GTSP

Global Energy Technology Strategy Program

On the Value of Technology

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GTSP Technical Review Meeting

May 24, 2005

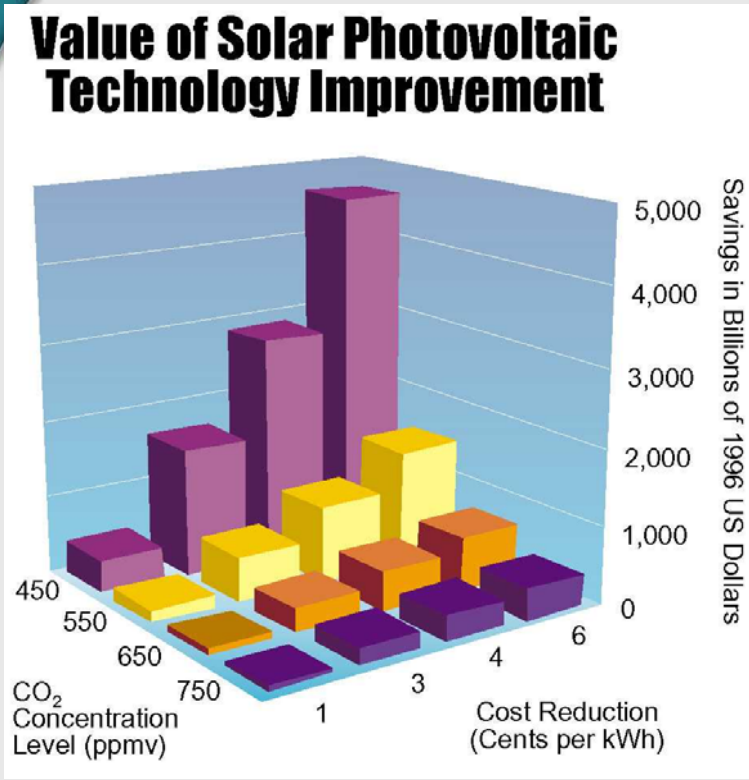
Battelle

JGCRI Joint Global Change Research Institute

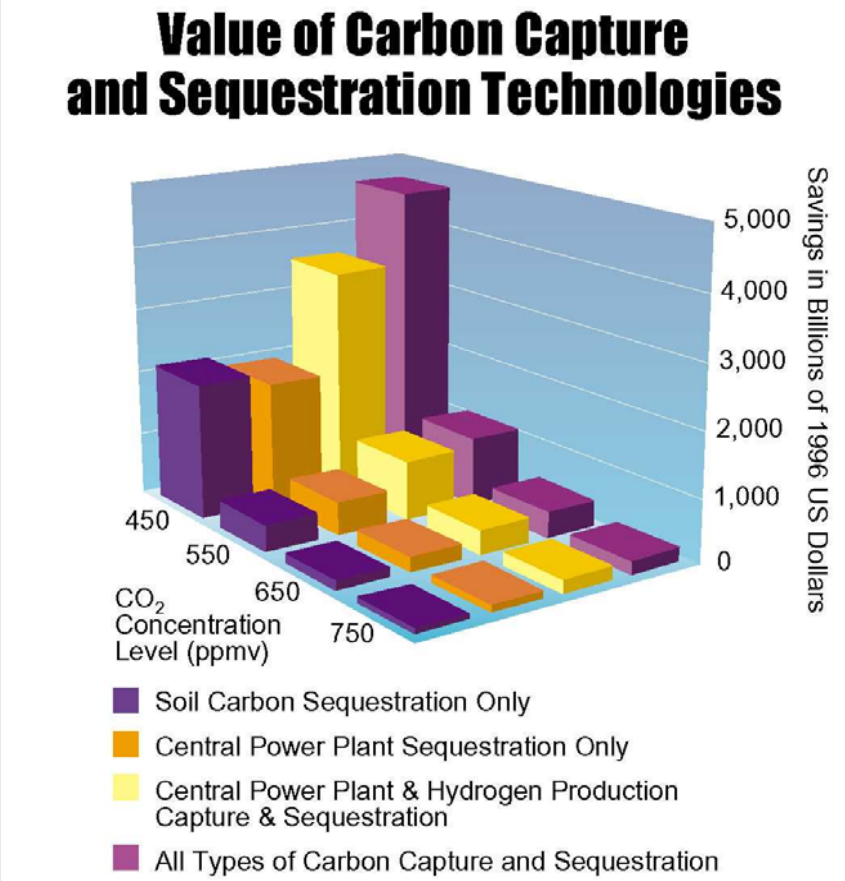
UNIVERSITY OF MARYLAND

Pacific Northwest National Laboratory
Operated by Battelle for the U.S. Department of Energy

