

COSTS OF LCS AND TECHNOLOGY

Five Principles of an Economically Efficient LCS

Low Carbon Society Workshop
Tokyo, Japan

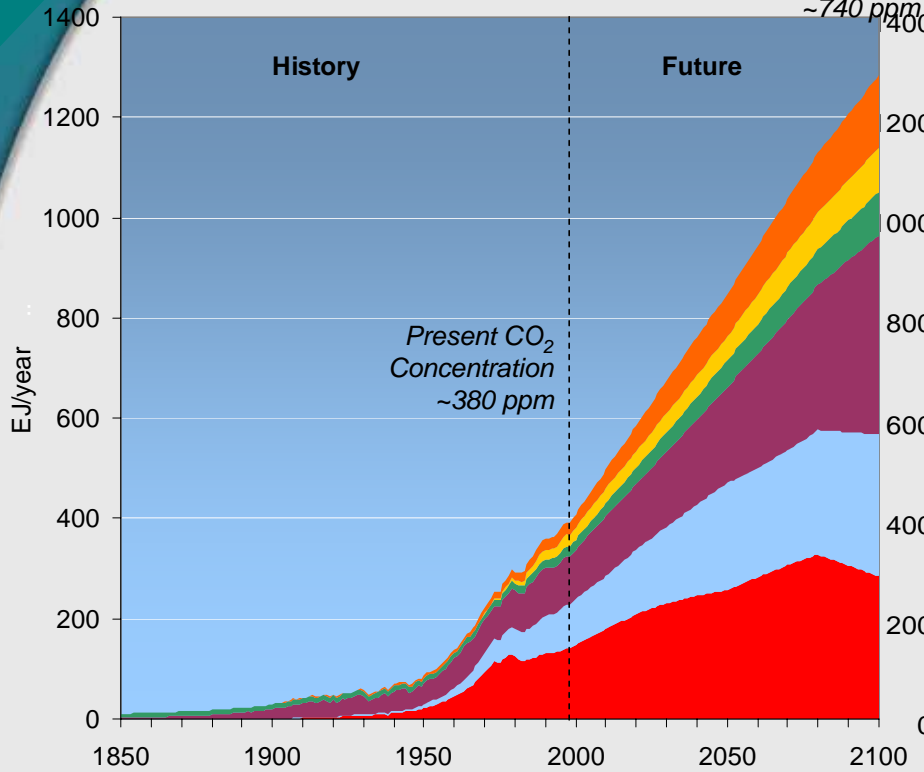
Jae Edmonds

February 13, 2008

Stabilizing CO₂ concentrations means fundamental change to the global energy system

