

2007
Summer
Seminar

The Power to Reduce CO₂ Emissions

The Full Portfolio

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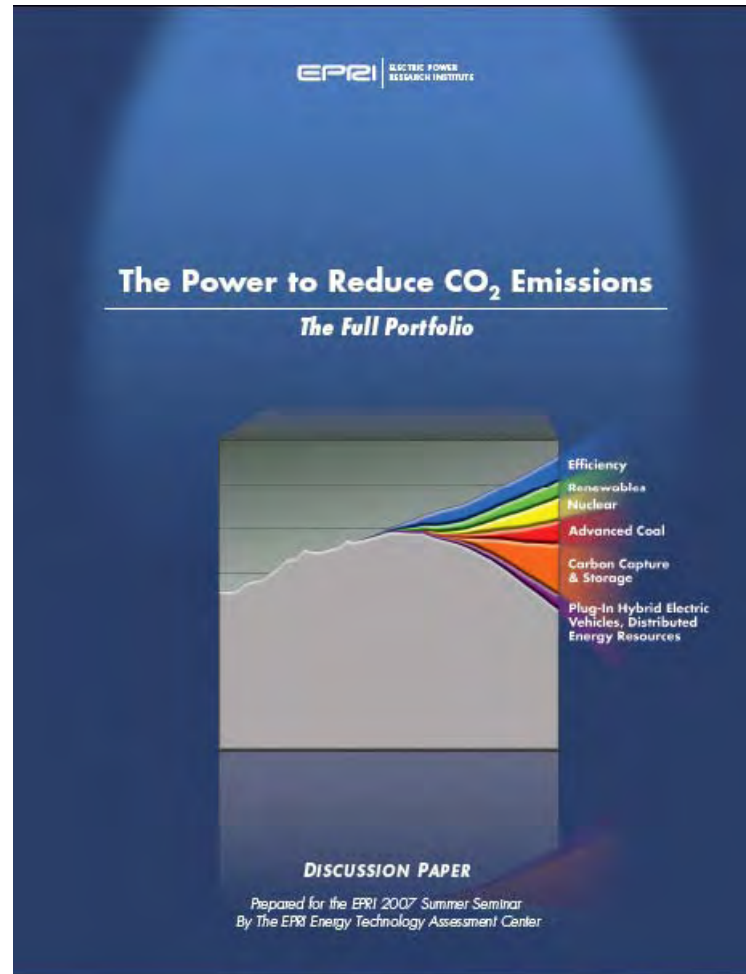
ASERTTI Fall Meeting

October 25, 2007

EPRI Objective...Provide a Framework

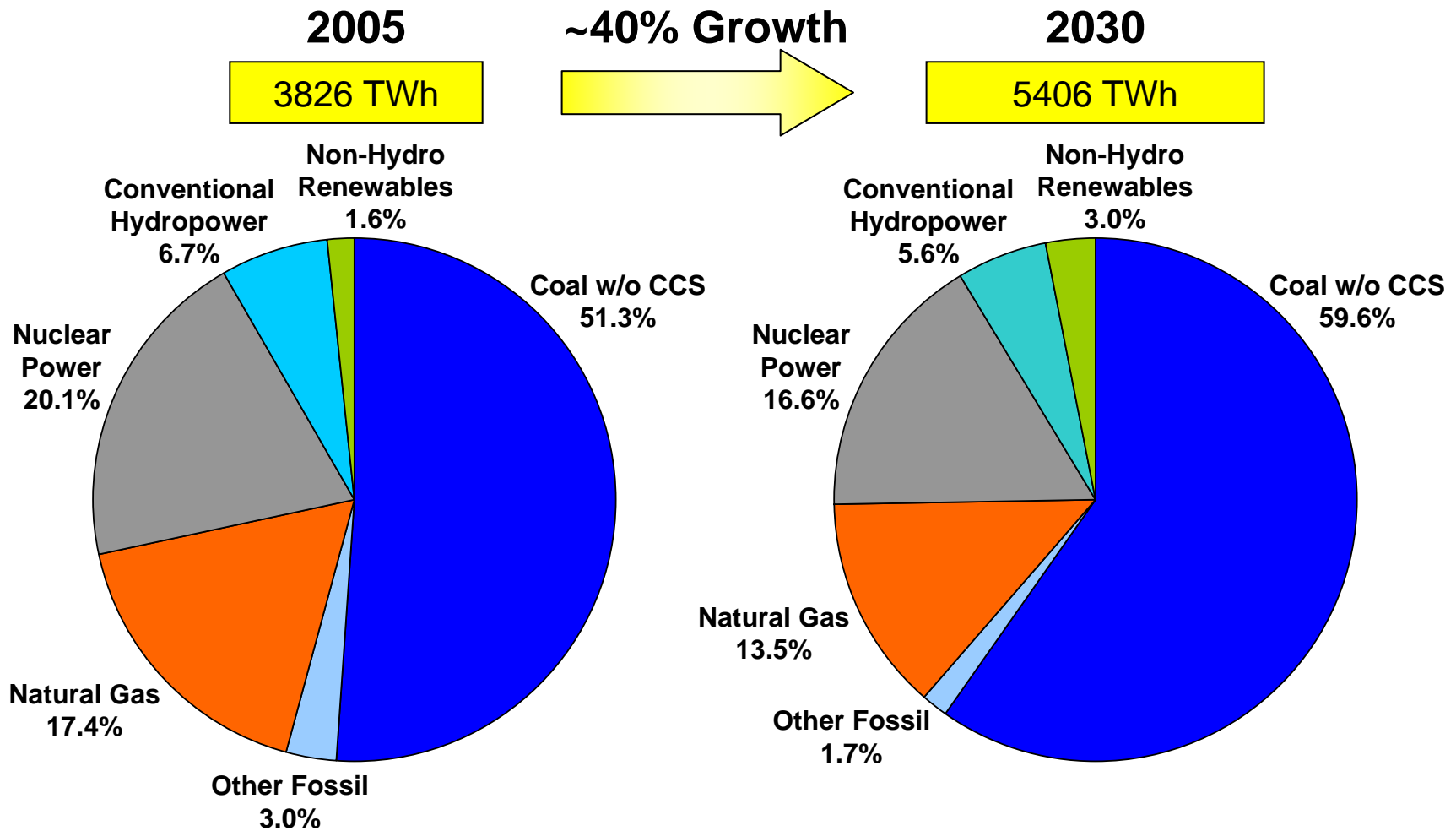
- PRISM Technology Assessment
- MERGE Economic Assessment
- Key Technology Challenges

