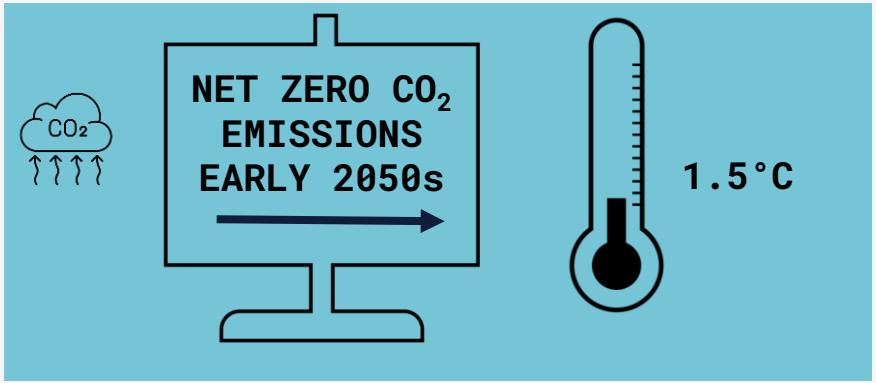
- Global GHG emissions peak before 2025, reduced by 43% by 2030.
- Methane reduced by 34% by 2030

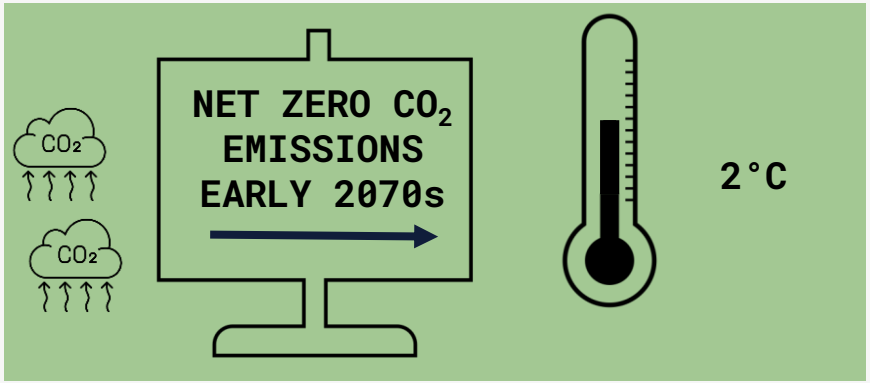
Limiting warming to around 2°C

- Global GHG emissions peak before 2025, reduced by 27% by 2030.

(based on IPCC-assessed scenarios)

The temperature will stabilise when we reach net zero carbon dioxide emissions





(based on IPCC-assessed scenarios)

There are options available **now** in every sector that can at least **halve** emissions by 2030

Demand and services

Energy

Land use

Industry

Urban

Buildings

Transport

C.4 **Reducing GHG emissions across the full energy sector requires major transitions, including a substantial reduction in overall fossil fuel use, the deployment of low-emission energy sources, switching to alternative energy carriers, and energy efficiency and conservation.** The contin
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C.5 **Net-zero CO_2 emissions from the industrial sector are challenging but possible. Reducing industry emissions will entail coordinated action throughout value chains to promote all mitigation options, including demand management, energy and materials efficiency, circular**

C.6 **Urban areas can create opportunities to increase resource efficiency and significantly reduce GHG emissions through the systemic transition of infrastructure and urban form through low-emission development pathways towards net-zero emissions. Ambitious mitigation efforts for established, rapidly growing and emerging cities will encompass 1) reducing or changing energy and material consumption, 2) electrification, and 3) enhancing carbon uptake and storage in the urban environment. Cities can achieve net-zero emissions, but only if emissions are reduced**

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regions. There are many sustainable options for demand management, materials efficiency, and circular material flows that can contribute to reduced emissions, but how these can be applied will vary across regions a
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technolog
scenarios

C.7. **In modelled global scenarios, existing buildings, if retrofitted, and buildings yet to be built, are projected to approach net zero GHG emissions in 2050 if policy packages, which combine ambitious sufficiency, efficiency, and renewable energy measures, are effectively implemented and barriers to decarbonisation are removed. Low ambitious policies increase the**

underestimated compared to bottom-up industry-specific models. (*high confidence*) {3.4, 5.3, Figure