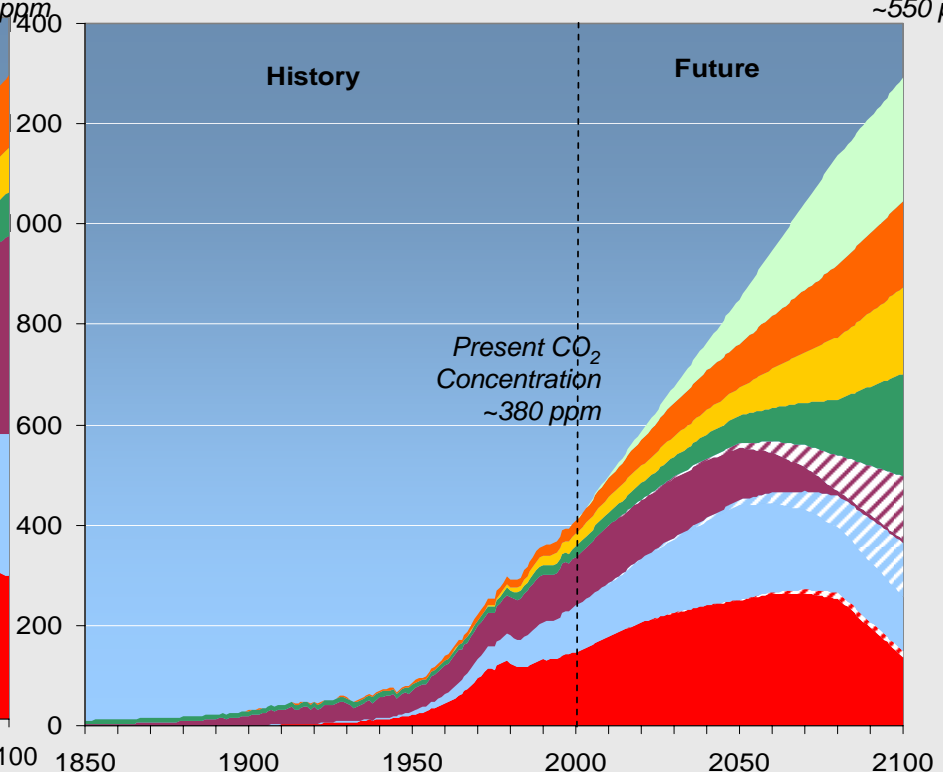
History and Reference Case

2100 CO₂
Concentration
~740 ppm



Stabilization of CO₂ at 550 ppm

2100 CO₂
Concentration
~550 ppm



Preindustrial CO₂
Concentration
~280 ppm

- Oil
- ▨ Oil + CCS
- Natural Gas
- ▨ Natural Gas + CCS
- Coal
- ▨ Coal + CCS
- Biomass Energy
- Nuclear Energy
- Non-Biomass Renewable Energy
- End-use Energy

More Information Is Available in the GTSP Report

Hard Copies of the Report are Available upon request

Summarizing
Ten Years of
Technology
Research



And on the Web

<http://www.pnl.gov/gtsp>

or

<http://gtsp.battelle.org>

Five Principles for Achieving an Economically Efficient LCS

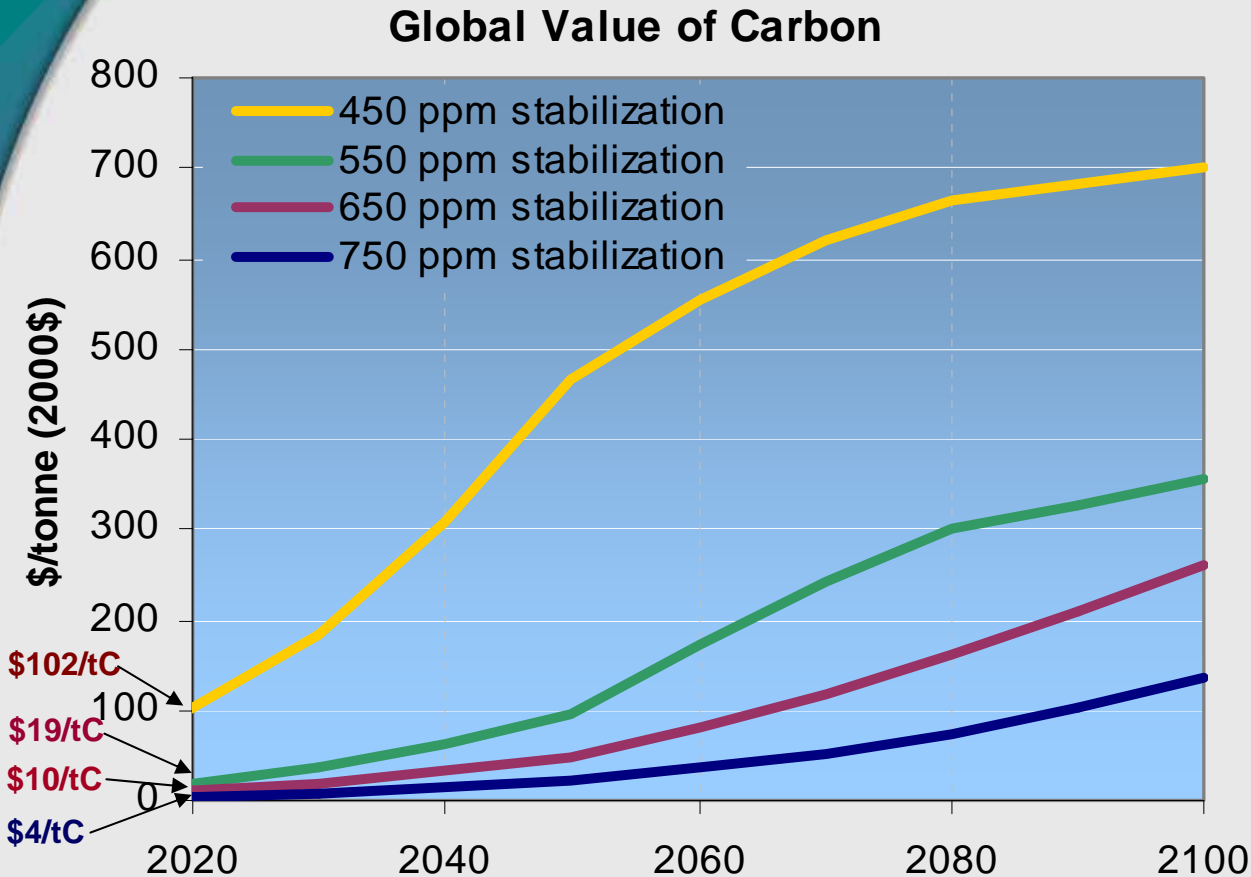
1. Stabilization requires that greenhouse gases have a price—implicit or explicit.
2. The price of a greenhouse gas should rise at the rate of interest plus the natural rate of removal of the gas from the atmosphere.
3. The price of a greenhouse gas should be the same for a gas irrespective of the emissions source.
4. Decision makers should be able to form a reasonable expectation that the price will rise at a regular rate of doubling.
5. Increase R&D, energy-climate R&D in the near- and mid-terms, basic science for the long term.