2007 EPRI Summer Seminar Discussion Paper



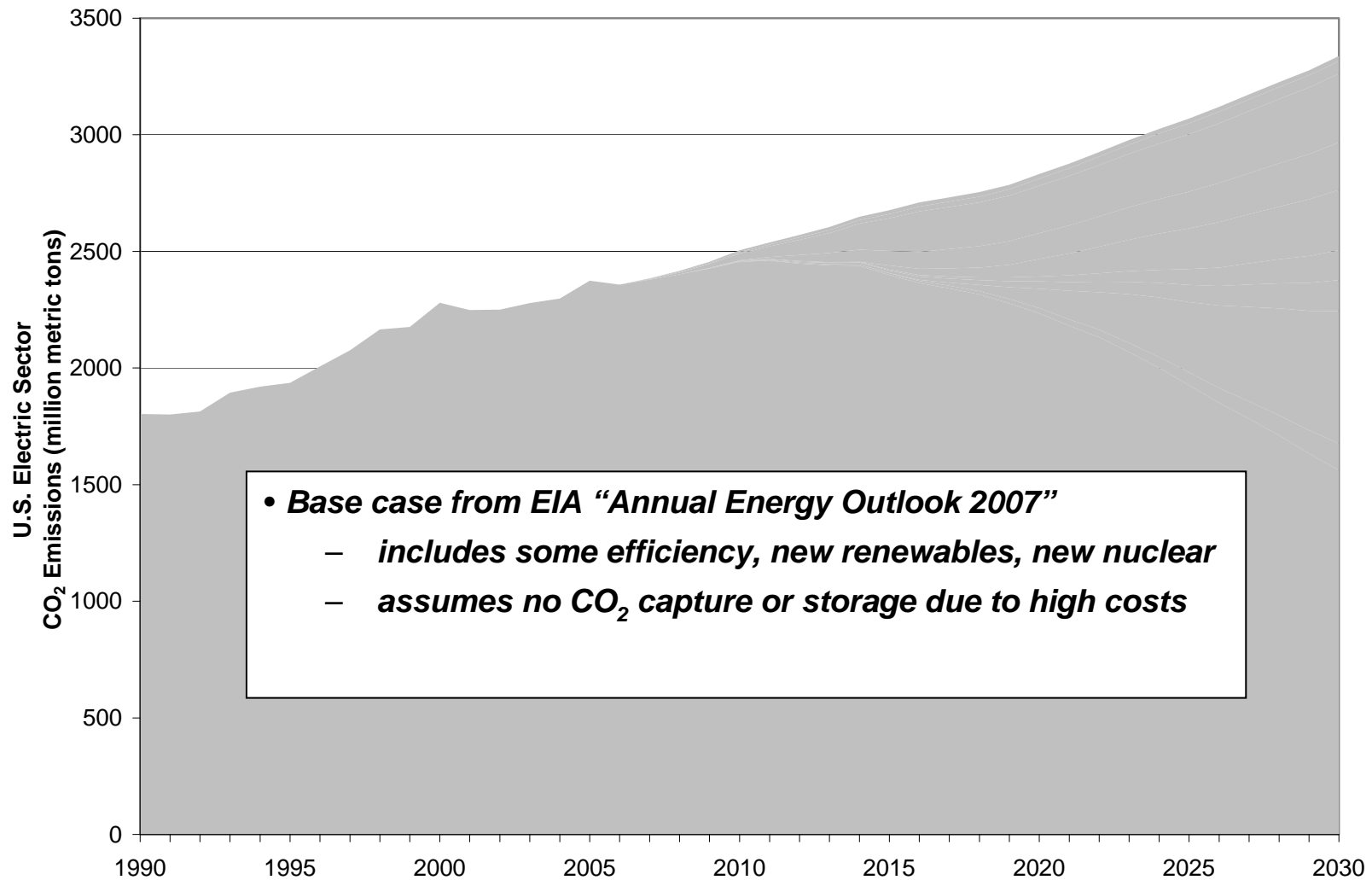
Available on www.epri.com

U.S. Electricity Generation Forecast*



* Base case from EIA "Annual Energy Outlook 2007"

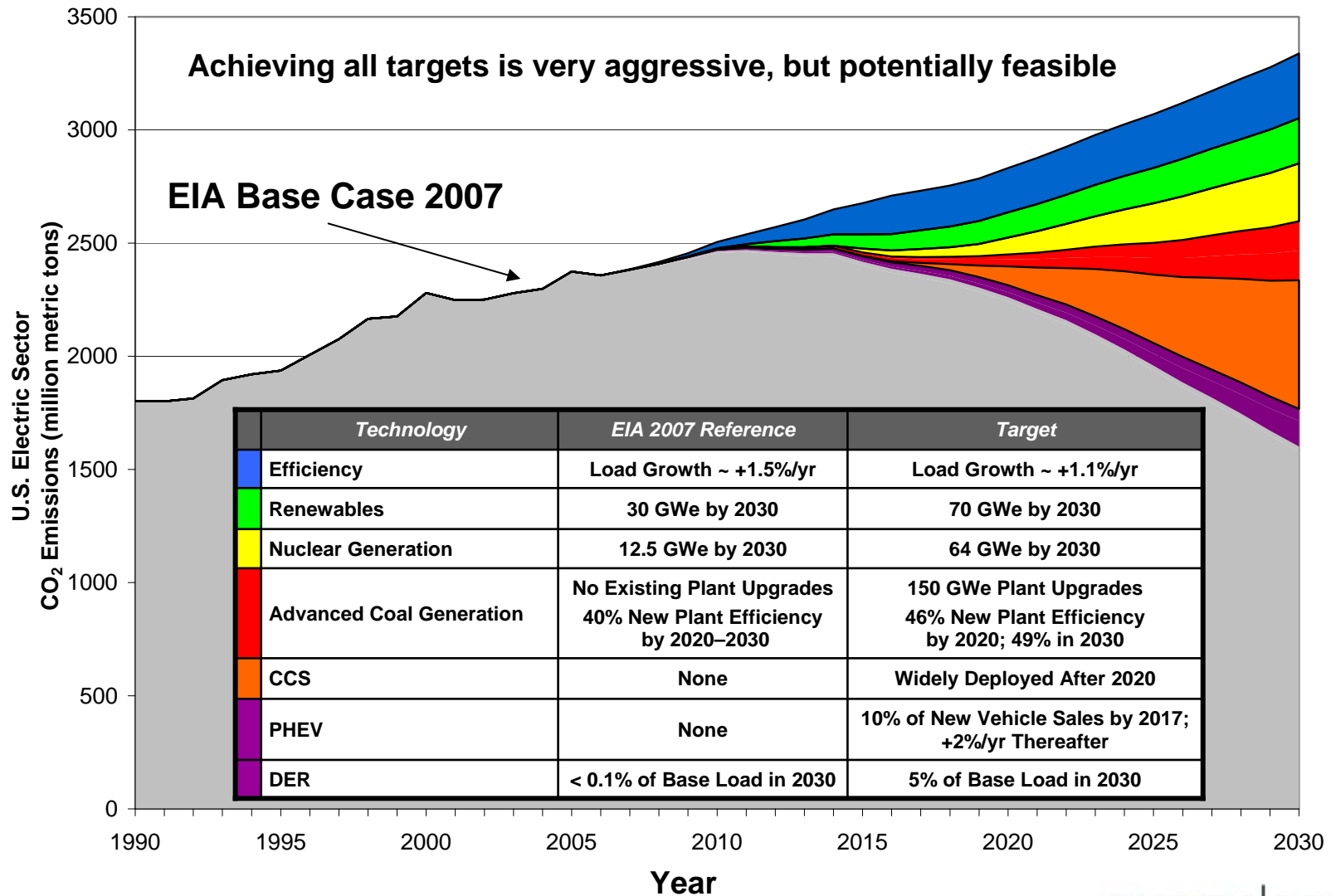
Forecasted U.S. Electricity Sector CO₂ Emissions



PRISM Analysis Targets

Technology	EIA 2007 Base Case	PRISM Analysis Target*
Efficiency	Load Growth ~ +1.5%/yr	Load Growth ~ +1.1%/yr
Renewables	30 GWe by 2030	70 GWe by 2030
Nuclear Generation	12.5 GWe by 2030	64 GWe by 2030
Advanced Coal Generation	No Existing Plant Upgrades 40% New Plant Efficiency by 2020–2030	150 GWe Plant Upgrades 46% New Plant Efficiency by 2020; 49% in 2030
Carbon Capture and Storage (CCS)	None	Widely Available and Deployed After 2020
Plug-in Hybrid Electric Vehicles (PHEV)	None	10% of New Vehicle Sales by 2017; +2%/yr Thereafter
Distributed Energy Resources (DER) (including distributed solar)	< 0.1% of Base Load in 2030	5% of Base Load in 2030

EPRI CO₂ PRISM



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- **MERGE Economic Assessment**
- Key Technology Challenges