Value of Solar and Carbon Capture and Sequestration Technologies
From GTSP 1

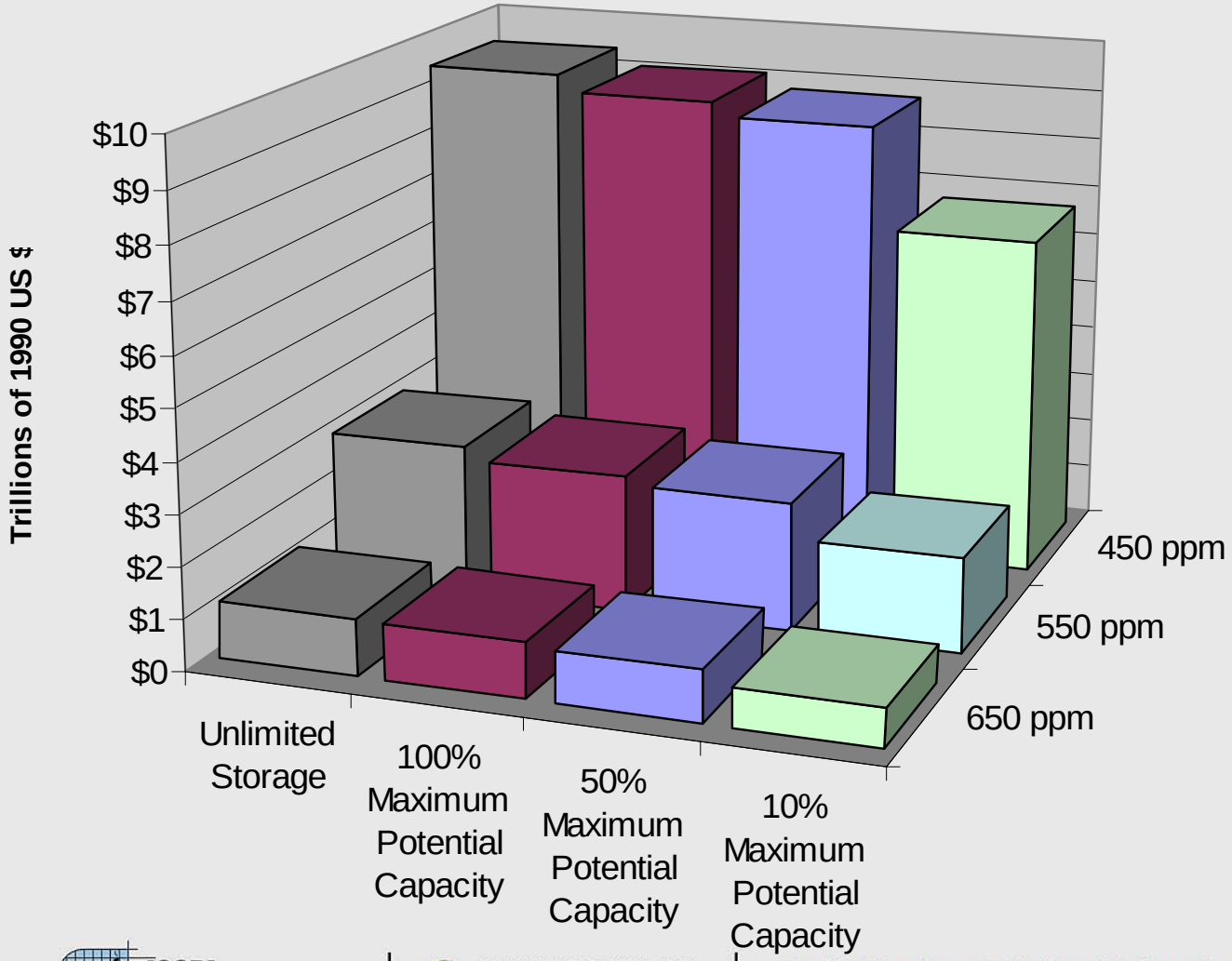


From a baseline of 9 cents/kWh

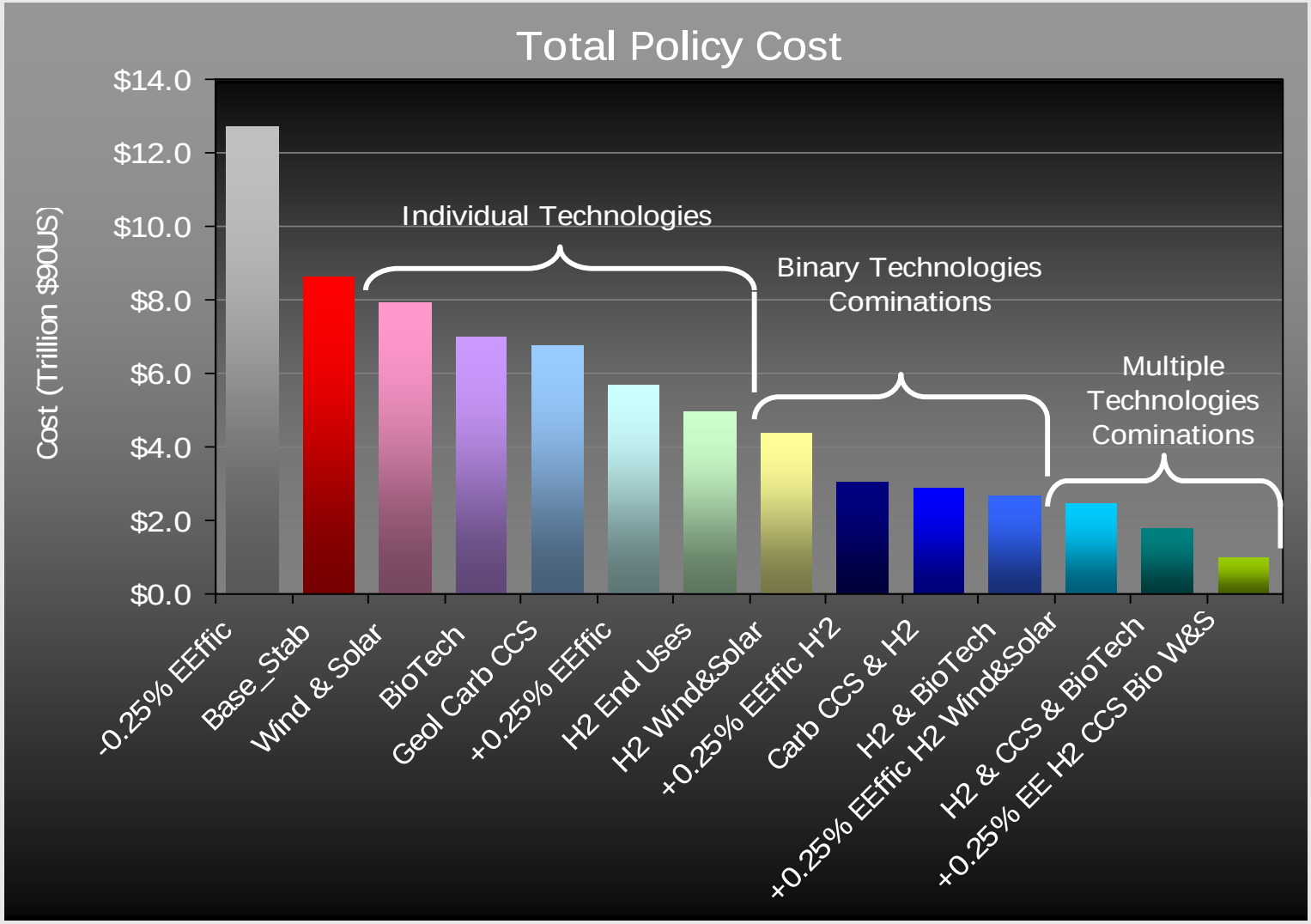


Value of CCS with Alternative CO_2 Storage Assumptions

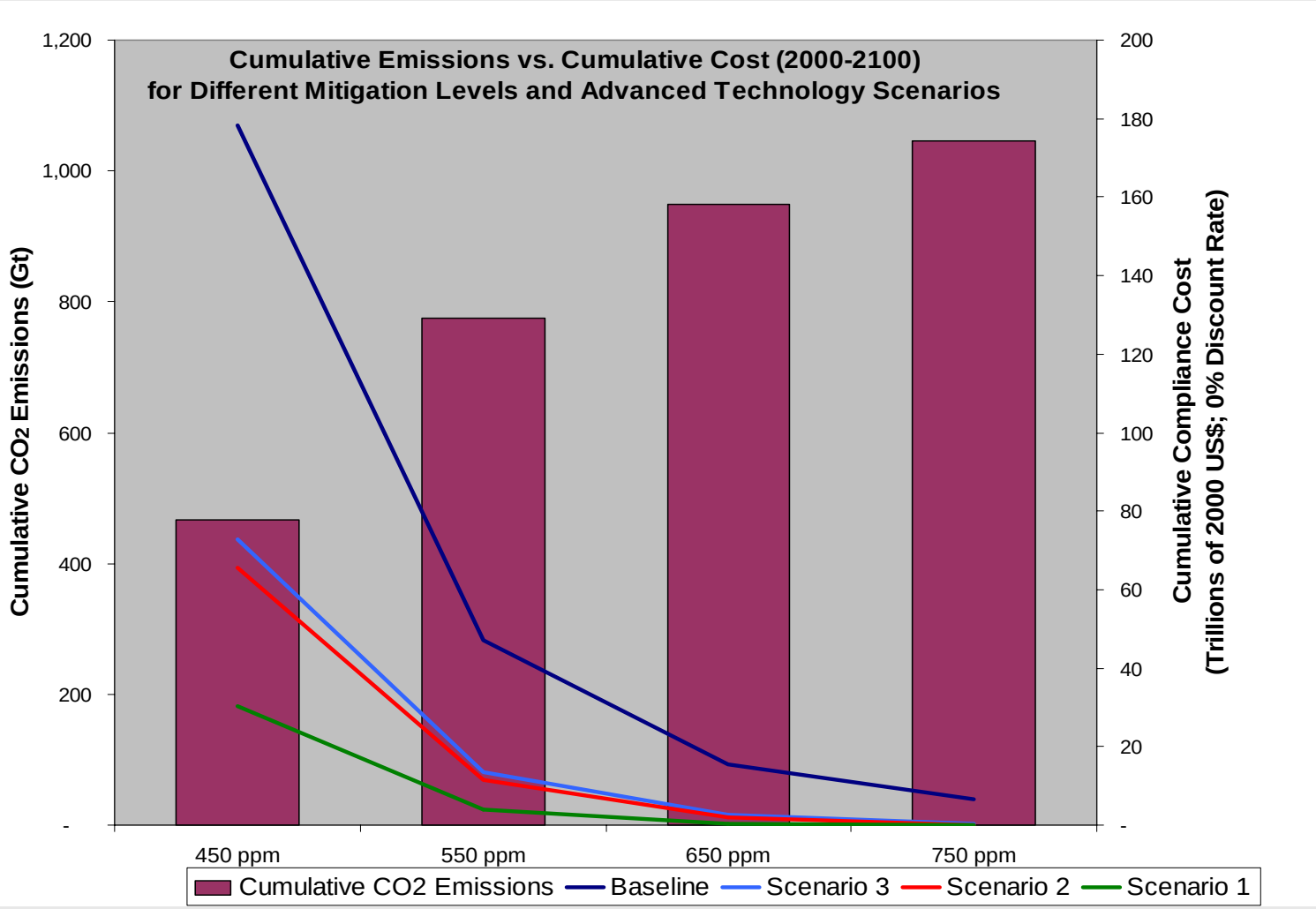
- Preliminary estimate
- 2005 Present Value of Cost Reduction 2005 to 2095
- Discounted @ 5%/year