1. Stabilization requires that greenhouse gases have a price—implicit or explicit.

▶ **Climate is a Public Good**

- ▶ You cannot solve a **public** goods problem with better **private** decisions alone.
 - Public goods problems require public intervention.
 - Markets are needed to communicate the public interest to private decision makers.
- ▶ A price of carbon should reflect the social value of carbon.

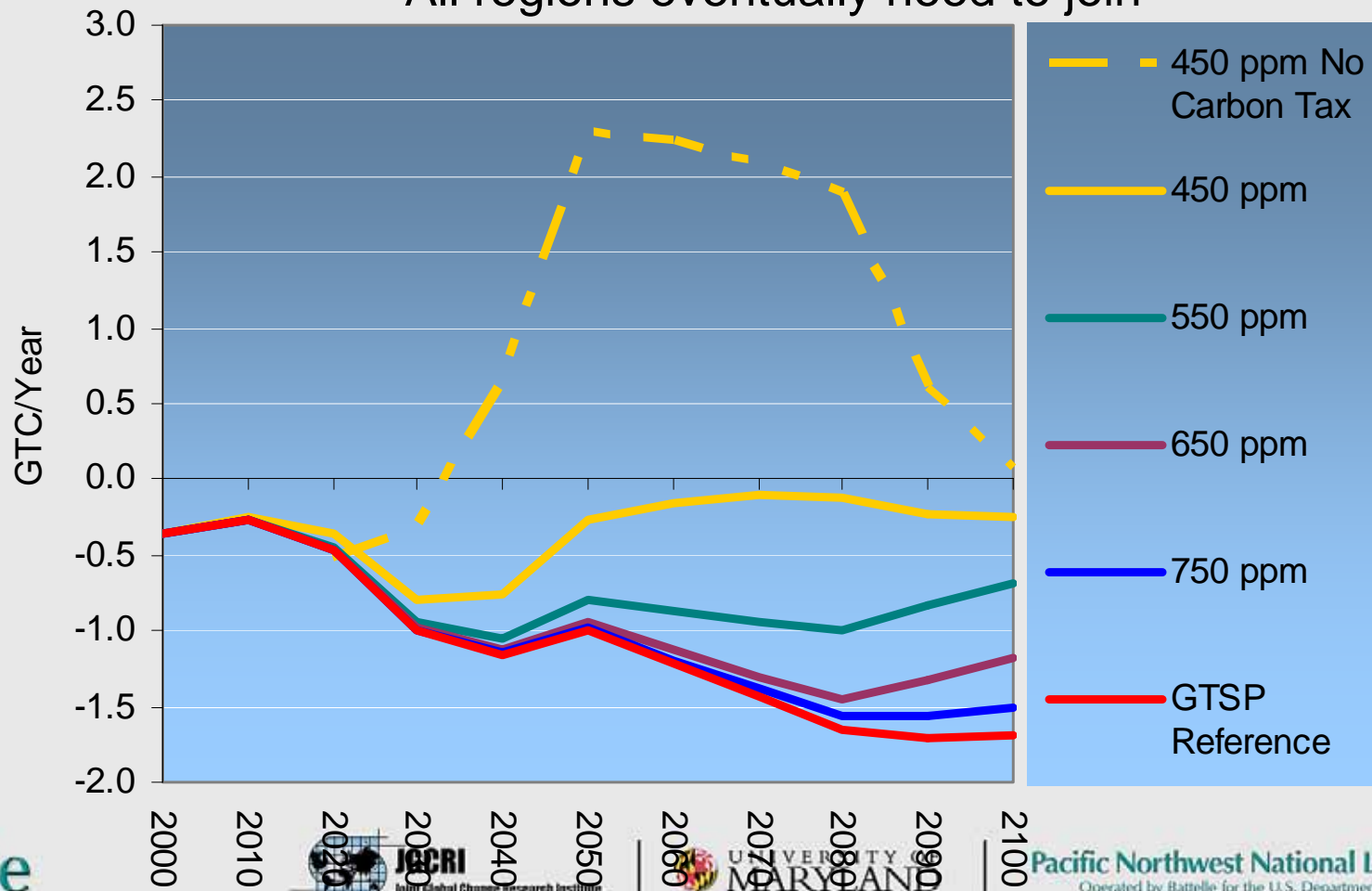
2. The price of carbon should rise at the rate of interest plus the rate of removal from the atmosphere.



