Air Transport in its Energy-Economy-Environment Context

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Science > Carbon Cycle Basics

- **Small reductions are nice but don't help.**
- **Big reductions need everyone. If US + Europe + Japan emissions go to zero, China and India's emissions still exceed natural uptake -- *and vice versa*.**
- **Aviation emissions at 3% of total emissions are closer to 6% of natural uptake**
- **Possibilities:**
  - Huge cuts in emissions
  - Miracle: alternative fuel or carbon capture
  - Allow GHG concentrations to increase and hope it works out

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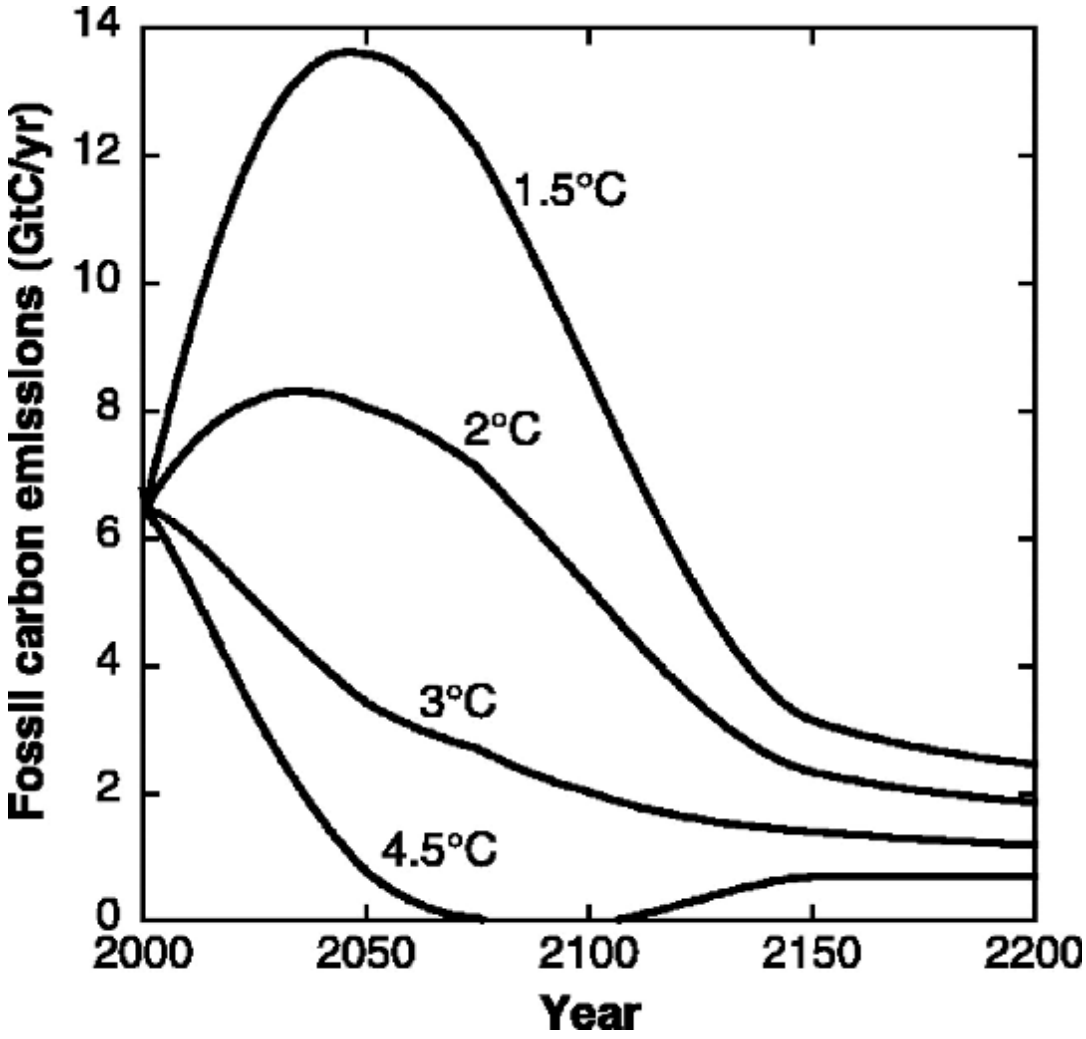
Science > Uncertainty

- **It's not clear what emissions trajectory is needed to meet any particular GHG concentration or temperature constraint.**
  - Climate sensitivity?
  - Carbon cycle – temperature feedbacks?

