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Role of Renewable Energy in a Sustainable Electric Generation Portfolio

EIA Energy Outlook, Modeling, and Data Conference
Washington, DC
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Context

- Growing scientific findings and public opinion that GHG emissions are contributing to climate change…
- Priority of 110th Congress …
- U.S. responsible for 1/4 of worldwide CO_2 emissions…
- Electric utilities responsible for 1/3 of U.S. CO_2 emissions…
- Agreement that technology solutions are needed…

…But What is Feasible???

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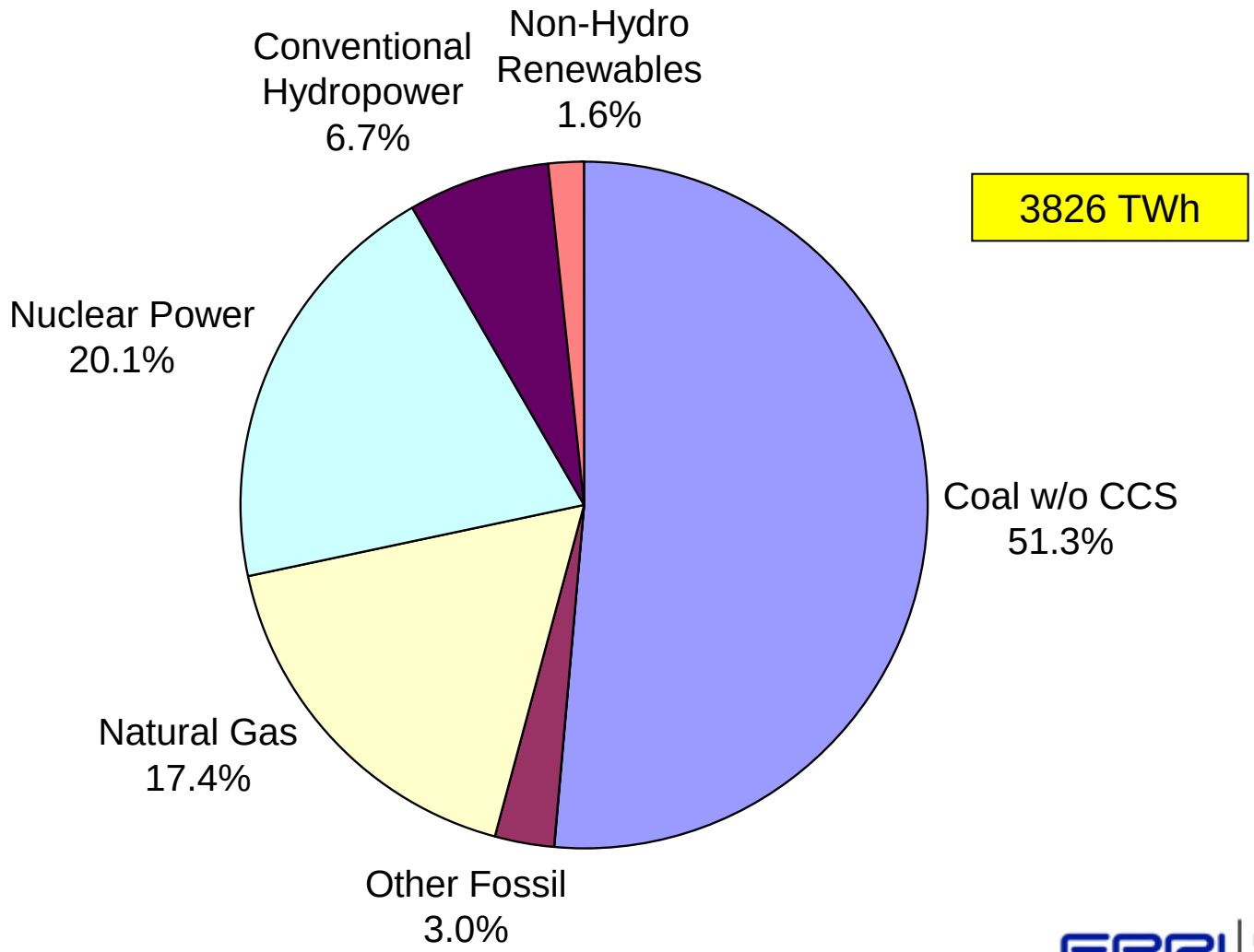
Approach

- The industry asked EPRI to estimate the technical potential for CO_2 emissions reductions from the electricity sector.
- EPRI developed 7 technology deployment targets and estimated the CO_2 reductions that could result between now and 2030.
- Conclusions:
  - It is technically feasible for the electricity sector to significantly reduce CO_2 emissions over the coming decades.
  - No one technology will be a silver bullet – a portfolio of technologies will be needed.
  - Much of the needed technology isn't available yet – substantial R&D, demonstration is required.

