The Transition to 1.5

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DRAFT PRESENTATION—COMMENTS WELCOME

United Nations

Framework Convention
on Climate Change

PARIS2015
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 Fuglestvedt

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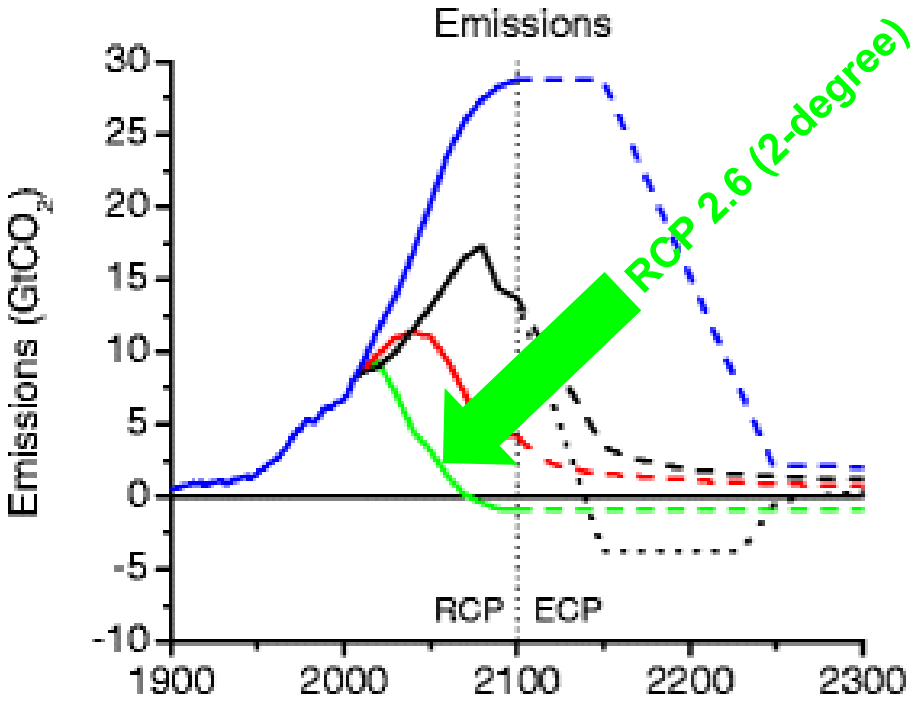
- When the Paris Agreement was negotiated no scenario pathways had been developed that showed that 1.5 was possible.
- That literature has grown rapidly since.

All CO_2 emissions scenarios are alike—They all end at zero

- Cumulative emissions of CO_2 will determine climate CO_2 climate forcing—and climate—for the next century.
- Non-CO_2 emissions will become more important as CO_2 emissions decline to zero

