

# The Transition to 1.5

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DRAFT PRESENTATION—COMMENTS WELCOME



United Nations



Framework Convention  
on Climate Change



PARIS 2015  
UN CLIMATE CHANGE CONFERENCE  
COP21·CMP11

### **Article 2**

(a) Holding the increase in the global average temperature to well below 2 °C above pre-industrial levels and to pursue efforts to limit the temperature increase to 1.5 °C above pre-industrial levels,....

**Article 4:** In order to achieve the long-term temperature goal set out in Article 2, Parties aim 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.

Courtesy: Jan Sigurd Fuglestad



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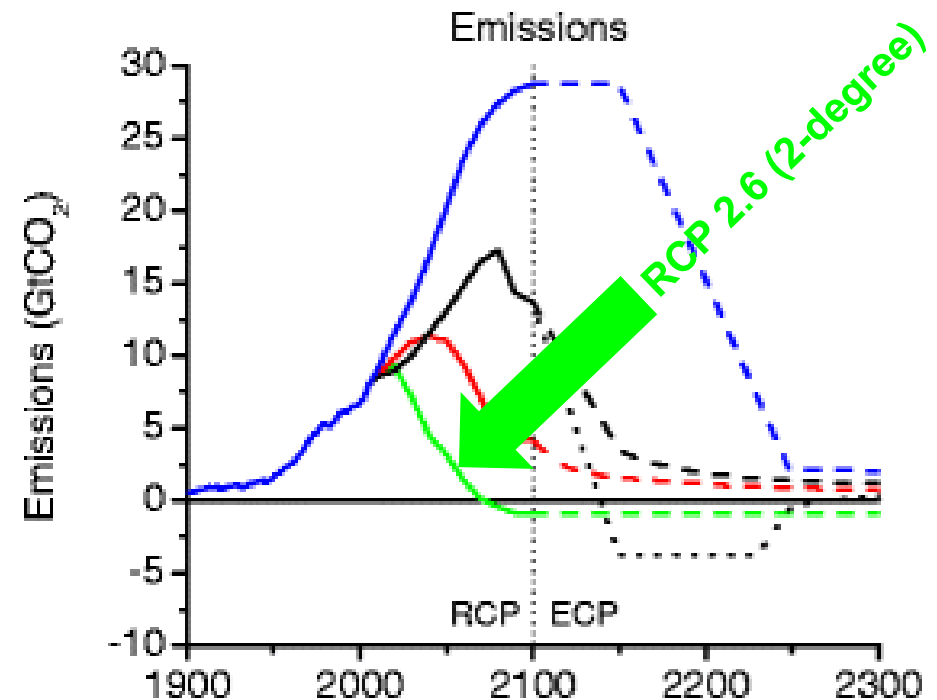


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- When the Paris Agreement was negotiated no scenario pathways had been developed that showed that 1.5 was possible.
- That literature has grown rapidly since.

## All CO<sub>2</sub> emissions scenarios are alike—They all end at zero

- Cumulative emissions of CO<sub>2</sub> will determine climate CO<sub>2</sub> climate forcing—and climate—for the next century.
- Non-CO<sub>2</sub> emissions will become more important as CO<sub>2</sub> emissions decline to zero
- CO<sub>2</sub> has no atmospheric sink—it doesn't disappear
- Carbon that was removed from the atmosphere over millions of years, can only be partitioned between atmosphere, ocean and land
  - Atmosphere (~20% on average will remain permanently)
  - Oceans (~80% on average will end up in oceans)