Total U.S. Electricity Generation: 2005 EIA



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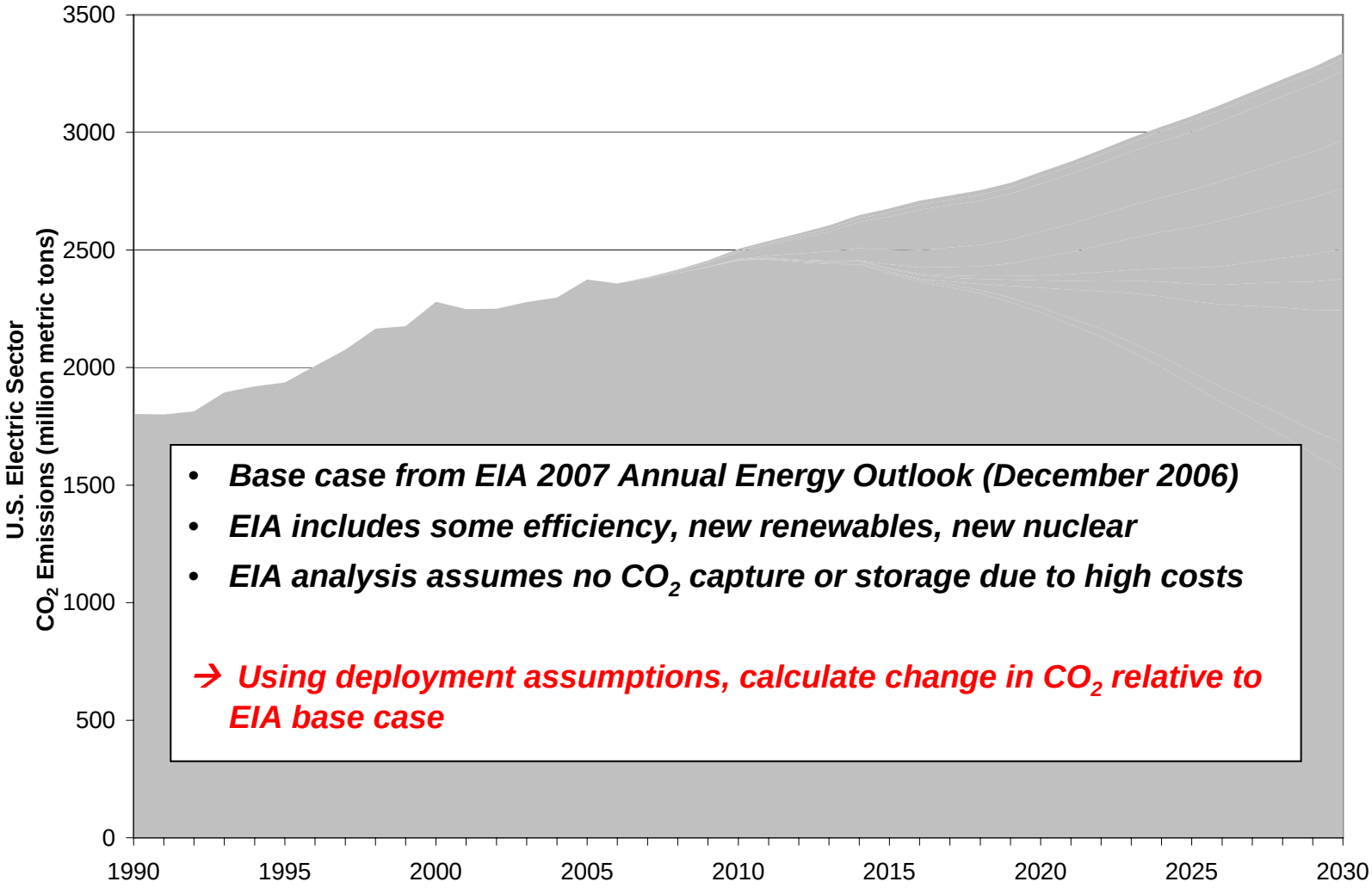
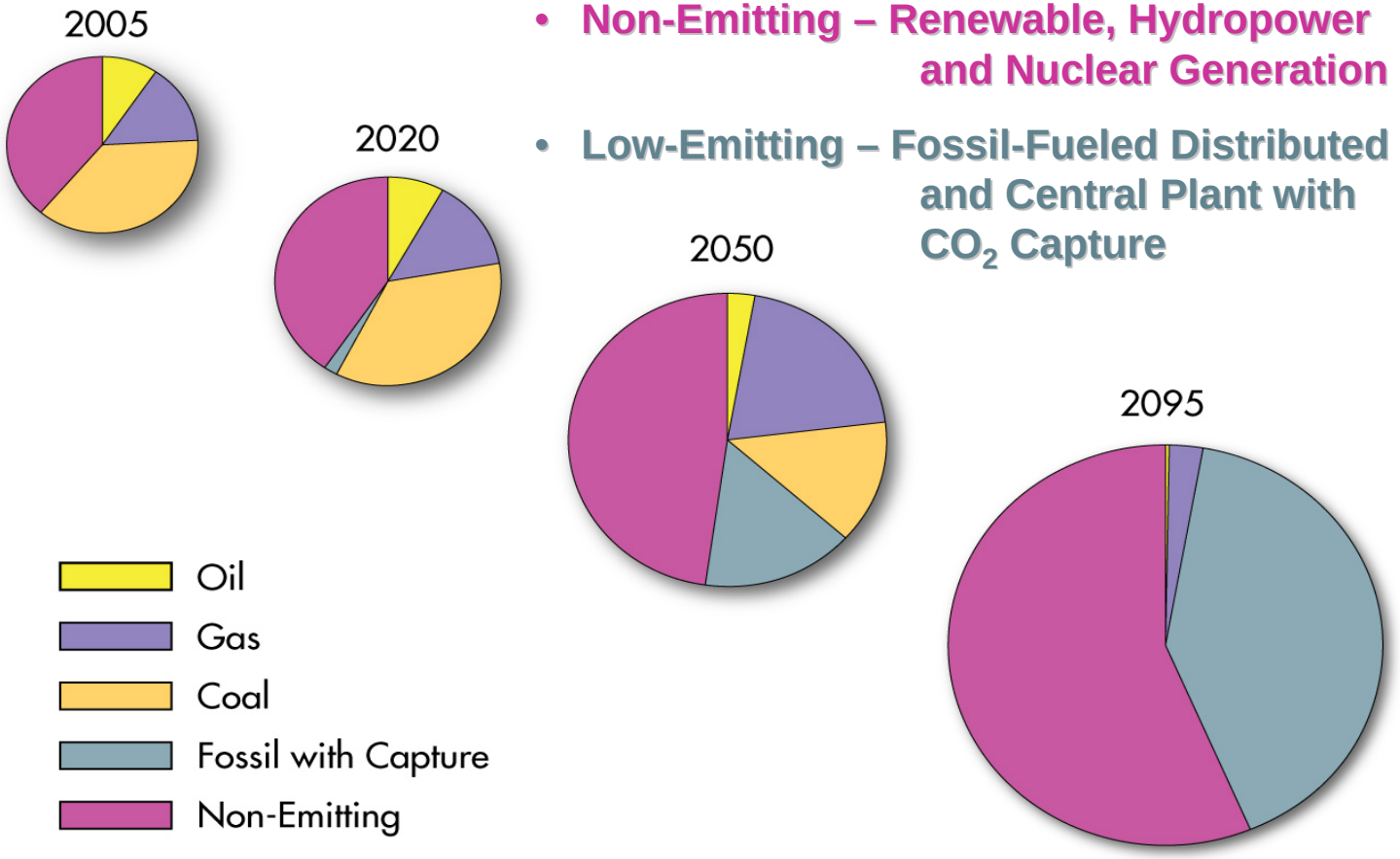
U.S. Electricity Sector CO_2 Emissions



Growth and Mix of World's Electricity Use to Stabilize CO_2 Concentrations at 550 ppm



