Costs of reducing carbon emissions in the U.S.: Some recent results

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To download the report: http://www.ornl.gov/ORNL/Energy_Eff/CEF.htm

To get relevant data: http://enduse.lbl.gov/Projects/CEF.html

To download the talk:

http://enduse.lbl.gov/shareddata/CEFsummary020215.ppt

Presented at Sonoma State University

February 20, 2002

SUMMARY OF TALK

- Context on assessing GHG mitigation costs
- Background on Clean Energy Futures (CEF) study & methodology
- Energy and carbon results
- Economic results
- Conclusions

ECONOMICS OF CLIMATE CHANGE MITIGATION HOTLY DEBATED

- Many respected institutions on both sides of the heated discussion, BUT
- There is some common ground:
  - Some successful policies both save money and reduce pollution
  - The real debate is over how many of such policies actually exist and how successful they will be if scaled up.

THE ECONOMIST'S STATEMENT

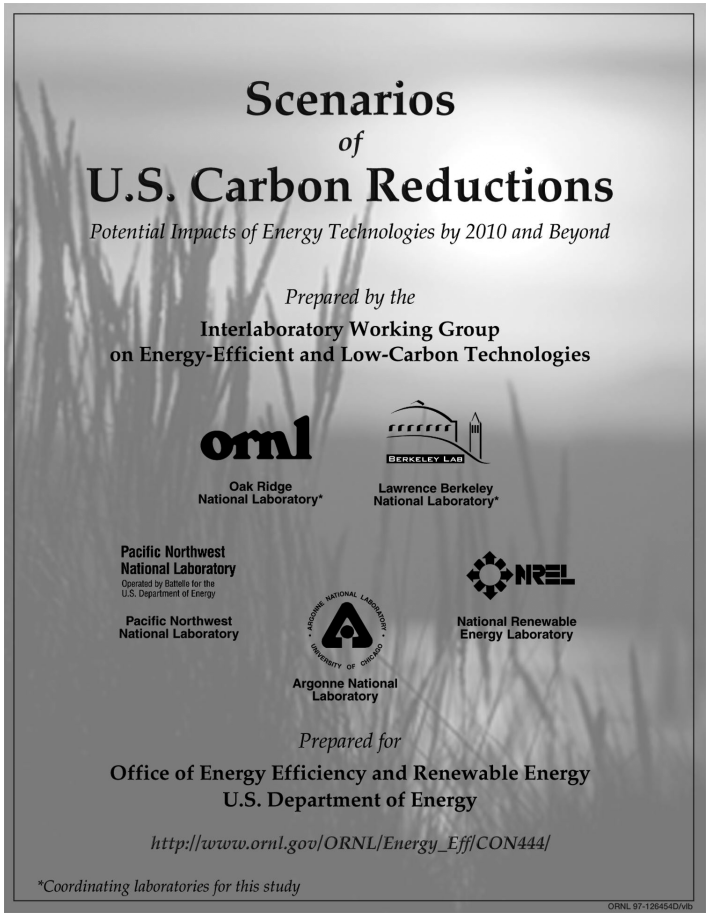
- On February 13, 1997, two thousand economists, including 6 Nobel Laureates, declared:

  Economic studies have found that there are many potential policies to reduce greenhouse-gas emissions for which the total benefits outweigh the total costs. For the United States in particular, sound economic analysis shows that there are policy options that would slow climate change without harming American living standards, and these measures may in fact improve U.S. productivity in the longer run.

AT THE CORE OF THE DEBATE

- Are there $20 bills on the sidewalk?
  - Most economists say no, on theoretical grounds, because someone would have picked them up already
  - Some economists and most engineers, physicists, and business practitioners say yes, on empirical grounds (they see the opportunities with their own eyes).
  - Ultimately an empirical question.

