What is new in the Special Report on 1.5C

November 6, 2018
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.
IPCC = Intergovernmental Panel on Climate Change

Jointly organized by UN Environmental Programme and World Meteorological organization

Scientists write the report, governments accept summary for policy makers, line by line.
The report in numbers

- 91 Authors from 40 Countries
- 133 Contributing authors
- 6000 Studies
- 1113 Reviewers
- 42,001 Comments
Summary for policy makers approved line-by-line by IPCC Panel of governments.

Governments agree that the SPM represents the science assessed in the report correctly.

Approved by consensus

Work done Monday through Friday, October 1-5, 2018

Supposed to be done Friday 7pm.

Sessions:
10am-1pm 3pm-7pm
Wednesday added evening session: 8:00-10:30pm
Thursday added night session: 11pm-2am
Friday went all night straight through to Saturday 3pm.
Co-chairs introduce session

Authors come up to front and describe/defend each bullet point sentence.

Read the headline statements first, then approve the bullet points, and then come back and approve headline statements.

Co-Chairs opened discussion of bullets and then sent them to ‘huddles’ (informal sessions with authors and governments) and (contact groups: format sessions chaired by governments).

Authors have final say on what text says, but governments have choice to approve or not approve. Need almost all governments to approve EVERY sentence.
Success!
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.
Two other special reports as well as AR6 underway

• Special report on climate change and oceans and the cryosphere (SROCC): September 2019
• Special report on climate change, desertification, land degradation, sustainable land management, food security and green house gas fluxes in terrestrial ecosystems (SR2): September 2019
• Working group 1: physical climate system
• Working group 2: impacts, vulnerability, adaptation and risks
• Working group 3: mitigation
Understanding Global Warming of 1.5°C
Where are we now?

Since pre-industrial times, human activities have caused approximately 1°C of global warming.

- Already seeing consequences for people, nature and livelihoods
- At current rate, would reach 1.5°C between 2030 and 2052
- Past emissions alone do not commit the world to 1.5°C
SPM1 Cumulative emissions of CO$_2$ and future non-CO$_2$ radiative forcing determine the probability of limiting warming to 1.5°C

a) Observed global temperature change and modeled responses to stylized anthropogenic emission and forcing pathways

Global warming relative to 1850-1900 (°C)
Cumulative emissions of CO₂ and future non-CO₂ radiative forcing determine the probability of limiting warming to 1.5°C

a) Observed global temperature change and modeled responses to stylized anthropogenic emission and forcing pathways

Global warming relative to 1850-1900 (°C)

- Observed monthly global mean surface temperature
- Estimated anthropogenic warming to date and likely range

Global CO₂ emissions reach **net zero in 2055** while net non-CO₂ radiative forcing is **reduced after 2030** (grey in b, c & d)

- Faster CO₂ reductions (blue in b & c) result in a **higher probability** of limiting warming to 1.5°C
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- Faster CO₂ reductions (blue in b & c) result in a **higher probability** of limiting warming to 1.5°C
- **No reduction** of net non-CO₂ radiative forcing (purple in d) results in a **lower probability** of limiting warming to 1.5°C
Cumulative emissions of CO₂ and future non-CO₂ radiative forcing determine the probability of limiting warming to 1.5°C.

Maximum temperature rise is determined by cumulative net CO₂ emissions and net non-CO₂ radiative forcing due to methane, nitrous oxide, aerosols and other anthropogenic forcing agents close to peak temperature.
Projected Climate Change, Potential Impacts and Associated Risks
Impacts of global warming 1.5°C

At 1.5°C compared to 2°C:

- Less extreme weather where people live, including extreme heat and rainfall
- By 2100, global mean sea level rise will be around 10 cm lower but may continue to rise for centuries
- 10 million fewer people exposed to risk of rising seas
Impacts of global warming 1.5°C

At 1.5°C compared to 2°C:

- Lower impact on biodiversity and species
- Smaller reductions in yields of maize, rice, wheat
- Global population exposed to increased water shortages is up to 50% less
Impacts of global warming 1.5°C

