Incorporating black carbon, methane, and nitrous oxide into state climate stabilization planning

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CATF: Helping states build climate stabilization plans

- In the US, the state role is likely to become increasingly important, and state actions are expected to play a major role in federal climate change solutions.
- The challenge before each state is formidable, because stabilizing climate will require deep greenhouse gas cuts over the next half century.
- How can non-CO_2 forcers be taken into consideration in climate action plans?

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Assumptions about what is needed for climate stabilization

- To avoid DAI, temperature increase can't exceed 1°C beyond today's temperature **and** at least .5°C is already "warming in the pipeline", with the resultant inevitable, if not fully predictable, impacts.
- Stabilizing at this target means atmospheric concentrations probably need to be less than 450 ppm. Here I round up to 450 ppm.
- This means an addition of no more than 1 W/m^2.

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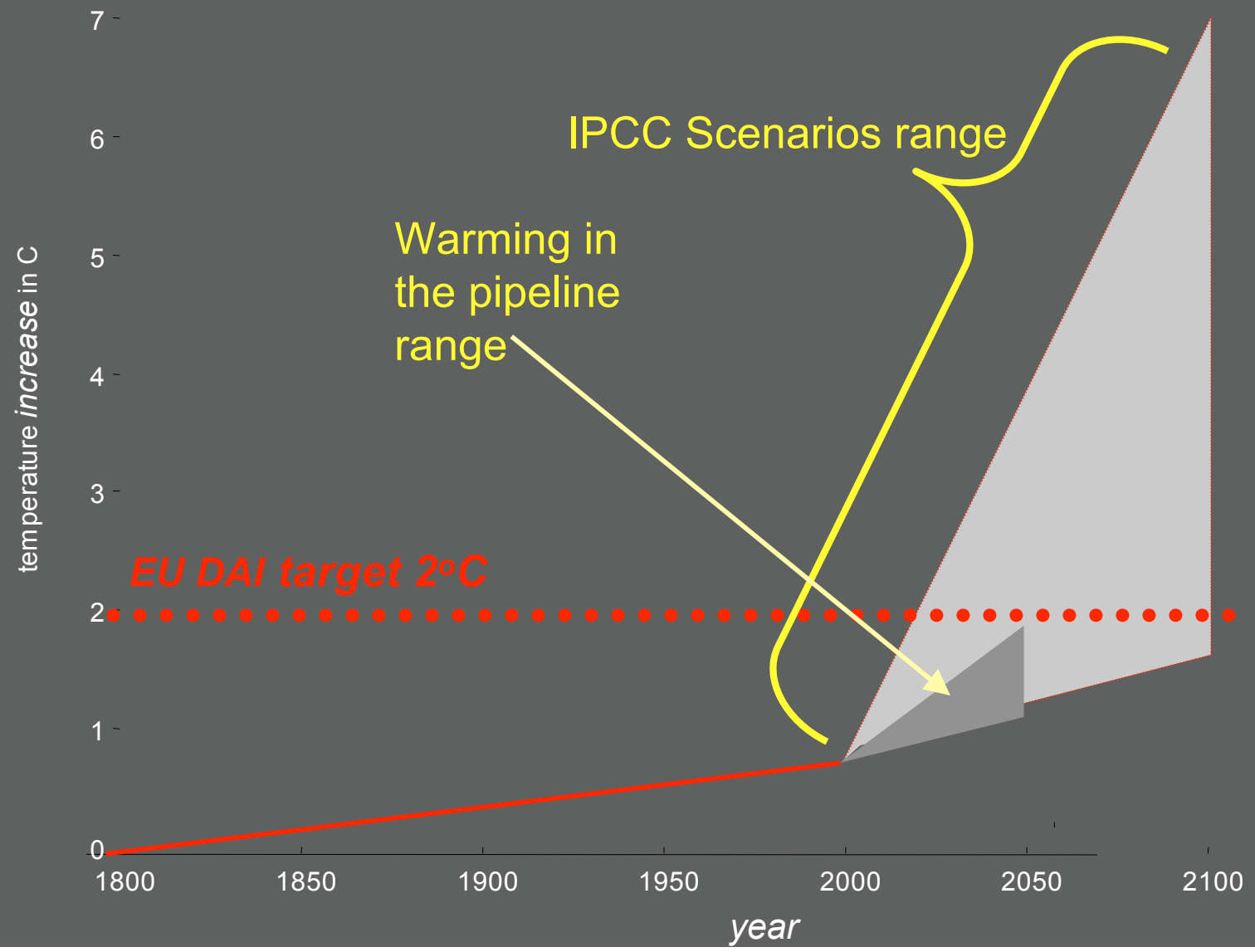
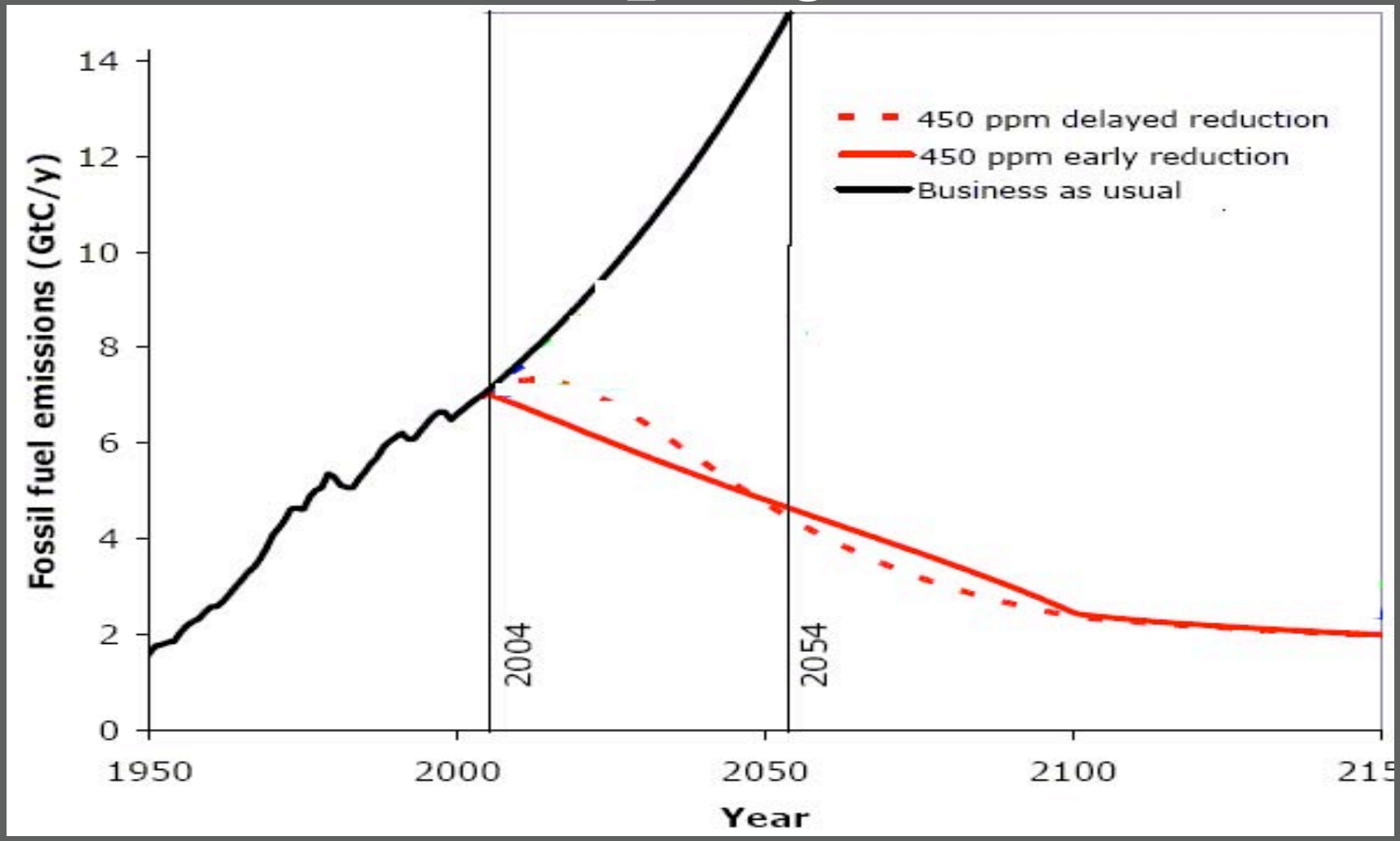
Warming in pipeline