BACKGROUND

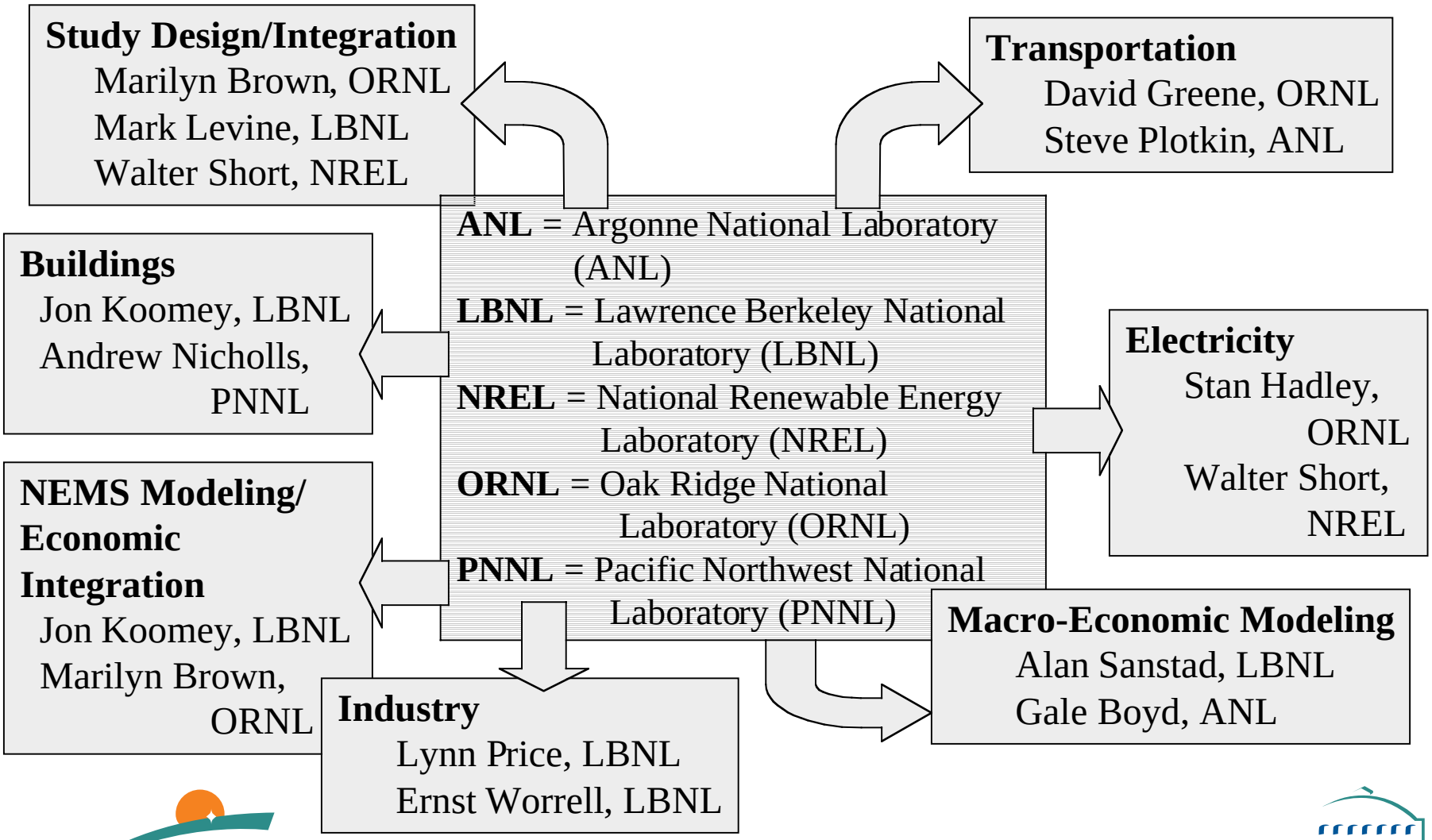


- The previous "5-lab Study": *Scenarios of U.S. Carbon Reductions* (1997) was influential, but was criticized because it did not
  - explicitly identify technologies, programs, and policies;
  - treat fuel price interactions; or
  - incorporate macroeconomic impacts of an emissions trading system.
- CEF was undertaken to address these key criticisms.

BACKGROUND (Continued)

- The Clean Energy Futures (CEF) Study Initiated by the U.S. Department of Energy in Nov. 1998.
- **Goal:** to identify and analyze policies that promote efficient and clean energy technologies to reduce carbon emissions and improve oil security and air quality
- Published in Nov. 2000

LABORATORY TEAM LEADS



METHODOLOGY: DIFFERENT MODELING APPROACHES

- Top down/econometric
- Bottom-up/engineering-economic
- Hybrids (like CEF-NEMS)

N.B., All methods susceptible to the inappropriate use of historically-based parameters to model futures that are quite different from the business-as-usual case.

METHODOLOGY (CONTINUED)

- Analyze and compile latest technology data by sector and end-use.
- Define scenarios in detail, relying on program experience and judgment.
- Change decision parameters and technology costs in CEF-NEMS to reflect the scenarios.
- Run the CEF-NEMS model and associated spreadsheets to capture fuel-price feedbacks and direct cost impacts.
- Analyze second-order impacts of emissions trading using latest literature.

TWO SCENARIOS

Defined by policies that reflect increased levels of national commitment to energy and environmental goals.

(1) **Moderate Scenario:** relatively non-intrusive, no-regrets or low-cost policies.

- assumes some shift in political will & public opinion
- excludes fiscal policies that involve taxing energy

(2) **Advanced Scenario:** more vigorous policies.

- assumes a nationwide sense of urgency
- includes a domestic carbon trading system with assumed permit price of $50/tC.

The scenarios are not forecasts or recommendations; they are possible pathways to a cleaner energy future.