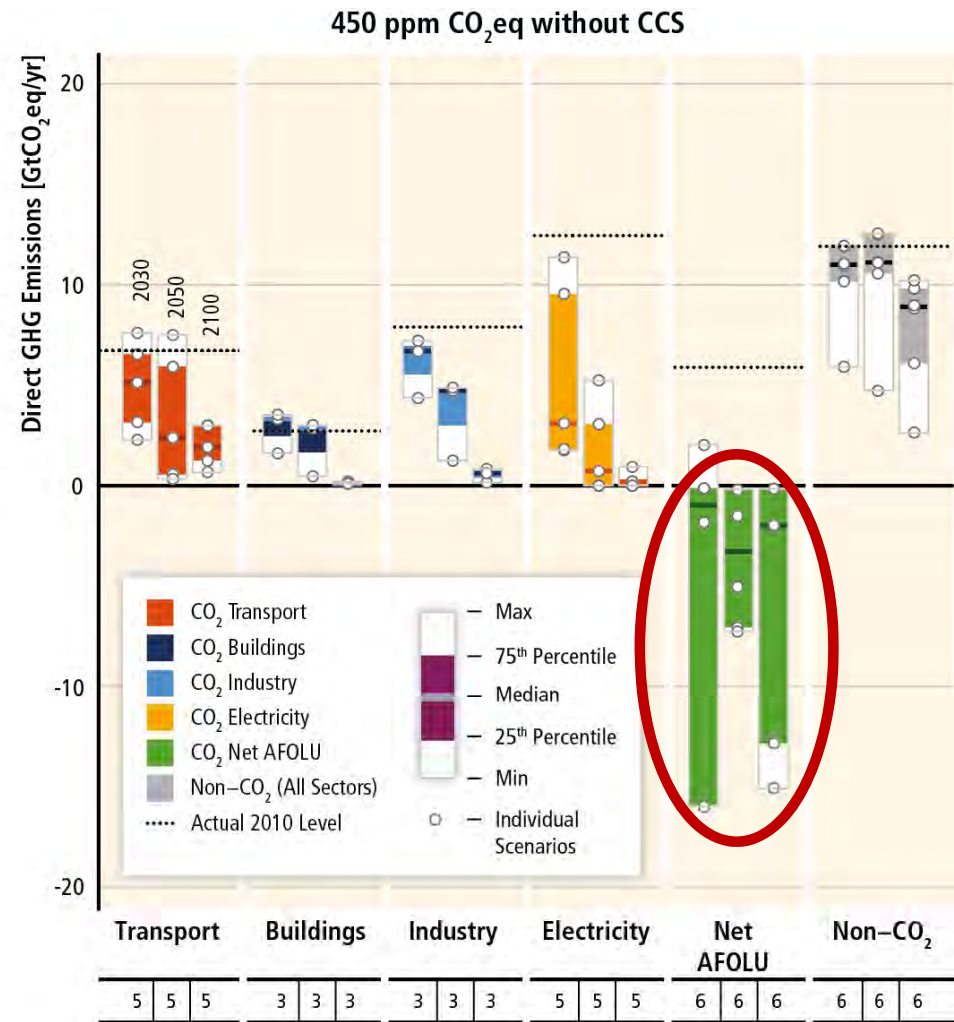
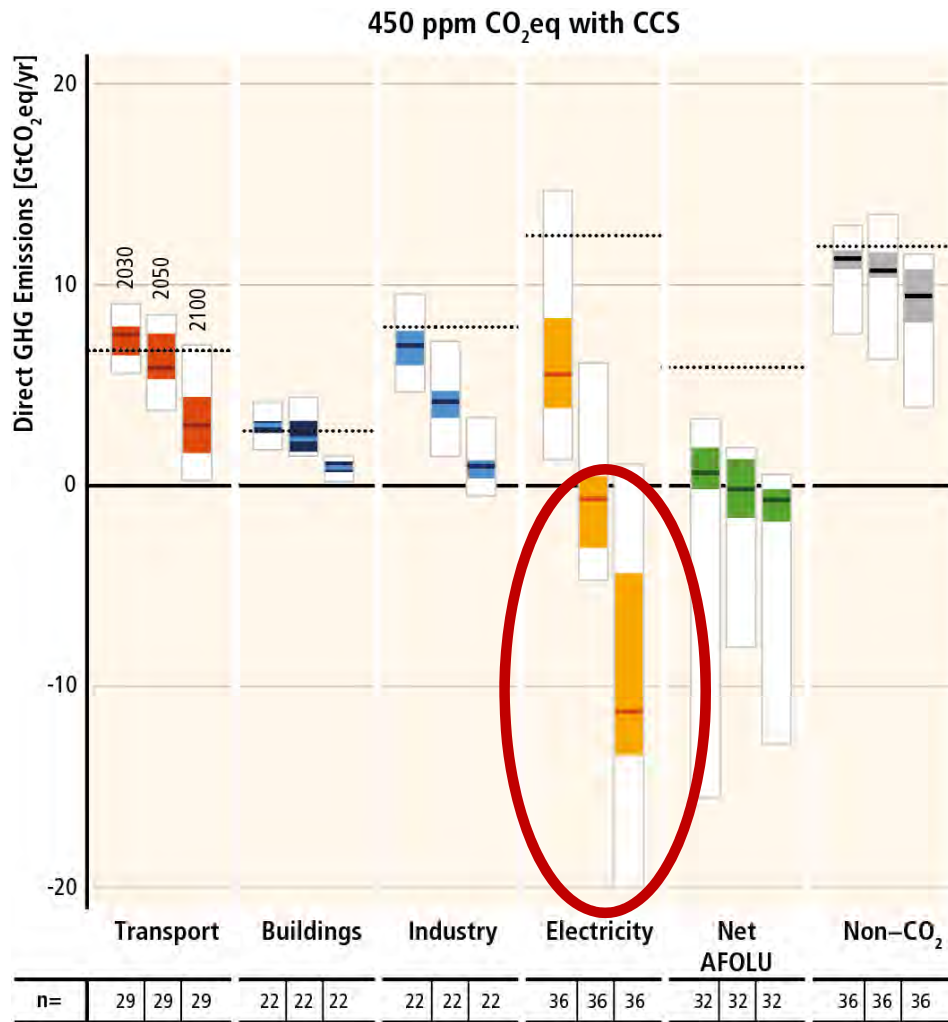
4 Representative Concentration Pathways and Extensions