- CO_2 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

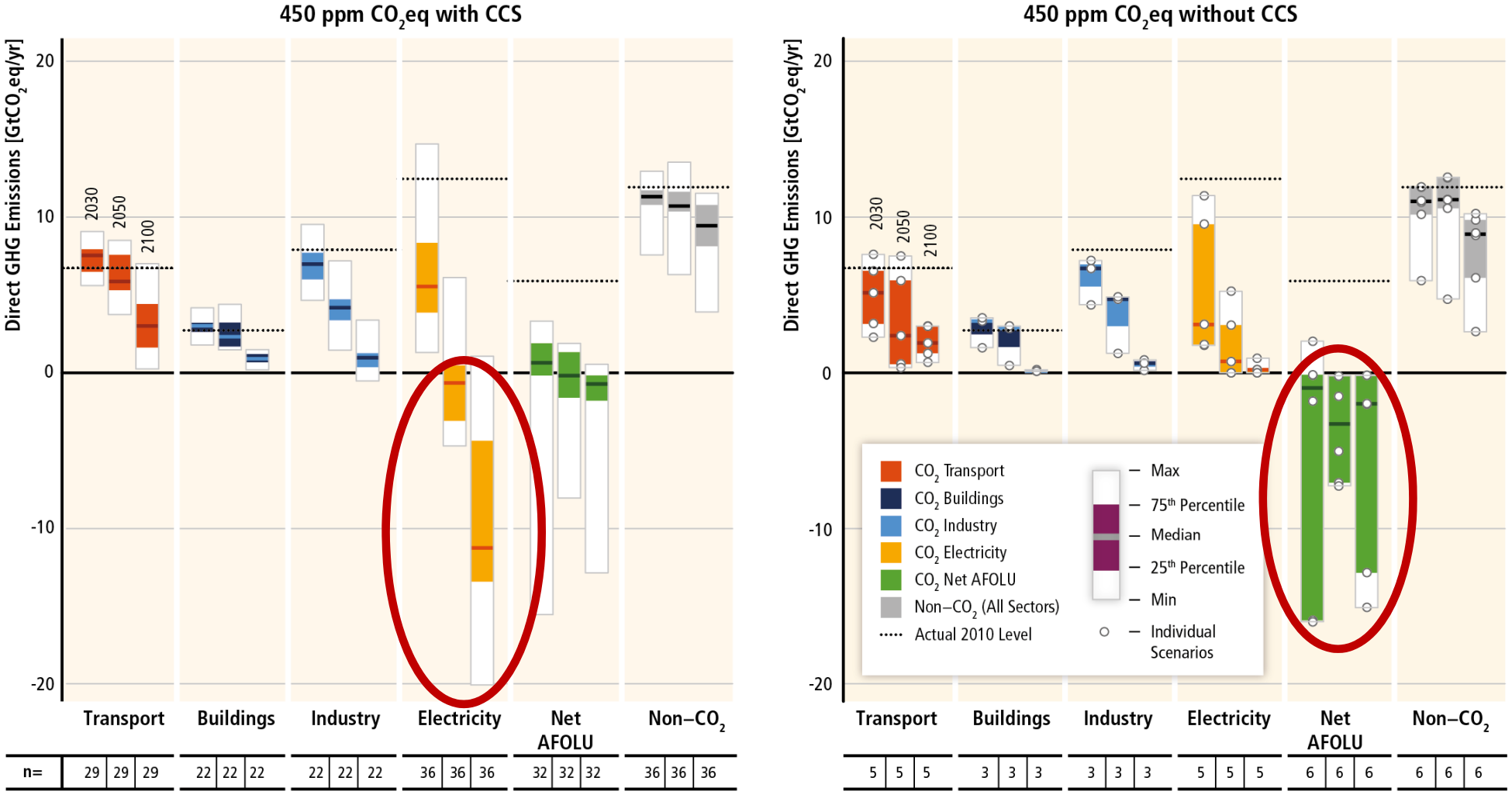
- Electrify Buildings and Industry
  as much as economical

- Decarbonize transport
  - Electrify
  - Biofuels
  - H2

Source: http://www.energy.gov/science-innovation/energy-sources/renewable-energy/wind

- Halt deforestation/afforestation and continue improving crop yields

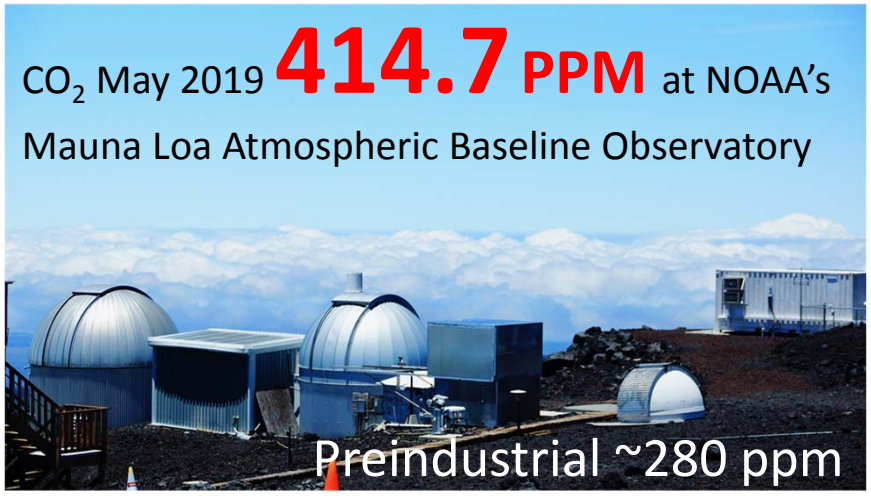
Getting to zero—ALL sectors need to get close to zero or less



Source: IPCC, AR5, SPM

The Challenge of Getting to 1.5

- CO_2 is measured in both tons of CO_2 and tons of C
- 3.667 ton CO_2 = 1 tons C
- \$1/tCO_2 = \$3.67/tC



CO2-equivalent (ppm)	Radiative Forcing (W/m^2)	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_2 doubled.

