U.S. DOE GPRA Benefits Process

Presented At:

International Energy Agency

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Energy Modeling at U.S. DOE

- Many models used at U.S. DOE (recent estimate of over 130 models)
- Use of MARKAL at U.S. DOE R&D policy decisions
  - Office of Policy and International Affairs
  - Applied R&D Programs (EERE, FE, NE & OE) – GPRA
  - Office of Nuclear Energy – GNEP
  - Energy-Water Nexus
- Government Performance and Reporting Act (GPRA) Benefits Process
  - Prospective benefit estimates based on stated program output goals that are achievable with current funding levels.
  - For the budget, benefits are counted for only future program activities.
  - No new policies (other than planned RD&D)
  - Benefits analysis is conducted annually and is incorporated in budget submissions to the Office of Management and Budget (OMB) and Congress.

Using Benefits Analysis to Inform the Budget Process

- Integrated benefits analysis provides a framework for:
  - Understanding how DOE R&D technologies interact with each other as well as compete with expected improvements to existing technologies.
  - Understand the implications of supply, demand and substitution and physical constraints in the energy system and capital stock turnover.
  - Alternative scenarios can be easily constructed to look at benefits of R&D portfolios under alternative conditions.
- The more we understand future markets, the better we can tailor technology R&D and deployment efforts for success.
  - Select R&D portfolio mix that achieves results
  - Align portfolio with evolving needs
  - Adapt to future market and public policy uncertainties

Two Models, Three Scenarios & Many Technology Cases

- 2 Integrated Energy Models
  - NEMS – 2007 to 2030
  - MARKAL – 2007 to 2050
- Business-as-Usual (BAU) Scenario
  - Based on EIA's 2006 Annual Energy Outlook Projection (AEO2006)
  - Provides baseline technology improvement assumptions with some modifications
- Carbon Constraint Scenario
  - Based loosely on the high control (lower PPM) side of the CCSP envelope
  - By 2020: 1607 mmtce, by 2030: 1445 mmtce, by 2050: 1200 mmtce
- High Fuels Prices Scenario
  - Based on the AEO2006 high price case
- Technology Cases run for each scenario
  - Base "no DOE R&D" Case
  - Individual R&D goal cases for each DOE R&D Program
  - DOE R&D Portfolio Case