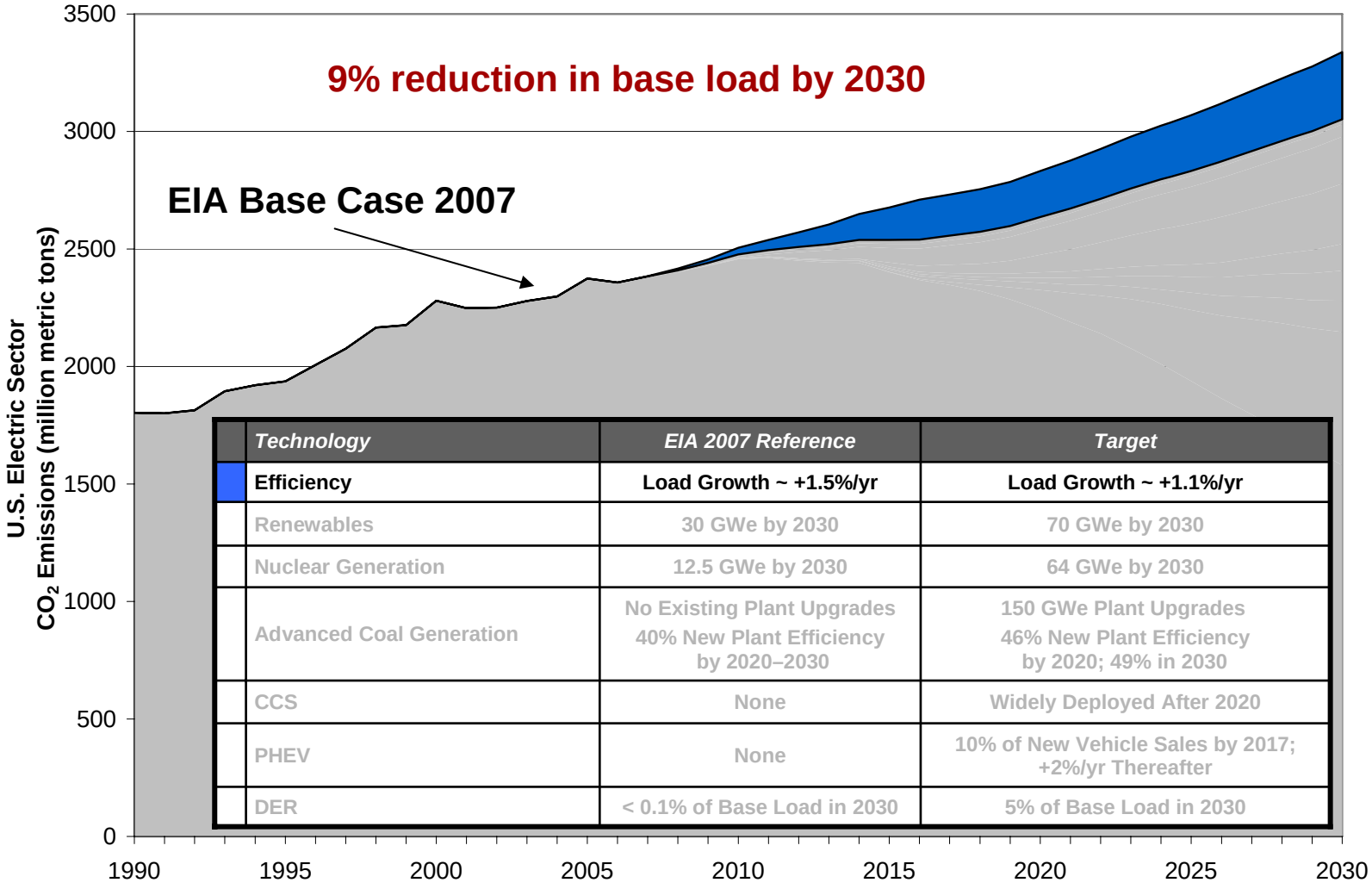
- **Non-Emitting – Renewable, Hydropower and Nuclear Generation**
- **Low-Emitting – Fossil-Fueled Distributed and Central Plant with CO_2 Capture**

From T. Wilson, EPRI, etal, "Electrification of the Economy and CO2 Emissions Mitigation," *Journal of Environmental Economics and Policy Studies*, Vol. 7/No. 5, 2005

Electric Sector Technology Options in a Carbon-Constrained Future

Technology	*EIA 2007 Base Case*	*EPRI 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**

Benefits of Achieving Efficiency Target



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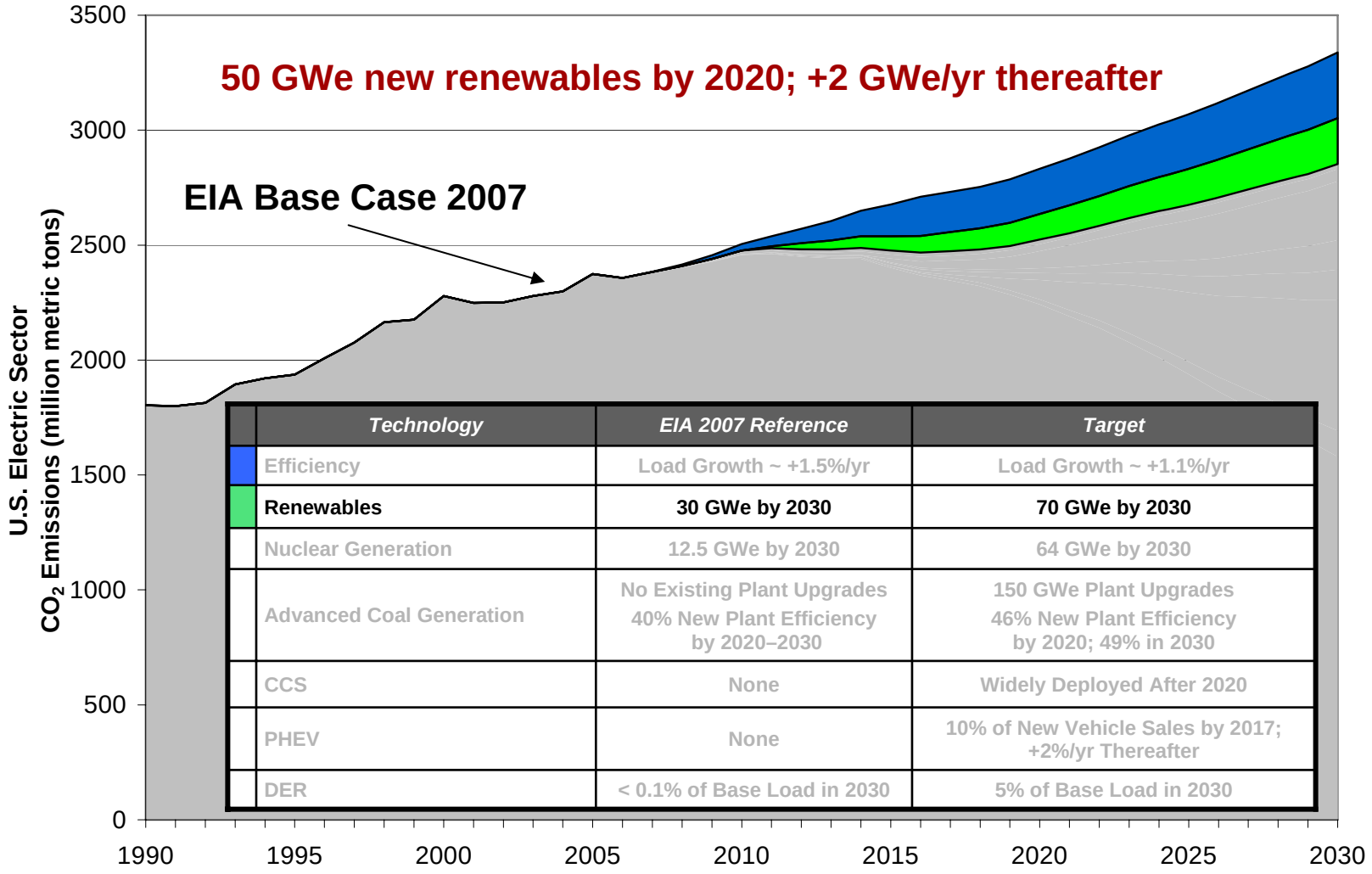
Benefits of Achieving Renewables Target