Hurdle to clear with a 450 ppm CO_2 target



SOURCE: Pacala and Socolow, *Science,* August 2004

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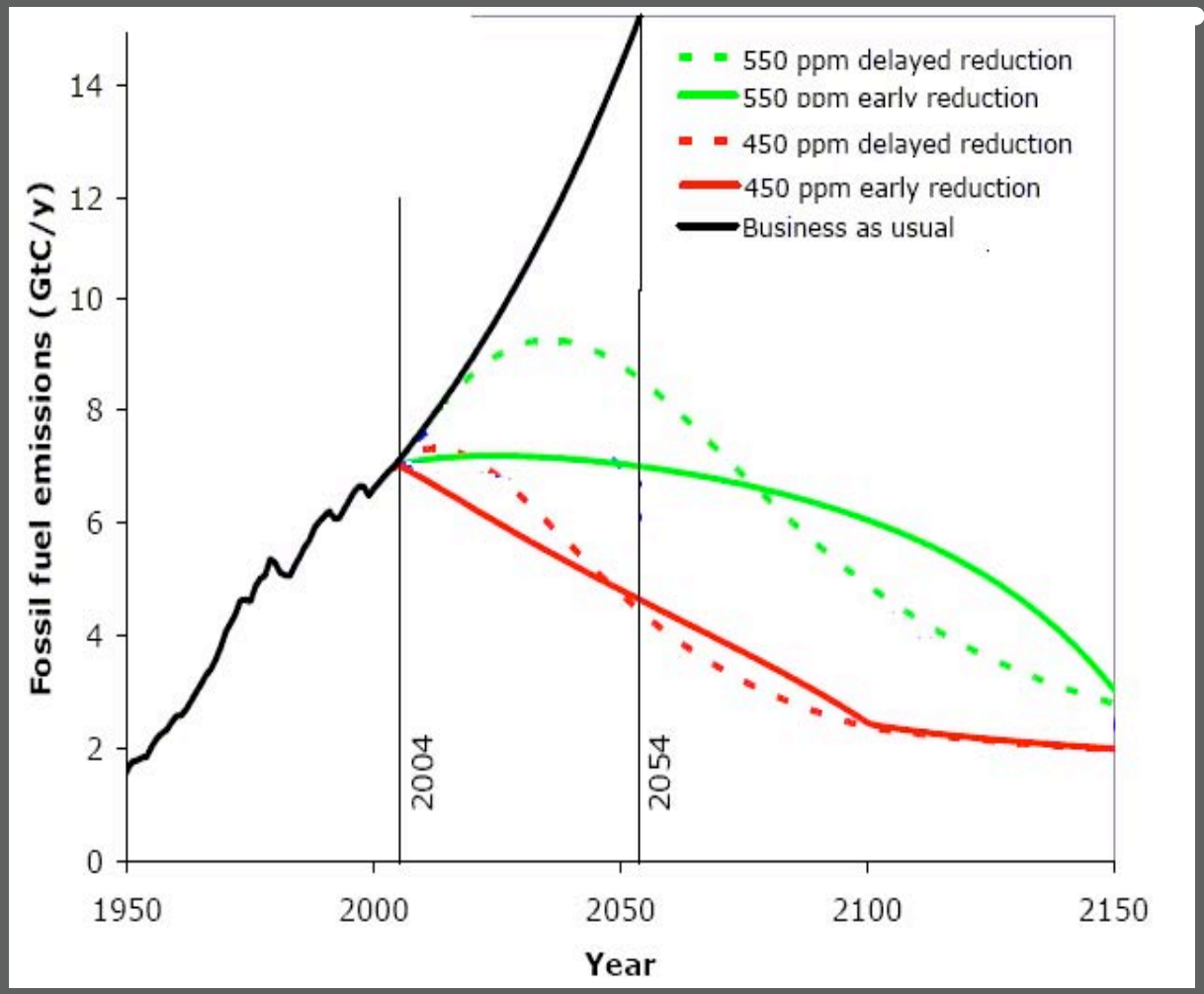
Meeting the target with non-CO_2 forcers

- Hansen suggests that if we cut non-CO_2 forcers by .5 W/m^2, then we could stabilize CO_2 at 440 ppm, not 520 ppm. That should mean that if we could reduce non-CO_2 forcers by .8 W/m^2, we could stabilize CO_2 at 550 ppm, not 450 ppm.
- Malte Meinshausen calculates a radiative forcing delta between 450 and 550 to be just over 1 W/m^2.
- What are reductions over the next 50 years that could attain .8 W/m^2 - 1 W/m^2?