Energy

- **major transitions** are required to limit global warming
- reduction in fossil fuel use and use of carbon capture and storage
- low- or **no-carbon** energy systems
- widespread **electrification** and improved energy **efficiency**
- **alternative fuels**: e.g. hydrogen and sustainable biofuels

Demand and services

- potential to **bring down** global **emissions** by **40-70%** by 2050
- walking and cycling, electrified transport, reducing air travel, and adapting houses make large contributions
- **lifestyle changes** require **systemic changes** across all of society
- **some** people require additional **housing**, **energy** and **resources** for human wellbeing

[Bosch, Unsplash/Yoav Aziz, Adam Bartoszewicz, Victor Hernandez]

Transport

- **reducing demand** and **low-carbon** technologies are key to reducing emissions
- **electric vehicles**: greatest potential
- **battery technology**: advances could assist electric rail, trucks
- **aviation** and **shipping**: alternative fuels (low-emission **hydrogen** and **biofuels**) needed
- Overall, substantial potential but depends on **decarbonising the power sector**.

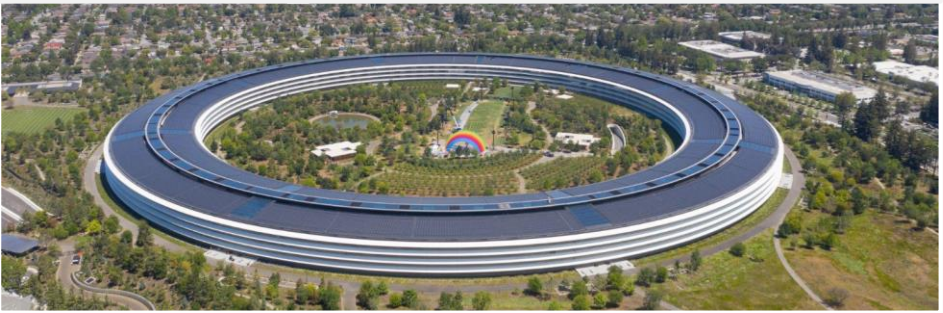
[United Airlines, Jeremy Segrott CC BY 2.0, Andreas160578/Pixabay]

Cities and urban areas

- better urban planning, as well as:
- sustainable production and consumption of goods and services,
- **electrification** (low-emission energy),
- enhancing **carbon uptake and storage** (e.g. green spaces, ponds, trees)

There are options for existing, rapidly growing *and* new cities.

[Pelargoniums for Europe/Unsplash, City of St Pete CC BY-ND 2.0, Victor/Unsplash, EThekwini Municipality, Arne Müseler/arne-mueseler.com, CC BY-SA 3.0 de]



Buildings

- buildings: possible to reach net zero emissions in 2050
- action in this decade is critical to fully capture this potential
- involves retrofitting existing buildings and effective mitigation techniques in new buildings
- requires ambitious policy packages
- zero energy and **zero-carbon** buildings exist in new builds **and retrofits**

[Pelargoniums for Europe/Unsplash, City of St Pete CC BY-ND 2.0, Victor/Unsplash, EThekwini Municipality, Arne Müseler/arne-mueseler.com, CC BY-SA 3.0 de]

Industry

- using materials more **efficiently**, **reusing**, **recycling**, **minimising waste**; currently **under-used** in policies and practice
- **basic materials**: low- to zero-greenhouse gas production processes at **pilot** to **near-commercial** stage
- achieving **net zero** is challenging





[Ahsanization/Unsplash, IMF Focus | Industry and Manufacturing CC BY-NC-ND 2.0, Rwanda Green Fund CC BY-ND 2.0, ILO/M. Fossat CC BY-NC-ND 2.0, Stephen Cornwell Pxhere.com]

Carbon Dioxide Removal

- required to **counterbalance hard-to-eliminate** emissions
- through **biological** methods: reforestation, and soil carbon sequestration
- **new technologies** require more **research**, up-front **investment**, and proof of concept at **larger scales**
- **essential** to **achieve net zero**
- **agreed methods** for measuring, reporting and verification required

[Forest Service Northern Region CC BY 2.0, Fiston Wasanga/CIFOR CC BY-NC-ND 2.0, Climeworks]