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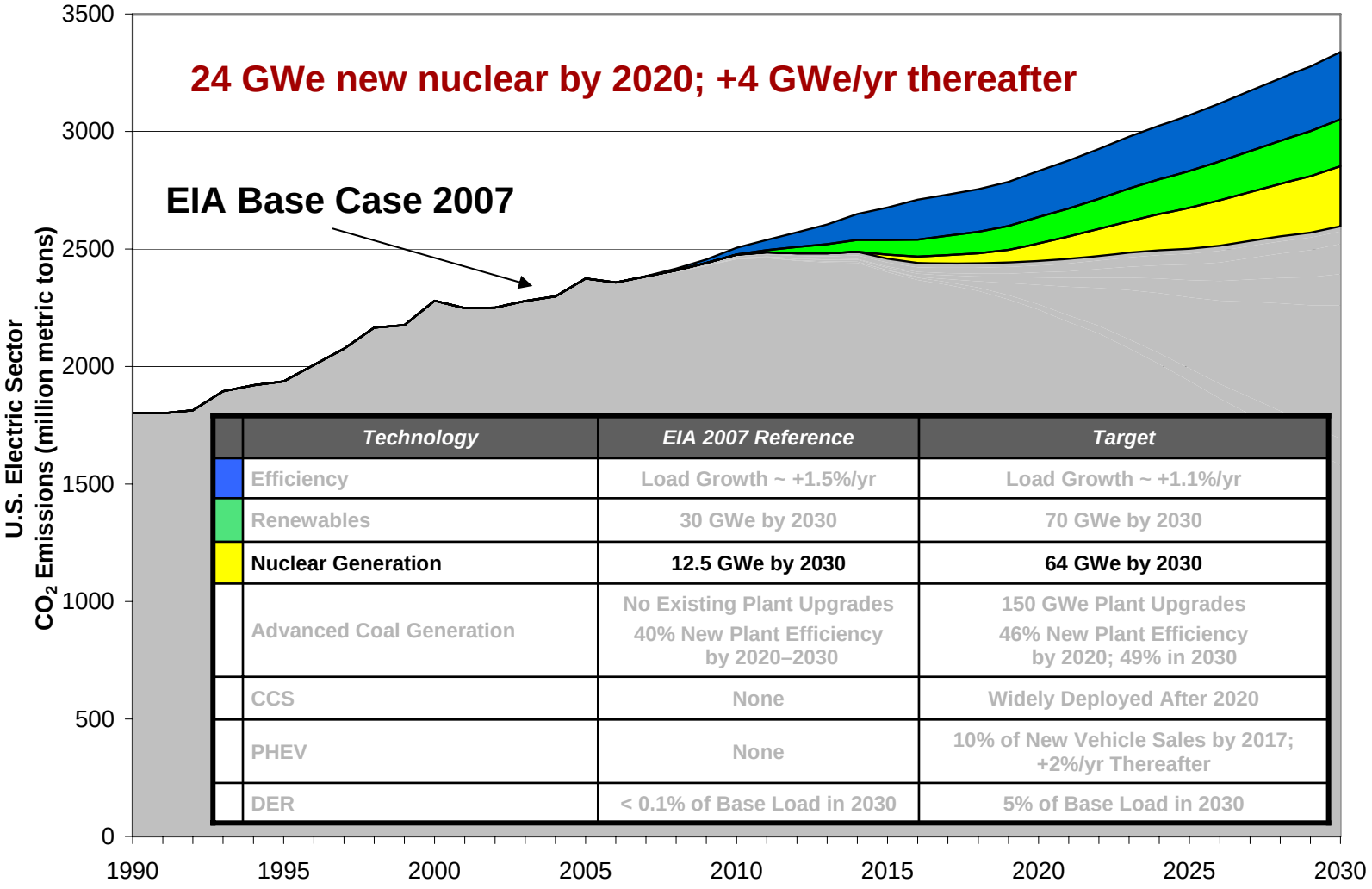
Benefit of Achieving Nuclear Generation Target



