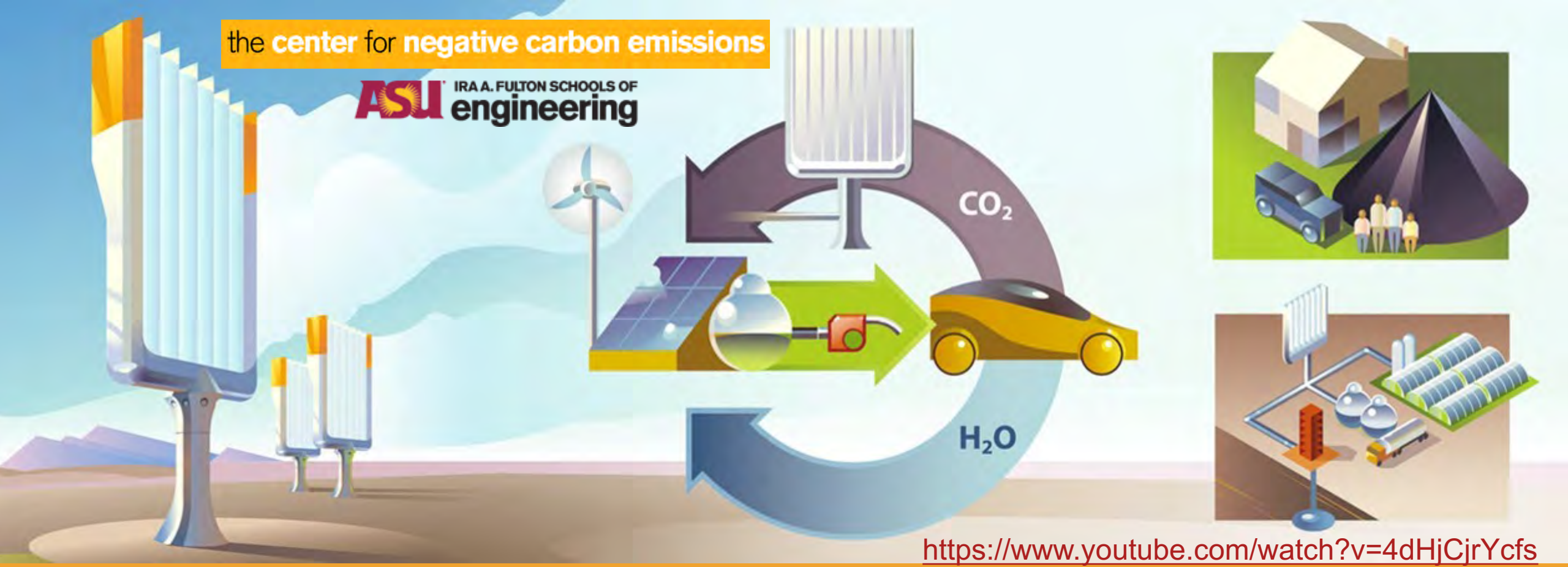
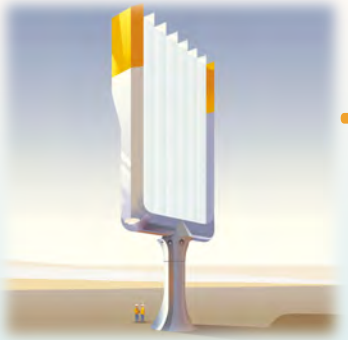