# Getting to Zero—Five strategy elements

- Energy efficiency—reduce demand for energy as much as economical
- Decarbonize power generation
  - Fossil fuel with CCS
  - Renewable power
  - Nuclear power
  - Bioenergy
  - Bioenergy with CCS
- Electrify Buildings and Industry as much as economical
- Decarbonize transport
  - Electrify
  - Biofuels
  - H2
- Halt deforestation/afforestation and continue improving crop yields



# Getting to zero—ALL sectors need to get close to zero or less

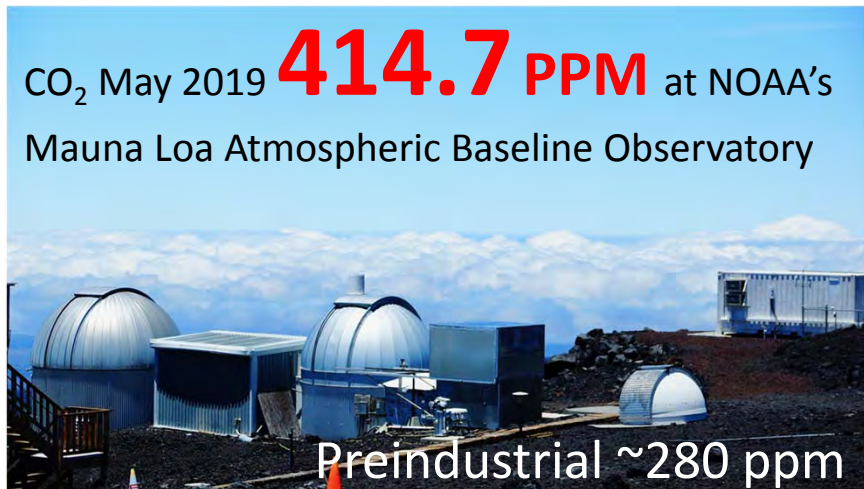


Source: IPCC, AR5, SPM

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## The Challenge of Getting to 1.5