KEY POLICIES- ADVANCED SCENARIO*

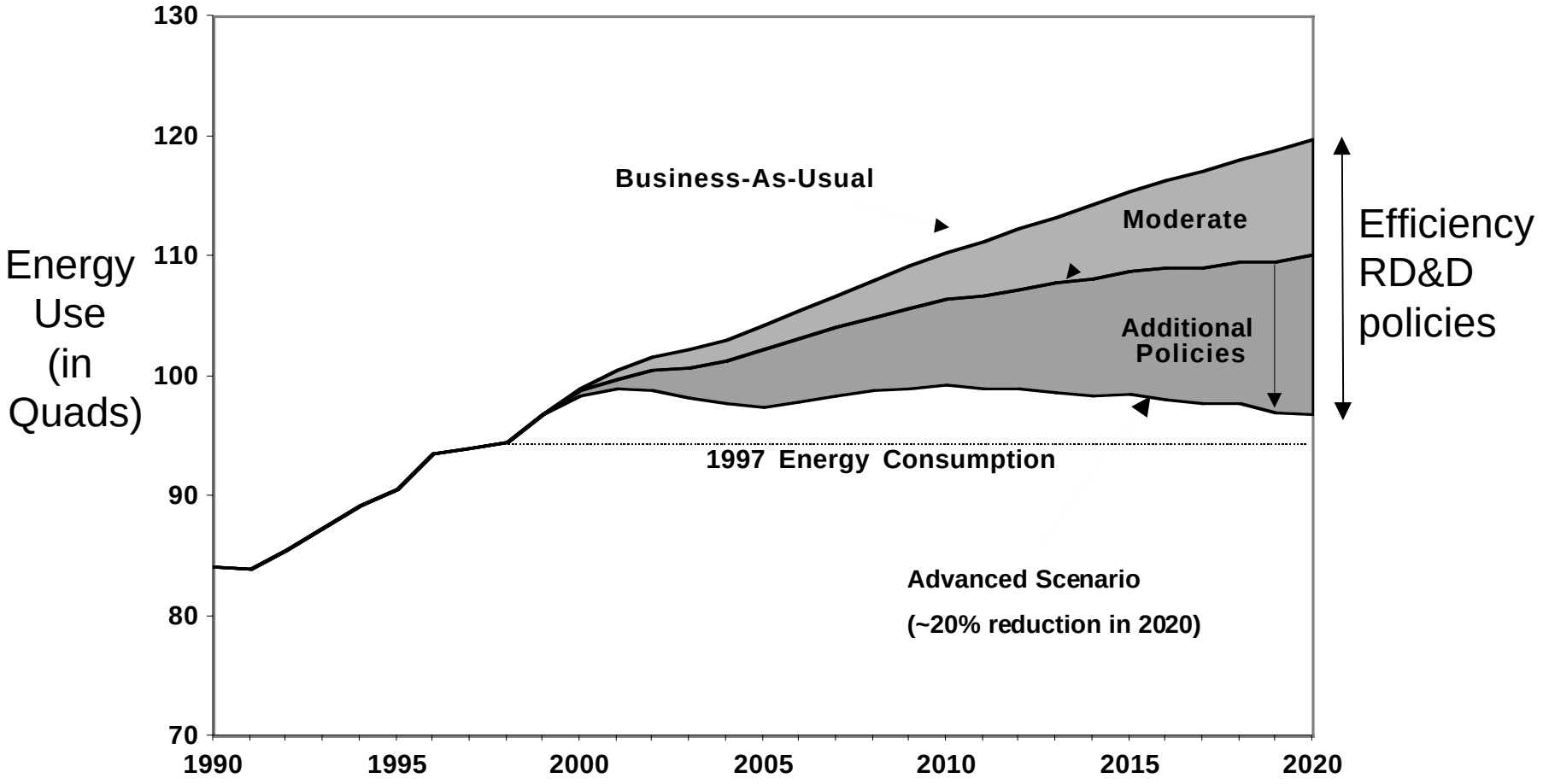
Buildings	Industry
–Efficiency standards for equipment –Voluntary labeling and deployment programs	–Voluntary programs –Voluntary agreements with individual industries and trade associations
Transportation	**Electric Utilities**
–Voluntary fuel economy agreements with auto manufacturers –“Pay-at-the-pump” auto insurance	–Renewable energy portfolio standards and production tax credits –Electric industry restructuring
Cross-Sector Policies	
– Doubled federal R&D	–Domestic carbon trading system

*The scenarios are defined by approximately 50 policies. These 10 are the most important ones in the Advanced scenario. Each policy is specified in terms of magnitude and timing (e.g., “431 kWh/year dishwasher standard implemented in 2010”).