Remaining Carbon Budget

- By the end of 2017, 2200 ± 320 $GtCO_2$ has been emitted by human activities
- **Currently, emitting 42 ± 3 $GtCO_2$/yr**

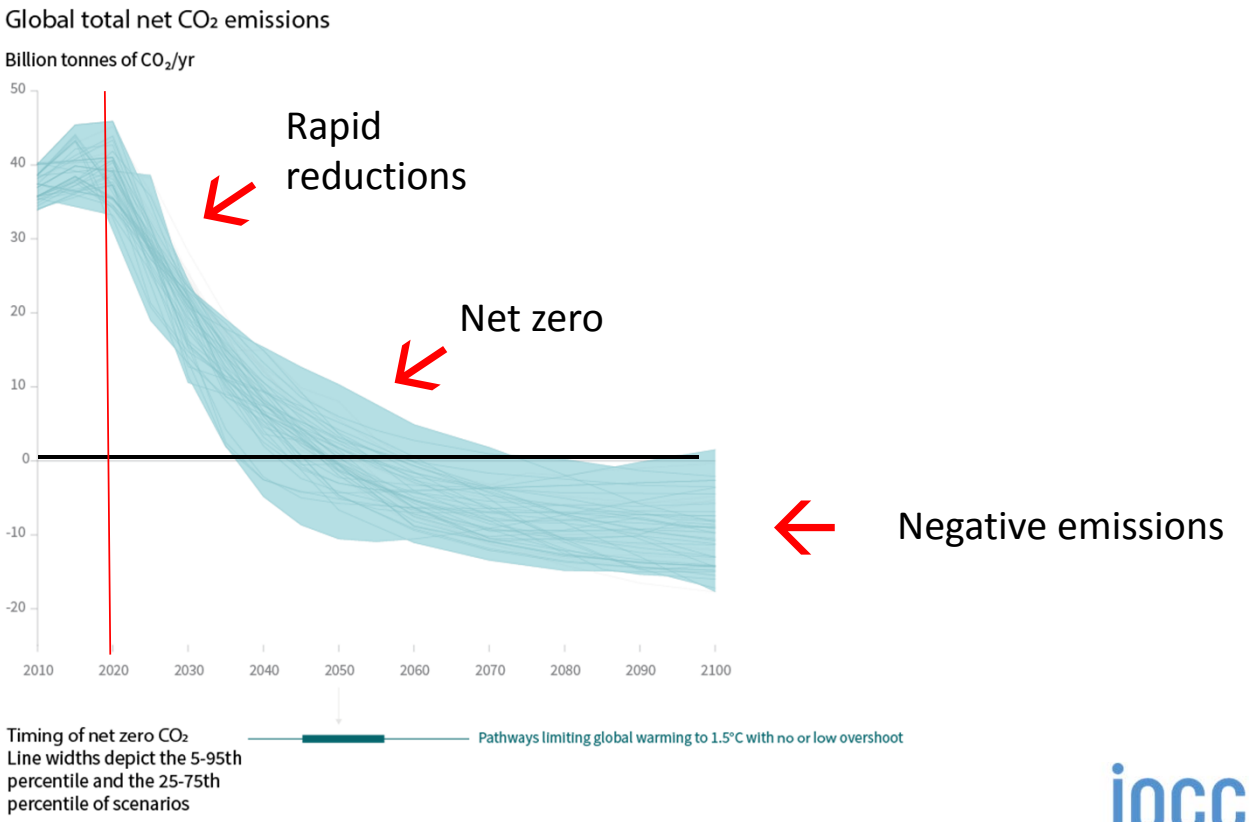
Choice of the measure of global temperature affects the estimated remaining carbon budget

Using global mean surface air temperature, as in IPCC AR5:
580 $GtCO_2$ left (50% chance of 1.5 °C)
420 $GtCO_2$ left (66% chance of 1.5 °C)

Using global mean surface temperature (GMST)
770 $GtCO_2$ left (50% chance of 1.5 °C)
570 $GtCO_2$ left (66% chance of 1.5 °C)