There is a difference between 450 and 550



SOURCE: Pacala and Socolow, *Science,* August 2004

550 ppm roughly means holding emissions at 2004 levels.

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Where might .8- 1 W/m^2 come from?

One recipe:

70% reduction in anthropogenic methane (from global total of 1755 ppb to 1018 ppb)	= .50*
12% reduction in anthropogenic N_20 (from 315 ppb to 309 ppb)	= .075
90% BC reduction from mobile source diesel	= .23
TOTAL	**. 8 W/m^2**

* Assumes direct methane and tropospheric ozone and water vapor reductions

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Including these reductions targets in climate planning

- Later this spring the Ohio Environmental Council (OEC) will release an *Ohio Climate Roadmap* that identifies Ohio's share of climate stabilization goals and outlines a path to achieve them.
- The Roadmap includes the recognition that non-CO_2 reductions might occur faster, could have a speedier climate response, and for the most part would provide other environmental and public health benefits.
- OEC worked with the non-CO_2 targets to see what it would take to implement them, based on current technology or technologies on near horizon.
- Non-CO_2 targets in Ohio changes the amount needed to reduce CO_2 by 2100 from 63.75 MMTCE to 47.75 MMTCE. CO_2 reductions dominate OEC strategies.
- Work assumes Ohio's share mimics the global targets. This would ultimately not be the case, since emissions are not even across the globe and were they constant, the obligation for reduction would probably not be shared evenly.

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Methane: 70% anthropogenic reduction

- Landfills, animal feedlots, coal mines, and waste water treatment total 85% of Ohio's methane inventory can be captured and burned, and in many cases, the fuel can be used to generate electricity. Capturing, burning and in many cases generating electricity from these sources would cut the MMTC eqv of methane from Ohio by more than 70%.

- Other potential reduction sources are:

  – Modification of livestock feed to reduce enteric emissions.

  – Enhanced inspection and maintenance programs along pipelines to reduce fugitive methane emissions.