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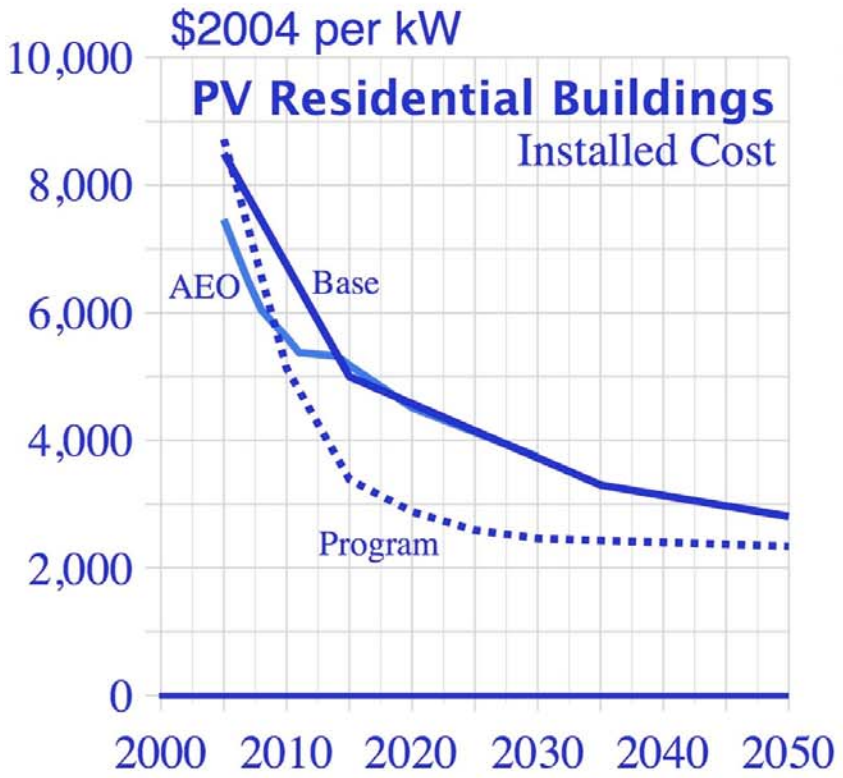
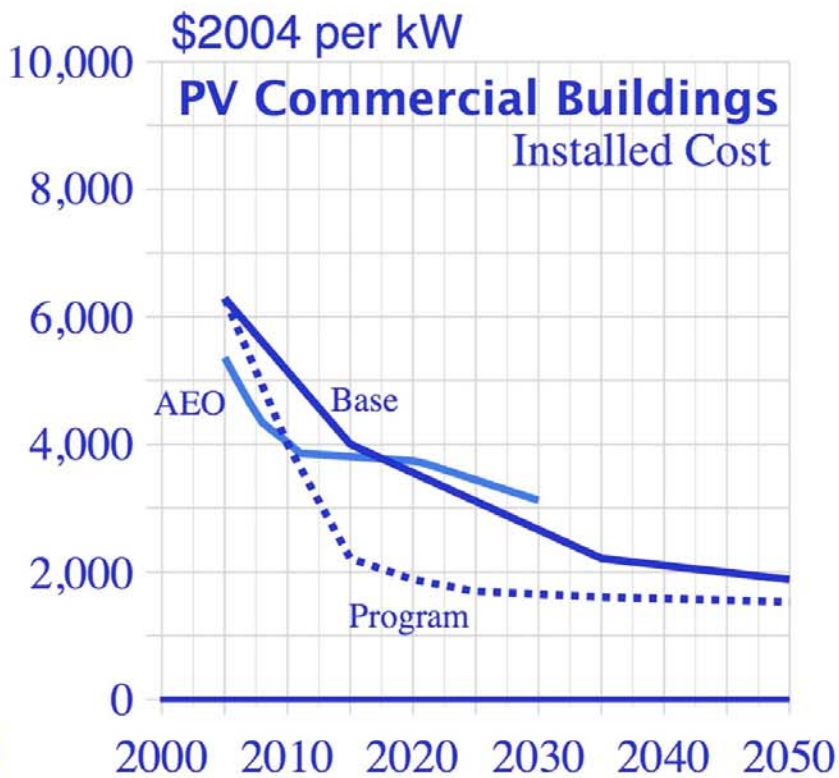
Solar Program GPRA Inputs - PV

- PV costs are assumed to decline significantly in the Base Case. The Solar Program R&D accelerates this cost decline.