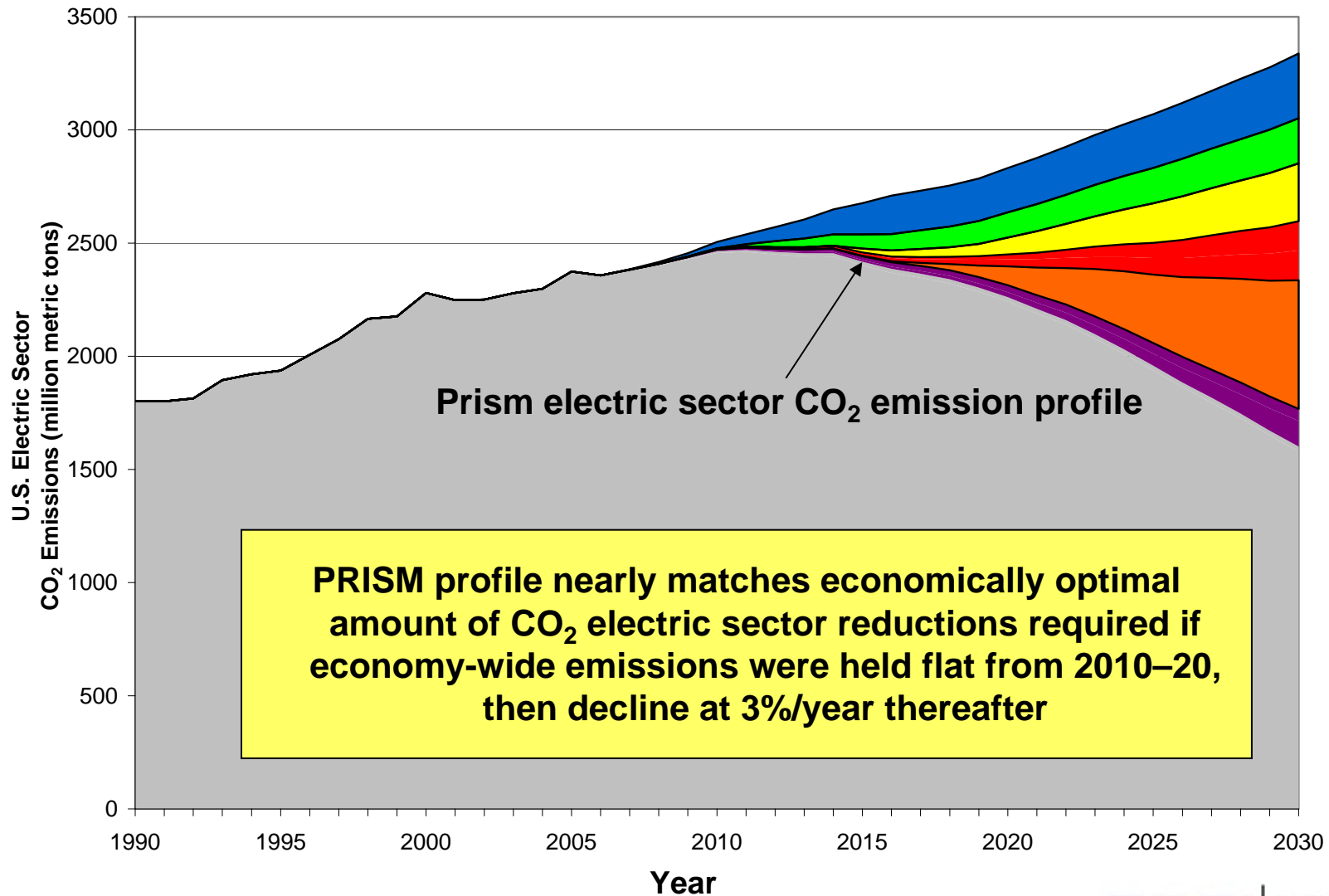
Economic Assessment

EPRI Economic Analysis Model (MERGE)

- Economy-wide analysis of economic growth using a general equilibrium macro-economic model
- MERGE seeks lowest-cost technology mix able to meet specified emissions requirement

One of three models used by U.S. Climate Change Science Program and in many international and domestic studies.