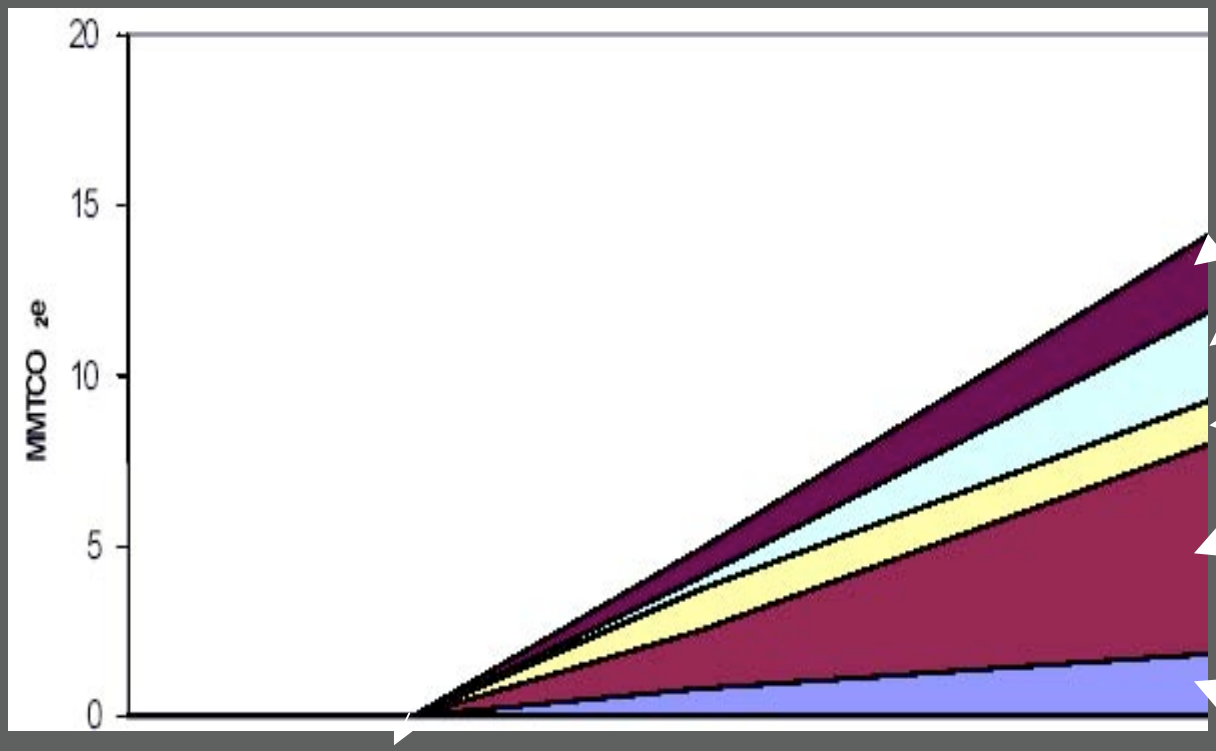
Nitrous Oxide: 12% reduction

- Reduction target may be feasible by making adjustments to fertilizer management.

Black carbon from diesel: 90% cut

- Beginning in 2007, all new on-road diesel engines will be required to reduce particle emissions by 90%; requirement for non-road diesels begins in 2010.
- Because diesels are so long-lived, the reductions won't be fully felt until 2035. Reductions for diesels on the road today can be achieved with existing technology.
  - Replacing mufflers with a diesel particulate filter that can also reduce black carbon emissions by 90%. The ultra low sulfur diesel fuel needed for the filters will likely be widely available in Ohio in 2006.
  - Older diesels that are not electronically controlled can use diesel emulsion fuels to reduce the black carbon portion of diesel soot by 50%.

BC reductions have been included in Connecticut Climate Plan.



Black Carbon from diesel reductions (220 GWP)

Other transportation reductions

Ag, forestry and waste

Power sector reductions, some energy efficiency

Residential, commercial, industrial; bulk of energy efficiency

SOURCE: Connecticut Climate Action Plan

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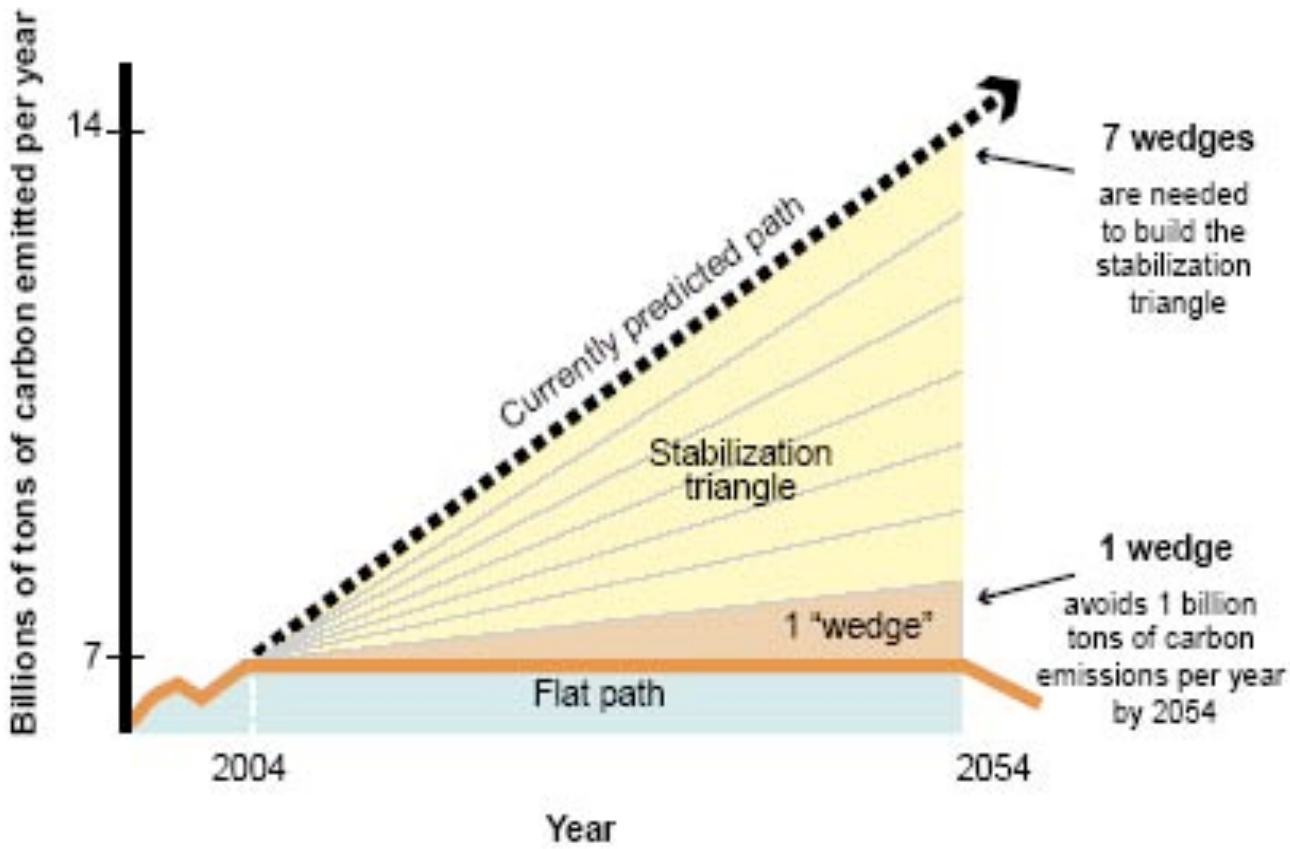
Another approach: Non-CO_2 wedges