At 1.5°C compared to 2°C:

- Lower risk to fisheries and the livelihoods that depend on them
- Up to several hundred million fewer people exposed to climate-related risk and susceptible to poverty by 2050
SPM2

How the level of global warming affects impacts and/or risks associated with the Reasons for Concern (RFCs) and selected natural, managed and human systems

Confidence level for transition: L=Low, M=Medium, H=High and VH=Very high
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Emission Pathways and System Transitions Consistent with 1.5°C Global Warming
Greenhouse gas emissions pathways

- To limit warming to 1.5°C, CO₂ emissions fall by about 45% by 2030 (from 2010 levels)
  → Compared to 20% for 2°C

- To limit warming to 1.5°C, CO₂ emissions would need to reach ‘net zero’ around 2050
  → Compared to around 2075 for 2°C

- Reducing non-CO₂ emissions would have direct and immediate health benefits
Greenhouse gas emissions pathways

- Limiting warming to 1.5°C would require changes on an unprecedented scale
  - Deep emissions cuts in all sectors
  - A range of technologies
  - Behavioural changes
  - Increased investment in low carbon options
Greenhouse gas emissions pathways

• Progress in renewables would need to be mirrored in other sectors

• We would need to start taking carbon dioxide out of the atmosphere

• Implications for food security, ecosystems and biodiversity
Greenhouse gas emissions pathways

• National pledges are not enough to limit warming to 1.5°C → consistent with 3°C rise.

• Avoiding warming of more than 1.5°C would require CO₂ emissions to decline substantially before 2030.
Global total net CO₂ emissions
Billion tonnes of CO₂/yr

In pathways limiting global warming to 1.5°C with no or limited overshoot as well as in pathways with a high overshoot, CO₂ emissions are reduced to net zero globally around 2050.

Non-CO₂ emissions relative to 2010
Emissions of non-CO₂ forcers are also reduced or limited in pathways limiting global warming to 1.5°C with no or limited overshoot, but they do not reach zero globally.

Methane emissions

Black carbon emissions

Nitrous oxide emissions
SPM3b | Characteristics of four illustrative model pathways

**Breakdown of contributions to global net CO₂ emissions in four illustrative model pathways**

- **Fossil fuel and industry**
- **AFOLU**
- **BECCS**

**P1**: A scenario in which social, business and technological innovations result in lower energy demand up to 2050 while living standards rise, especially in the global South. A downsized energy system enables rapid decarbonization of energy supply. Afforestation is the only CDR option considered; neither fossil fuels with CCS nor BECCS are used.

**P2**: A scenario with a broad focus on sustainability including energy intensity, human development, economic convergence and international cooperation, as well as shifts towards sustainable and healthy consumption patterns, low-carbon technology innovation, and well-managed land systems with limited societal acceptability for BECCS.

**P3**: A middle-of-the-road scenario in which societal as well as technological development follows historical patterns. Emissions reductions are mainly achieved by changing the way in which energy and products are produced, and to a lesser degree by reductions in demand.

**P4**: A resource- and energy-intensive scenario in which economic growth and globalization lead to widespread adoption of greenhouse-gas-intensive lifestyles, including high demand for transportation fuels and livestock products. Emissions reductions are mainly achieved through technological means, making strong use of CDR through the deployment of BECCS.
### Characteristics of four illustrative model pathways