https://www.youtube.com/watch?v=4dHjCjrYcfs

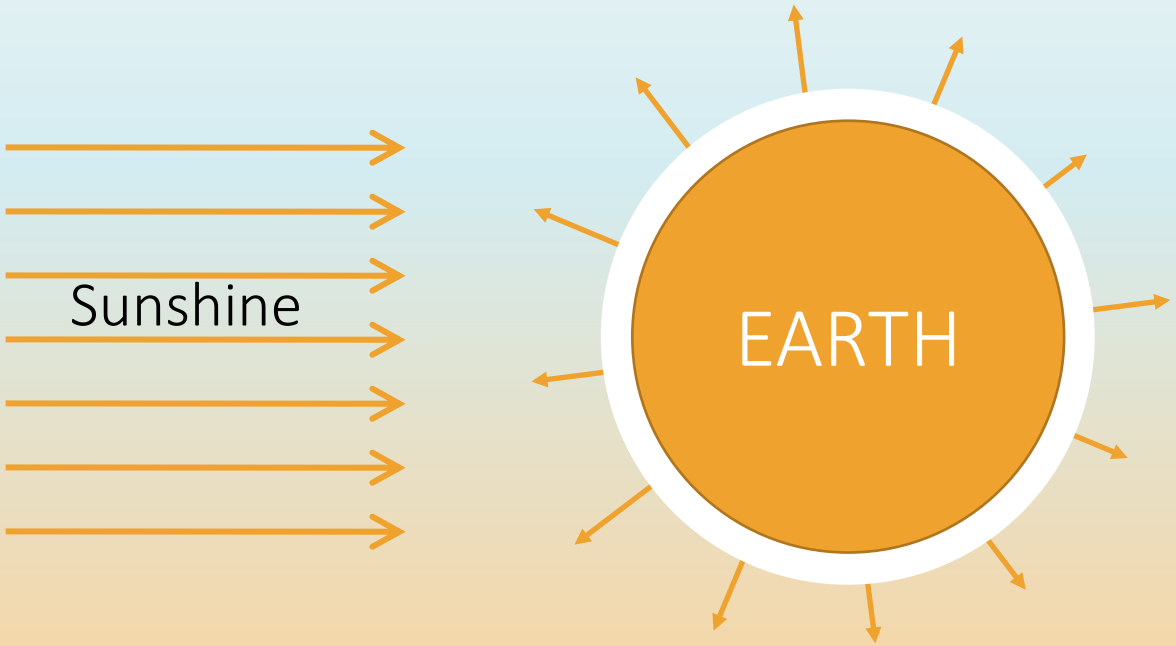
Reflections on IPCC Perspectives Progression in the world's Climate Change Thinking

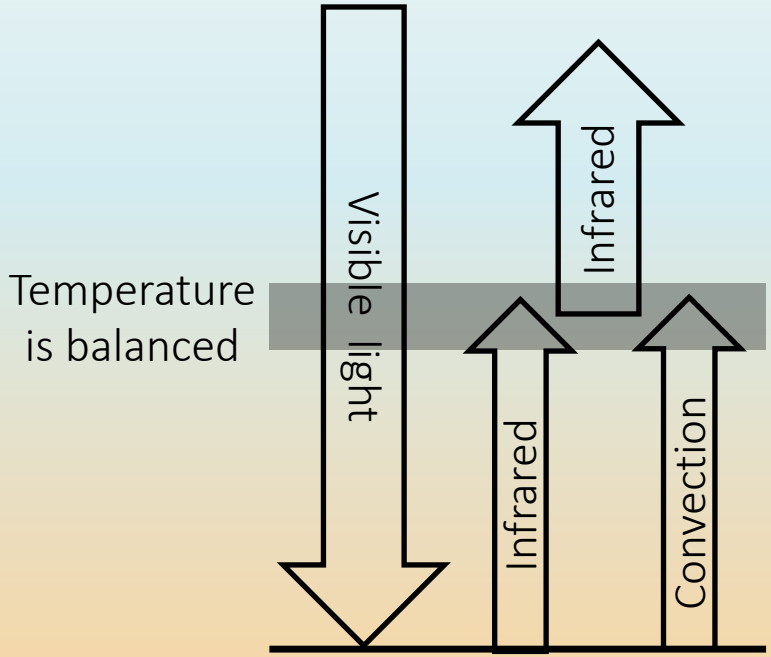
Klaus S Lackner

October, 2018

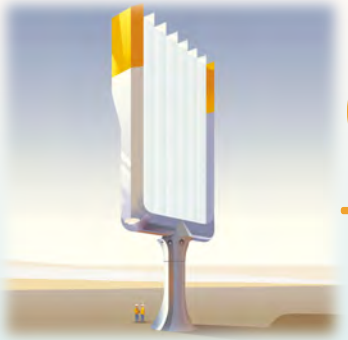


The Greenhouse Effect





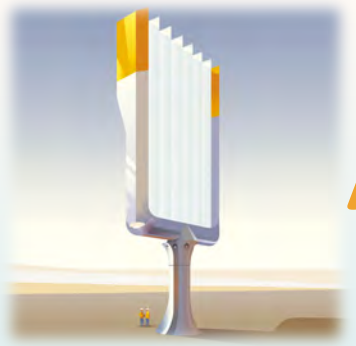
- 1824 Fourier understood the concept
- 1859 Tyndall measures infrared absorption of gases
- 1896 Arrhenius estimates the Greenhouse effect
- 1960s Keeling establishes the rise in CO_2