Value of Various Technological Advances and Combinations to Meet 2 Degree C Target



Value of a Three Suites of Technological Advance



Question 1: What Portfolio of Approaches?

A wide range of policy options are available to spur technological advance

Emissions Instruments

- Emissions Taxes
- Emissions Quotas
- Tradable Permits

Technology Instruments

Technology-Push Instruments

Government R&D
Public-Private Partnerships
R&D Subsidies

Demand-Pull Instruments

Technology Standards
Catalytic Converters

Adoption Subsidies
Tax Breaks for Renewables
Utility DSM Programs

Other Factors

- Patent Law
- Trade Policies
- University System
- Antitrust Policies

Question 2: How Much Effort and How to Allocate?

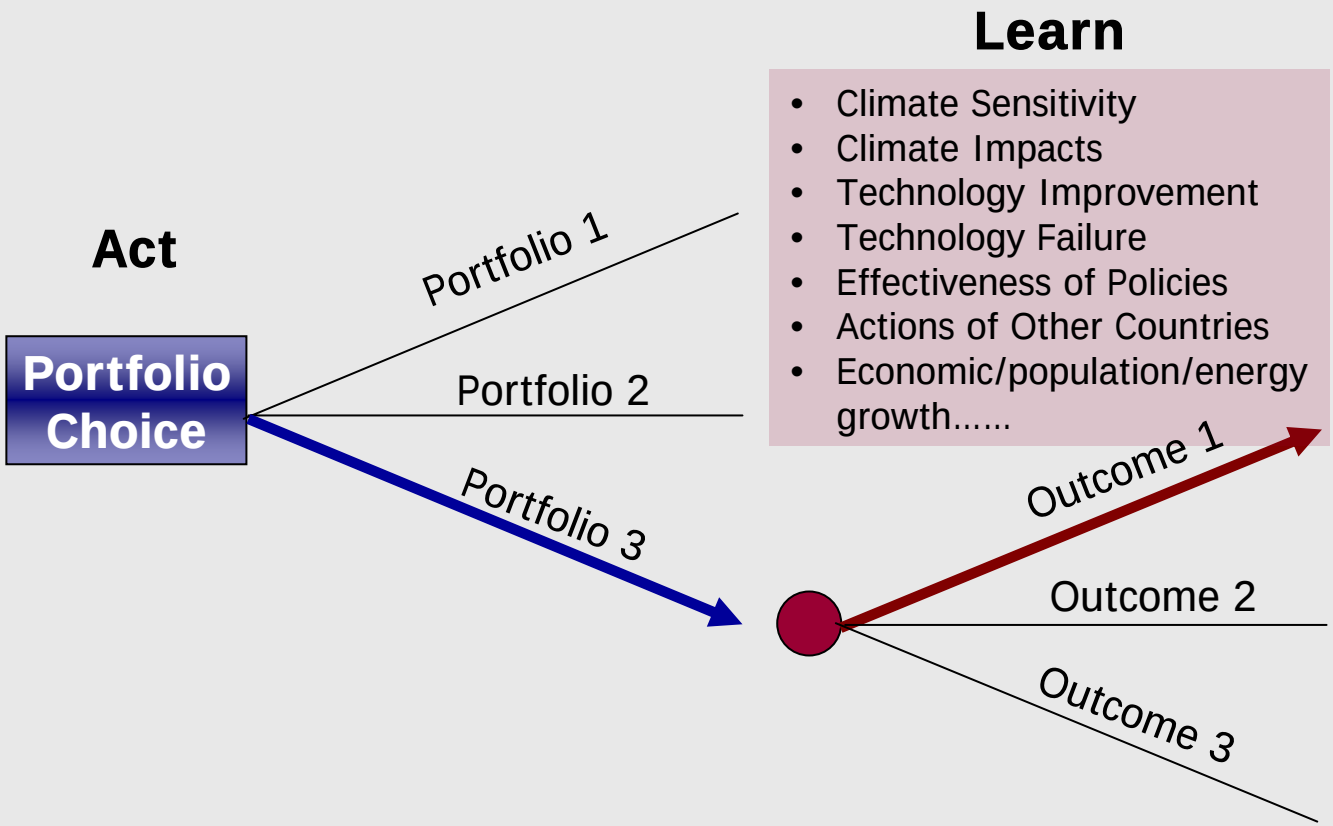
Evidence generally points toward a diversified portfolio:

- Decreasing returns to scale in R&D
- Risk management
- Heterogeneous applications
- Spillovers

But there are many diversified portfolios...how should funding and emphasis be allocated between research areas?

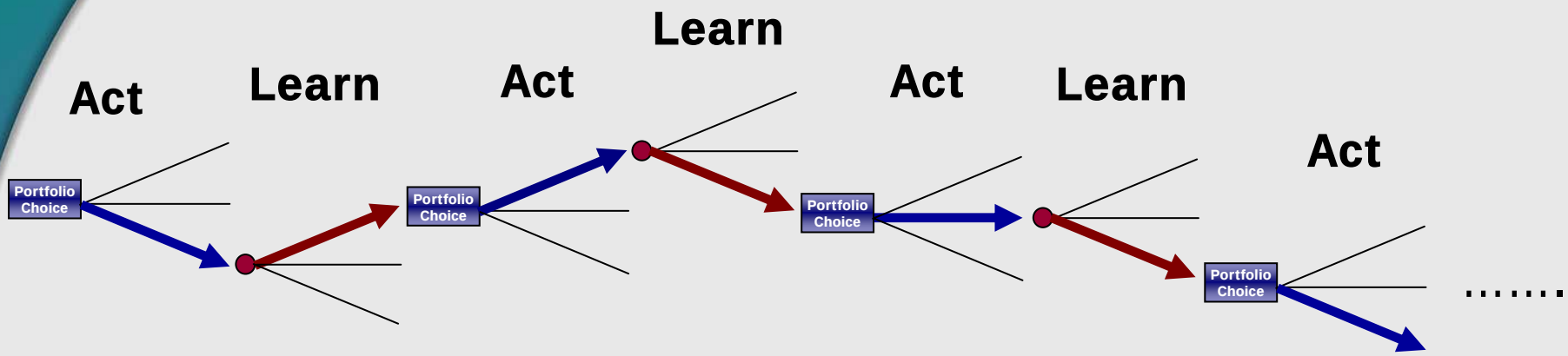
The Normative R&D Strategy Challenge

Act-Learn-Act-Learn-.....