- CO<sub>2</sub> is measured in both tons of CO<sub>2</sub> and tons of C
- 3.667 ton CO<sub>2</sub> = 1 tons C
- \$1/tCO<sub>2</sub> = \$3.67/tC



| CO2-equivalent (ppm) | Radiative Forcing (W/m <sup>2</sup> ) | Avg. Global Temp. Change Long-term (ΔT)* |
|----------------------|---------------------------------------|--|
| 1360                 | 8.5 (RCP)                             | 6.8 °C                                   |
| 1030                 | 7.0                                   | 5.6 °C                                   |
| 850                  | 6.0 (RCP)                             | 4.8 °C                                   |
| 650                  | 4.5 (RCP)                             | 3.6 °C                                   |
| 550                  | 3.7                                   | 2.9 °C                                   |
| 450                  | 2.6 (RCP)                             | 2.1 °C                                   |
| 400                  | 1.9                                   | 1.5 °C                                   |

\* Assumes a climate sensitivity of 3°C. Climate sensitivity is the number of degrees the planet would warm in the long term if the concentration of CO<sub>2</sub> doubled.



## Remaining Carbon Budget

- By the end of 2017,  $2200 \pm 320$  GtCO<sub>2</sub> has been emitted by human activities
- **Currently, emitting  $42 \pm 3$  GtCO<sub>2</sub>/yr**

### Choice of the measure of global temperature affects the estimated remaining carbon budget

Using global mean surface air temperature, as in IPCC AR5:

**580 GtCO<sub>2</sub> left (50% chance of 1.5 °C)**

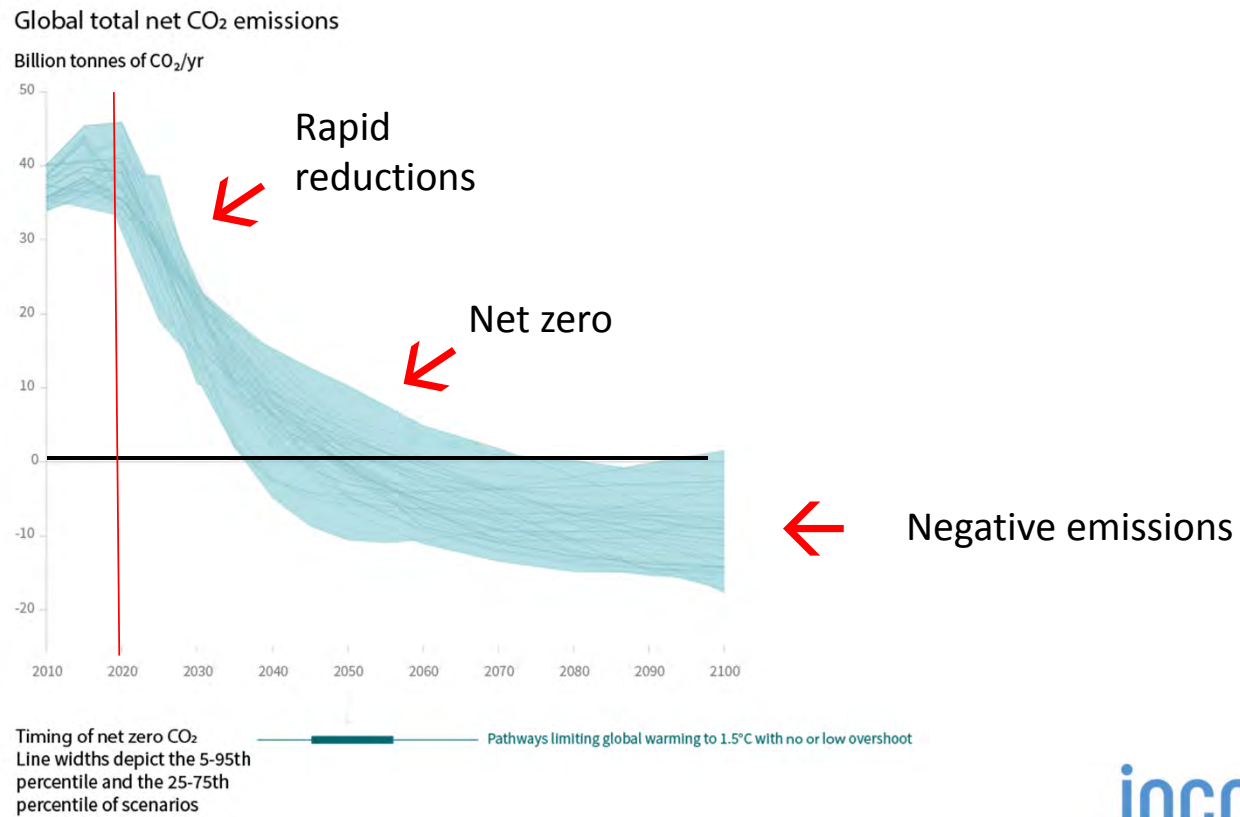
420 GtCO<sub>2</sub> left (66% chance of 1.5 °C)