- **It's not clear what price of carbon is needed to yield a given emissions trajectory**
  - Business-as-usual growth?
  - Technical options?

Figure 1. Allowable emissions of CO2 to the atmosphere to produce climate stabilization at a 2°C global mean warming relative to the preindustrial state, shown for different climate sensitivities. To achieve this climate stabilization, we could either allow today's emission rate to double by mid-century or need to bring emissions near zero, depending on whether climate sensitivity is 1.5° or 4.5°C per CO2 doubling.



K. Caldeira et al., Science 299, 2052 -2054 (2003)

Published by AAAS

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State of Policy

- **On aviation…**
  - UNFCC kicks international aviation to ICAO
  - EU ETS bringing aviation into trading
  - North American regional policies (California, WCI, RGGI, etc.) do not tackle aviation
    - Exception: BC Carbon Tax includes aviation fuel at ~2.5¢/liter, $10/tonCO2eq
  - Other regional and sectoral ambitions are aggressive (e.g., IATA “net zero” by 2050) but not implemented
- **In general…**
  - Negotiations are hung up, because negotiators don’t have mandates that yield space for agreement on aggressive measures
  - The policy space is confused by basic technical concepts (tons carbon vs. tons CO2) as well as bathtub dynamics of climate
  - Science arguments, e.g., the correct multiplier from contrails, are not meaningful
- **Result: local controls are bubbling up from the bottom**
  - Imitation effects are likely to be powerful.