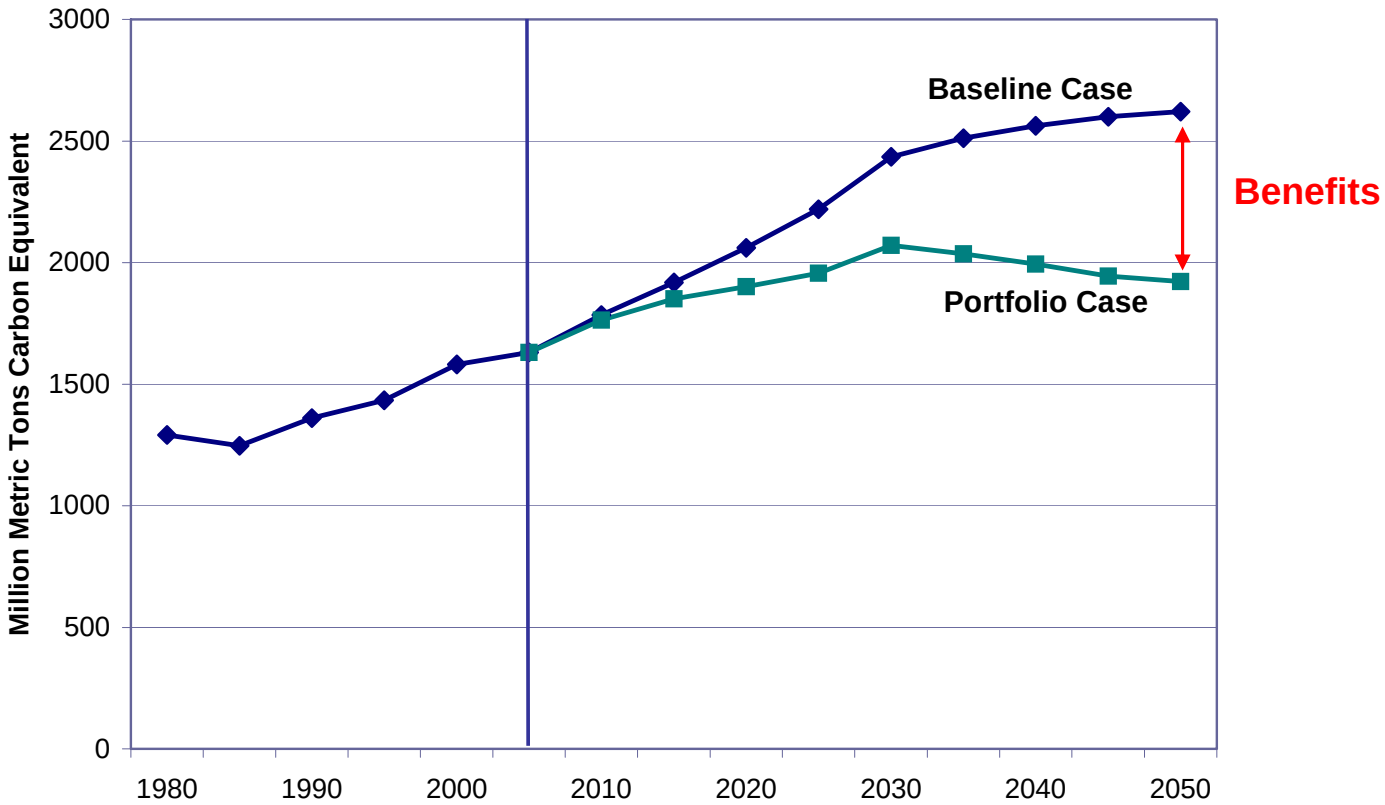




Source: John Sheehan, NREL

GPRA Benefits Estimation

- Benefits are measured by the difference in projections *with* and *without* the R&D programs.



