Reflections on IPCC Perspectives
Progression in the world’s
Climate Change Thinking

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https://www.youtube.com/watch?v=4dHjCjrYcfs
The Greenhouse Effect

- 1824 Fourier understood the concept
- 1859 Tyndall measures infrared absorption of gases
- 1896 Arrhenius estimates the Greenhouse effect
- 1960s Keeling establishes the rise in CO₂
Climate Change Poses a Real Threat
Throwing blankets on the planet

- Greenhouse effect: simple in concept, difficult in details
  - Potential for serious harm and even collapse
- $\text{CO}_2$ from fossil fuels are the major cause of greenhouse warming
  - More than 80% of our energy comes from fossil fuels
- Cost of uncontrolled climate change damage
  - Will continue to rise with $\text{CO}_2$ emissions
  - Will far exceed the cost of a new energy system
- Transition to zero emission can be delayed but not avoided
  - We have entered an overshoot scenario
  - Need to take the blankets off the planet or suffer overheating
Awareness goes far back

- **1979 Geneva:**
  - World Meteorological Organization
    - *Fight man-made climate*

- **1988 Toronto:**
  - First time that developed nations pledged mitigation targets
  - This meeting led to the formation of the IPCC

- **1992 Rio Earth Summit**
  - Formation of the UNFCCC
  - The basis of all future agreements

- **The Conferences of the Parties**
  - COP 1 - 23

Stabilization of GHG concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference
The Ups and Downs

- 1995 COP-1 Berlin – Concern over ability to meet obligations
- 1997 COP-3 Kyoto – The Kyoto Agreement
- 2005 COP-11 Montreal – Kyoto Agreement is in force
- 2009 COP-15 Copenhagen – A failure to agree
- 2011 COP-17 Durban – Agree to agree in 2015
- COP-21 Paris – Hold the line at 2°C or even at 1.5°C
- COP-23 Bonn – Guidelines to make it work

Aspirations and targets continue to change
What is required

• Emissions reductions?
• Stopping emissions?
• Stock problem or flow problem?
• Temperature target?
• CO₂ target
• Other greenhouse gases?
Various approaches

**Early Limit: 550 ppm**
Avoid doubling $CO_2$ in the atmosphere

**Serious Climate Concern:**
350 ppm
Jim Hansen, 350.org
Avoid big changes

**How about 450 ppm?**
In 2000 still attainable
Vaguely related to 2°C

2°C Warming
Pre-Paris Consensus

1.5°C Warming
Post-Paris Consensus

Return to 280 ppm?

$ppm$ or $ppm_e$
Temperature CO$_2$ relationship

- Temperature is driven by cumulative CO$_2$ emissions
  - Temperature rise due to 1 Gt of CO$_2$ remains constant for 1000 years
  - CO$_2$ moving into the ocean and ocean warming cancel out
- Temperature rises linearly with cumulative emissions
  - Complex compensatory effects cancel out logarithmic relationship
- Simple risk free model
Linear model makes simple predictions

• If emissions stopped today, 1.5°C warming would be avoided
• Remaining budget is nearly half of what we have emitted for 1.5°C
• We are just past the midpoint for a 2°C limit

5th Assessment report:
Probability of 2°C remains low as long as greenhouse gases remain below 450 ppm_e

1.5 °C Report: Warming by 1.5 is unlikely if emissions stop now.
(Current greenhouse gas level is about 450 ppm_e)
1.5°C-consistent emission pathways are defined as those that, given current knowledge of the climate response, provide a one-in-two to two-in-three chance of warming either remaining below 1.5°C, or returning to 1.5°C by around 2100 following an overshoot.

*IPCC report Global Warming on 1.5°C*
Carbon dioxide piles up like garbage

- Carbon dioxide emissions stay in the atmosphere for centuries
- Warming from carbon dioxide lasts for a millennium
- Excess carbon acidifies the ocean for millennia
- Geological weathering resets carbon on the 10,000 to 100,000 year time scale

- Moving to a waste management paradigm represents a big shift in dealing with CO\(_2\)
- Reduce, Reuse, Recycle + DISPOSAL
- Cost of Disposal motivates Reuse
- Long term goal: Zero waste in a circular carbon economy

Need to convince people and corporations to clean up their CO\(_2\) garbage
Create a movement like recycling
Stuck in the old paradigm

Representative Concentration Pathway at various climate forcing in W/m²
Scenarios and Realism
Carbon Dioxide Removal

• Integrated Assessment Models (IAMs)
  • BECCS is the one way for IAMS to deliver CO₂ reductions
  • Is it real? Is it feasible? Does it hit limits?
  • Is it only way or even the best way?
  • CDR has been criticized as BECCS

Extrapolating established technologies also leads to difficulties
Negative Emissions Scenario’s - 1500 Gt of CO₂/100 ppm

- Preindustrial Level: 280 ppm
- Hazardous Level: 450 ppm
- Continued Exponential Growth
- Constant Emissions after 2010: 100% of 2010 rate
- Negative Emissions Scenario’s: -1500 Gt of CO₂/100 ppm
The world needs energy

- Achieving and sustaining a decent living standard for all
- Stabilizing the world population
- Cleaning up after ourselves

Must not eliminate access to energy