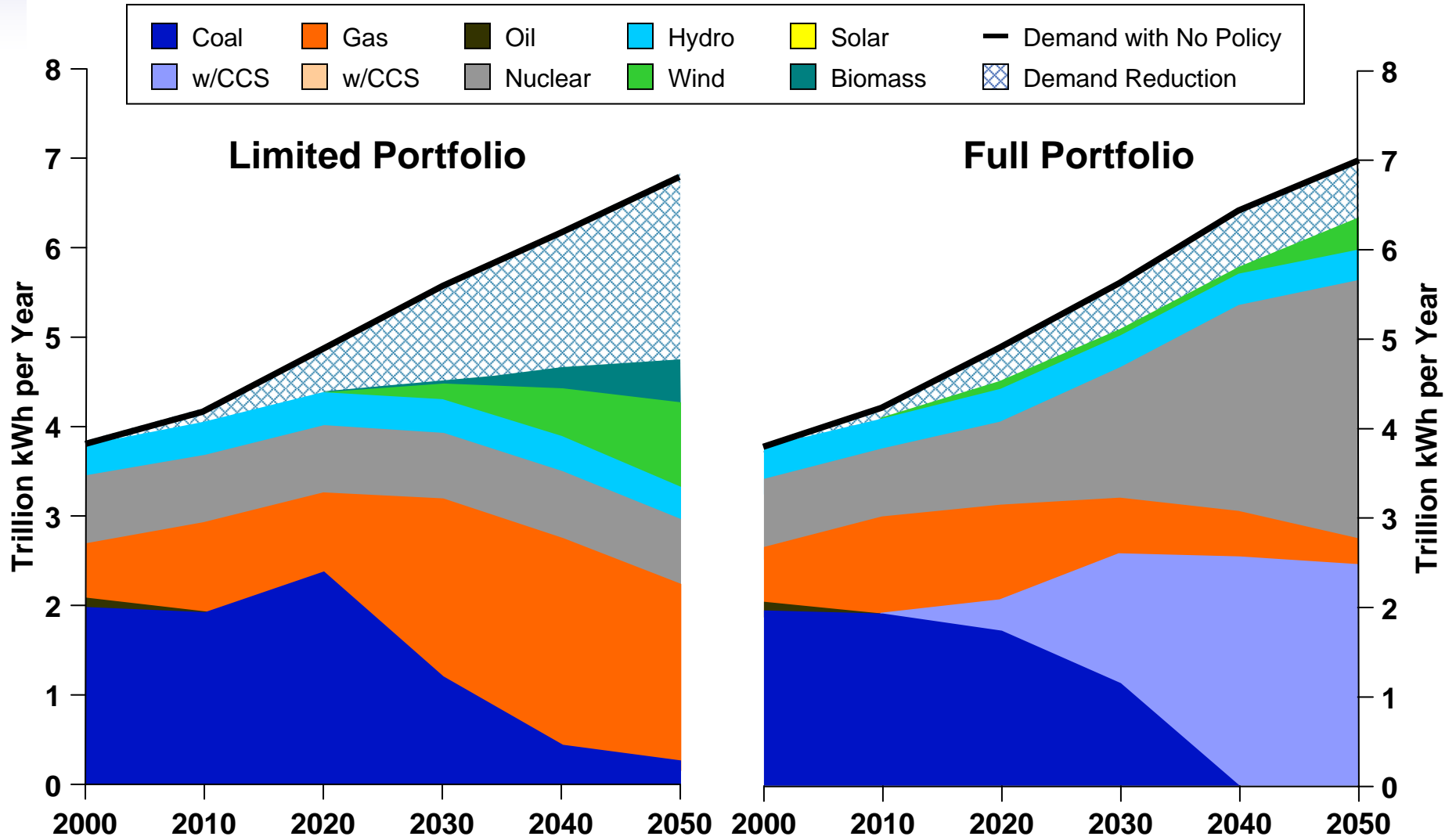
Assumed Economy-Wide CO₂ Constraint



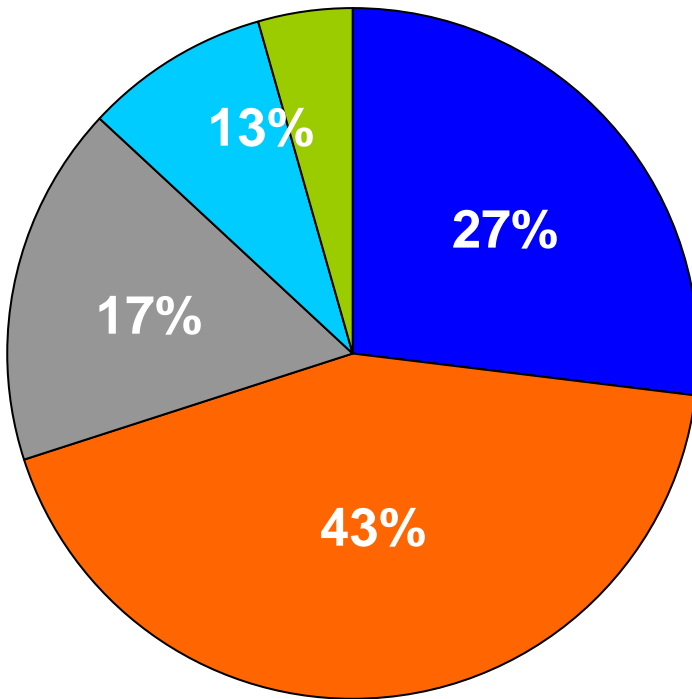
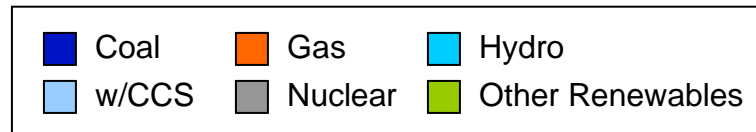
Electricity Technology Scenarios

	Limited Portfolio	Full Portfolio
Supply-Side		
Carbon Capture and Storage (CCS)	Unavailable	Available
New Nuclear	Existing Production Levels	Production Can Expand
Renewables	Costs Decline	Costs Decline Faster
New Coal and Gas	Improvements	Improvements
Demand-Side		
Plug-in Hybrid Electric Vehicles (PHEV)	Unavailable	Available
End-Use Efficiency	Improvements	Accelerated Improvements