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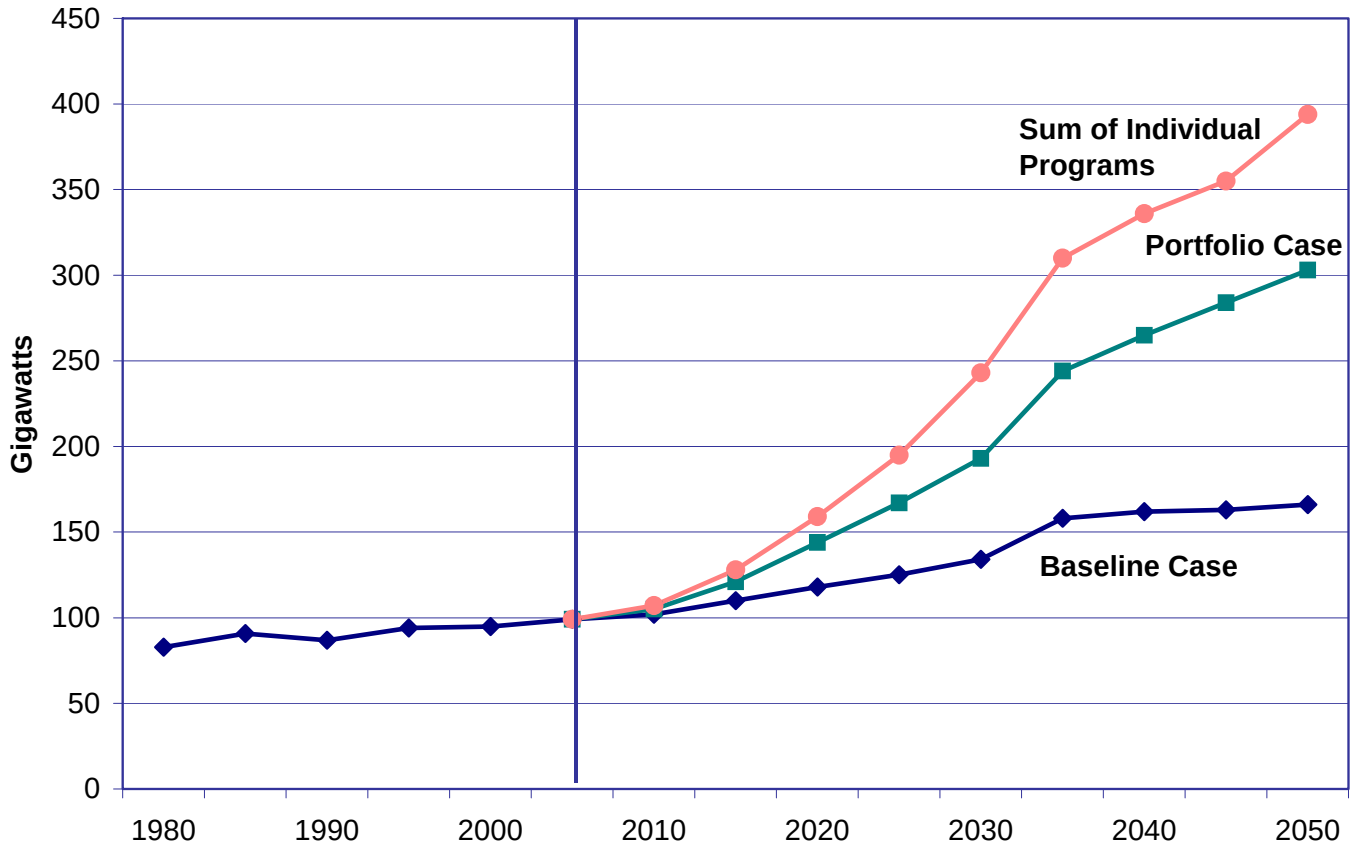
Portfolio Effects

- The portfolio impact is not always the same as the sum of individual programs.



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FY2008 GPRA BAU Scenario Results
EERE RD&D Portfolio

	MID-TERM BENEFITS					LONG-TERM BENEFITS			
Metric	2010	2015	2020	2025	2030	2035	2040	2045	2050
ECONOMIC BENEFITS ("AFFORDABLE")									
Reduction in Average Delivered Natural Gas Price (Percent)	1%	0%	3%	5%	2%	5%	10%	16%	12%
Energy System Cost Savings (bil 2004$) 1/	nr	nr	nr	nr	nr	$120	$146	$173	$203
Consumer Savings, Annual (bil 2004$)	4	12	43	86	110	232	322	385	381
Consumer Savings, NPV (bil 2004$) 2/	6	46	148	359	632	1,518	2,088	2,707	3,278
Electric Power Industry Savings, Annual (bil 2004$) 3/	1	5	13	21	26	51	63	77	69
Electric Power Industry Savings, NPV (bil 2004$) 2/ 3/	2	18	54	110	174	419	536	658	766
Reduction in Fraction of Household Income Spent on Energy	0.3%	0.7%	2.0%	3.6%	4.8%	8%	9%	10%	10%
Reduced Energy Intensity of Economy (Percent)	0.3%	1.7%	3.9%	6.1%	7.8%	10%	13%	15%	17%
ENVIRONMENTAL BENEFITS ("CLEAN")									
Avoided Greenhouse Gas Emissions, Annual (MMTCE/year)	6	33	101	165	219	447	508	539	505
Avoided Greenhouse Gas Emissions, Cumulative (MMTCE) 5/	12	116	470	1158	2136	4630	7047	9680	12276
Reduced Cost of Criteria Pollutant Control, NPV (bil 2004$) 2/	0	1	3	9	13	nr	nr	nr	nr
SECURITY BENEFITS ("RELIABLE")									
Avoided Oil Imports, Annual (mbpd)	ns	0.2	0.6	1.2	2.1	5.3	6.9	7.1	6.8
Avoided Oil imports, Cumulative (bil barrels) 4/ 5/	ns	0.3	1.0	2.8	6.1	17	28	41	54
Security Fuel Economy Improvement (MPG of Crude Oil)	0.1	0.5	1.3	2.8	5.3	23	38	51	64
Improved Transportation Fuel Diversity (percent) 6/	ns	ns	4%	10%	24%	82%	86%	67%	42%
Reduced Oil Intensity of the Economy (percent)	0.2%	1%	3%	6%	9%	26%	32%	33%	33%