Using global mean surface temperature (GMST)

**770 GtCO<sub>2</sub> left (50% chance of 1.5 °C)**

570 GtCO<sub>2</sub> left (66% chance of 1.5 °C)

## Global emissions pathway characteristics



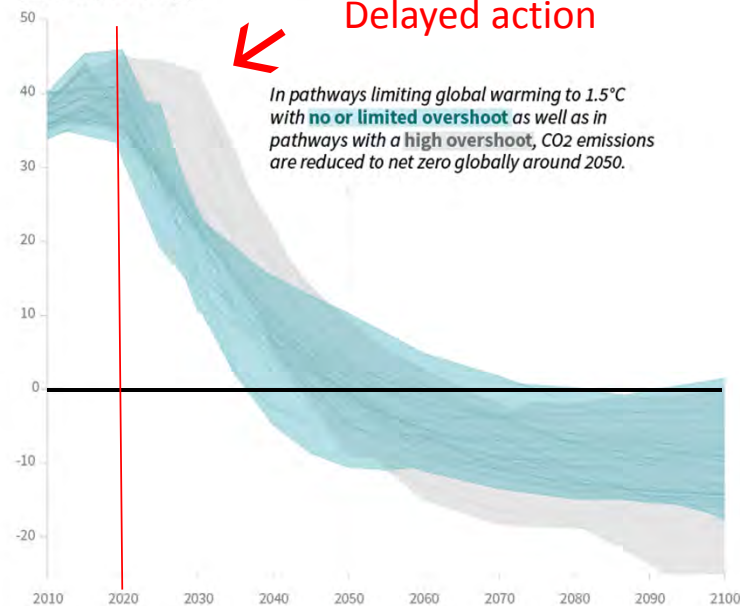
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## Global emissions pathway characteristics

Global total net CO<sub>2</sub> emissions

Billion tonnes of CO<sub>2</sub>/yr



Timing of net zero CO<sub>2</sub>  
Line widths depict the 5-95th percentile and the 25-75th percentile of scenarios

Pathways limiting global warming to 1.5°C with no or low overshoot  
Pathways with high overshoot  
Pathways limiting global warming below 2°C (Not shown above)

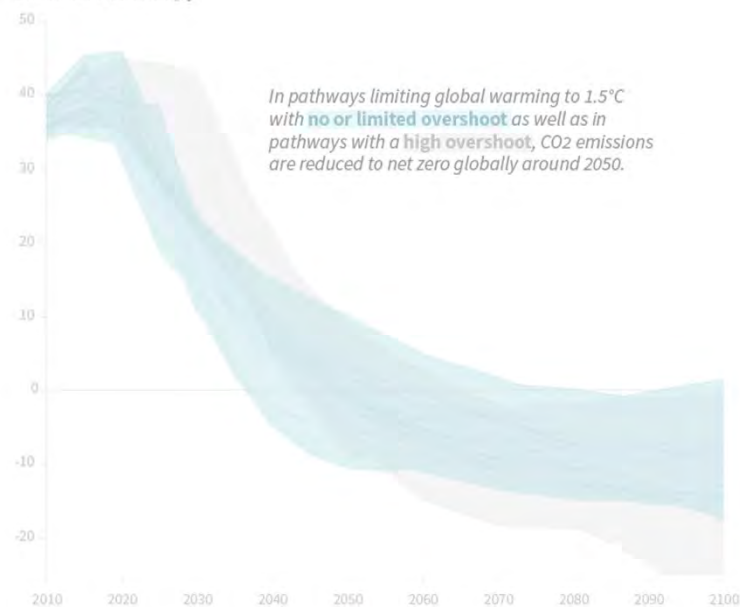
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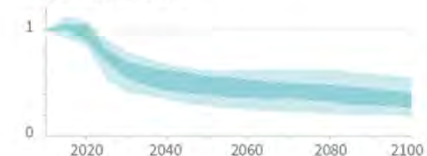
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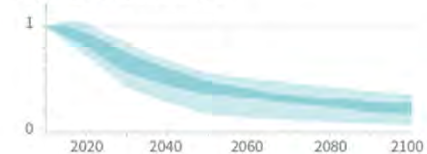
Non-CO<sub>2</sub> emissions relative to 2010