<table>
<thead>
<tr>
<th>Global indicators</th>
<th>P1</th>
<th>P2</th>
<th>P3</th>
<th>P4</th>
<th>Interquartile range</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Pathway classification</strong></td>
<td>No or low overshoot</td>
<td>No or low overshoot</td>
<td>No or low overshoot</td>
<td>High overshoot</td>
<td>No or low overshoot</td>
</tr>
<tr>
<td><strong>CO₂ emission change in 2030 (%) ref to 2030</strong></td>
<td>-58</td>
<td>-47</td>
<td>-41</td>
<td>4</td>
<td>(-59, -40)</td>
</tr>
<tr>
<td><strong>Kyoto-GHG emissions</strong>&lt;sup&gt; &lt;/sup&gt; in 2030 (%) ref to 2010</td>
<td>-93</td>
<td>-95</td>
<td>-91</td>
<td>97</td>
<td>(-104, -91)</td>
</tr>
<tr>
<td><strong>Kyoto-GHG emissions</strong>&lt;sup&gt; &lt;/sup&gt; in 2060 (%) ref to 2010</td>
<td>-40</td>
<td>-35</td>
<td>-1</td>
<td>-2</td>
<td>(-55, -38)</td>
</tr>
<tr>
<td><strong>Primary energy from coal in 2030 (%) ref to 2010</strong></td>
<td>-78</td>
<td>-61</td>
<td>-73</td>
<td>-97</td>
<td>(-95, -74)</td>
</tr>
<tr>
<td><strong>Transport share in electricity in 2030 (%)</strong></td>
<td>-32</td>
<td>2</td>
<td>21</td>
<td>44</td>
<td>(-11, -22)</td>
</tr>
<tr>
<td><strong>Final energy demand</strong>&lt;sup&gt; &lt;/sup&gt; in 2030 (%) ref to 2010</td>
<td>-15</td>
<td>-5</td>
<td>17</td>
<td>39</td>
<td>(-12, 7)</td>
</tr>
<tr>
<td><strong>Primary energy from oil in 2030 (%) ref to 2010</strong></td>
<td>-37</td>
<td>-13</td>
<td>-3</td>
<td>86</td>
<td>(-34, 3)</td>
</tr>
<tr>
<td><strong>Primary energy from gas in 2030 (%) ref to 2010</strong></td>
<td>-25</td>
<td>-20</td>
<td>33</td>
<td>37</td>
<td>(-26, 21)</td>
</tr>
<tr>
<td><strong>Cumulative CCS until 2100 (GtCO₂)</strong></td>
<td>0</td>
<td>348</td>
<td>667</td>
<td>1118</td>
<td>(550, 1017)</td>
</tr>
<tr>
<td><strong>Energy systems</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td><strong>Carbon dioxide removal</strong></td>
<td></td>
<td></td>
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<tr>
<td><strong>Agriculture</strong></td>
<td></td>
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</tbody>
</table>

NOTE: Indicators have been selected to show global trends identified by the Chapter 2 assessment. National and sectoral characteristics can differ substantially from the global trends shown above.

**Kyoto-gas emissions are based on SAR GWP-100**

**Changes in energy demand are associated with improvements in energy efficiency and behaviour change.**
DACCS = direct air capture and storage
BECCS = bioenergy carbon capture and storage

SR1.5 report (2018); Chapter 4.
SCS=soil carbon sequestration; OA=ocean alkanization; EW=enhanced weathering; AR=afforestation

SR1.5 report (2018); Chapter 4.
Strengthening the Global Response in the Context of Sustainable Development and Efforts to Eradicate Poverty
Climate change and people

- Close links to United Nations Sustainable Development Goals (SDGs)
- Mix of measures to adapt to climate change and reduce emissions can have benefits for SDGs
- National and sub-national authorities, civil society, the private sector, indigenous peoples and local communities can support ambitious action
- International cooperation is a critical part of limiting warming to 1.5°C
Indicative linkages between mitigation and sustainable development using SDGs (the linkages do not show costs and benefit)

Energy supply: switch over energy to sustainable energy

Energy Demand: behavior change

Land: reduce food waste, switching diets, soil C sequestration, forest preservation
Indicative linkages between mitigation and sustainable development using SDGs (the linkages do not show costs and benefit)
Summary

• 1C warming already: not impossible to be under 1.5C
• Need to adapt to current level and 1.5C or higher: already seeing harms

• Very ambitious to reach 1.5C or 2C
  • Need to move to sustainable energy now
  • Need to have behavior change now (less energy and ag used)
  • Need to move to sustainable ag now
  • Need to develop carbon dioxide removal technologies now (current technologies have many negative impacts)

• Report identifies many potential trade-offs between climate policy and sustainable development
  • Need to make sure expensive technologies aren’t required: don’t block developing countries or eradication of poverty.