Climate Change Poses a Real Threat

Throwing blankets on the planet

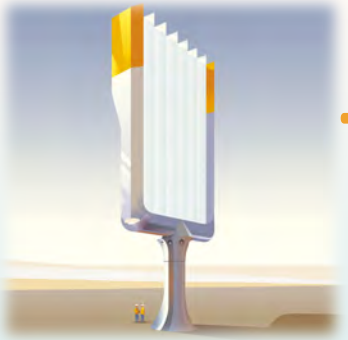
- Greenhouse effect: simple in concept difficult in details
  - Potential for serious harm and even collapse
- CO_2 from fossil fuels are the major cause of greenhouse warming
  - More than 80% of our energy comes from fossil fuels
- Cost of uncontrolled climate change damage
  - will continue to rise with 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

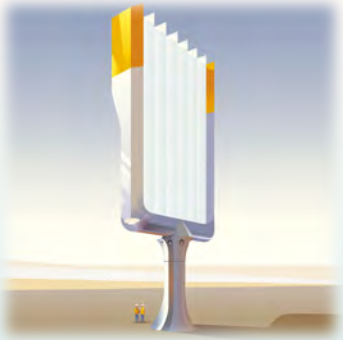
Stabilization of GHG concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference



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?
- CO_2 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

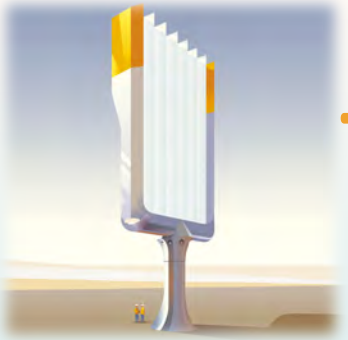
How about 450 ppm?
In 2000 still attainable
Vaguely related to 2°C

2°C Warming
Pre-Paris Consensus

1.5°C Warming
Post-Paris Consensus

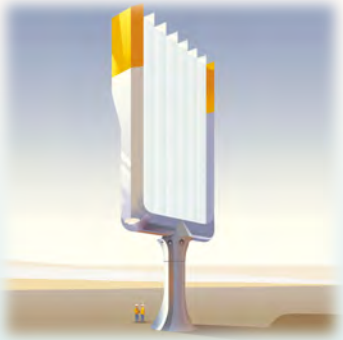
Return to 280 ppm?

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**

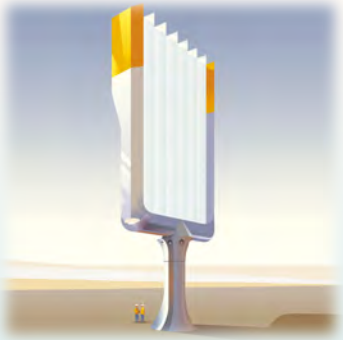


Linear model makes simple predictions

- 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

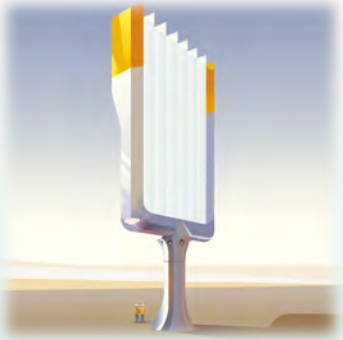
1.5 °C Report: Warming by 1.5 is unlikely if emissions stop now.
(Current greenhouse gas level is about 450 ppm_e0