Emissions of non-CO<sub>2</sub> 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.

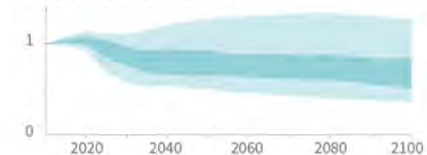
Methane emissions



Black carbon emissions



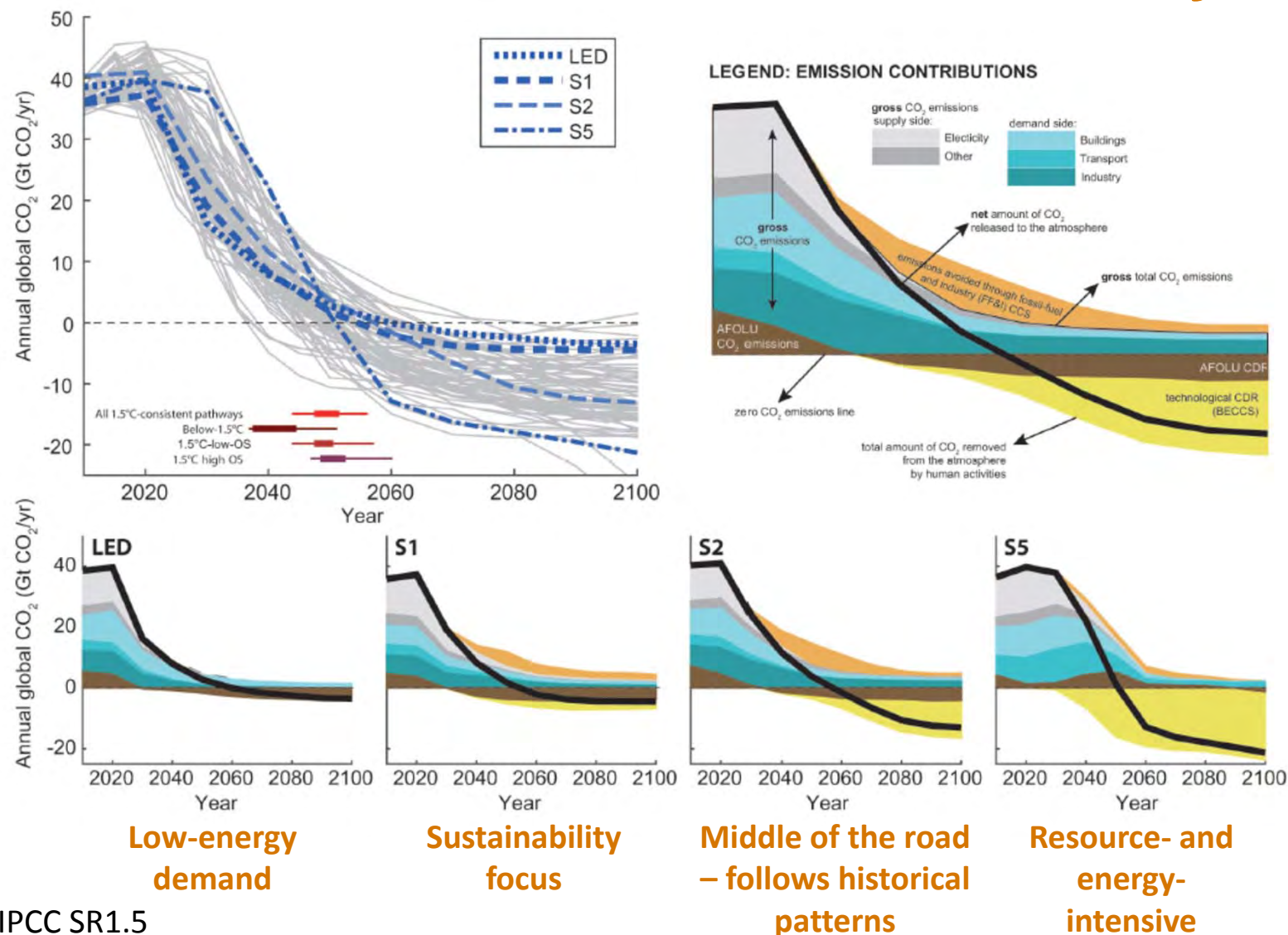
Nitrous oxide emissions



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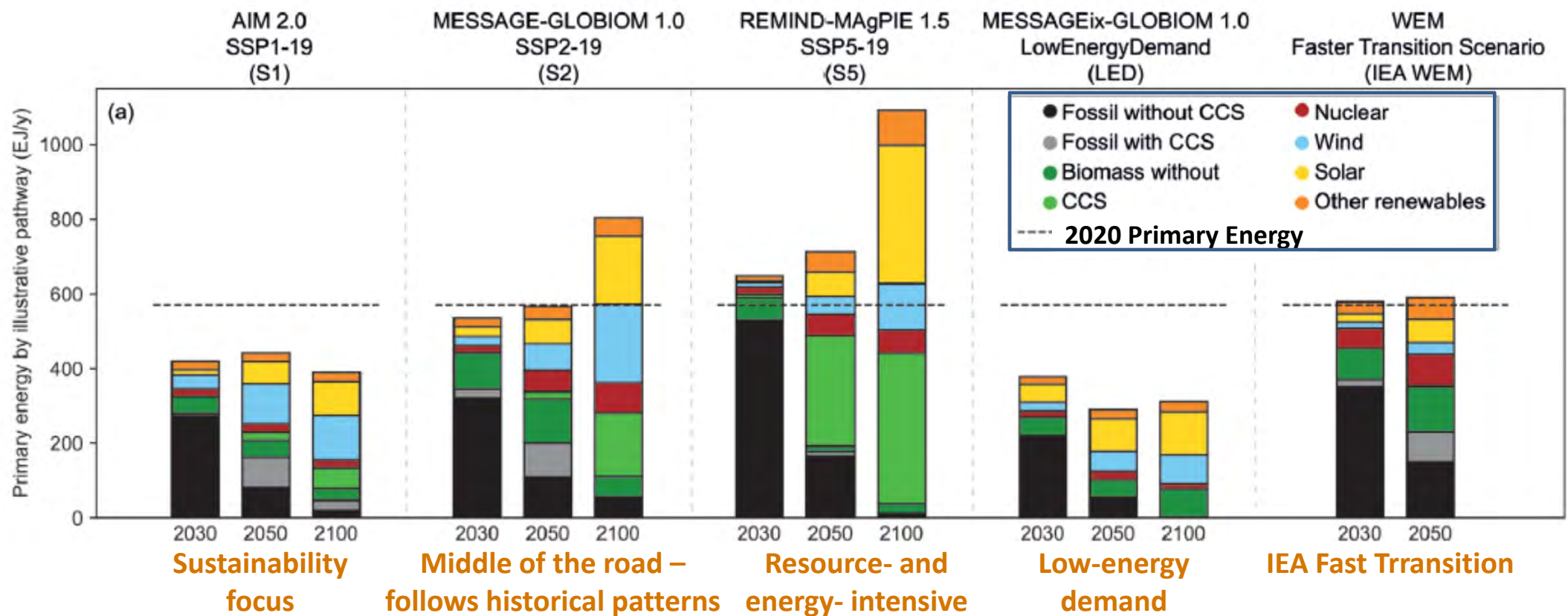