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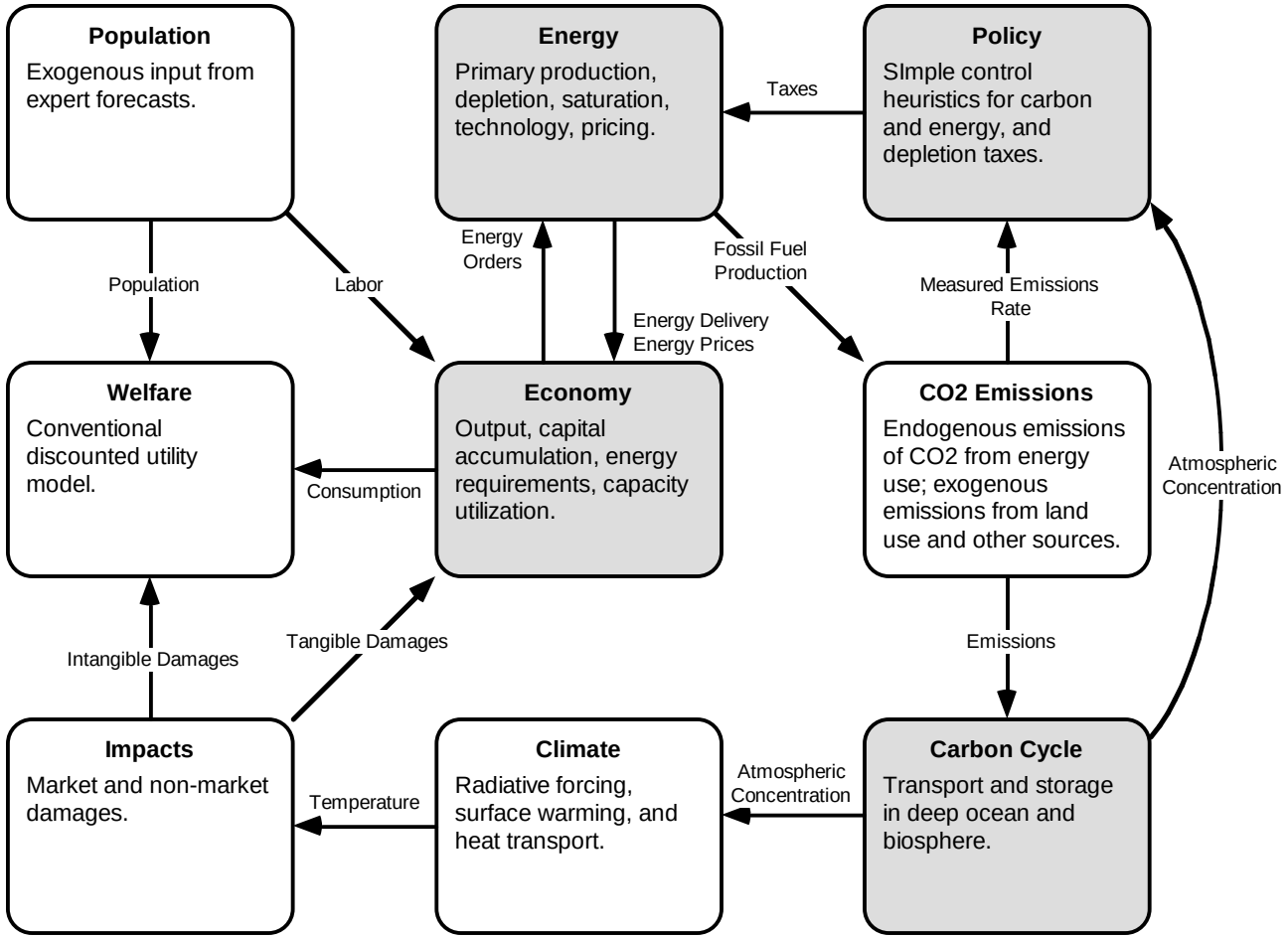
Integrated Assessment Models (IAMs)

- **IAMs are energy-economy models that simulate climate, GHG output, economic growth, energy consumption, and related policy (carbon taxes, permit trading etc.)**
- **Given their assumptions, the "best" policies for minimizing the cost of reducing GHG emissions are those that lead to a uniform global cost of carbon.**
  - Complementary policies are needed to remove barriers to innovation, and address other features of reality that are not modeled.
- **Emissions reductions are expected to fall to the most elastic sectors (e.g., electricity supply)**

Integrated Assessment Models (IAMs)



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Suspect Assumptions

- **discount rates on utility or cost and benefit flows that give a higher weight to the welfare of current generations,**
- **exogenous population,**
- **exogenous rates of economic growth (in cost-benefit models) or factor productivity (driving economic growth in general equilibrium models),**
- **autonomous energy efficiency improvement or carbon intensity reduction,**
- **exogenous evolution of energy technology,**
- **consumer and producer optimization with full information and, frequently, perfect foresight,**
- **rapid equilibration of factor inputs to production, and**
- **general exclusion of positive feedback mechanisms in the economy (other than capital stock growth).**

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What the IAMs May Be Missing: Examples

- **Overshoot in policy response**
- **Lack of coordination of policies could lead to losses greater than cost of efficient policies**
- **Opportunities for low-cost emissions reductions**
- **Peak oil**
- **Knock-on effects, e.g. emergence of regional instability**

  (e.g. climate change >

  precipitation pattern changes >

  water scarcity >

  population migration >

  war)