Taking risks

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



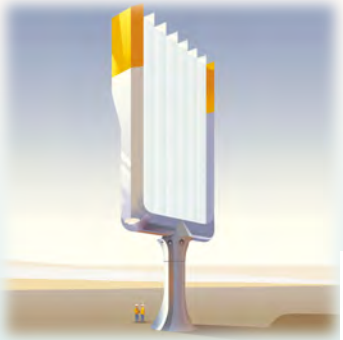
Carbon dioxide piles up like garbage

- 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

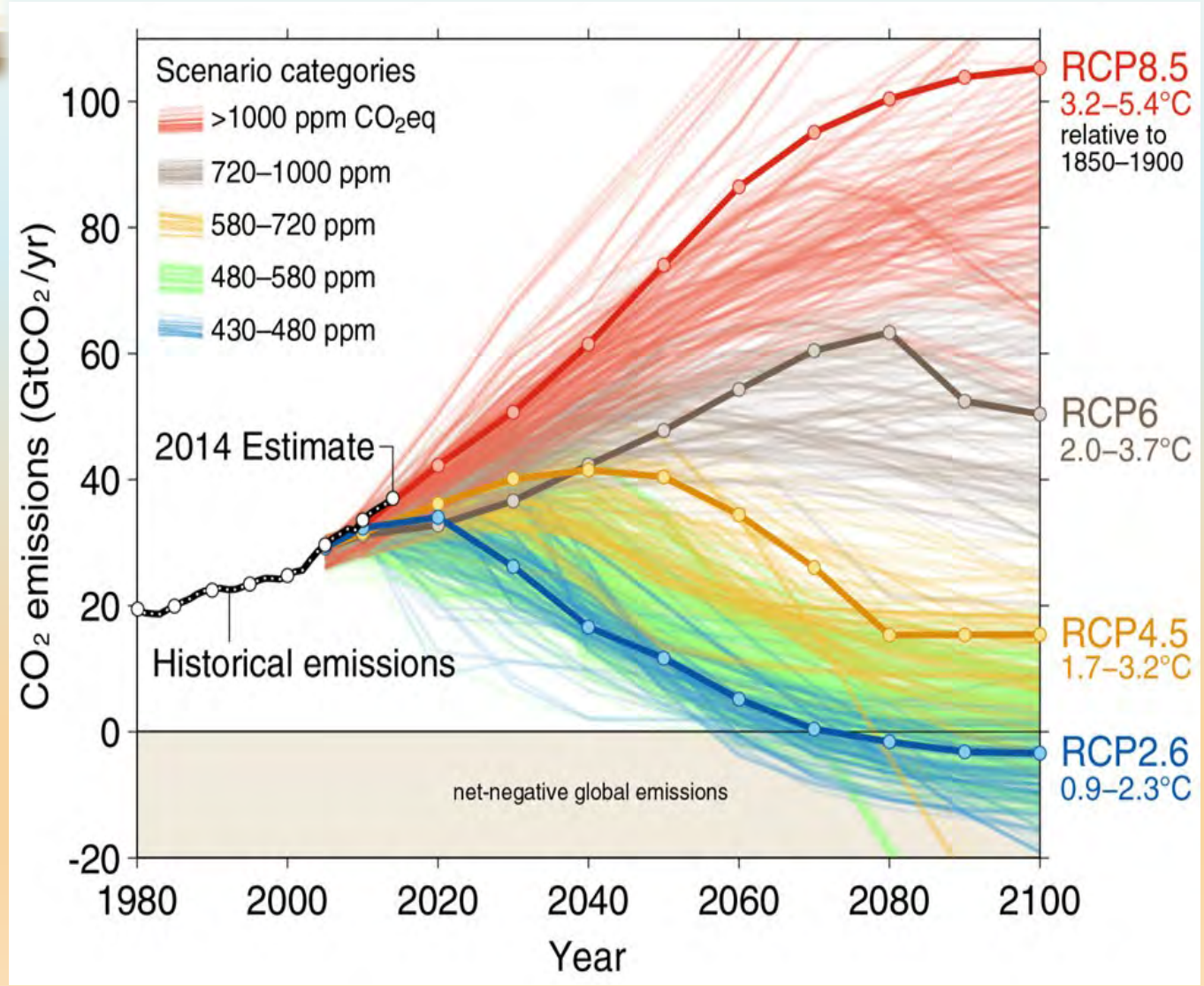
- Moving to a waste management paradigm represents a big shift in dealing with CO_2
- Reduce, Reuse, Recycle + DISPOSAL
- Cost of Disposal motivates Reuse
- Long term goal:
  Zero waste in a circular carbon economy