# Characteristics of Four Illustrative Pathways



Source: Figure 2.5, IPCC SR1.5

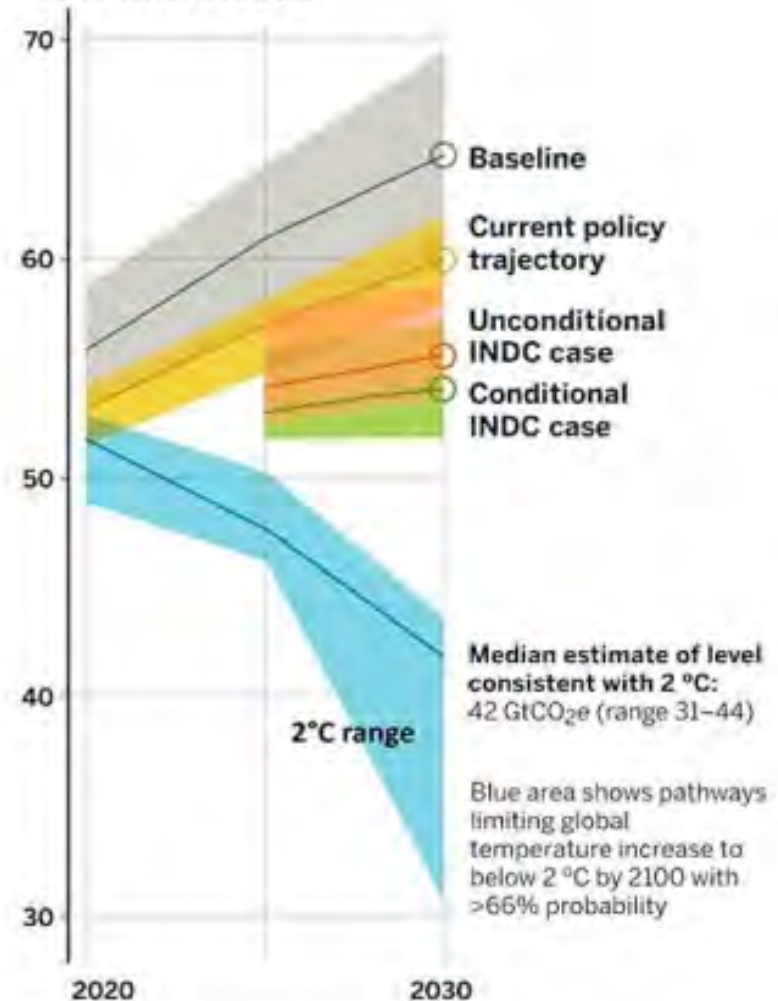
# The energy system will need to transform



# Progress to Date

- Current policies and measures are not adequate to meet Nationally Determined Contributions (NDC) to Paris Agreement.
- NDCs are inadequate to meeting either 2° or 1.5° long-term stabilization goals.

Annual global total greenhouse gas emissions (GtCO<sub>2</sub>e)



Source: <https://www.carbonbrief.org/look-beyond-emissions-gap-to-see-full-force-of-climate-pledges-says-unep-report>

GtCO<sub>2</sub>e = billion metric tons of CO<sub>2</sub> equivalent  
INDC = intended nationally determined contributions

# Final Thoughts

- Limiting climate change to any level involves eventually transitioning to a zero CO<sub>2</sub> emissions world
  - **All sectors** of energy and land systems must also decline toward zero or lower
  - **All regions** of the world must also decline toward zero or lower
- Lower limits of global temperature require faster transitions
- The challenge to achieving the 1.5° goal should not be underestimated.
  - **Global** emissions must begin to decline **before 2030**
  - **Global** carbon emissions must reach **zero around 2050**
  - And then go **negative**.
- Technology, policy and institutions will shape the mix of sectors and fuels.
- The world is currently **NOT** on track to achieve the 1.5° goal.

# DISCUSSION