Source: John Sheehan, NREL

For more information please go to http://www1.eere.energy.gov/ba/pba/gpra.html

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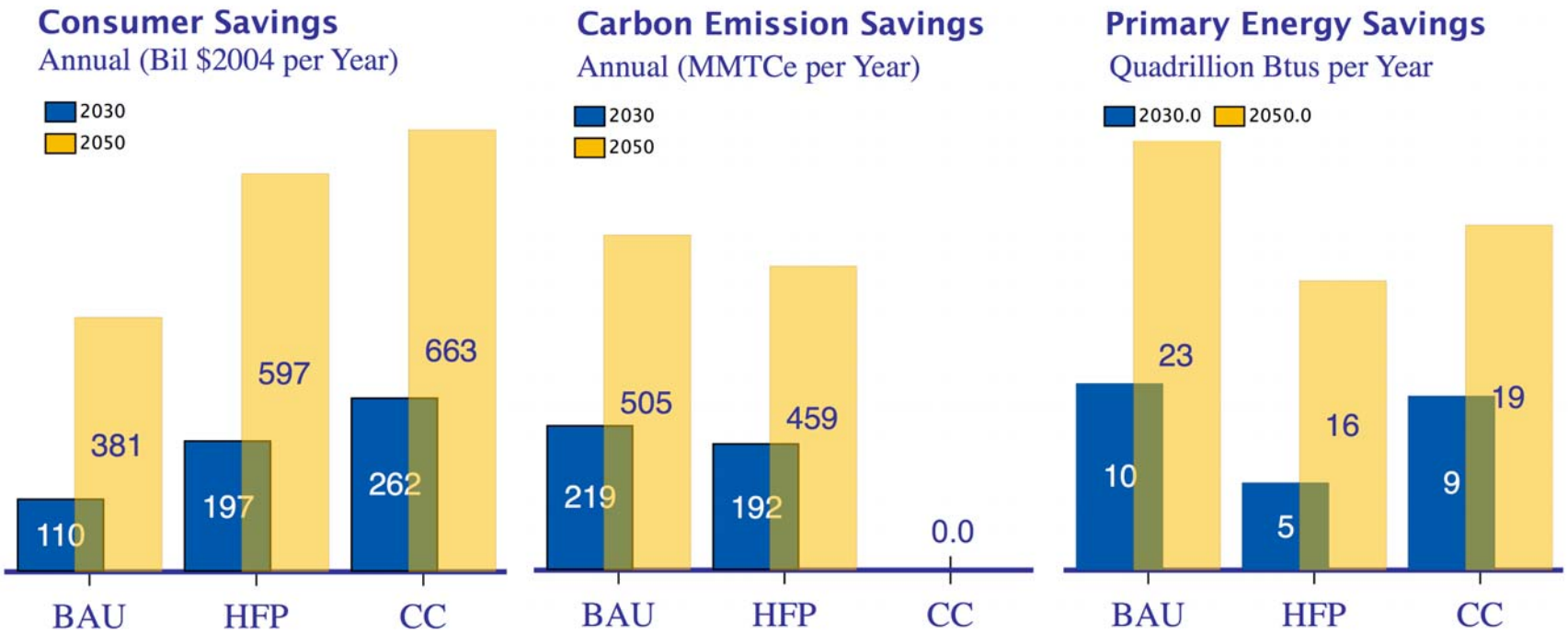
Selected FY2008 GPRA Scenario Results