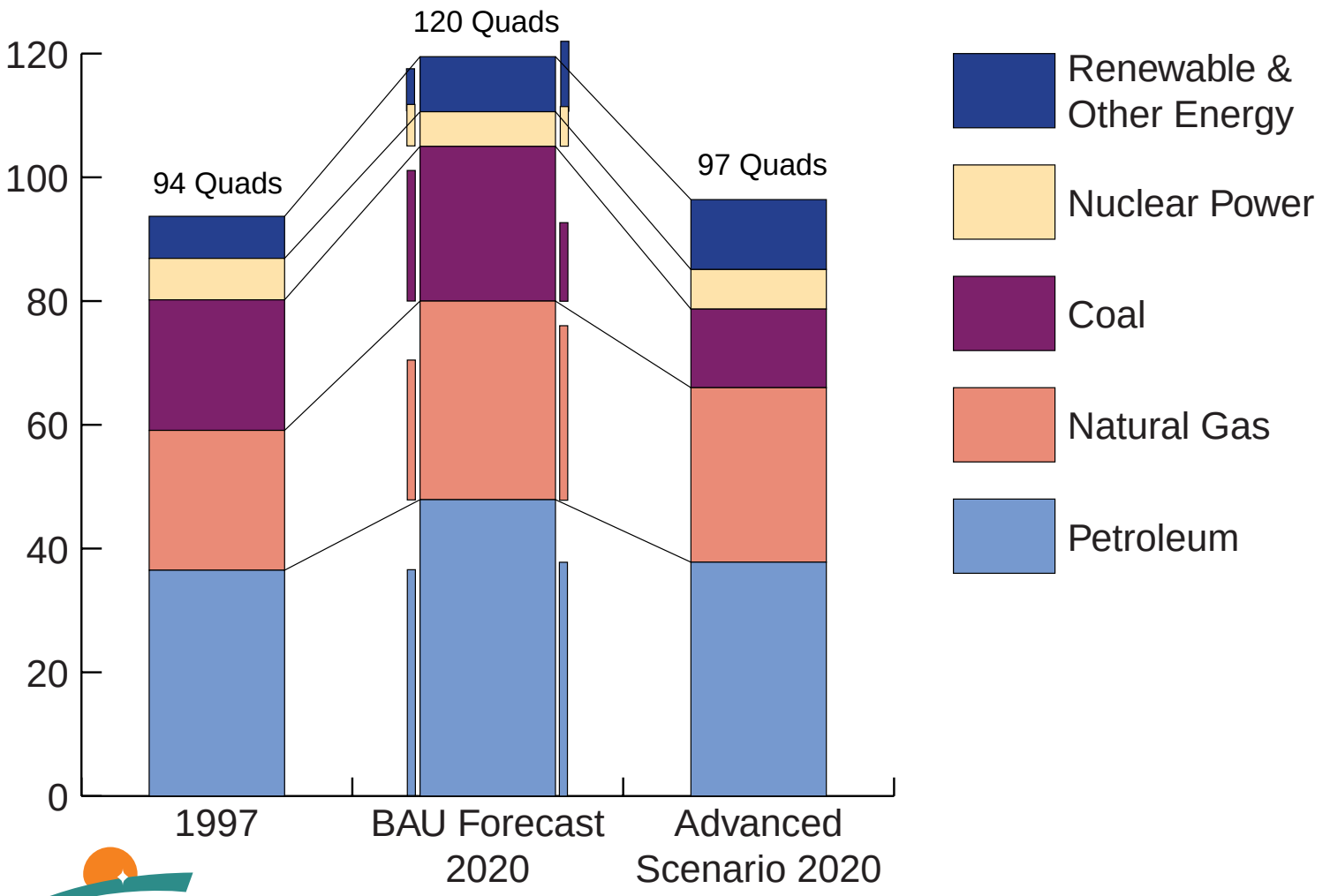
Enhanced R&D is estimated to improve technologies in all sectors.

Buildings	**Industry**
Heat Pump Water Heaters (HPWHs): R&D reduces the cost of HPWHs by 50% in 2005, relative to the BAU.	**Iron and Steel Technologies:** Near net shape casting technologies save up to 4 MBtu/ton steel and reduce production costs between $20 and $40/ton.
Small Metal Halide (Mini-HID) Lamps: R&D produces a 20-Watt mini-HID with an electronic ballast that has the same brightness as a 100-Watt incandescent lamp and an incremental cost of $7.50, available in 2005.	**Pulp and Paper Technologies:** R&D produces an efficient black liquor gasifier integrated with a combined cycle with primary energy savings of up to 5 MBtu/ton air-dried pulp.
Transportation	**Electric Generators**
Direct Injection Diesel Engines: R&D enables direct injection diesel engines to meet EPA's proposed Tier 2 NOx standards in 2004.	**Natural Gas Combined Cycle:** R&D reduces capital costs from the BAU forecast of $405/kW to $348/kW for the 5th of a kind plant; carbon sequestration adds $4/MWh.
Hydrogen Fuel Cell Vehicles: R&D drives down the cost of a hydrogen fuel cell system from $4,400 more than a comparable gasoline vehicle in 2005 to an increment of only $1,540 in 2020.	**Wind:** R&D reduces capital costs from $778/kW throughout the period in the BAU down to $611/kW in 2016; Fixed O&M costs decline from $25.9/kW-yr throughout the period in the BAU down to $16.4/kW-yr in 2020.