• Report identifies many potential synergies between climate action and other goals (clean air, clean water, biodiversity)
Questions?
Radiative forcing of climate between 1750 and 2011

<table>
<thead>
<tr>
<th>Forcing agent</th>
<th>Radiative Forcing (W m(^{-2}))</th>
</tr>
</thead>
<tbody>
<tr>
<td>Well Mixed Greenhouse Gases</td>
<td></td>
</tr>
<tr>
<td>CO(_2)</td>
<td>Very High</td>
</tr>
<tr>
<td>Halocarbons</td>
<td>Very High</td>
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<tr>
<td>Other WMGHG</td>
<td>Very High</td>
</tr>
<tr>
<td>CH(_4)</td>
<td>High</td>
</tr>
<tr>
<td>N(_2)O</td>
<td></td>
</tr>
<tr>
<td>Ozone</td>
<td>High</td>
</tr>
<tr>
<td>Stratospheric</td>
<td>Medium</td>
</tr>
<tr>
<td>Tropospheric</td>
<td>Medium</td>
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<tr>
<td>Stratospheric water vapour from CH(_4)</td>
<td>Medium</td>
</tr>
<tr>
<td>Surface Albedo</td>
<td>High/Low</td>
</tr>
<tr>
<td>Land Use</td>
<td>Medium</td>
</tr>
<tr>
<td>Black carbon on snow</td>
<td>Medium</td>
</tr>
<tr>
<td>Contrails</td>
<td>Medium/High</td>
</tr>
<tr>
<td>Contrail induced cirrus</td>
<td>Medium/High</td>
</tr>
<tr>
<td>Aerosol-Radiation Interac.</td>
<td>High</td>
</tr>
<tr>
<td>Aerosol-Cloud Interac.</td>
<td>Medium</td>
</tr>
<tr>
<td>Total anthropogenic</td>
<td>Medium</td>
</tr>
<tr>
<td>Natural</td>
<td></td>
</tr>
<tr>
<td>Solar irradiance</td>
<td>Medium</td>
</tr>
</tbody>
</table>

Confidence Level:
- Very High
- High
- Medium
- Low
C2.6 Total annual average energy-related mitigation investment for the period 2015 to 2050 in pathways limiting warming to 1.5°C is estimated to be around 900 billion USD2015 (range of 180 billion to 1800 billion USD2015 across six models\textsuperscript{17}). This corresponds to total annual average energy supply investments of 1600 to 3800 billion USD2015 and total annual average energy demand investments of 700 to 1000 billion USD2015 for the period 2015 to 2050, and an increase in total energy-related investments of about 12% (range of 3% to 23%) in 1.5°C pathways relative to 2°C pathways. Average annual investment in low-carbon energy technologies and energy efficiency are upscaled by roughly a factor of five (range of factor of 4 to 5) by 2050 compared to 2015 (medium confidence). {2.5.2, Box 4.8, Figure 2.27}

C2.7. Modelled pathways limiting global warming to 1.5°C with no or limited overshoot project a wide range of global average discounted marginal abatement costs over the 21st century. They are roughly 3-4 times higher than in pathways limiting global warming to below 2°C (high confidence). The economic literature distinguishes marginal abatement costs from total mitigation costs in the economy. The literature on total mitigation costs of 1.5°C mitigation pathways is limited and was not assessed in this report. Knowledge gaps remain in the integrated assessment of the economy wide costs and benefits of mitigation in line with pathways limiting warming to 1.5°C. {2.5.2; 2.6; Figure 2.26}
Cumulative emissions of CO₂ and future non-CO₂ radiative forcing determine the probability of limiting warming to 1.5°C
Cumulative emissions of CO₂ and future non-CO₂ radiative forcing determine the probability of limiting warming to 1.5°C.

Faster immediate CO₂ emission reductions limit cumulative CO₂ emissions.
Cumulative emissions of CO$_2$ and future non-CO$_2$ radiative forcing determine the probability of limiting warming to 1.5°C.
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