EERE RD&D Portfolio

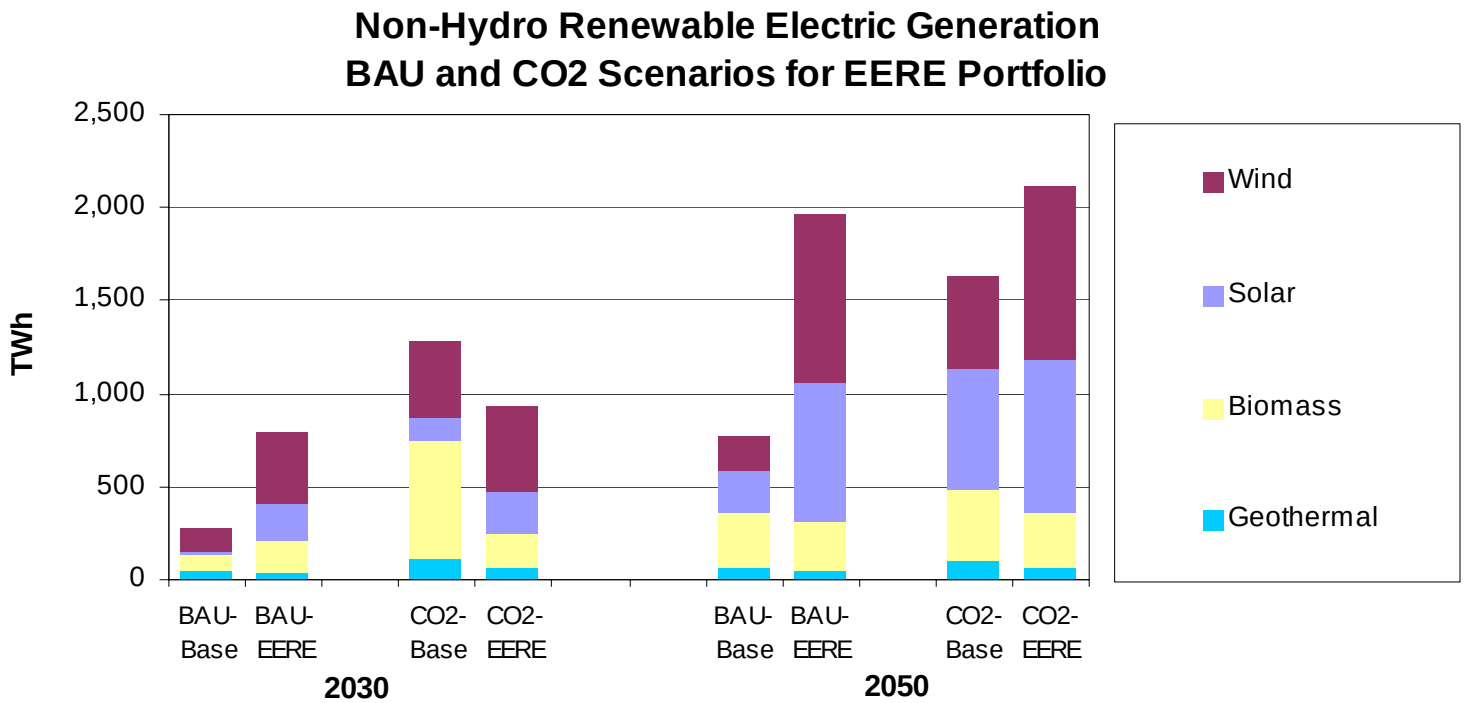
- The High Fuels and Carbon Scenario results may show lower benefits than the BAU Scenario for many metrics. However, we generally see increase in the economic metrics.
- Reduction in energy and carbon savings is due to increased penetration of renewables and more efficient end-use technologies in the Base Case.



Source: John Sheehan, NREL

Impacts of Carbon Scenario on Non-Hydro Renewable Electric Generation

- Baseline renewable technologies show greater penetration in the Carbon and High Fuels Scenarios than in the BAU Scenario.
- While the Program technologies also show greater penetration in the Carbon and High Fuels Scenarios, the increment over the respective Base Cases is generally smaller.