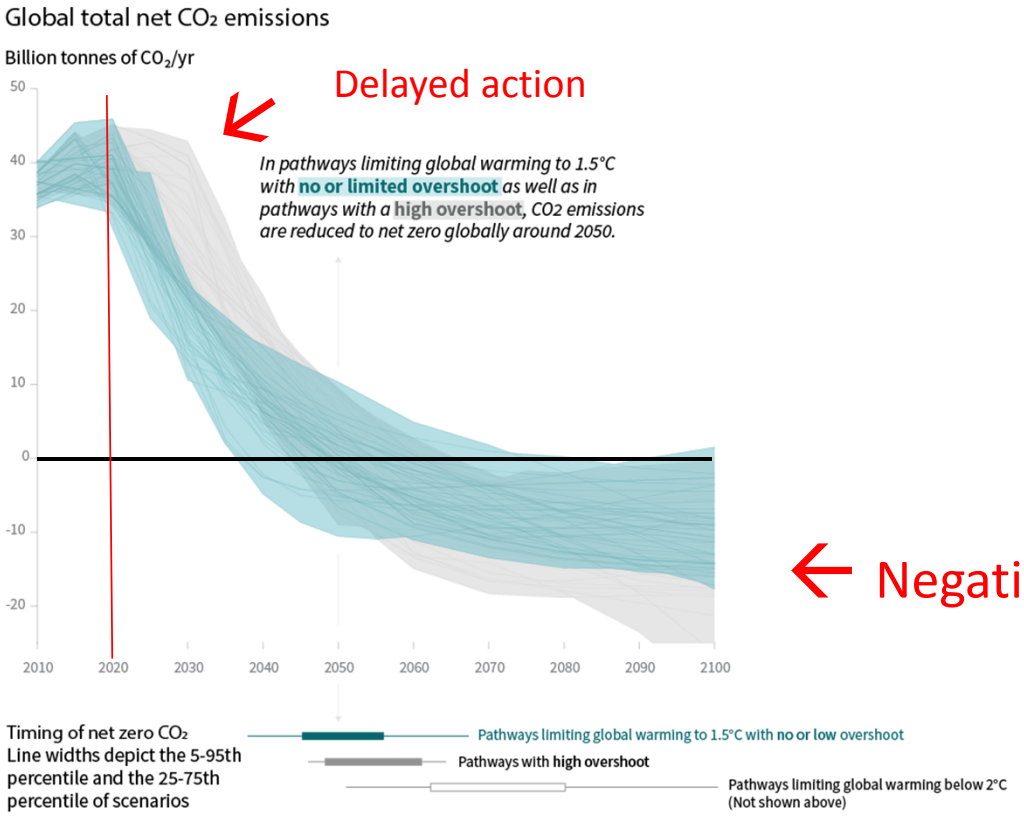
Courtesy: Jan Sigurd Fuglestvedt

Global emissions pathway characteristics



Courtesy: Jan Sigurd Fuglestvedt

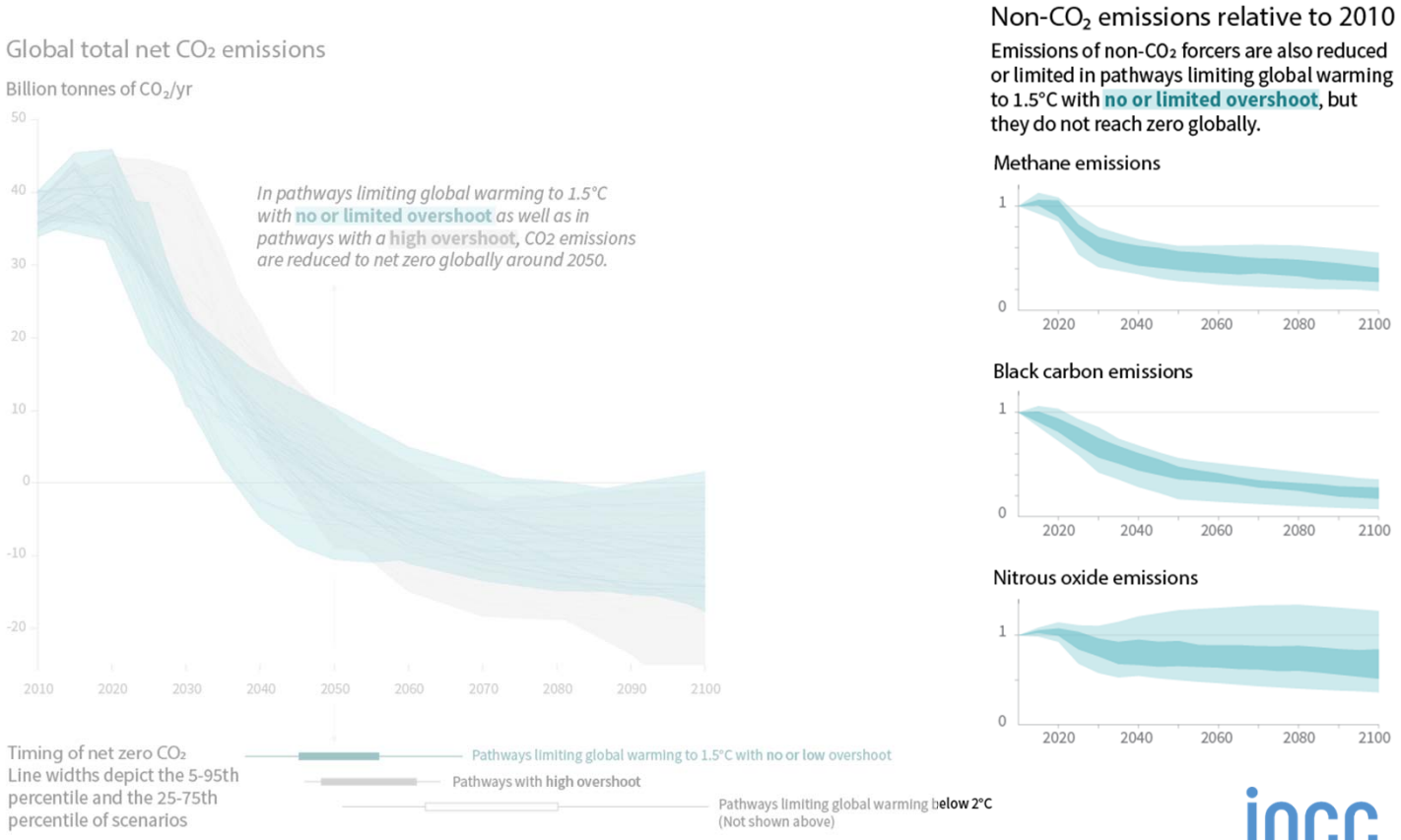
Global emissions pathway characteristics