The Normative R&D Strategy Challenge

Act-Learn-Act-Learn-.....



1. R&D planning is problem of dynamic control under uncertainty
2. The implications of actions we take today depends crucially on the series of actions we take in the future in response to what we learn
3. There is more value to R&D than advancing technology
   - Learning about the potential for improvement
   - Maintaining capabilities/minimizing adjustment costs

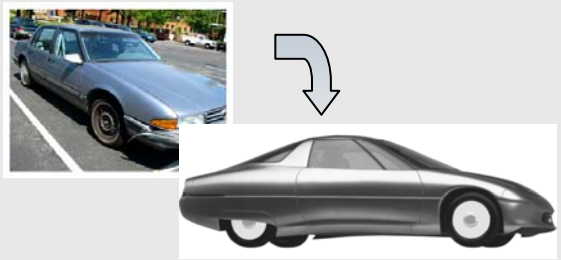
The Normative R&D Strategy Challenge

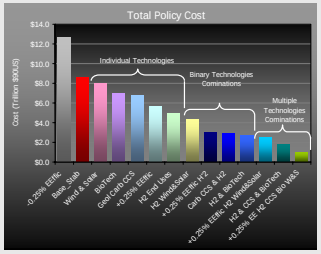
Issues and Tools

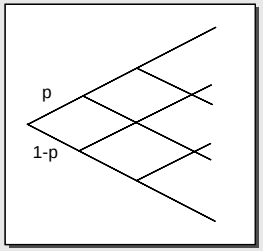
How can we better inform R&D strategy:

(1) how much effort is appropriate?

(2) how should it be allocated?







ISSUES

Potential for Advance, R&D Impact on Advance

Value of Technology

R&D Allocation Under Uncertainty

TOOLS

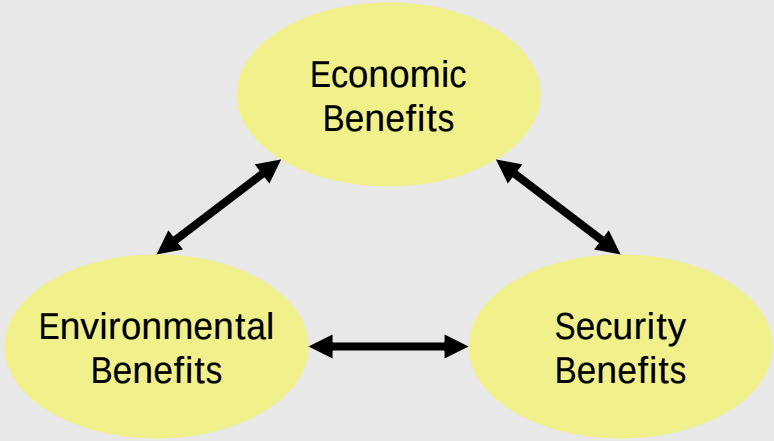
Technology Assessments
Historical Analysis

Integrated Assessment Models

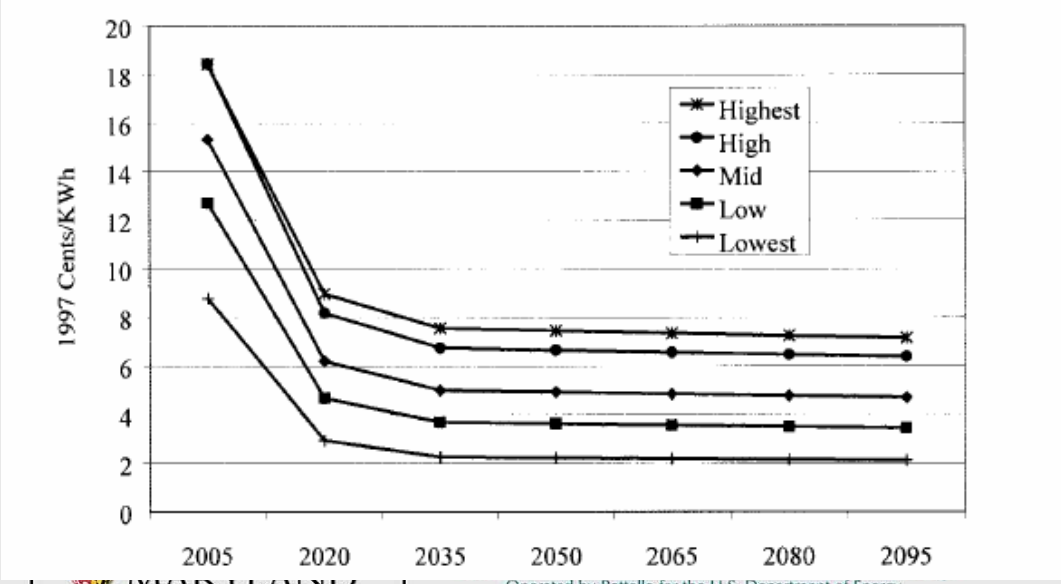
Portfolio Models, Decision Analysis

Value of Technology
Technical Challenges

- Metrics: What metrics are appropriate? What time period? What discount rate? From whose perspective? From what technological reference point?
- Multiple Benefits to Technology:



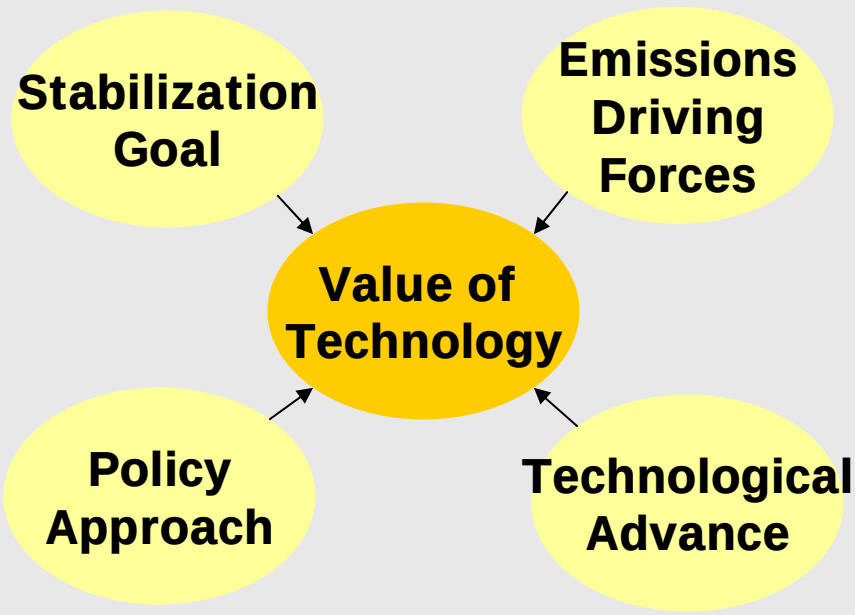
- Spillovers: consistent scenarios of advance – technology clusters
- Dynamics of Change: The value of technology accrues over time—it is based on a full time path of characteristics.



Technical Challenges: Uncertainty

What climate goals will society choose?

What will be the dynamics of key emissions drivers such as population growth and economic growth?