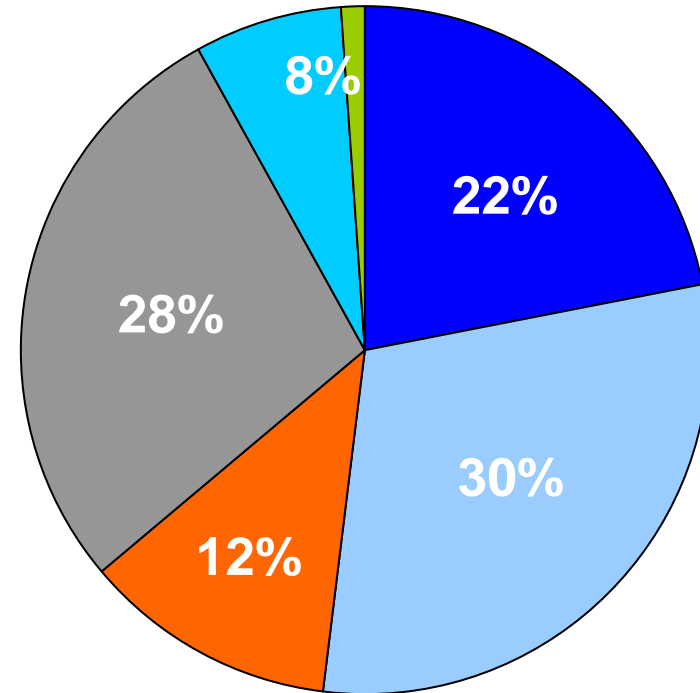
U.S. Electric Generation Deployment



Comparison of U.S. Electric Generation in 2030

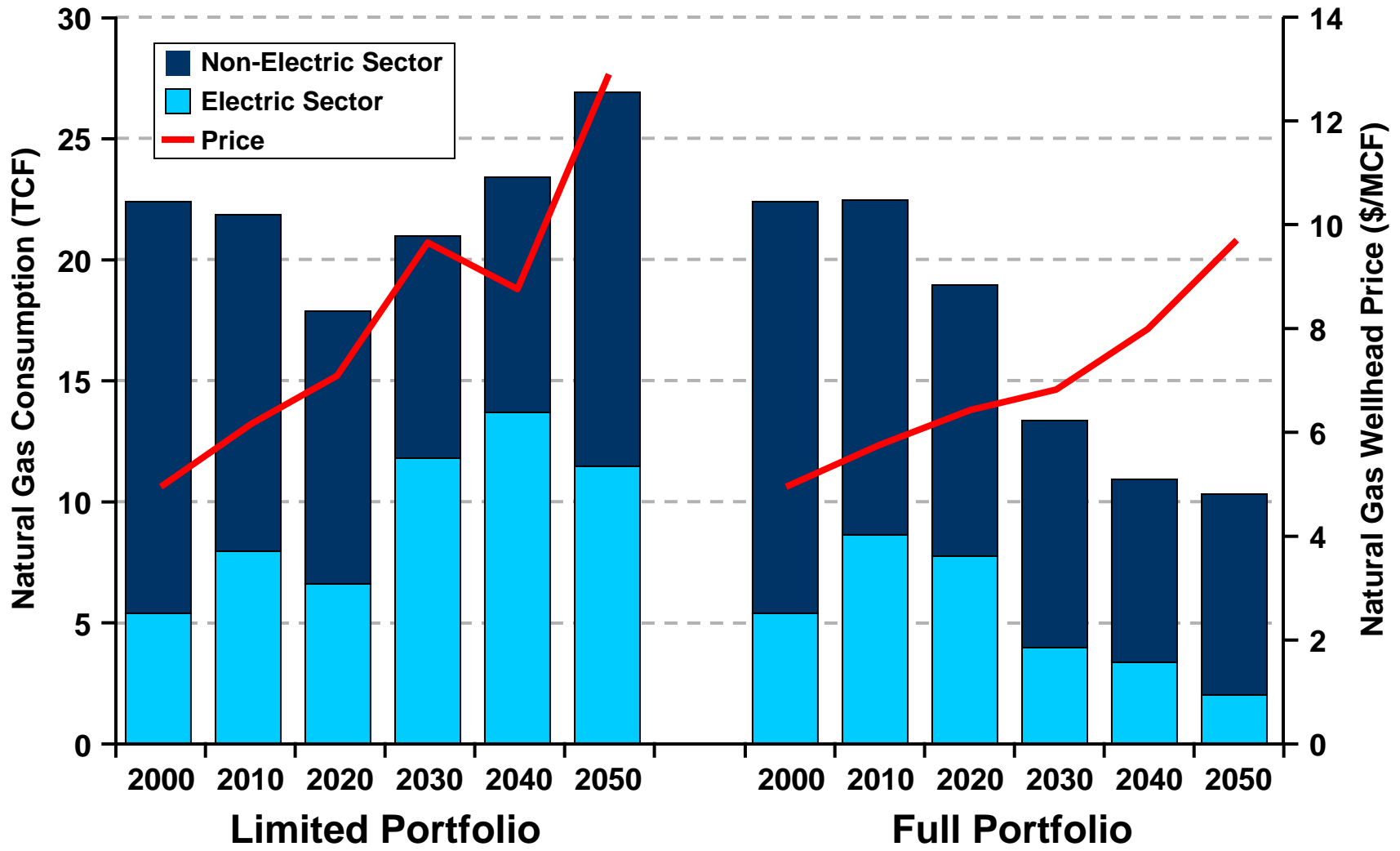


Limited Portfolio
Total: 4,500 TWh

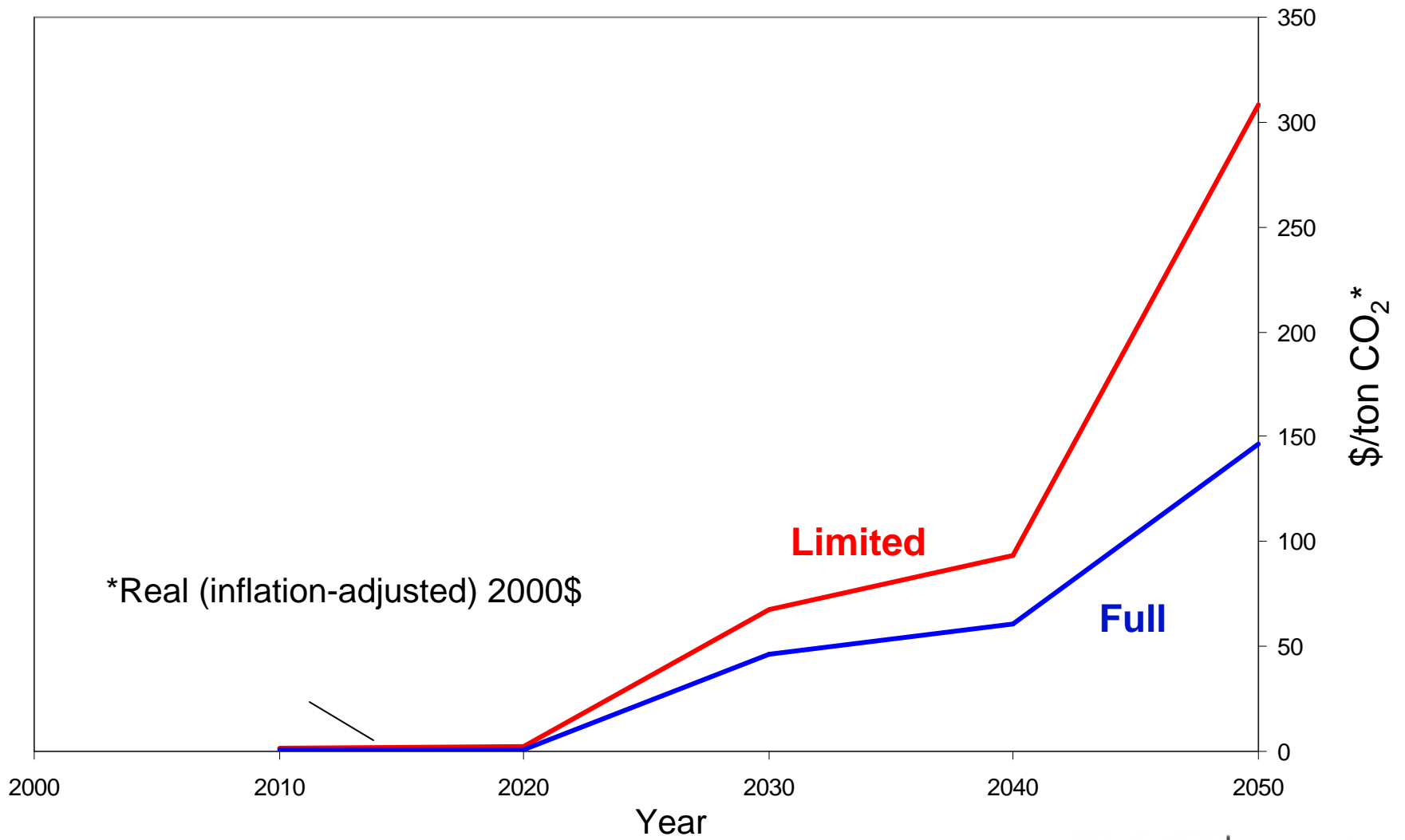


Full Portfolio
Total: 5,125 TWh

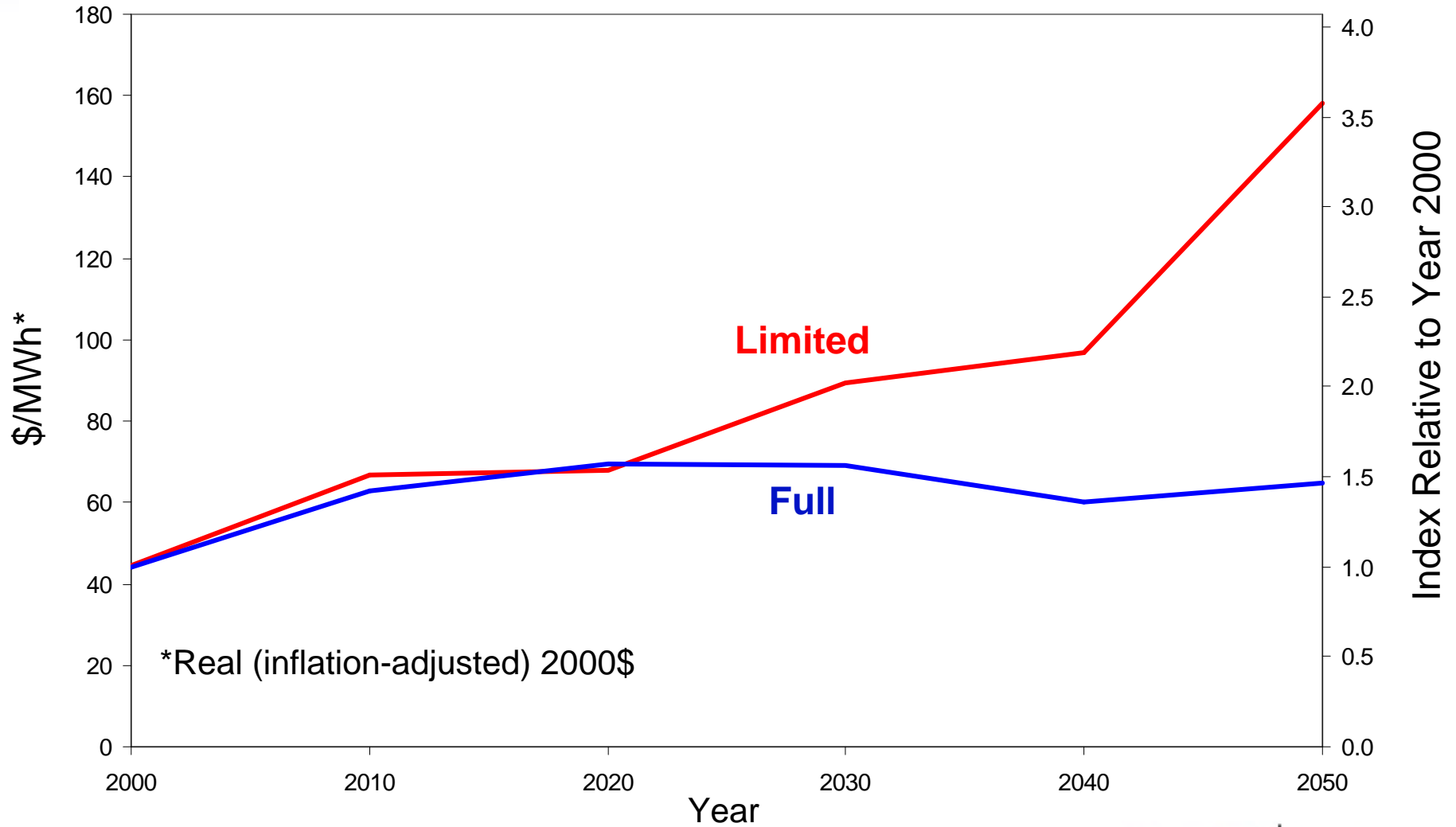
U.S. Natural Gas Use and Price



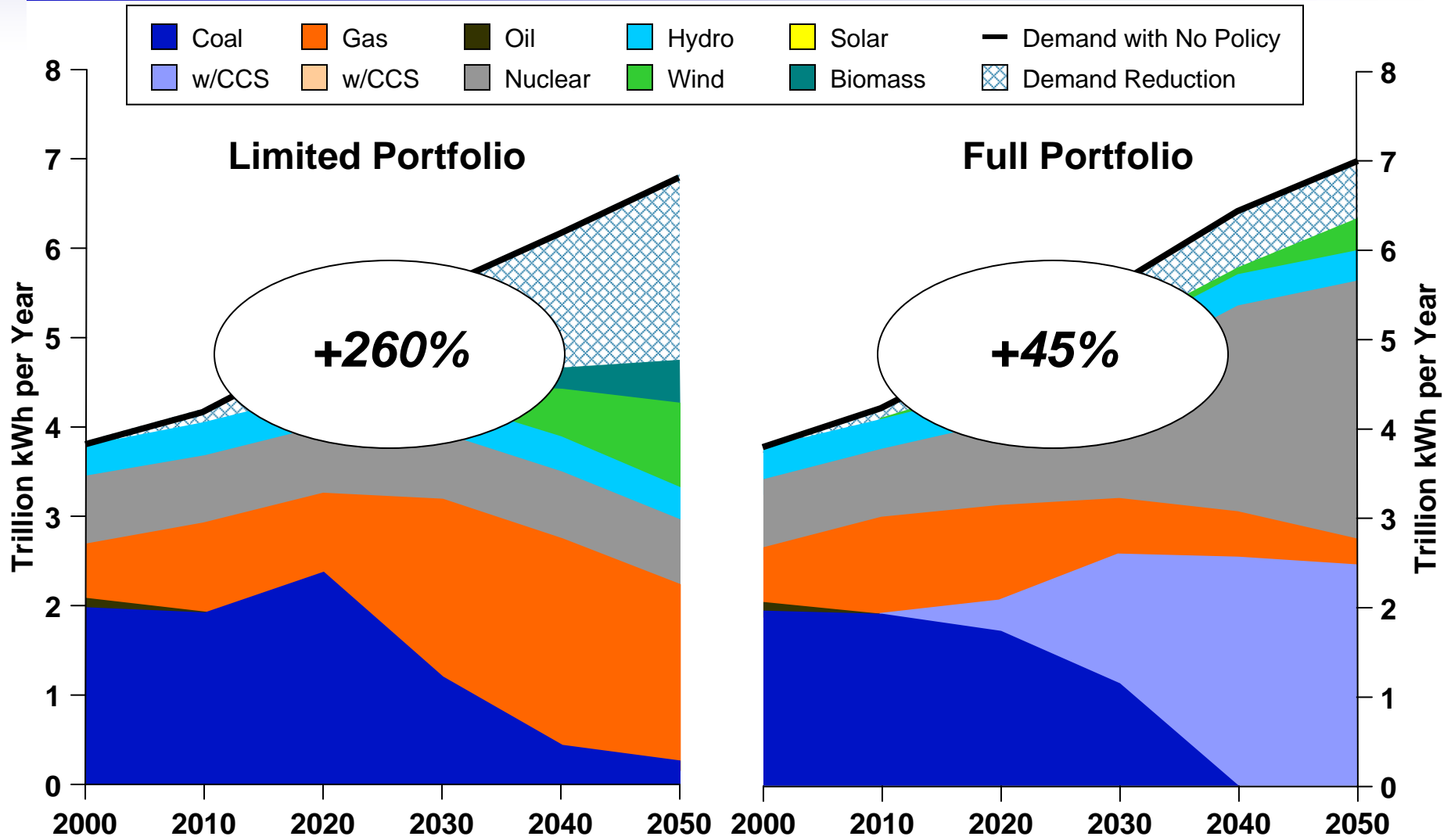
CO₂ Price



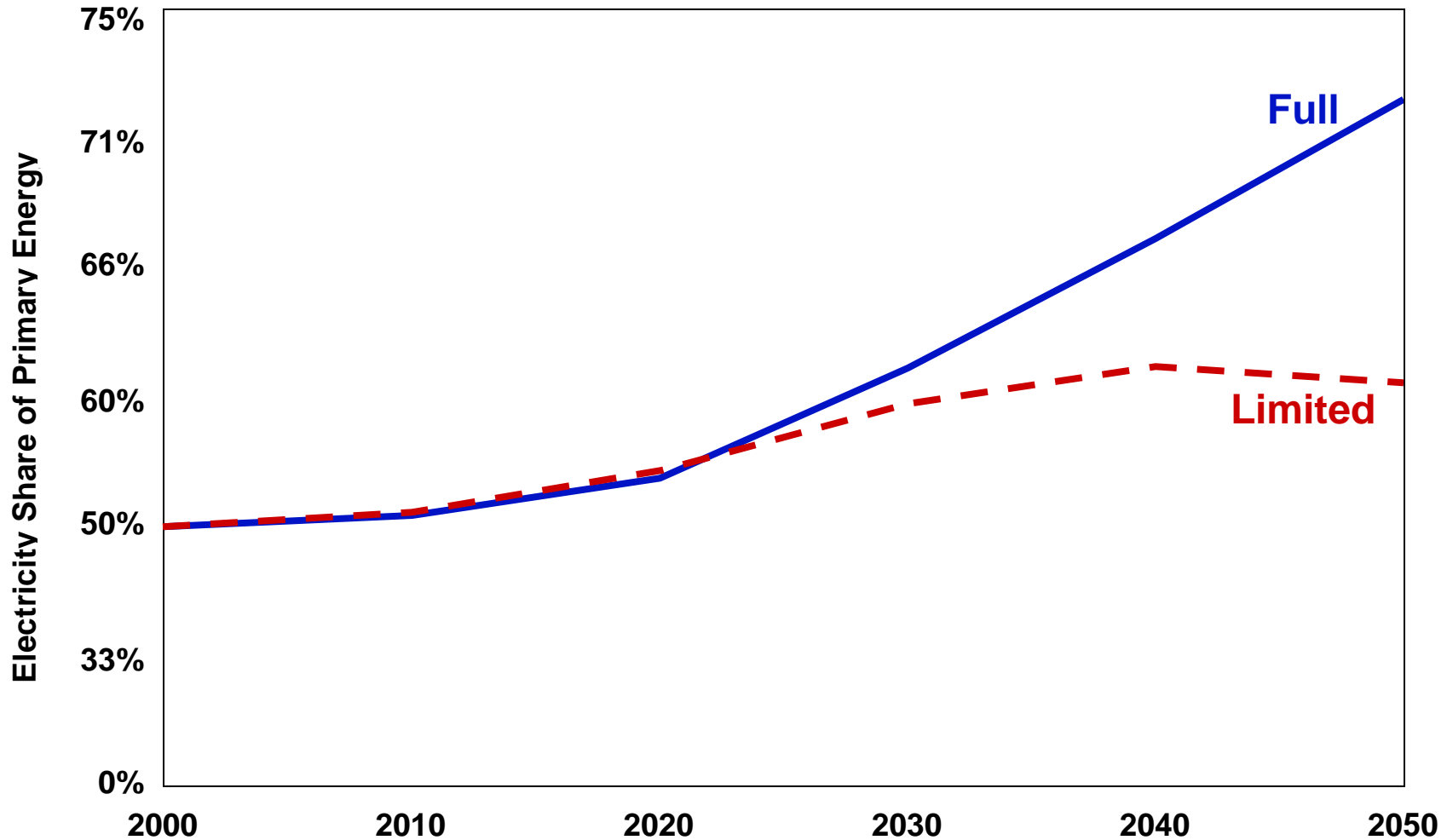
Wholesale Electricity Price



Increase in Real Electricity Prices...2000 to 2050



Decarbonization of the Electricity Sector Provides a Decarbonization Path for the Economy



The Bottom Line

- **The electricity sector's overall carbon footprint can be substantially reduced**
- **A decarbonized electricity sector enables other sectors to reduce emissions**
- **Technology enables this while minimizing impact on economy**