- ▶ **Climate change is a stock pollutant problem, NOT a flow pollutant.**
- ▶ Price of carbon should start low and rise steadily to minimize society's costs.
- ▶ Eventually all nations and economic sectors need to be covered as the atmosphere is indifferent as to the source of CO₂ emissions.

3. The price of a greenhouse gas should be the same for a gas irrespective of the emissions source.

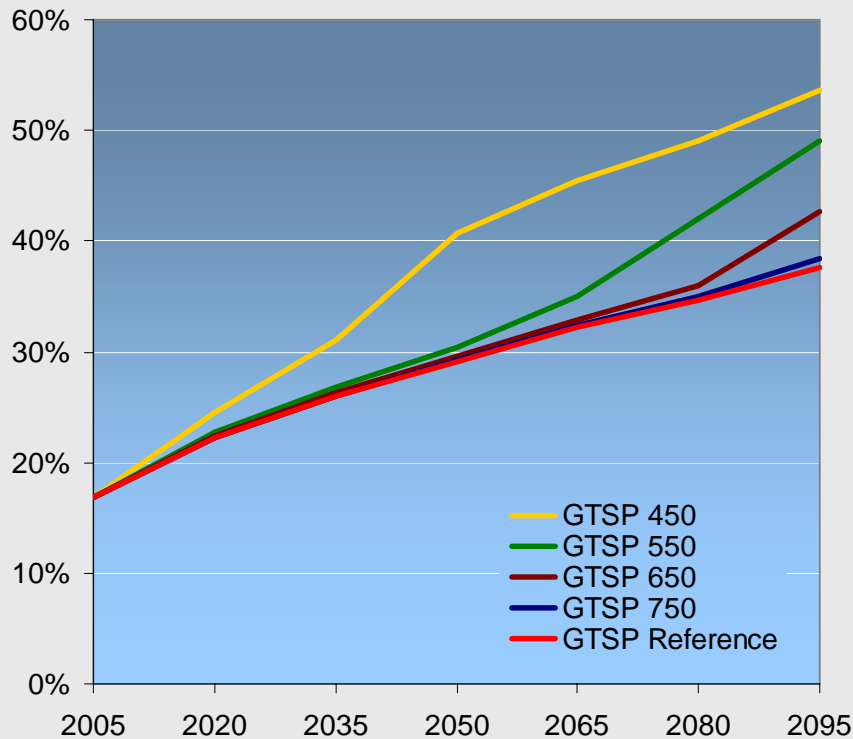
- Not just electricity
- Terrestrial carbon emissions**
- All regions eventually need to join