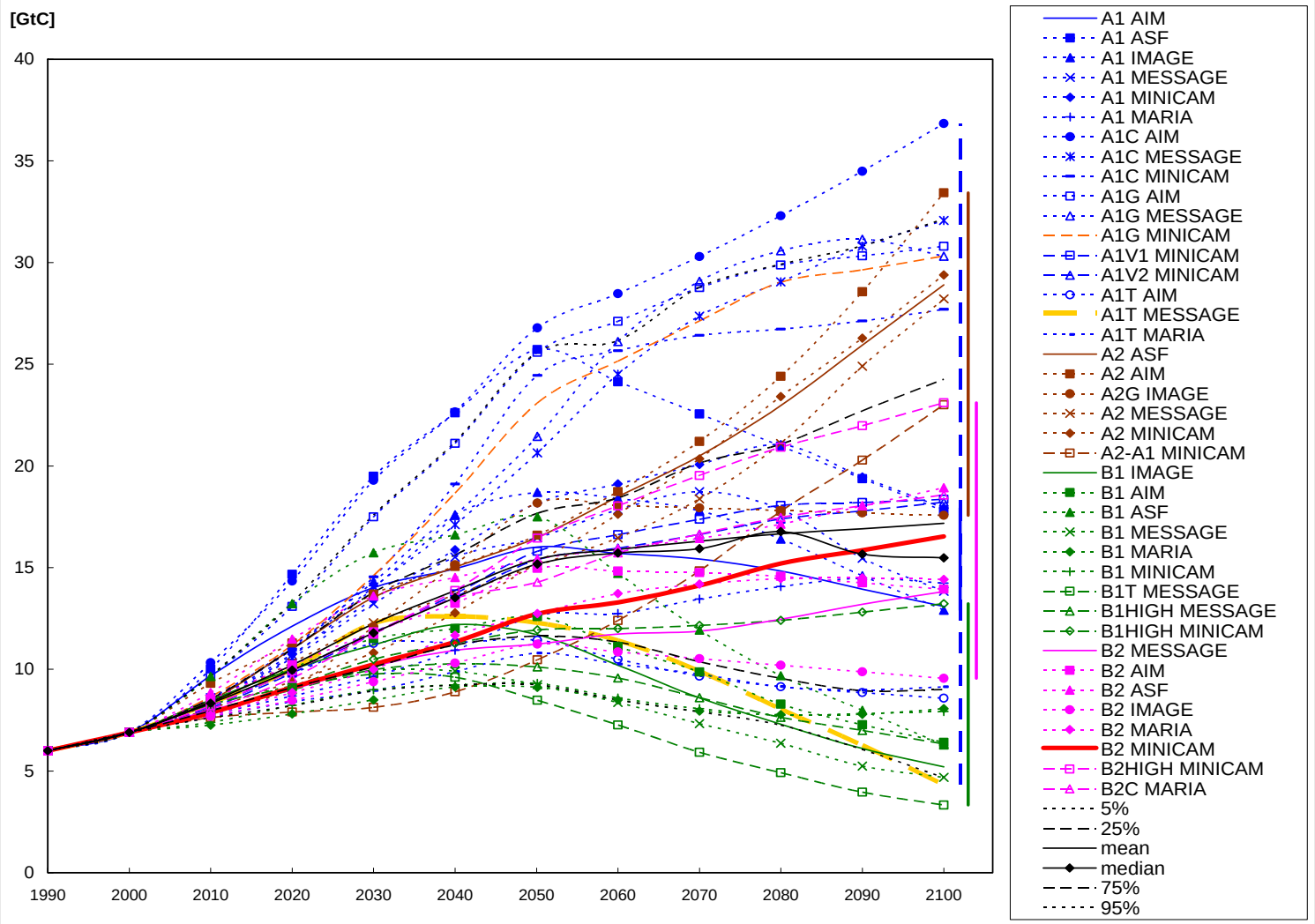


What policies are used to achieve climate goals?

What advances will occur in other technologies?

The value of technology depends on a broad set of factors that cannot be known today with certainty.

There is no single "best" reference case



Mapping the Value Space

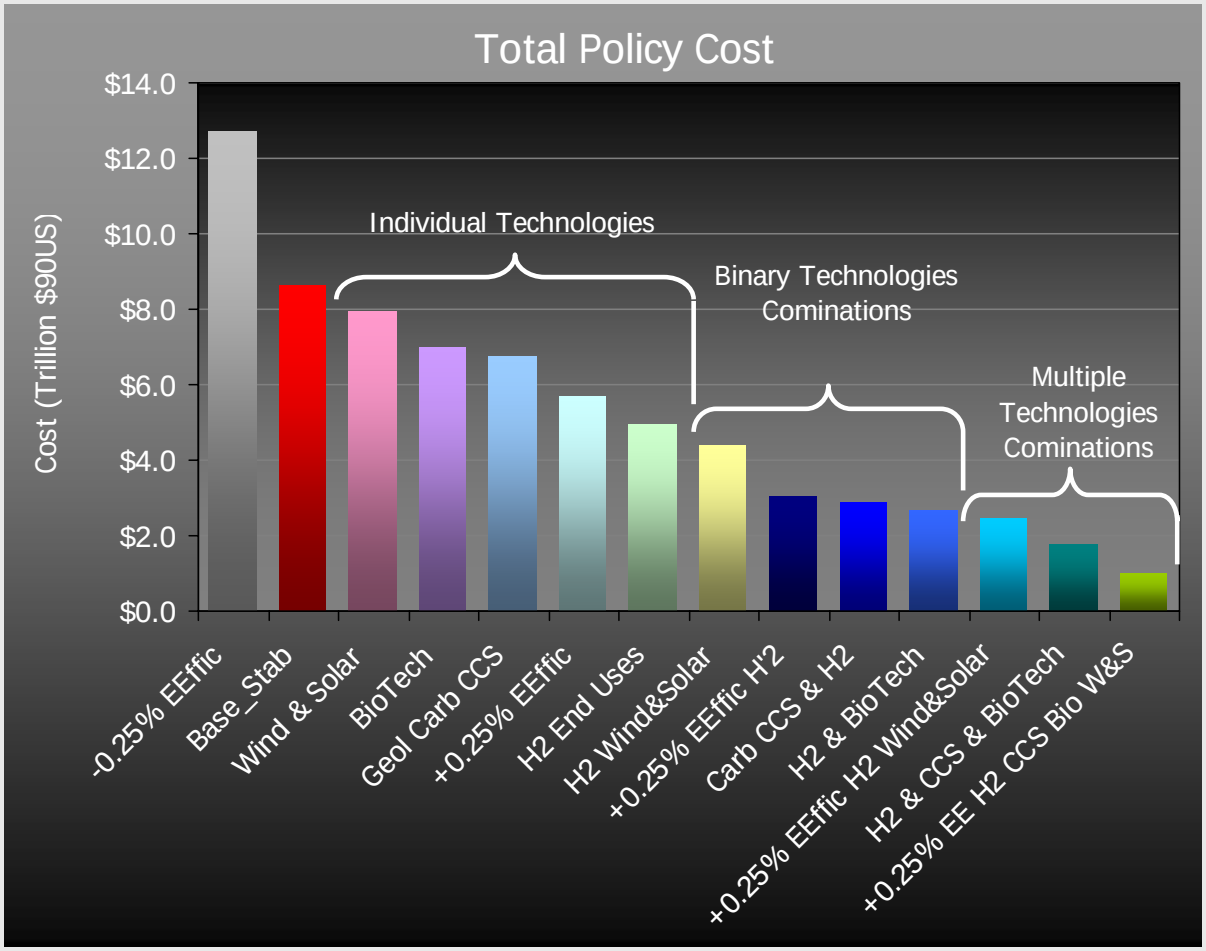
Evaluate technological advances over a consistent set of technology "suites" and stabilization levels.