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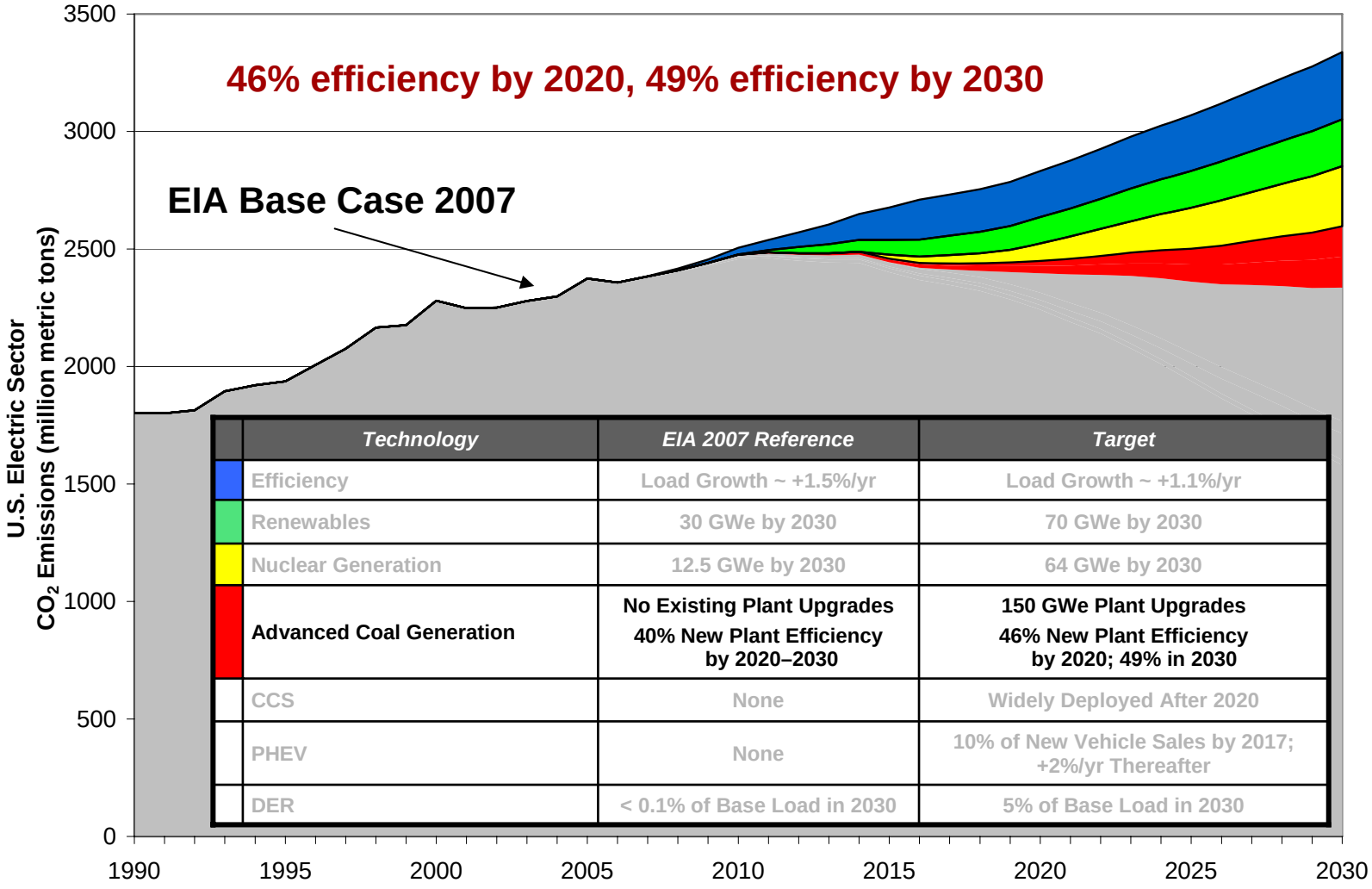
Benefit of Achieving Advanced Coal Generation Target



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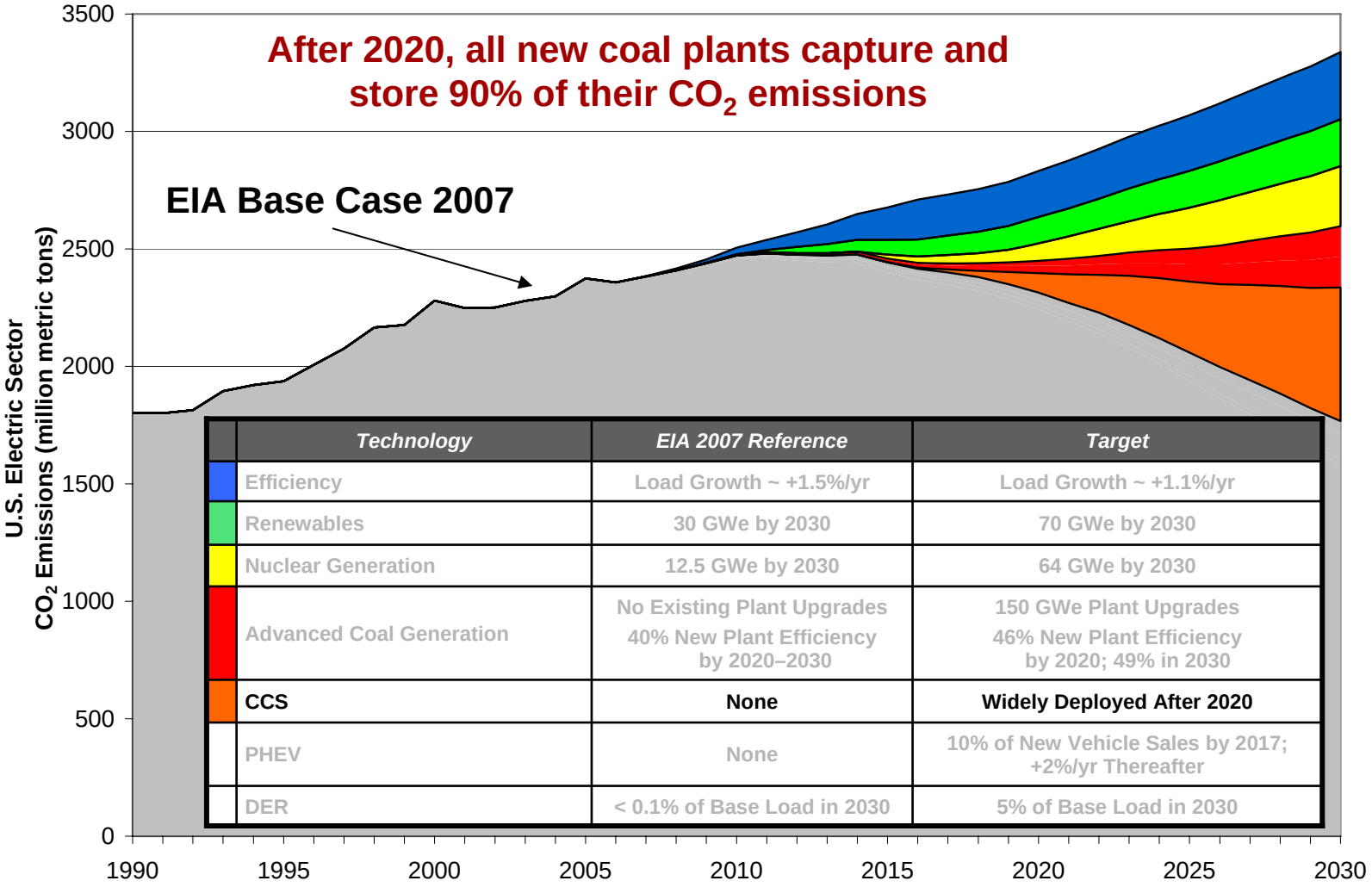
Benefit of Achieving the CCS Target