← Negative emission

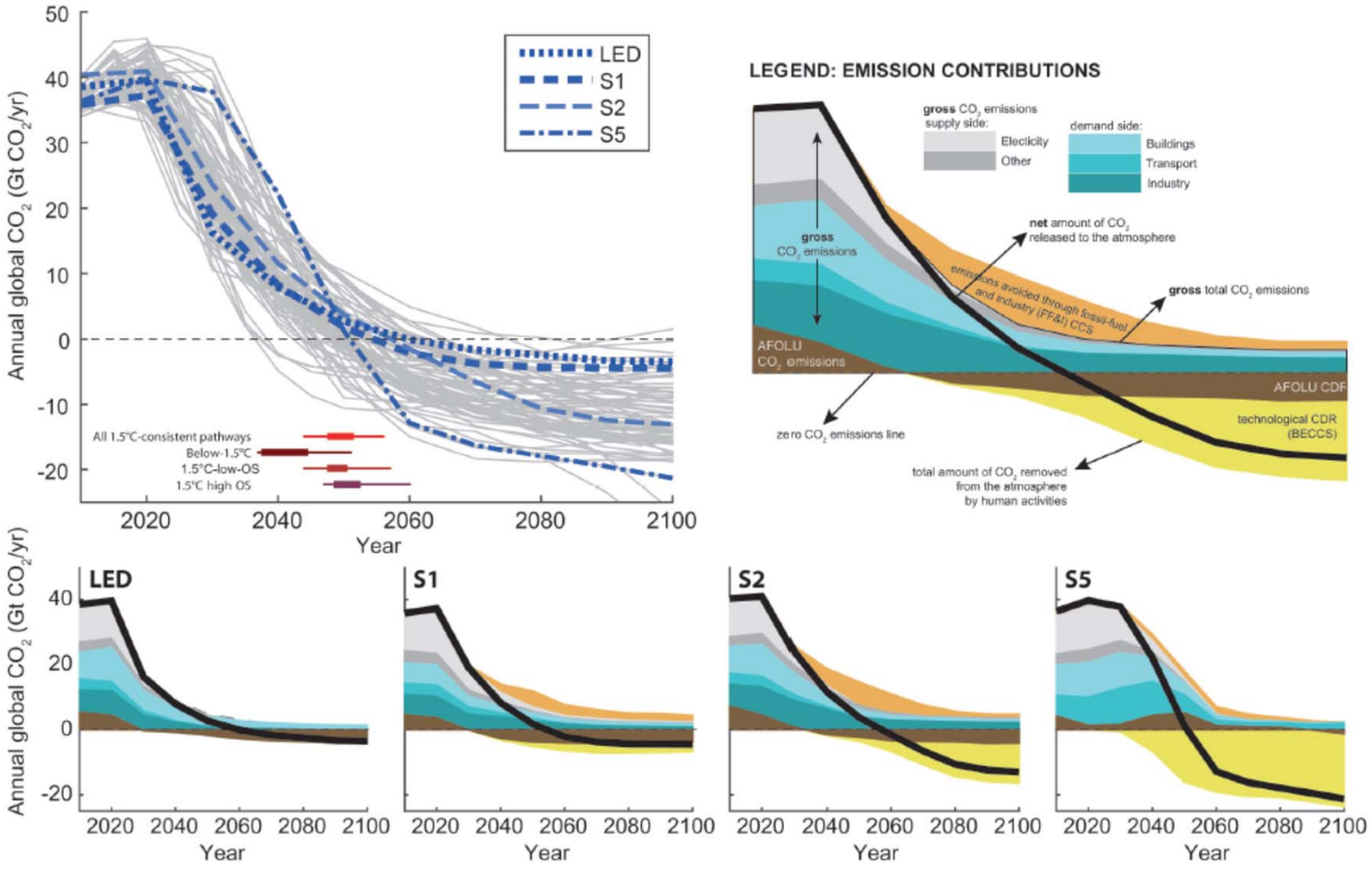
Courtesy: Jan Sigurd Fuglestvedt

Global emissions pathway characteristics



Courtesy: Jan Sigurd Fuglestvedt