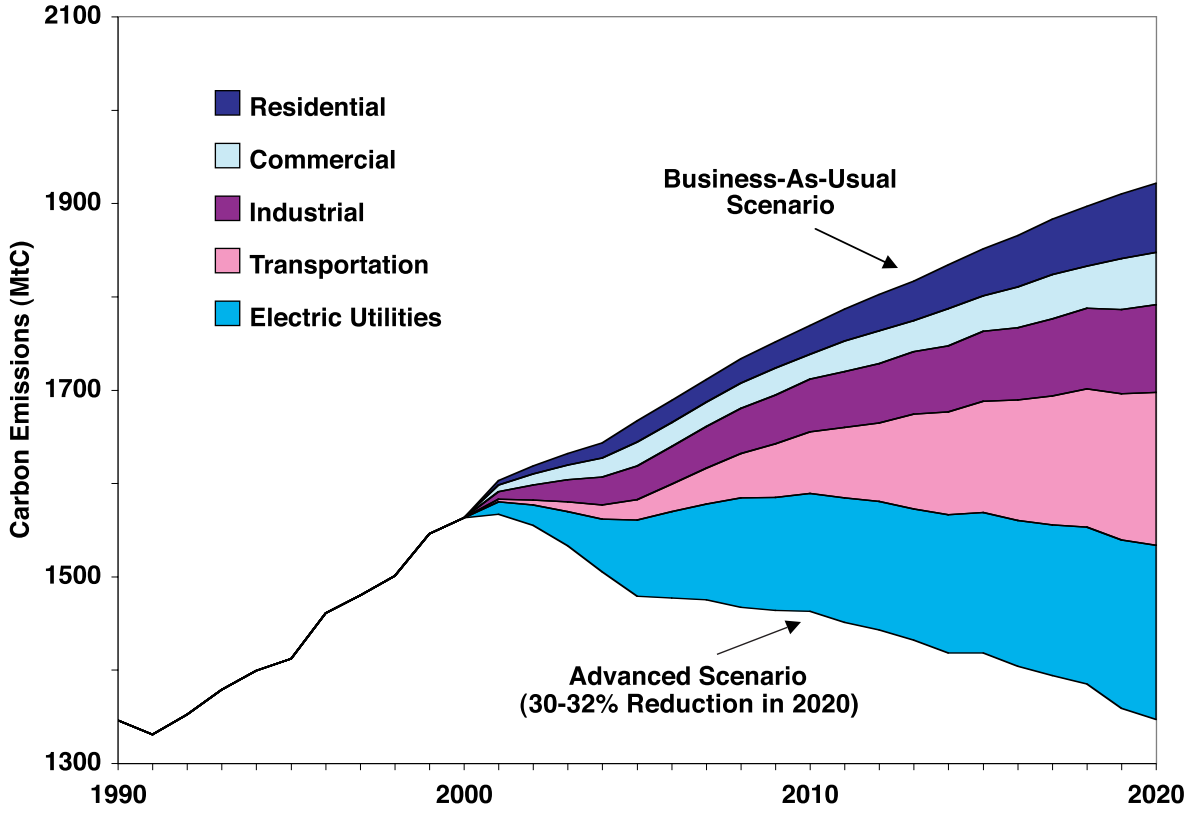
RESULTS: ENERGY USE



RESULTS: ENERGY SOURCES



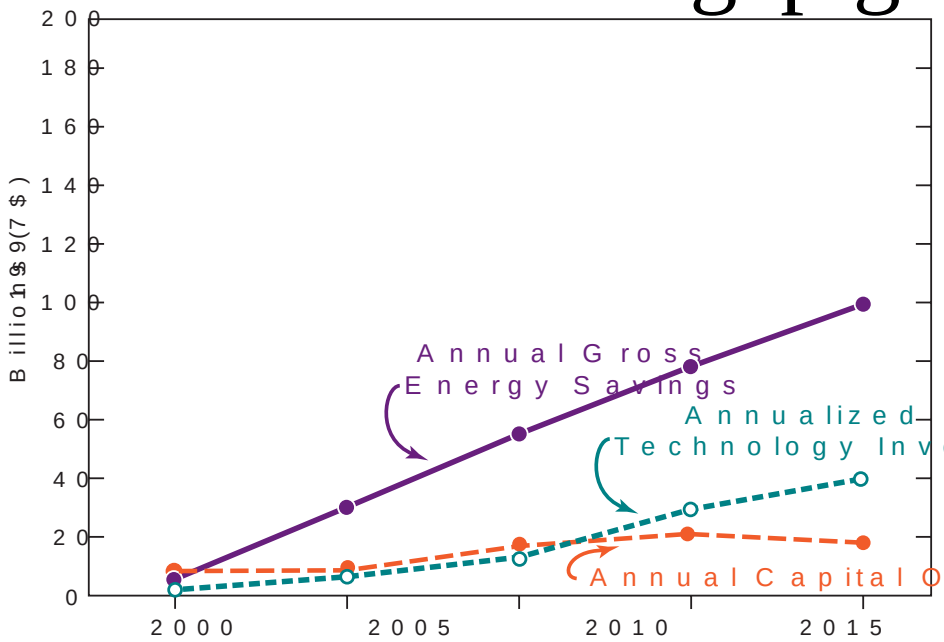
RESULTS: CARBON EMISSIONS



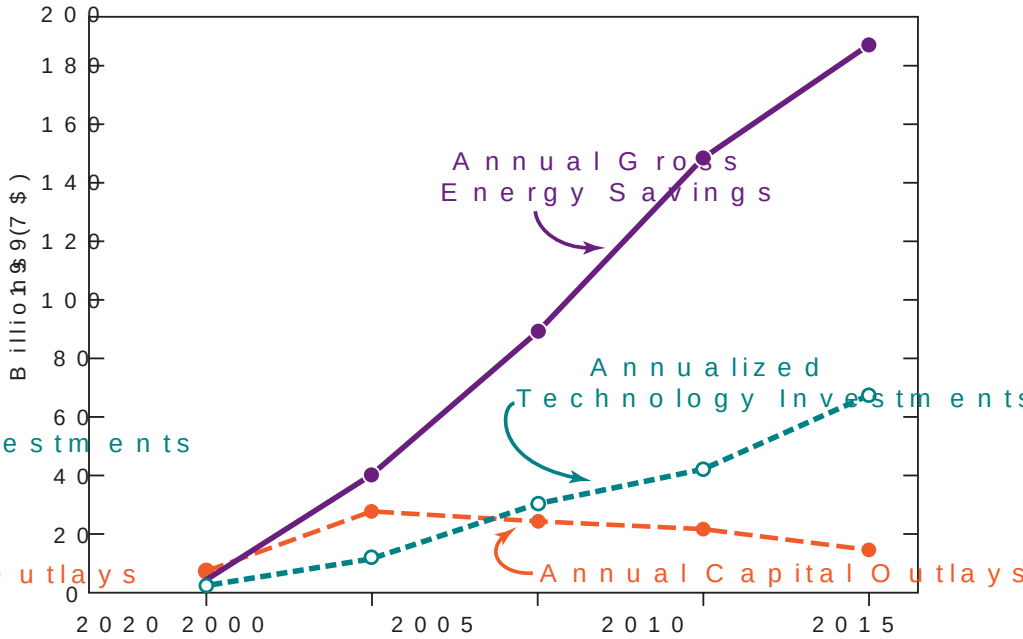
Need for R&D delays impacts on transportation, but by 2020 emission reductions are large.