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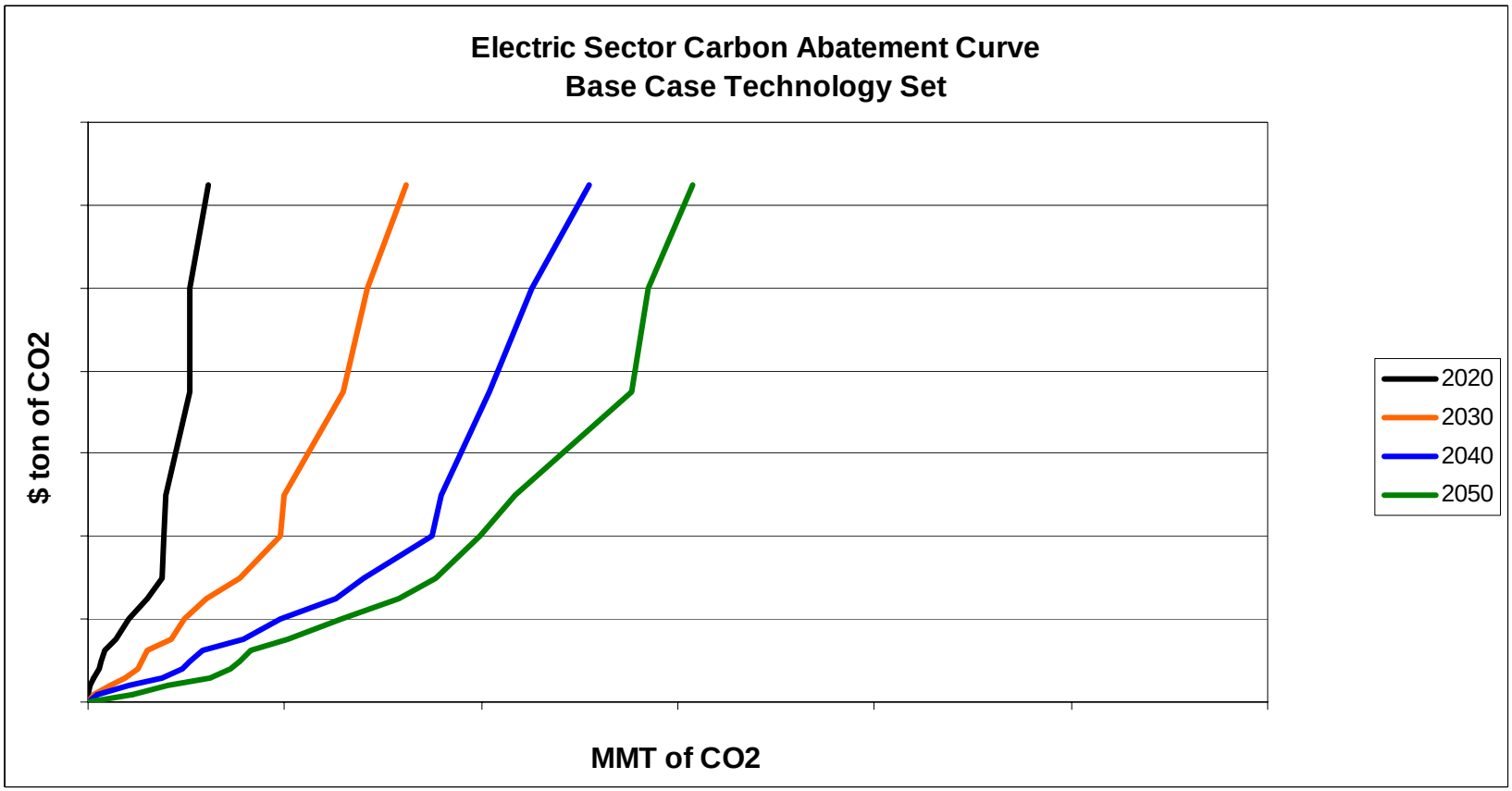
Carbon Abatement Curves Over Time