Land use

- can provide large-scale emissions reductions **and** remove and store CO_2 at scale
- protecting and restoring **natural ecosystems** to remove carbon: forests, peatlands, coastal wetlands, savannas and grasslands
- competing demands have to be **carefully managed**
- **cannot compensate** for **delayed** emission **reductions** in other sectors

Closing investment gaps

- financial flows: **3-6x lower** than levels needed **by 2030** to limit warming to below 1.5°C or 2°C
- there is **sufficient global capital** and liquidity to close investment gaps
- challenge of closing gaps is widest for developing countries

[Tobias/Unsplash, Rwanda Green Fund /CC BY-SA 2.0]

Policies, regulatory and economic instruments

- regulatory and economic instruments have **already proven effective** in reducing emissions
- **policy packages** and **economy-wide packages** are able to achieve **systemic change**
- ambitious and effective mitigation requires **coordination across government** and society

Technology and Innovation

- investment and policies **push forward low emissions** technological **innovation**
- **effective decision making** requires assessing potential benefits, barriers and risks
- **some options** are technically **viable**, rapidly becoming **cost-effective**, and have relatively **high public support**. Other options face barriers

Adoption of low-emission technologies is slower in most developing countries, particularly the least developed ones.

Accelerated climate action is critical to sustainable development

[Duy Pham/Unsplash]

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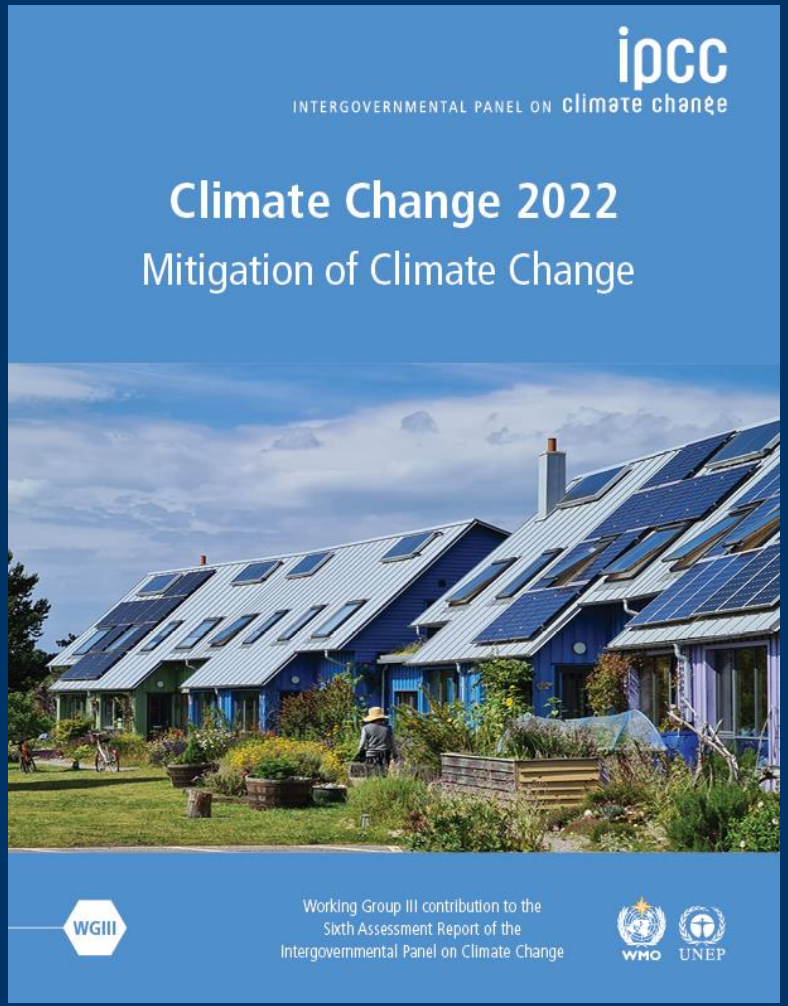
“ **The evidence is clear:**