Need to convince people and corporations to clean up their CO_2 garbage

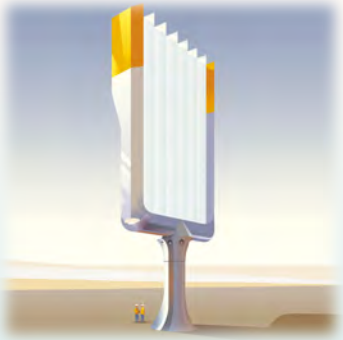
Create a movement like recycling



Stuck in the old paradigm



Representative Concentration Pathway at various climate forcing in W/m^2

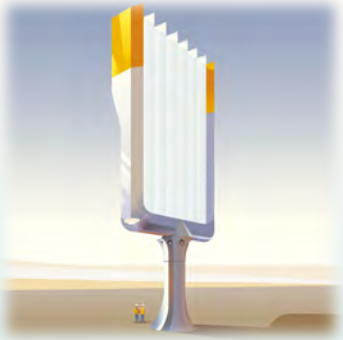


Scenarios and Realism
Carbon Dioxide Removal

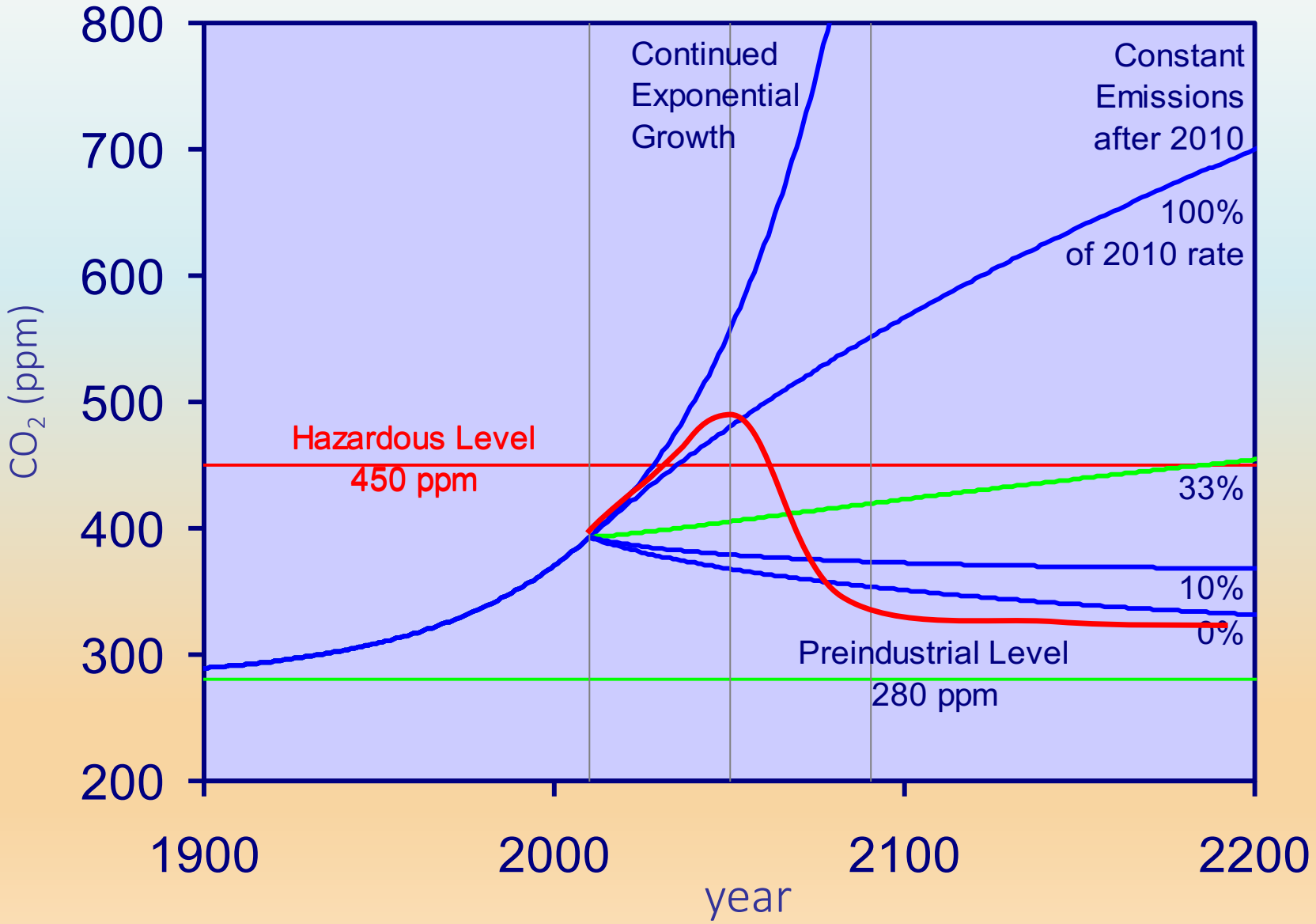
- Integrated Assessment Models (IAMs)
  - BECCS is the one way for IAMS to deliver CO_2 reductions
  - Is it real? Is it feasible? Does it hit limits?
  - Is it only way or even the best way?
  - CDR has been criticized as BECCS