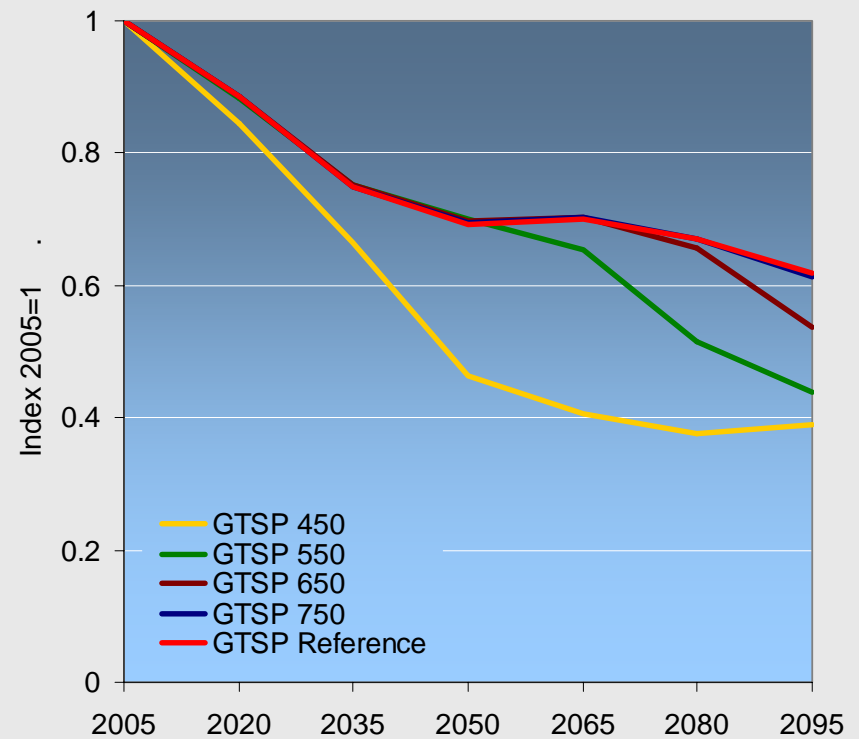
Electrification

- ▶ The world is electrifying.
- ▶ Emissions mitigation increases the relative role of electricity.
- ▶ Electricity prices fall relative to fossil fuel prices.