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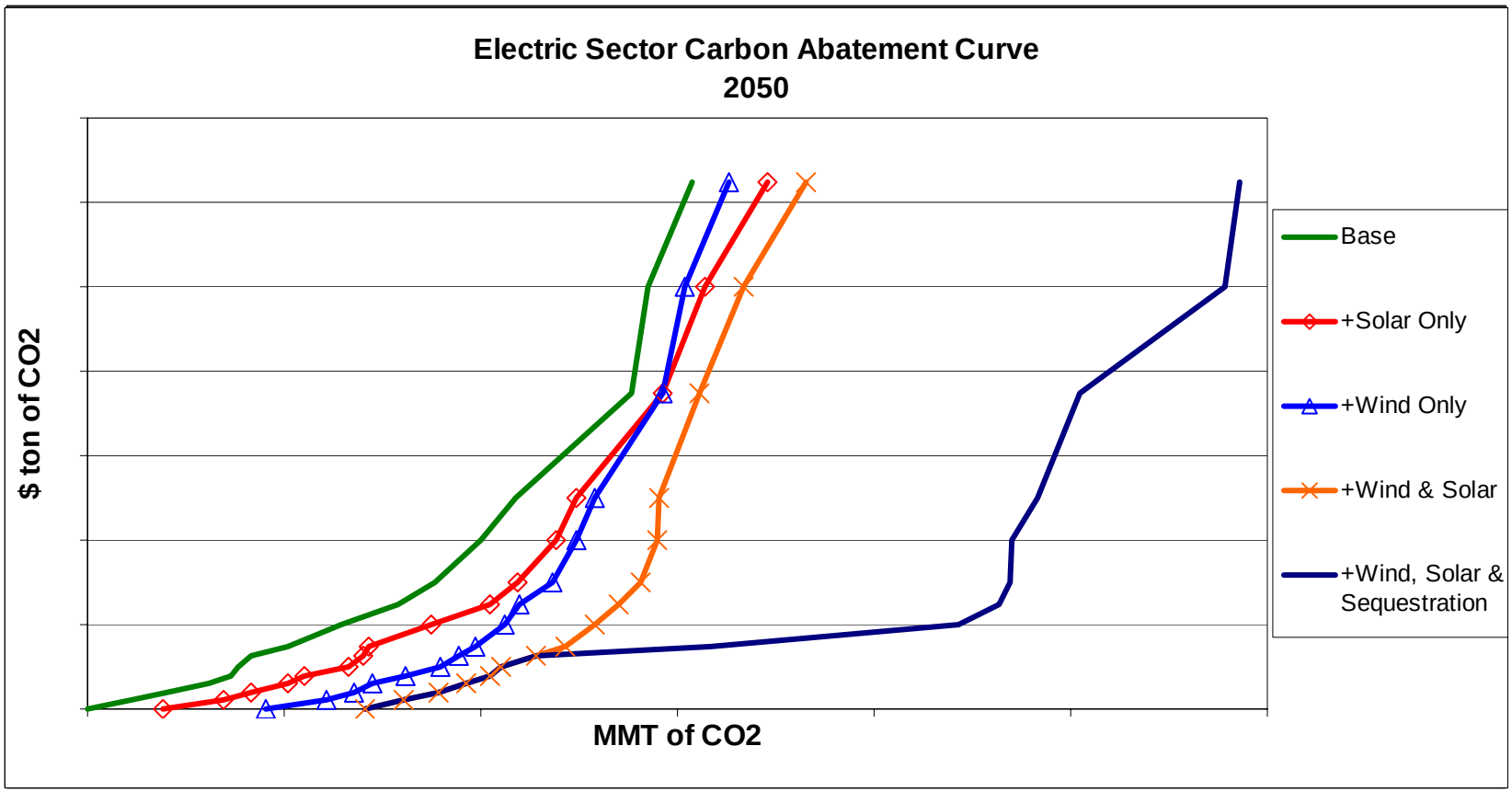
Effect of Technology R&D on Carbon Abatement Curves



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Planned Improvements to the GPRA Benefits Process

- Incorporate R&D risk
  - The results of Program R&D are uncertain.
  - Evaluating R&D risk is necessary in order to compare benefits between R&D Programs.

- Use sensitivity analysis to provide more insight to decision makers about the impacts of technology R&D on the energy system
  - Evaluate the impacts of changes in fuel prices, technology costs and performance characteristics on technology penetration and GPRA metrics.

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