The time for action is now

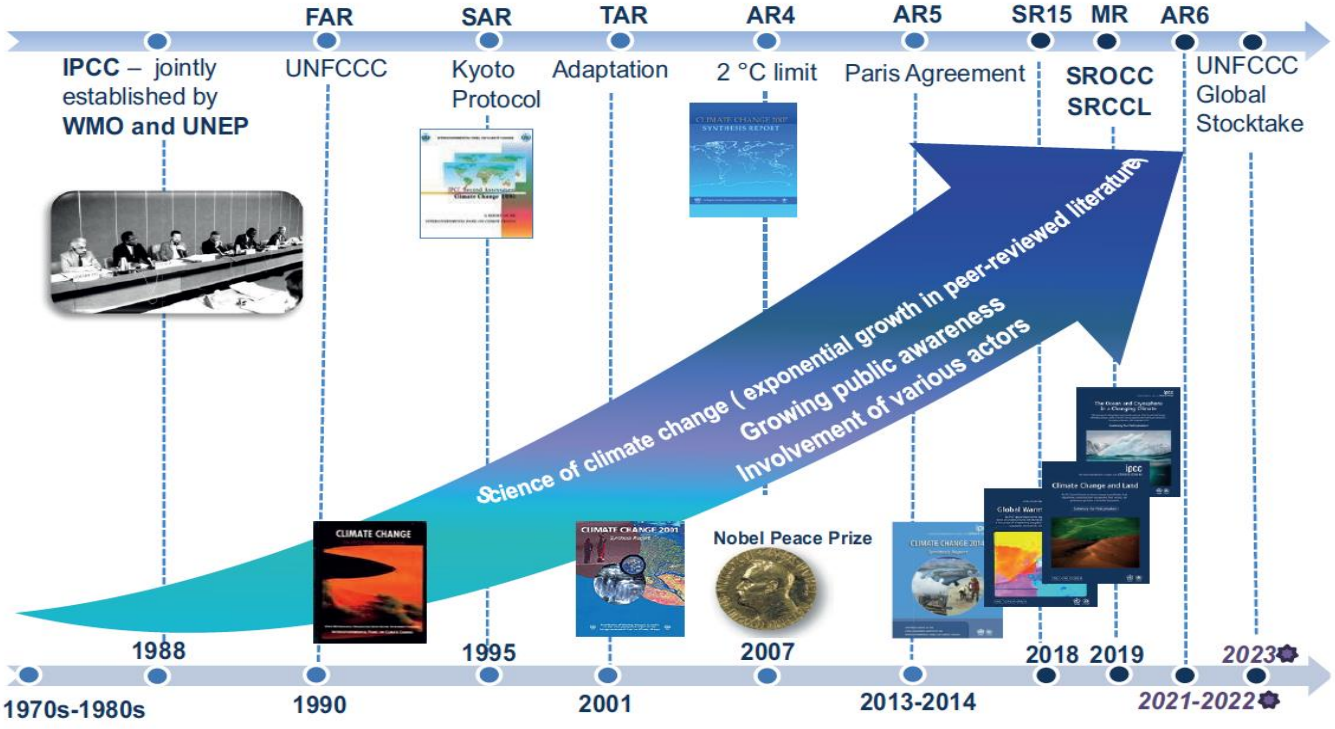


IPCC: Looking Back and Looking Forward

Lynn Price
Affiliate (retired Senior Scientist)
Lawrence Berkeley National Laboratory

[photo: Daniel Bernard]

IPCC contribution to climate science and policymaking



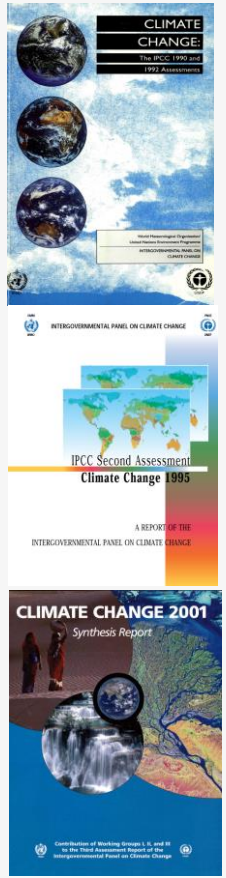
These dates are subject to change.

IPCC Assessment Reports – Influence of Human Activities

- FAR (1990): We are certain of the following: …emissions resulting from human activities are substantially increasing the atmospheric concentrations of the greenhouse gases: CO_2, methane, CFCs and nitrous oxide. These increases will enhance the greenhouse effect, resulting on average in an additional warming of the Earth's surface.