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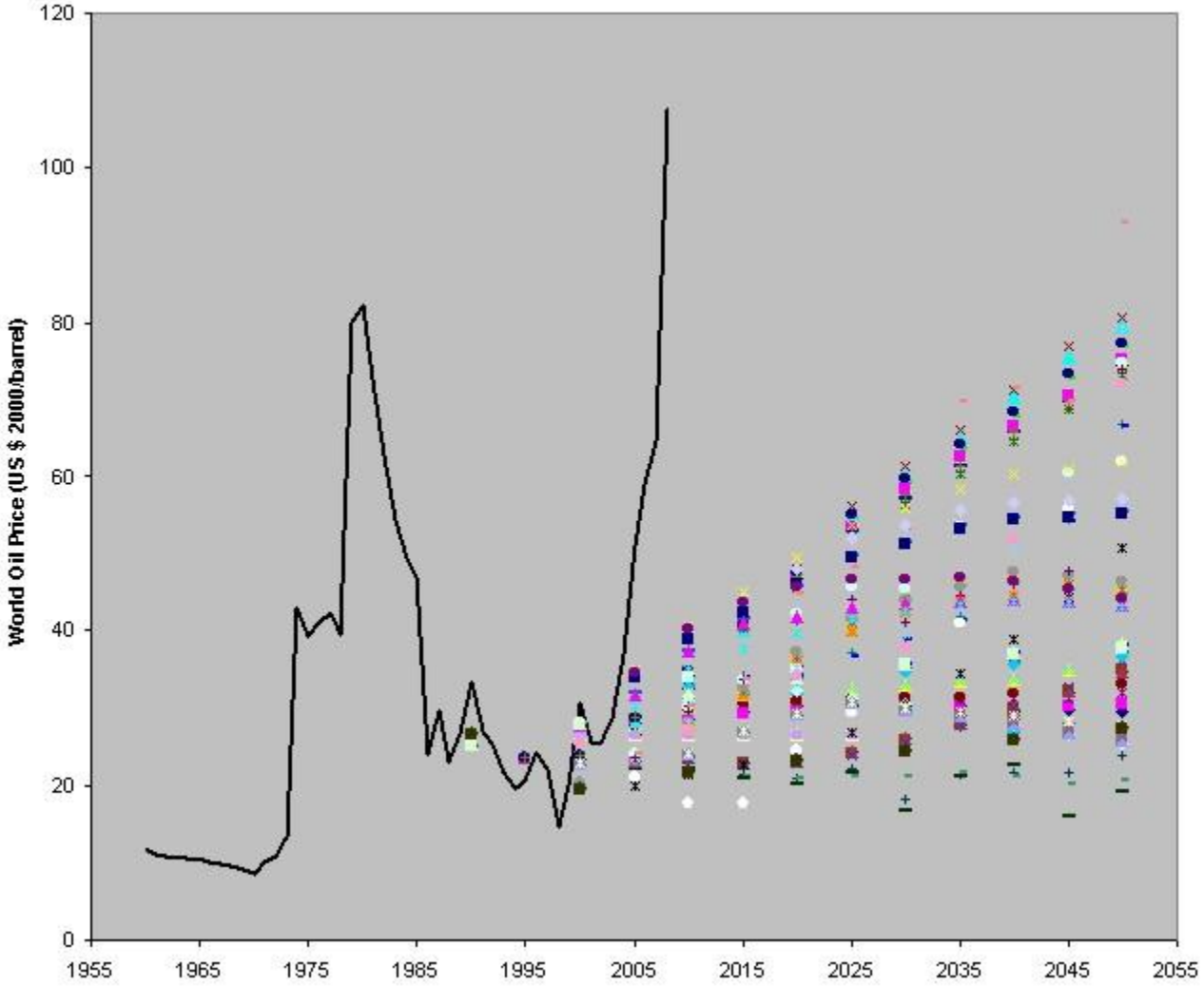
Reality diverges from model ideals