Electric sector policies account for a third of the carbon reductions in the Advanced scenario.

THE ECONOMICS:
Energy bill savings exceed investment costs, and the gap grows over time.



Moderate Scenario



Advanced Scenario

RESULTS: DIRECT COSTS IN 2010

Moderate Scenario

(units: Billions US $/year)

Energy bill savings:	+$55
Investment costs:	-$11
Program costs:	-$ 4
Recycle of carbon permit revenues to public:	$ 0
Net direct savings:	**+$40**

Advanced Scenario

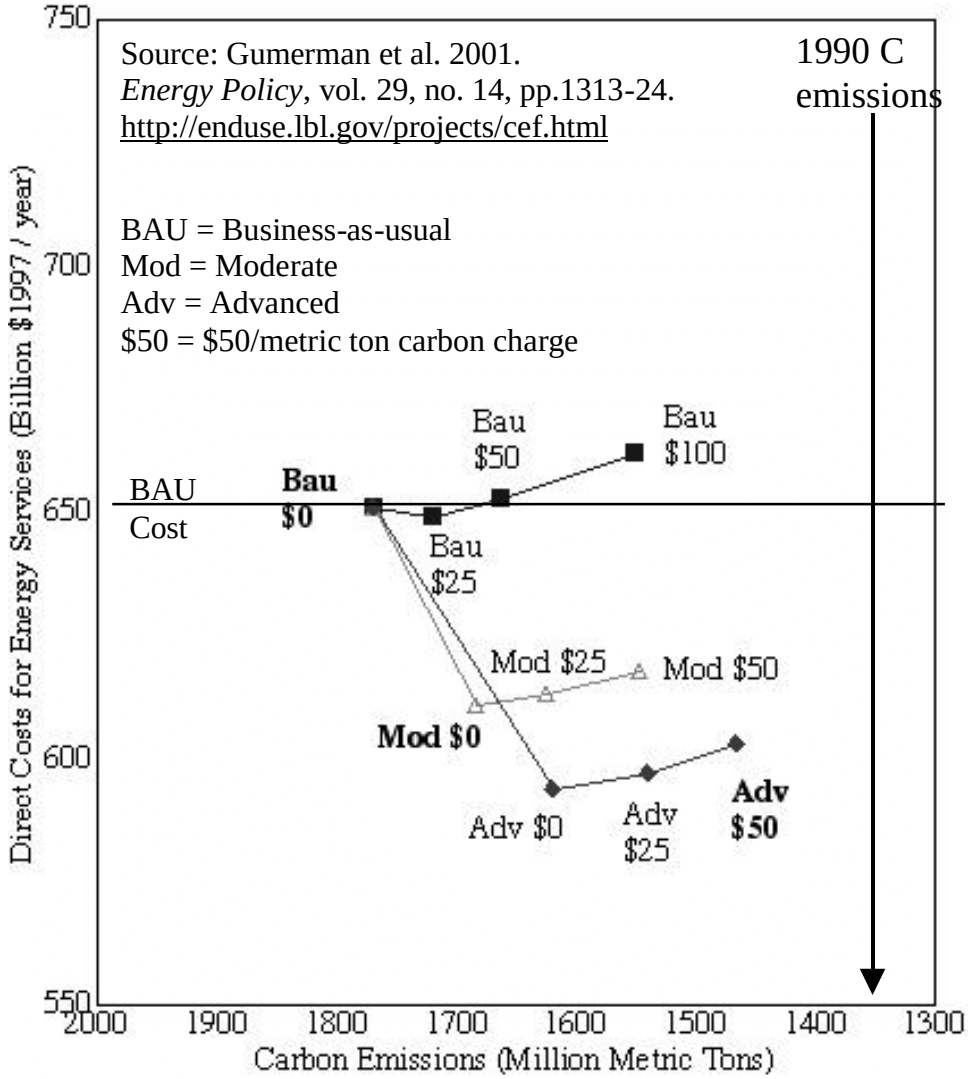
(units: Billions US $/year)

Gross energy bill savings:	$89
Carbon permit costs:	-$73
= Net energy bill savings:	+$16
Investment costs:	-$30
Program costs:	-$12
Recycle of carbon permit revenues to public:	+$73
Net direct savings:	**+$48**