- SAR (1995): …the observed trend in global mean temperature over the past 100 years is unlikely to be entirely natural in origin. More importantly, there is evidence of an emerging pattern of climate response to forcings by greenhouse gases and sulphate aerosols in the observed climate record. Taken together, these results point towards a human influence on global climate.

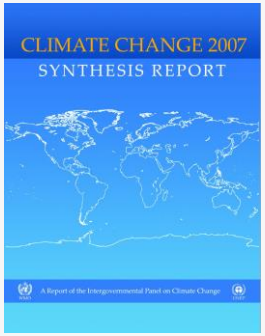
- TAR (2001): An increasing body of observations gives a collective picture of a warming world and other changes in the climate system…There is new and stronger evidence that most of the warming observed over the last 50 years is attributable to human activities.

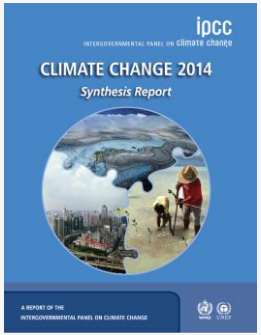


IPCC Assessment Reports – Influence of Human Activities

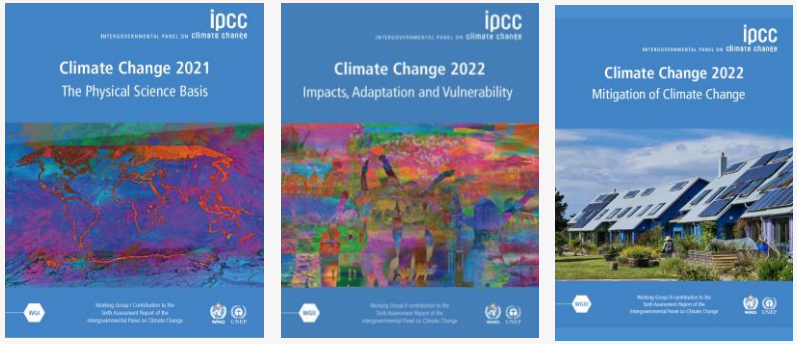
- AR4 (2007): Warming of the climate system is unequivocal. Most of the observed increase in global average temperatures since the mid-20th century is *very likely* due to the observed increase in anthropogenic GHG concentrations.

- AR5 (2013/2014): Human influence has been detected in warming of the atmosphere and the ocean, in changes in the global water cycle, in reductions in snow and ice, in global mean sea level rise, and in changes in some climate extremes. This evidence for human influence has grown since AR4. It is extremely likely that human influence has been the dominant cause of the observed warming since the mid-20th century.





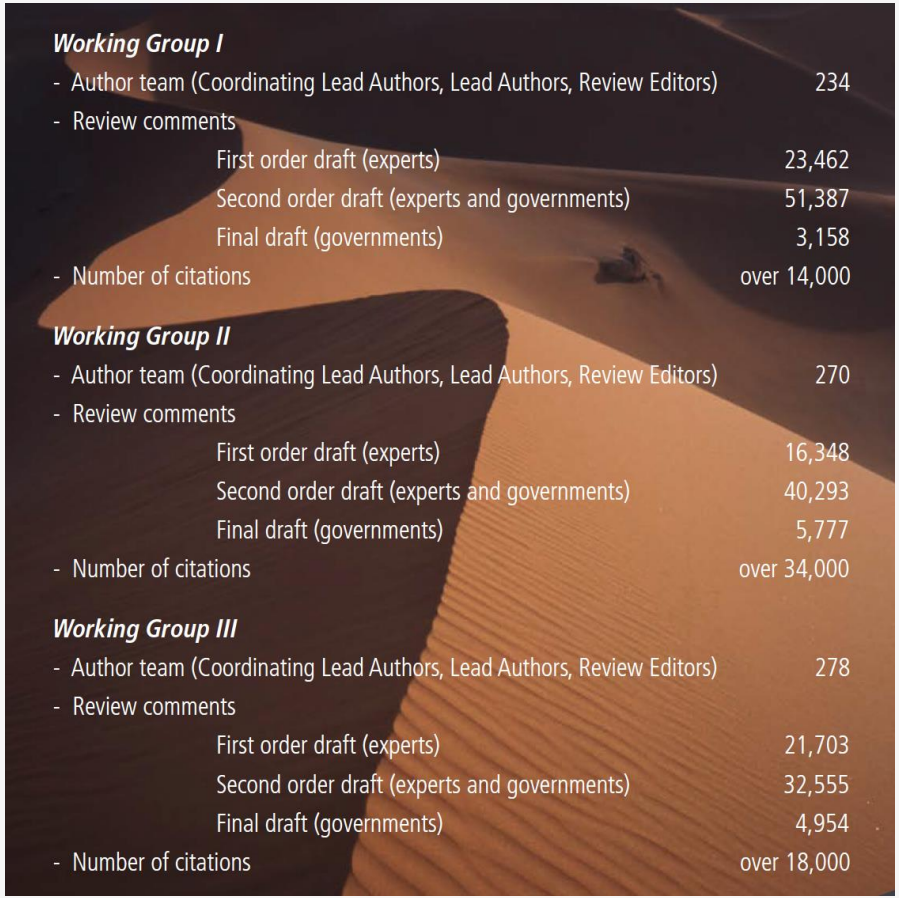
IPCC Assessment Reports – Influence of Human Activities