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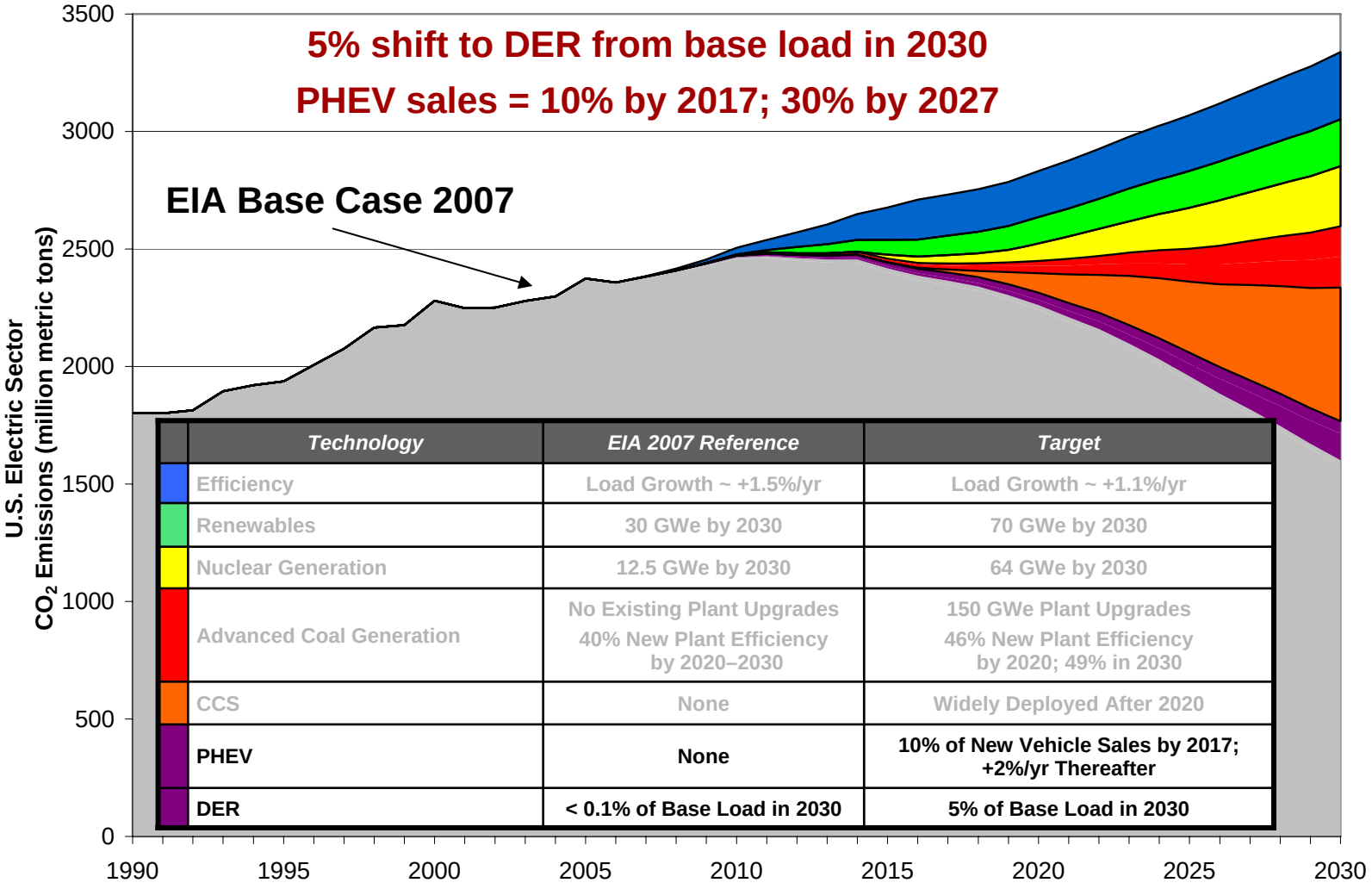
Benefits of Achieving PHEV and DER Targets



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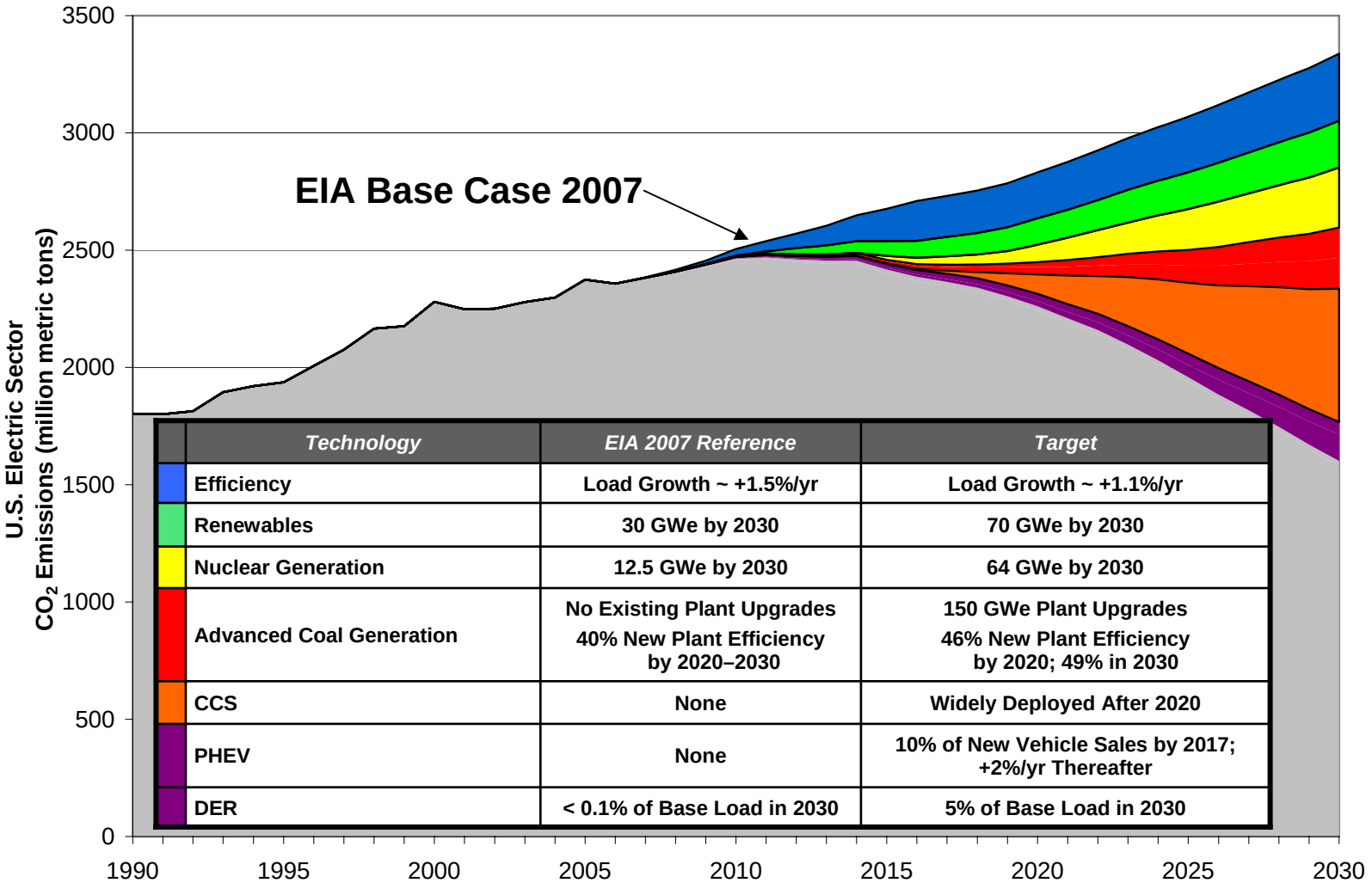
CO_2 Reductions…What's Technically Feasible