Technology Level	450 ppm			550 ppm			650 ppm		
	Low Suite	Medium Suite	High Suite	Low Suite	Medium Suite	High Suite	Low Suite	Medium Suite	High Suite
Low									
Medium									
High									

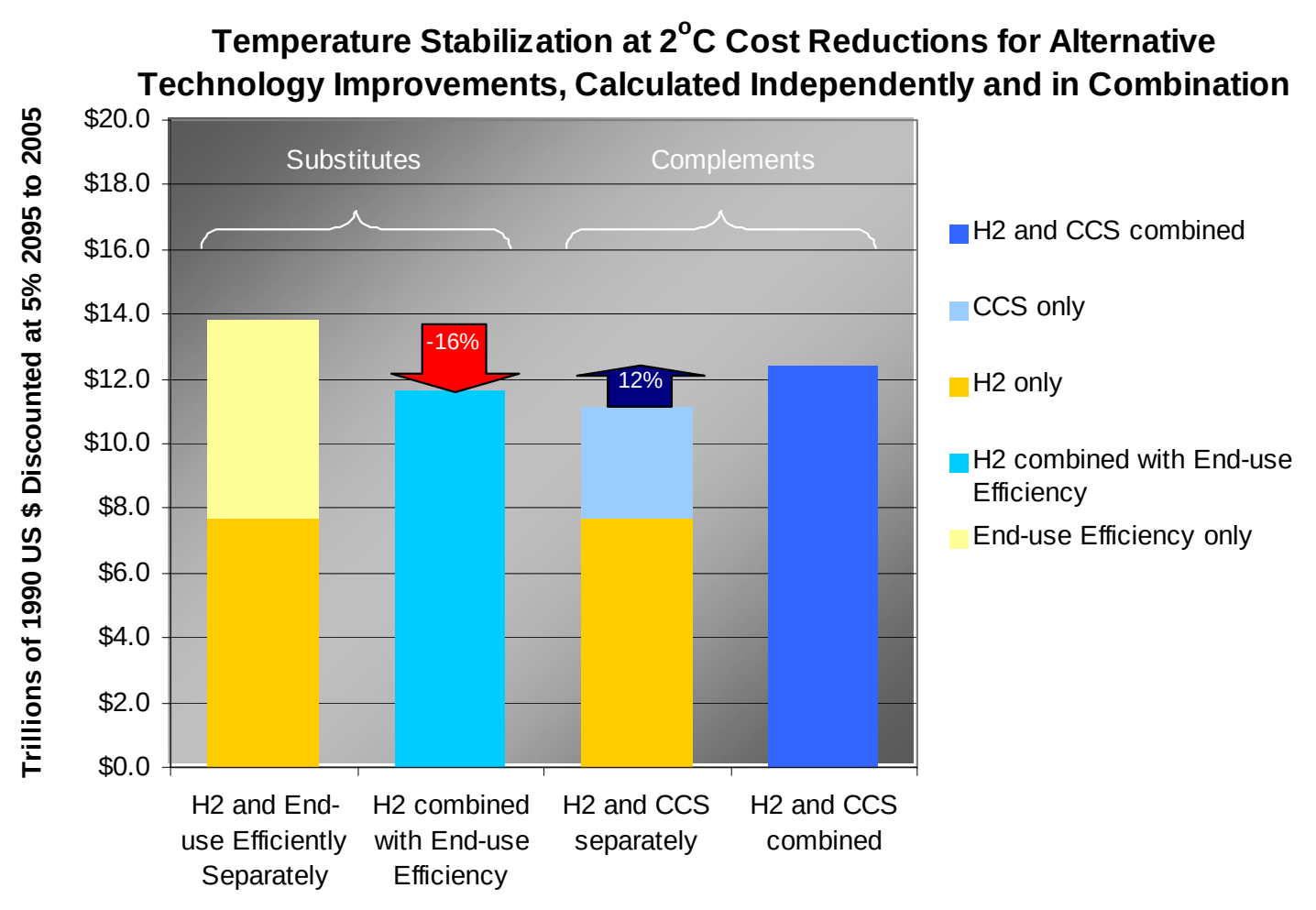
Can we reduce the uncertainty space?

What insights are robust across the uncertainty space?

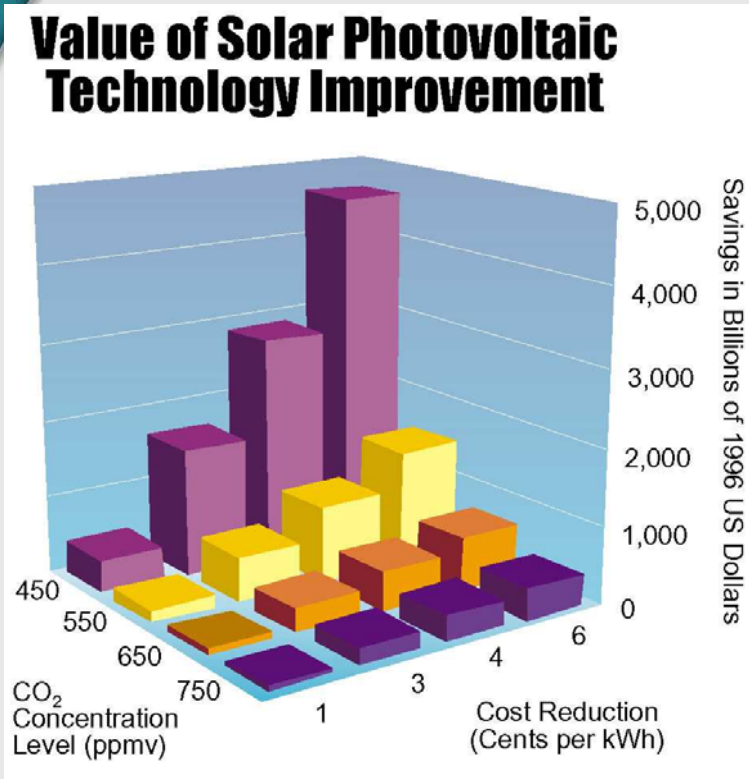
Most advances are substitutes, meaning the value of technology is generally less than additive