Characteristics of Four Illustrative Pathways



Low-energy demand

Sustainability focus

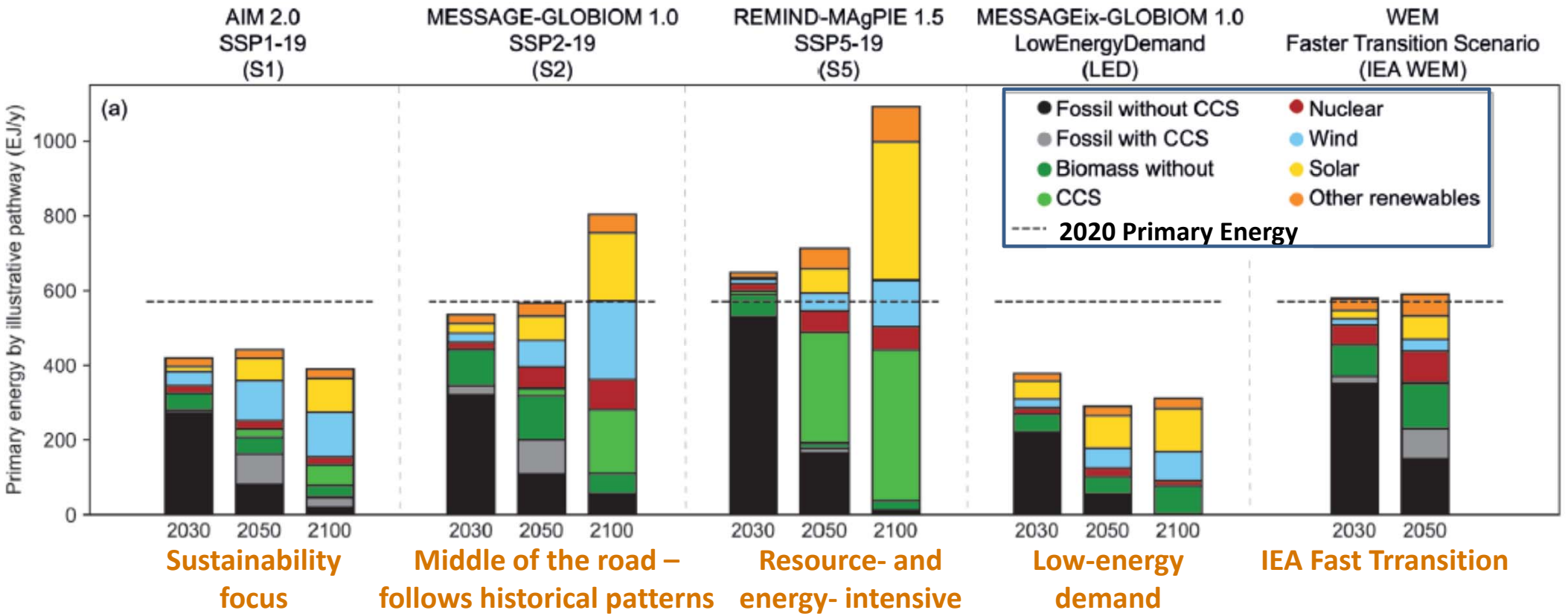
Middle of the road – follows historical patterns