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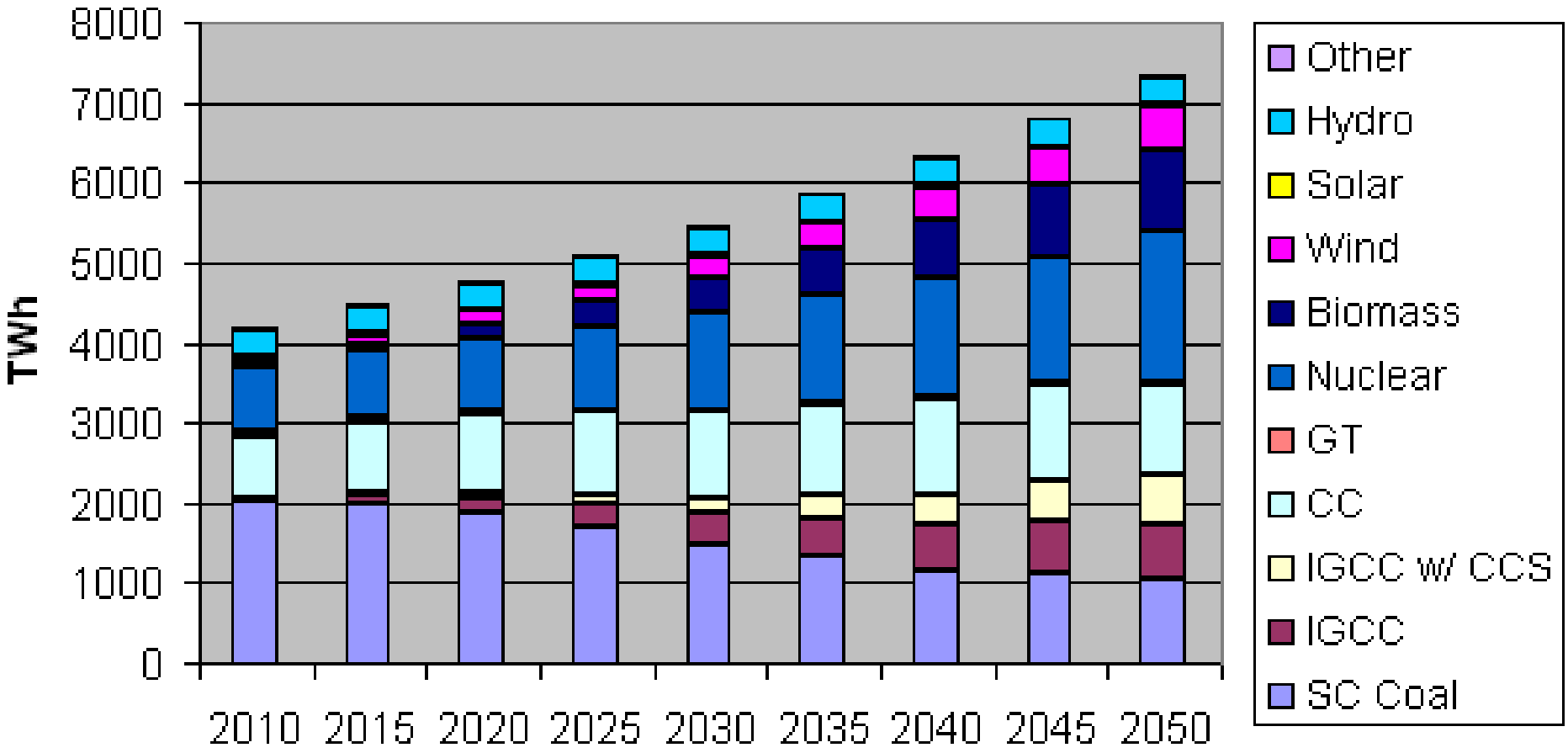
Additional Results from EPRI Energy System Modeling with a CO_2 Tax Considered



Equilibrium model, generation supply to meet demand based on NEMS 2006 output, considers, daily load duration, fuel costs, various technology availabilities, capacity factors, capital cost estimates, O&M, incentives, reserve margins, etc.

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EPRI Model Results: Price Sensitivity Cases….for Renewable Resources

Technology	Base Case	Natural Gas Price +$2/ MMBtu	Natural Gas Price Escalation +3% Post 2030	Nuclear Fuel Price Escalation +2% Post 2030	Lower CO_2 Value	Higher CO_2 Value
	Capacity Additions in MW, 2010-2050					
Biomass	128,318	139,076	144,605	132,192	117,669	126,459
Wind	241,187	254,048	256,055	256,716	197,538	266,158
Solar	18,371	20,680	21,525	18,451	15,554	21,626
Value Measures	Present Value in 2010, $ million					
Customer Bill	3,760,011	4,306,743	3,868,198	3,772,769	3,364,891	4,480,100
Producer Surplus	1,290,016	1,644,923	1,382,335	1,292,137	1,211,408	1,497,268
Price in 2050	$/MWh					
Electricity Price	**93.74**	**96.74**	**119.84**	**97.26**	**73.30**	**135.78**