EPRI Objective...Provide a Framework

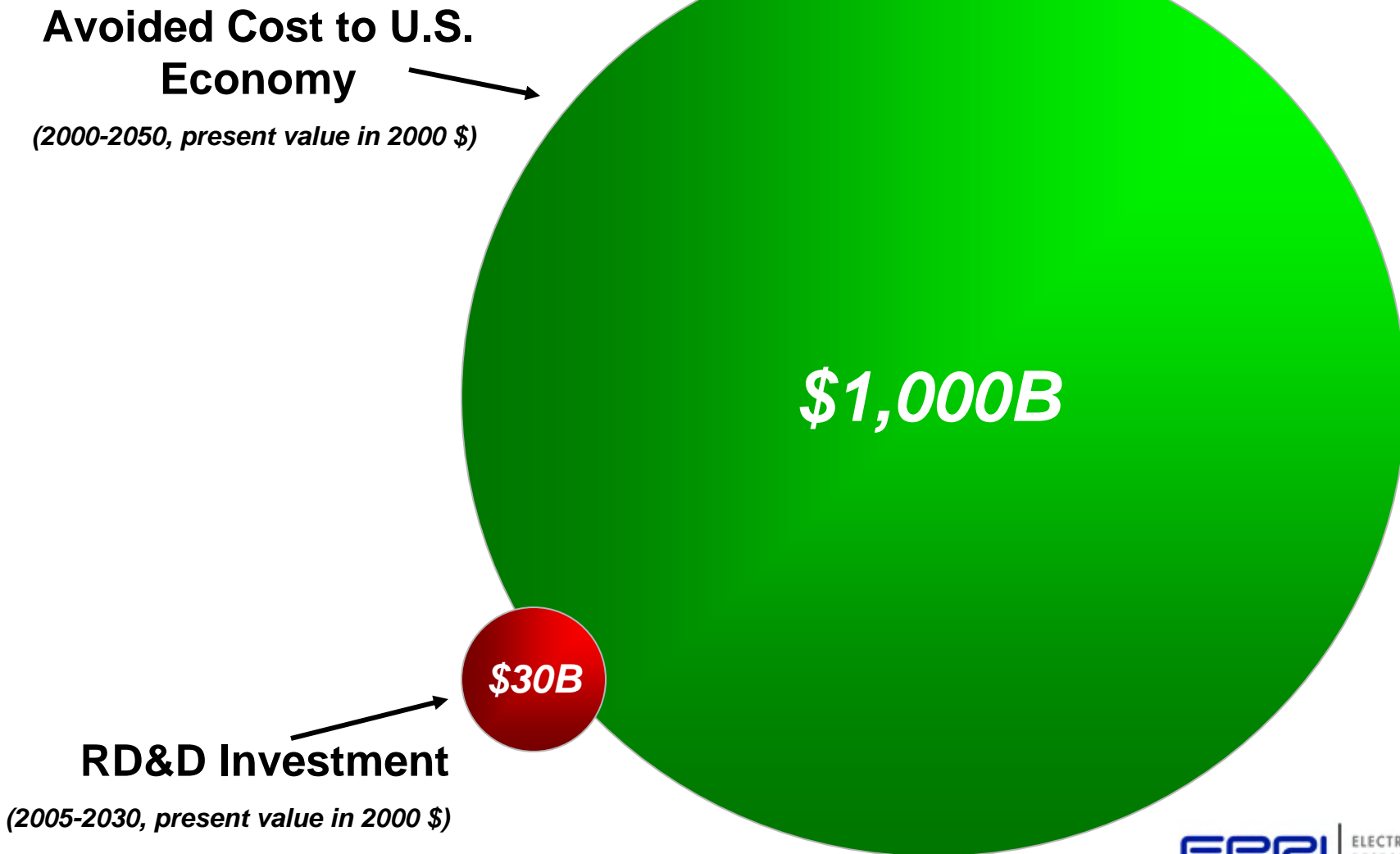
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Achieving the Full Portfolio

Technology advancements needed to enable the full portfolio of technologies to reduce CO₂ emissions over the coming decades:

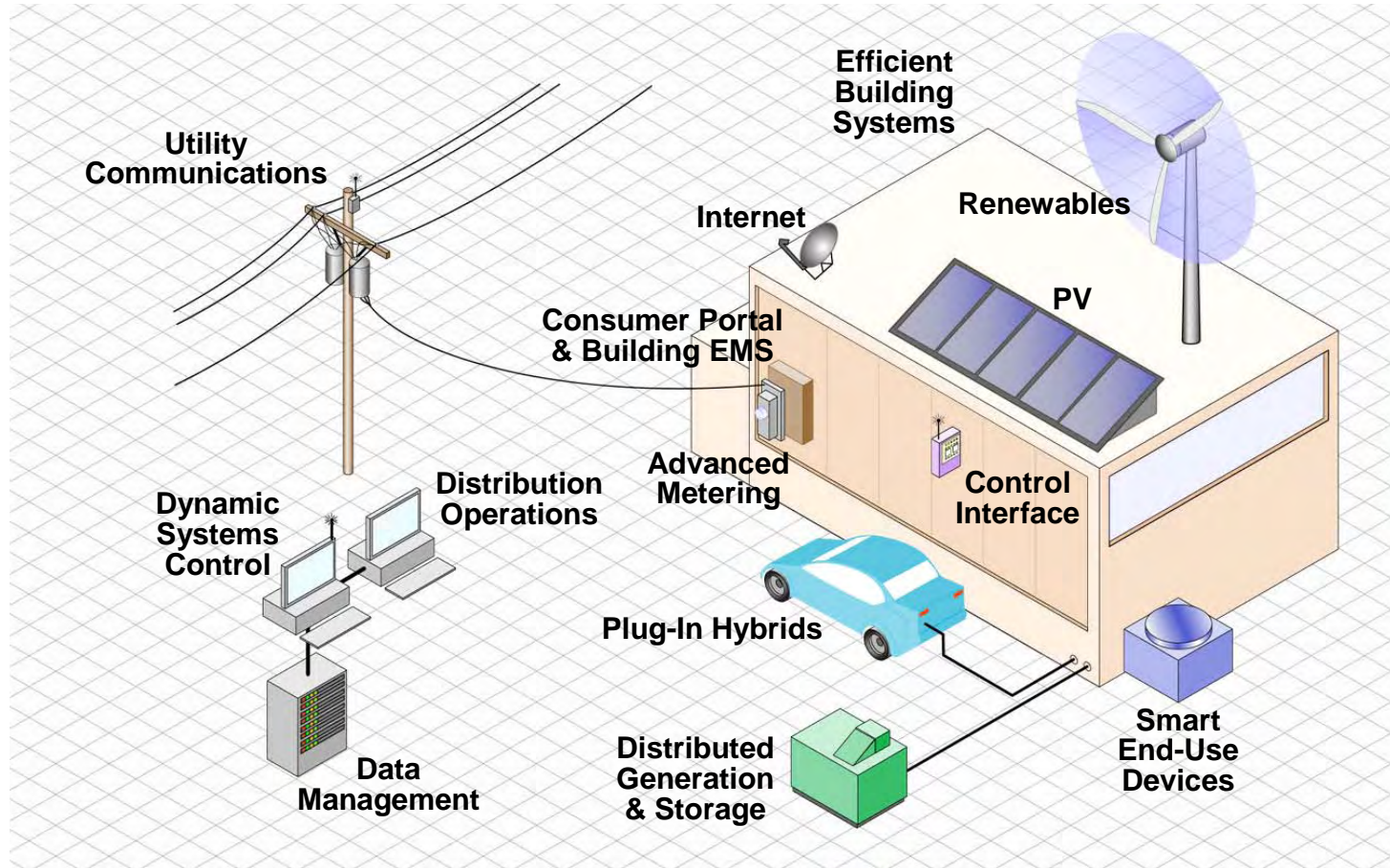
1. ***Smart grids and communications infrastructures*** to enable end-use efficiency and demand response, distributed generation, and PHEVs.
2. ***Transmission grids and associated energy storage infrastructures*** with the capacity and reliability to operate with 20–30% intermittent renewables in specific regions.
3. ***Advanced light-water reactors*** enabled by continued safe and economic operation of the existing nuclear fleet; and a long-term strategy for managing spent fuel.
4. ***Coal-based generation units with CCS*** operating with 90+% CO₂ capture and with the associated infrastructure to transport and permanently store CO₂ .