NOTE: The stabilization triangle in Figure 1a can be divided into seven equal "wedges" that represent activities capable of reducing one billion tons of carbon per year by 2054.

SOURCE: R. Socolow, R. Hotinski, J. B. Greenblatt, and S. Pacala.

To achieve 25 GT carbon of reduced emissions per wedge between now and 2054, how many wedges can be filled by non-CO_2 reductions?

Other opportunities?

Mixing and matching climate and with other benefits.

One idea:

- Gasify wood/crop residue to produce hydrogen gas and char
- Char can be used as a soil amendment to
  - improve plant productivity and support microrrhiza development
  - store in forest soils
  - decrease in soil emissions of methane and nitrous oxide -- important for air quality, climate and water quality
  - mix with N fertilizer and produce a slow release fertilizer, further reducing N_20 emissions.

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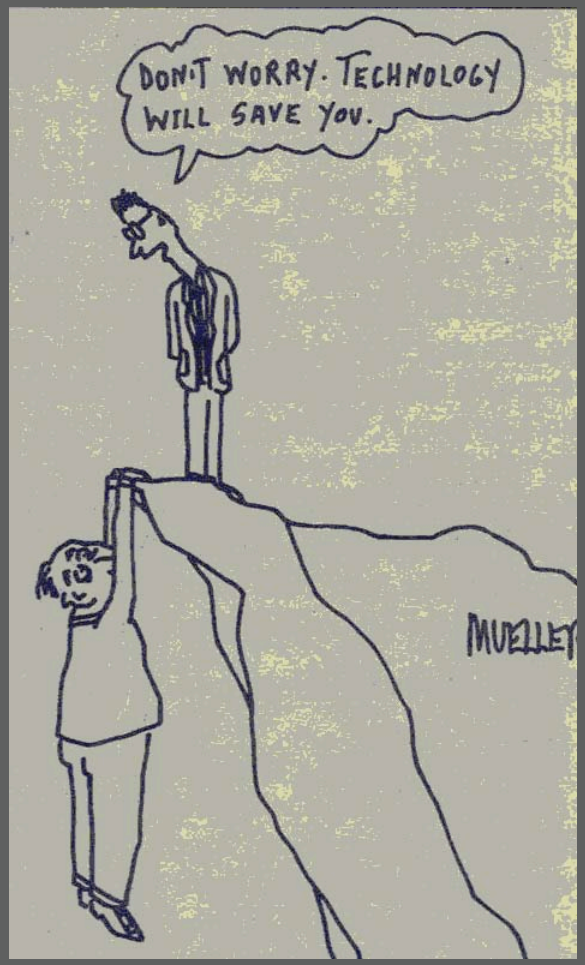
Where does technology innovation come from?

- Current knowledge of available and economic emissions reduction options may be a primitive version of what will become possible in the future.
- Economics will be one of the drivers of new technologies and strategies, i.e today's high and volatile natural gas prices.
- On the research side, what additional research needs to be done? By whom? How fast? What are the best mechanisms to support R&D and vet ideas.
- What new ideas are out there – often in atypical sectors – that can play a role in climate stabilization.



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