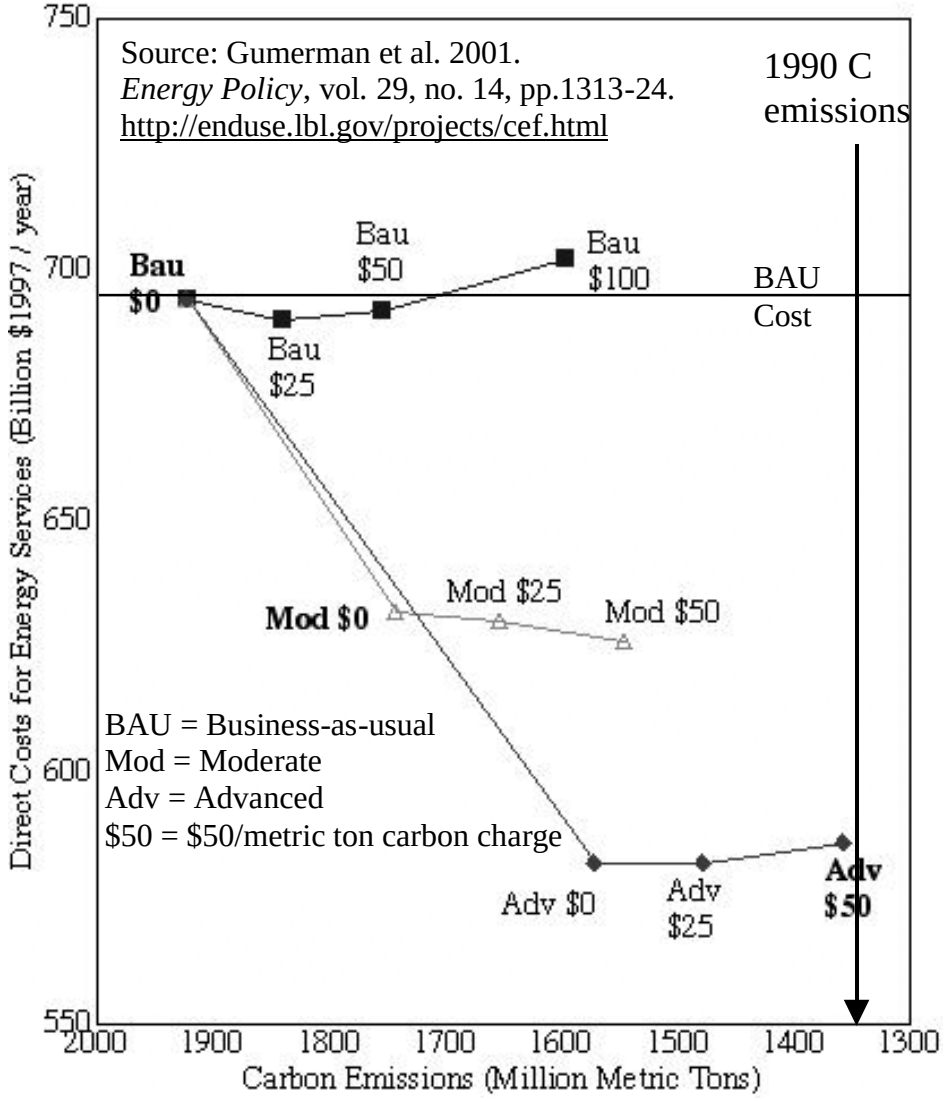
THE ECONOMICS

- Based on data from EMF 16 and worst case assumptions (no smart revenue recycling of advanced case carbon trading fees), indirect macroeconomic costs in the Advanced case in 2010 are in the same range as net direct benefits for a $50/tC carbon charge.
- Important transition impacts and dislocations could still be produced in the advanced case (e.g., reduced coal and railroad employment).
- "Green" industries could grow significantly (e.g., wind, agriculture, and energy efficiency).