Electricity as a Percentage of Total Final Energy

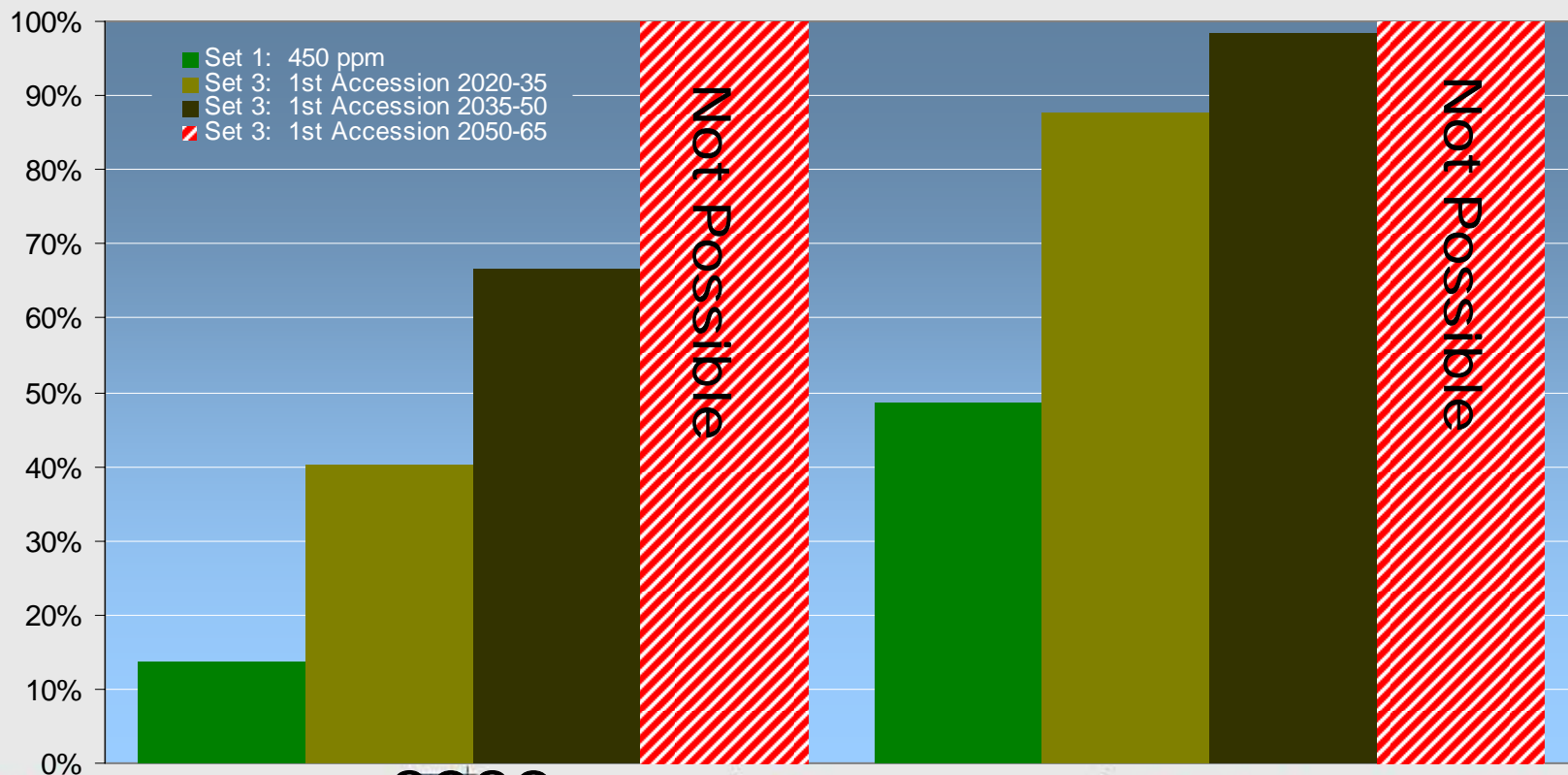


Average Electricity Price Relative to Oil Price



A LCS EVENTUALLY NEEDS A GLOBAL CONTROL REGIME

Year 2020 Annex I emissions mitigation, relative to 2005, for different accession assumptions: 450 ppm

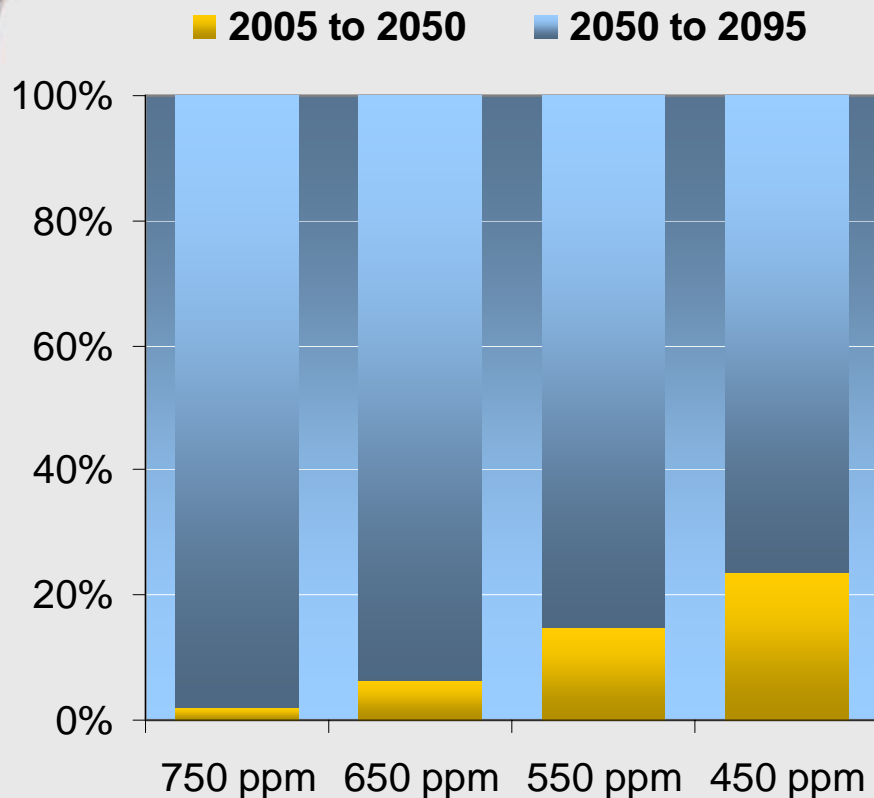


4. Decision makers should be able to form a reasonable expectation that the price will rise at a regular rate of doubling.

- ▶ The time when low-emission technologies enter into operation is dramatically accelerated when one of the cost elements (carbon emissions) is growing more rapidly than the rate of interest.
 - E.g. CCS will come into use long before the price of carbon reaches the point at which it would be sufficient to deploy the technology if it were held constant.
- ▶ Creating an expectation that carbon prices will double regularly has the side effect of lowering the carbon price needed to achieve a given emissions mitigation.
- ▶ Mechanisms exist to communicate appropriate expectation.
 - However, they require policies that extend indefinitely into the future—even if they include mechanisms for regular review and pegging of the price.
 - E.g. “safety valve” for cap and trade where the SV value escalates at the proper rate.

5. Increase R&D, energy-climate R&D in the near- & mid-terms, basic science for the long term.

Emissions Mitigation 2005 to 2050 and 2050 to 2095



- ▶ The time scale of emissions mitigation is a century or more.
- ▶ Energy technology will be needed to help control emissions in the NEAR-, MID-, and Long-term to address climate change.
- ▶ Investments in basic scientific research in the first half of the 21st century can be transformed into energy technologies that can become a major part of the global energy system in the second half of the century.

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