Research, Development and Demonstration is a Good Investment!



Research to Achieve the System of the Future

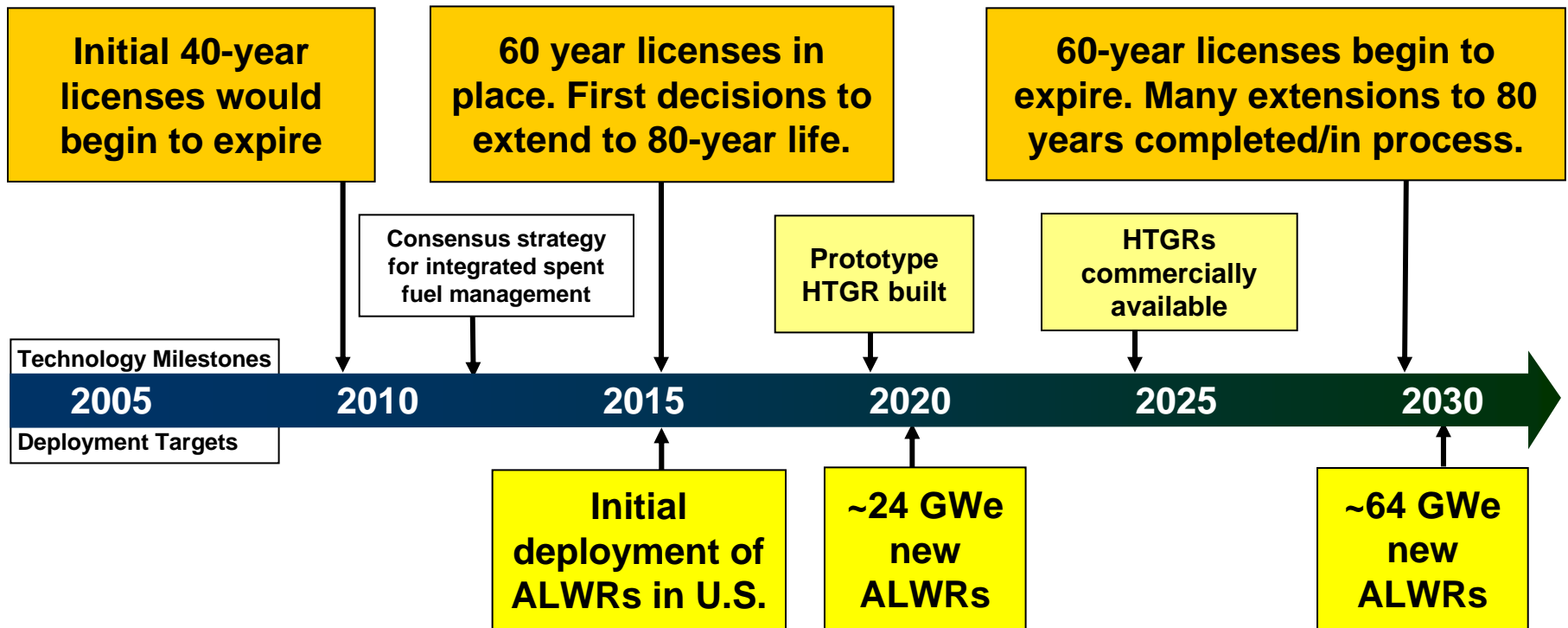
Efficient Use of Energy



- Provide information and tools to install infrastructure now
- Develop designs and migration strategies for “ideal” future

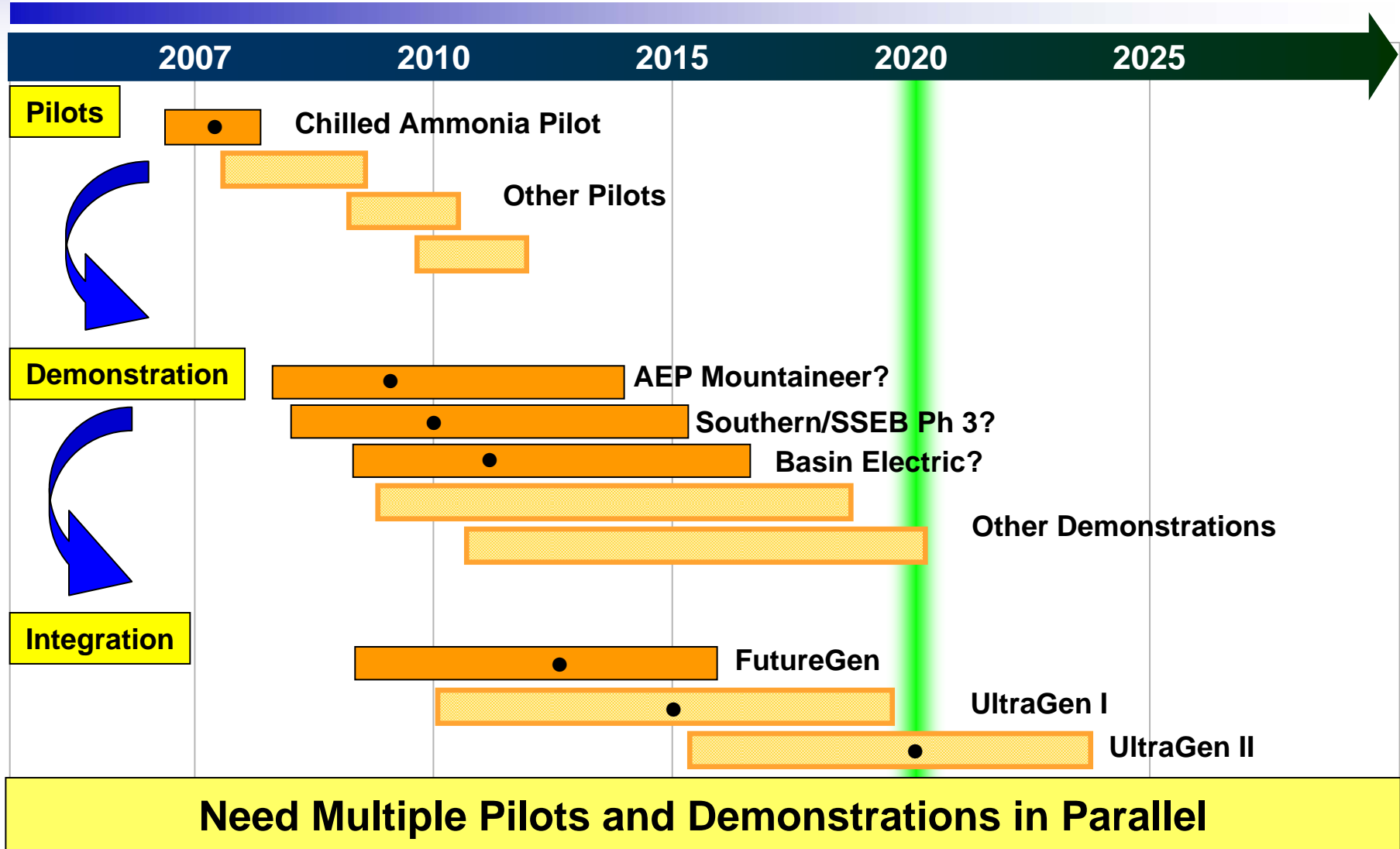
Nuclear: Keep Current Fleet Running – Deploy New Fleet

Current Fleet



New Fleet

Coal Plant CO₂ Capture and Storage



Next Steps

- Establish EPRI Board-endorsed Climate Technology RD&D plan
- Build collaboratives in 2007-08 to implement demonstration initiatives
- Communicate the “Full Portfolio” message