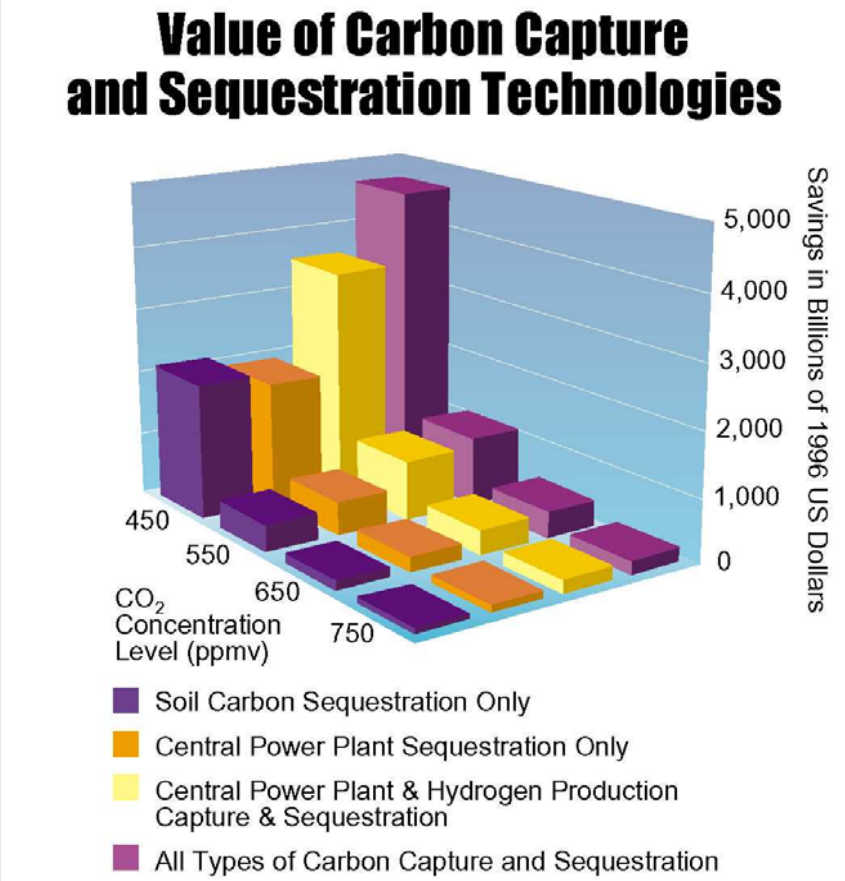


However, some technological advances are complementary

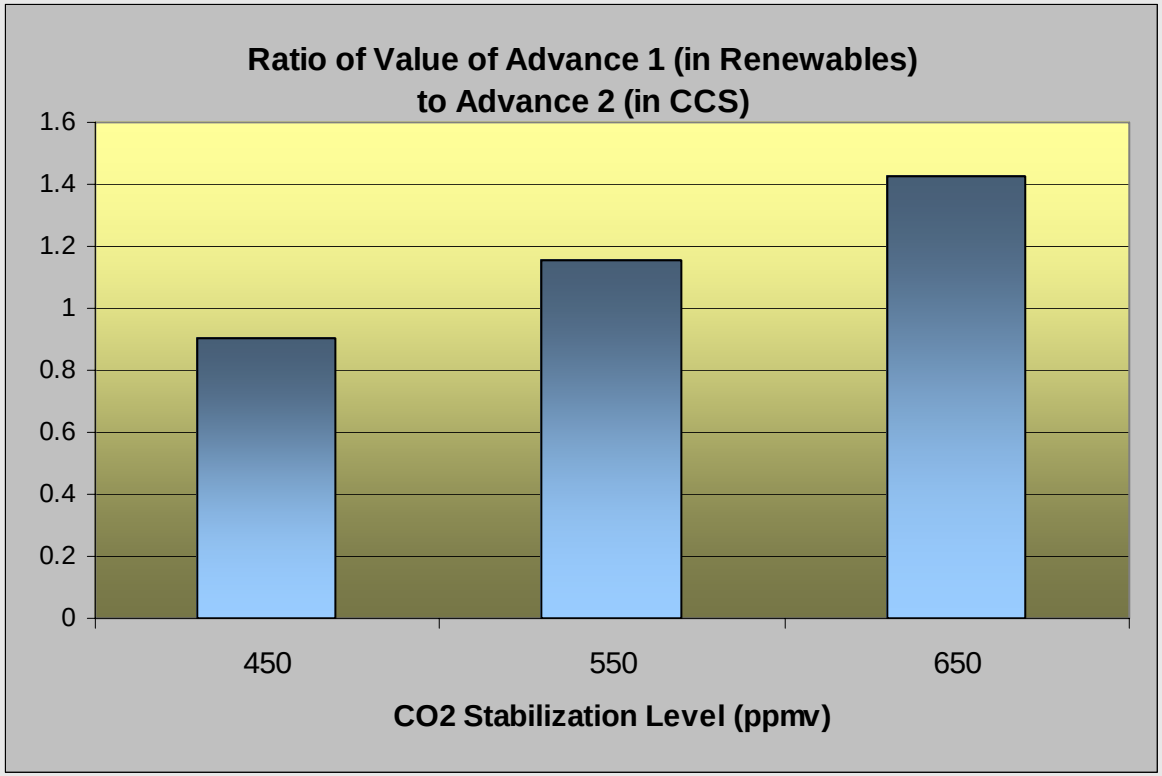


The value of technology generally increases with the degree of constraint

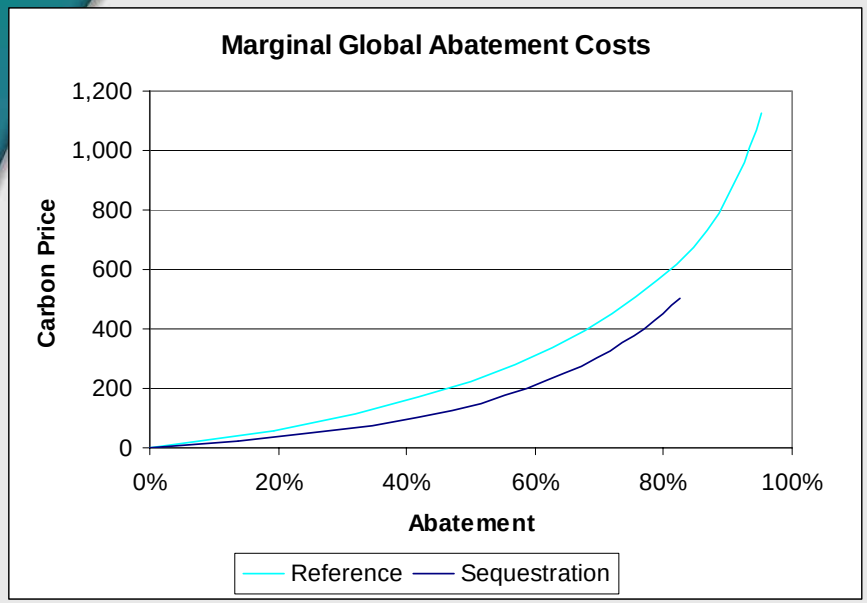




Is the relative value of technological advances consistent across stabilization levels?

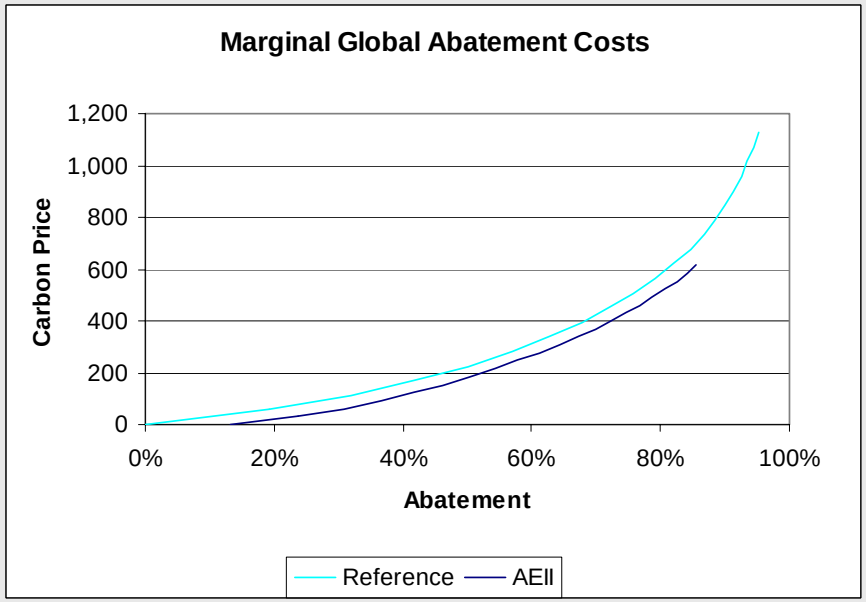


Different advances impact the costs of constraining carbon in different ways



Carbon Capture & Storage (Illustrative)