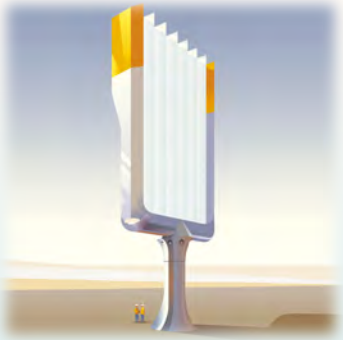
1.5°C

Extrapolating established technologies also leads to difficulties

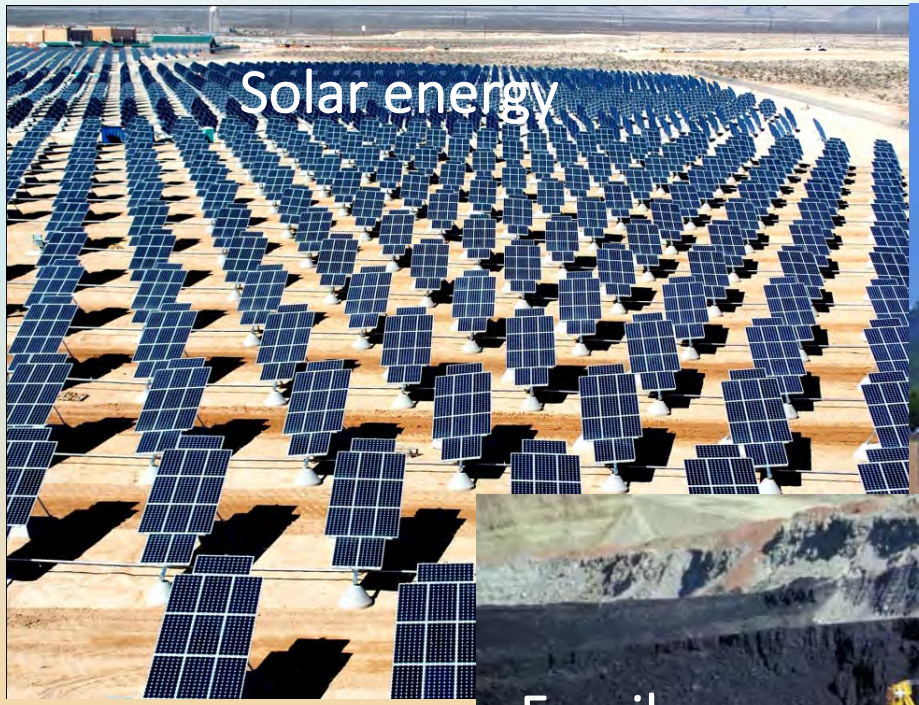


Negative Emissions Scenario's - 1500 Gt of CO_2/100 ppm





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