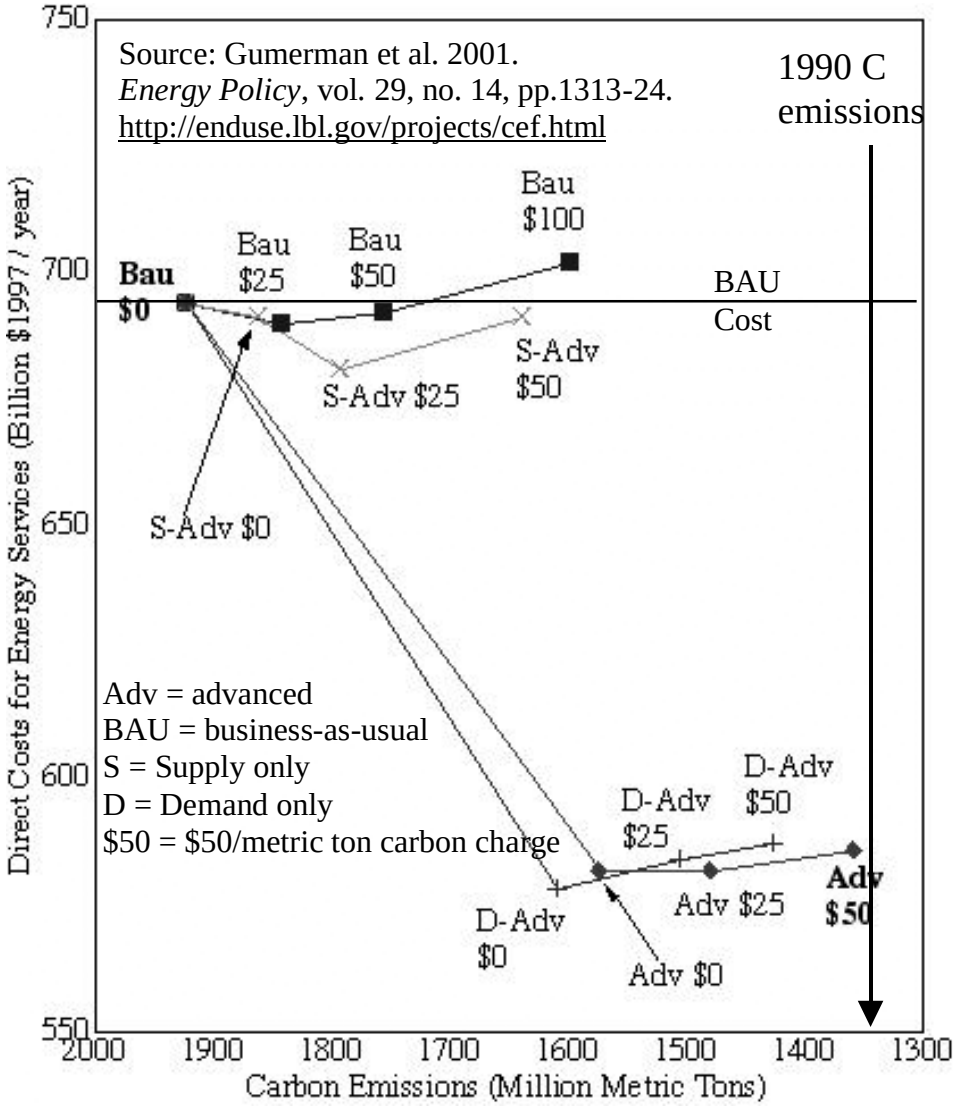
Direct costs vs. carbon emissions, 2010



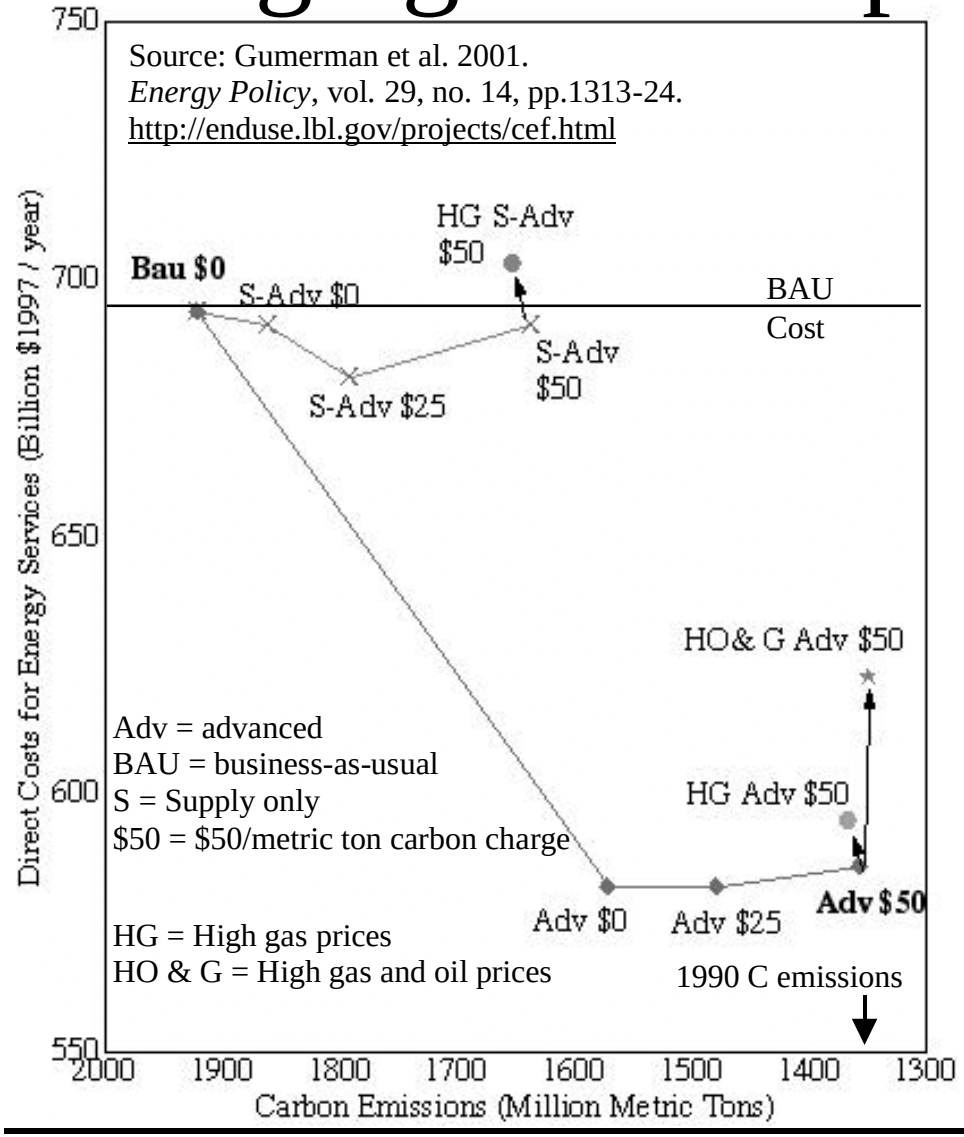
Direct costs vs. carbon emissions, 2020



Supply-side vs. demand-side, 2020



Effect of high gas & oil prices, 2020



CONCLUSIONS

- Smart public policies can significantly reduce not only carbon dioxide emissions, but also local air pollution, petroleum dependence, and inefficiencies in energy production and use.
- RD&D, voluntary programs, efficiency standards, and other non-price policies play a critical role in the realization of these scenarios.
- The overall economic benefits of these policies appear to be comparable to their overall costs in the Advanced case with a $50/t C charge in 2010.