Across the board end-use efficiency improvements (Illustrative)



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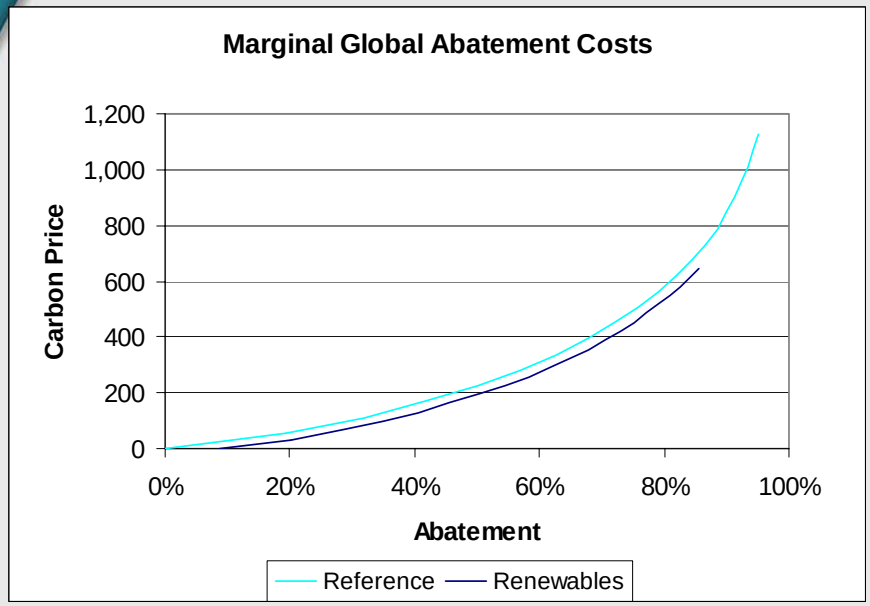
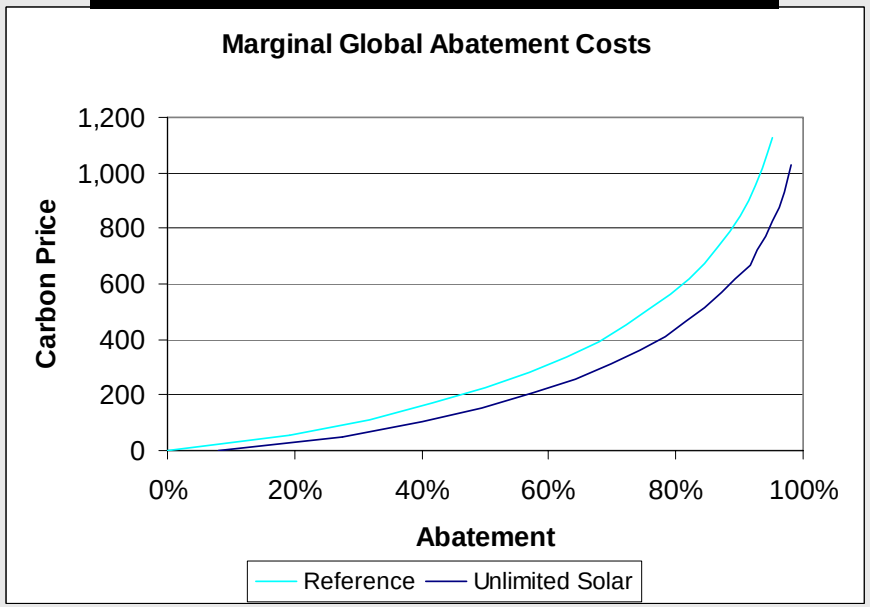
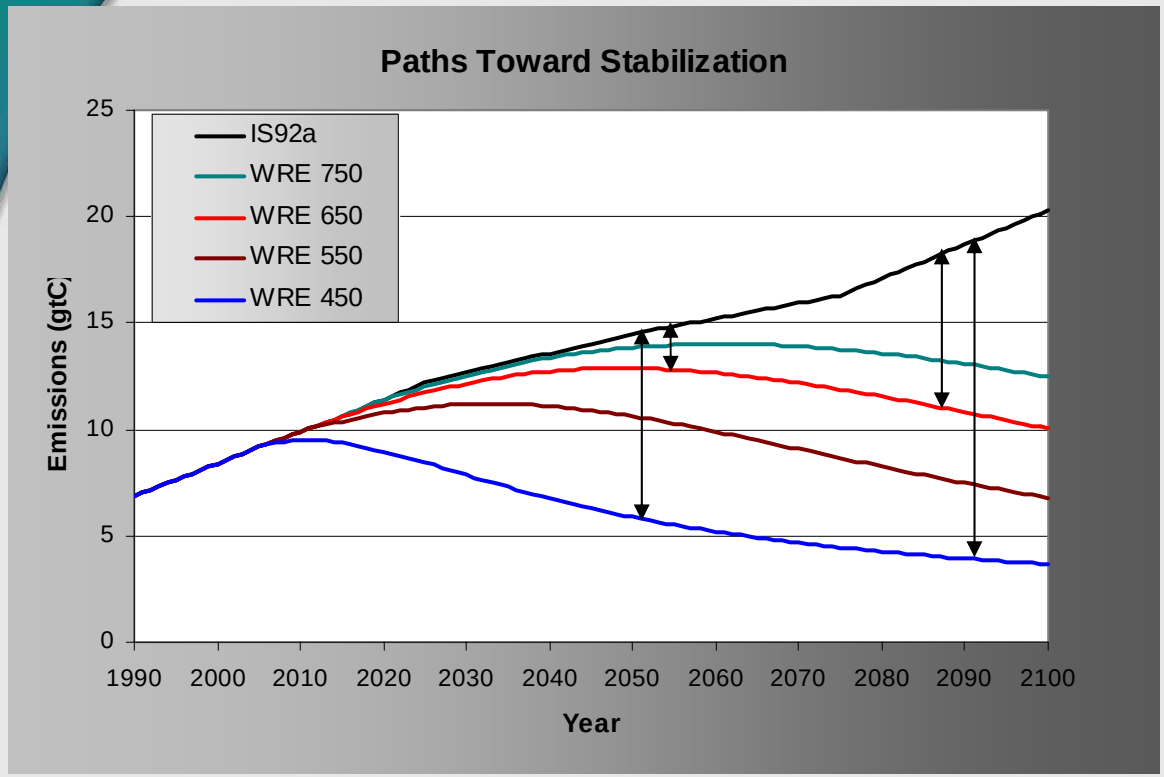


Solar Power w/ Limitations on Electricity Contribution (Illustrative)

Solar Power w/o Limitations on Electricity Contribution (Illustrative)

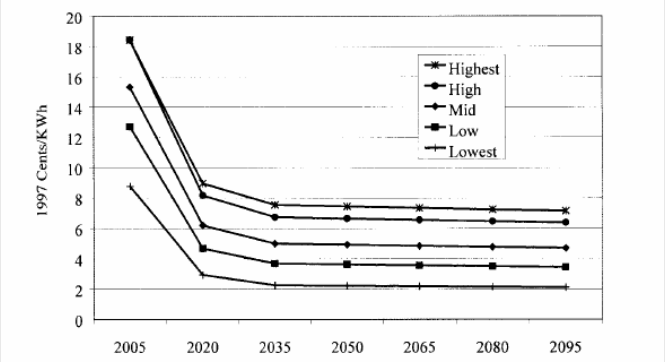


Deviations from the "reference" interact with the technology path



Technology paths that emphasize near-term change will be relatively advantaged for abatement paths that emphasize near-term abatement

Must specify a full path of technological advance



Questions