Resource- and energy-intensive

Source: Figure 2.5, IPCC SR1.5

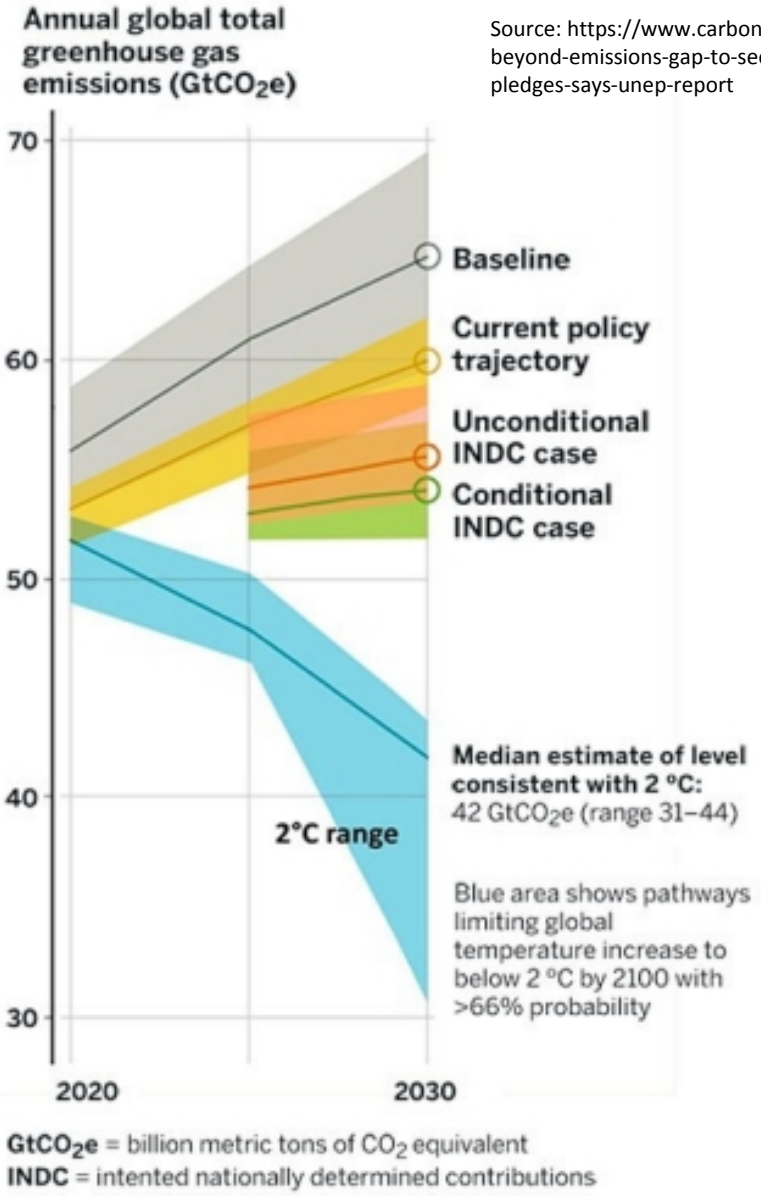
Source: Figure 2.15, IPCC SR1.5

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.



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

Final Thoughts

- Limiting climate change to any level involves eventually transitioning to a zero CO_2 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^{o} 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^{o} goal.

DISCUSSION