SRES oil price forecasts vs. actual, ca. June 2008



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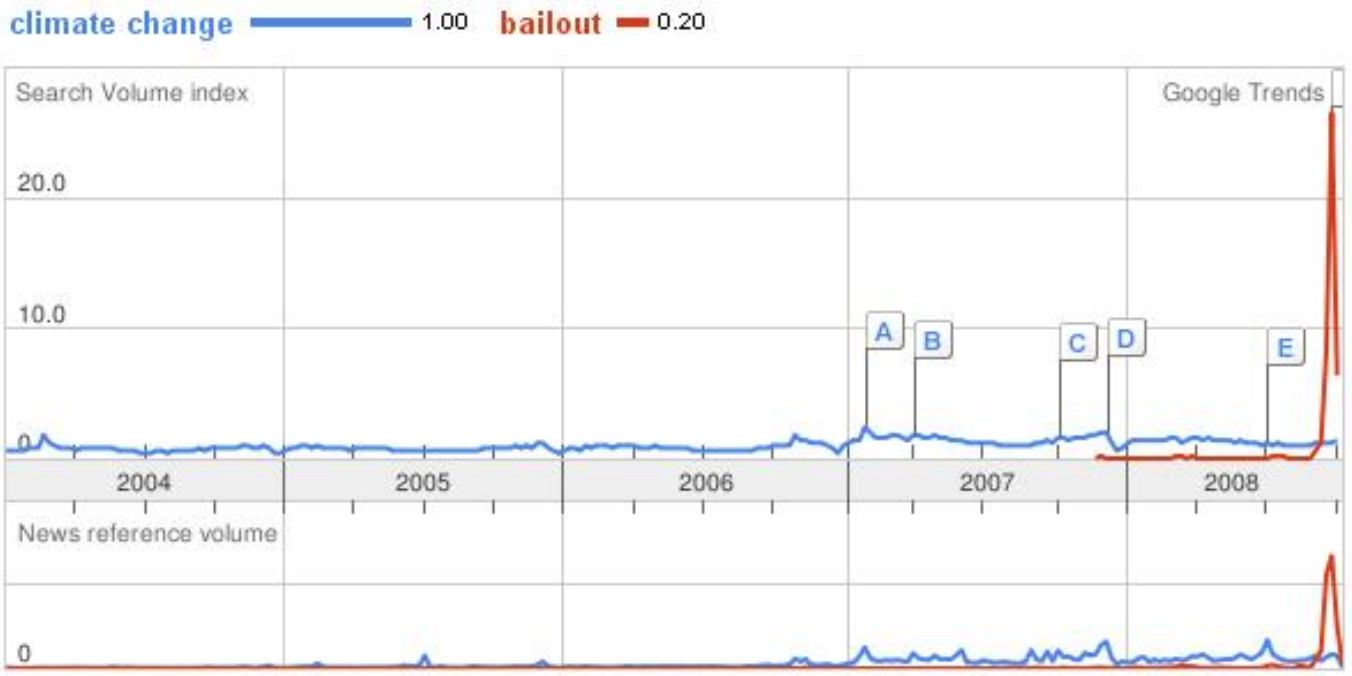
Policy diverges from model ideals

- **Misperception of feedbacks**
- **Complexity of negotiations**
- **Mistrust of instruments**
- **Competing problems**



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What's coming

- **Consensus growing that GHG must be stabilized, but global implementation remains to be seen**
- **In the absence of viable alternative fuels or sequestration, you get**
  - very high carbon prices or
  - failure to stabilize GHG concentration
- **Implications of high carbon prices are much clearer than implications of increased GHGs & climate impacts**

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Questions to ponder

- **What impacts fall within the lifetime of physical assets?**
- **Will foot-dragging yield savings, or eventual exclusion and punishment?**
- **How realistic are prospects for securing property rights (grandfathered emissions allocations)?**
- **Would you rather have predictable price or quantity?**

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What aviation can do

- **Aim for policies that preserve future ability for tradeoffs with other sectors & regions**
- **Preserve flexibility within the aviation system**
- **Aim for policies characterized by their direction and strategy, not numerical details**
- **Engage at the regional level, recognizing that US and global policy will likely be shaped by coalescence of local experiments**
- **Be prepared to lose free rides**
- **Account for (highly uncertain) GHG policy in capital planning**
- **Where authority doesn't exist to do what needs to be done most efficiently, seek it**