AR6 (2021/2022)

- The evidence for human influence on recent climate change strengthened from the IPCC First Assessment Report in 1990 to the IPCC Fifth Assessment Report in 2013/14, and is now even stronger in this assessment.
- In addition to global surface temperature, a wide range of indicators across all components of the climate system are changing rapidly, with many at levels unseen in millennia. The observed changes provide a coherent picture of a warming world, many aspects of which have now been formally attributed to human influence, and human influence on the atmosphere, ocean, and land components of the climate system, taken together, is assessed as unequivocal for the first time in an IPCC assessment report.

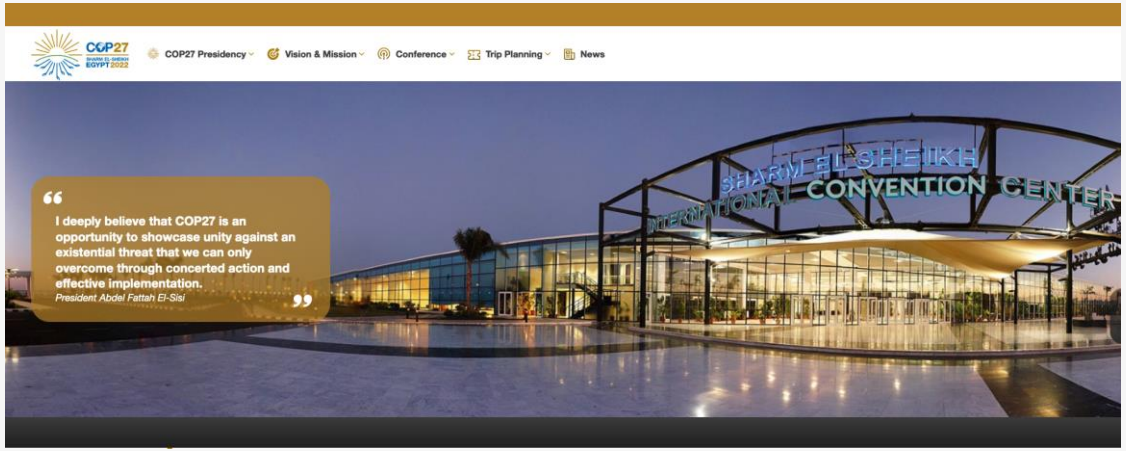
IPCC Sixth Assessment Report – By the Numbers



Sixth Assessment Report

- Authors: 782
- Review comments: 199,637
- Citations: over 66,000

Upcoming Events



- November 6-18, 2022: IPCC outreach at COP-27 in Sharm El Sheikh, Egypt
- March 20, 2023: Sixth Assessment Report (AR6) Synthesis Report released

Nobel Peace Prize - 2007

The Intergovernmental Panel on Climate Change and Albert Arnold (Al) Gore Jr. were awarded the Nobel Peace Prize ”for their efforts to build up and disseminate greater knowledge about man-made climate change, and to lay the foundations for the measures that are needed to counteract such change".