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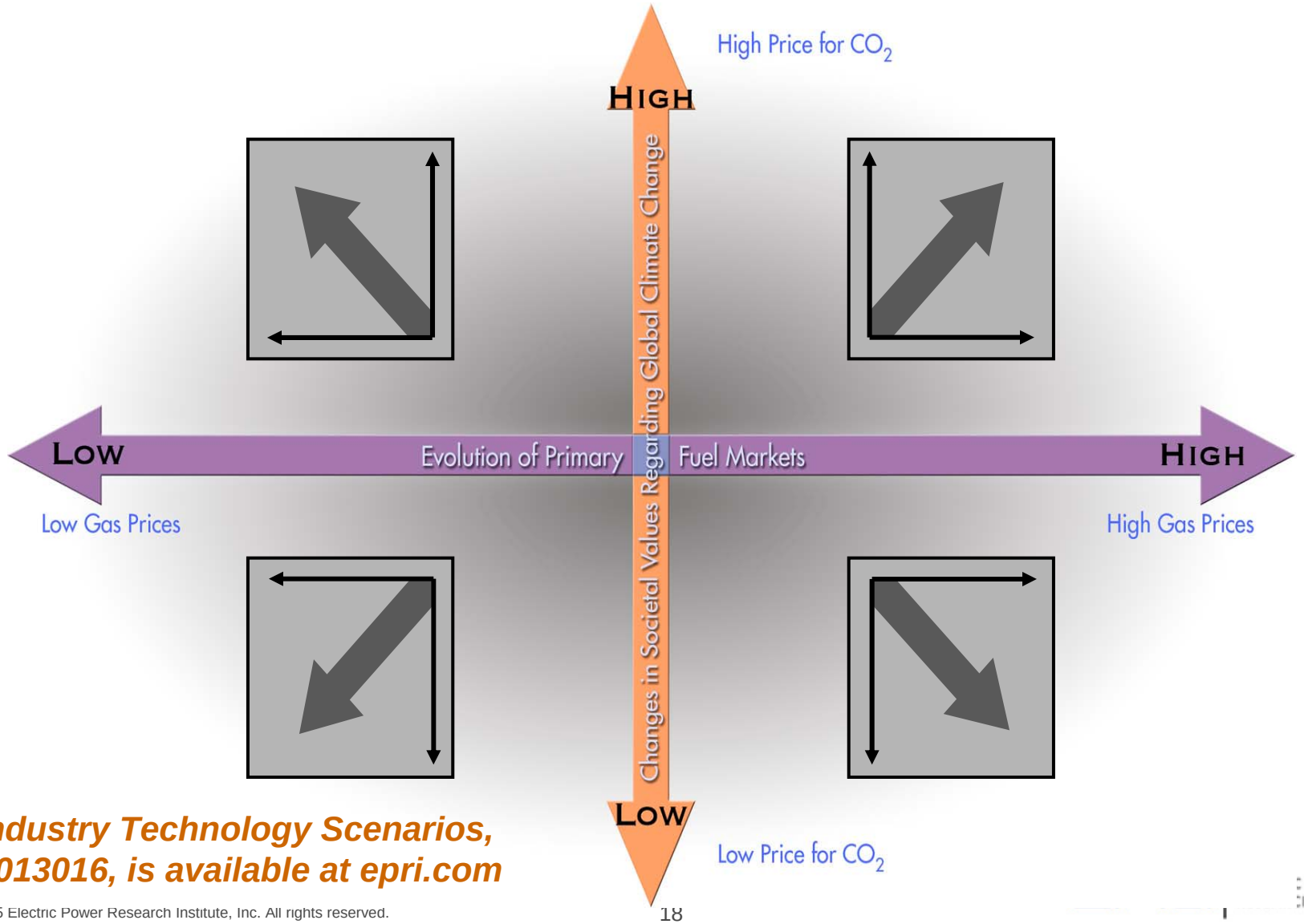
EPRI Model Results: Technology Sensitivity Cases….for Renewable Resources

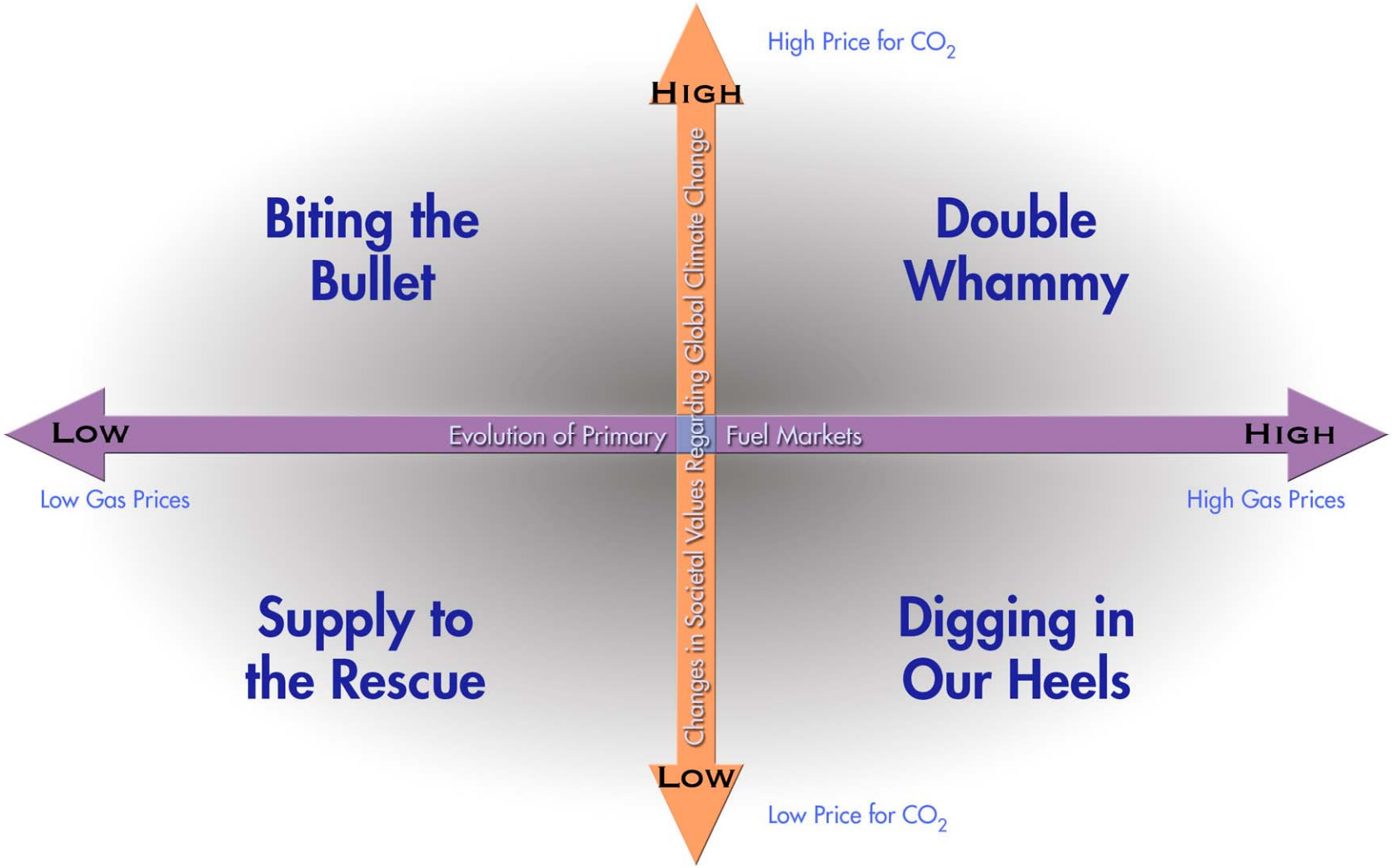
Technology	Base Case	No New Nuclear	No New Advanced Coal	Less Economic Renewables	No New Low- and Non-Emitting Options	25% Higher Capital Cost
	Capacity Additions in MW, 2010-2050					
Biomass	128,318	160,550	154,400	0	0	113,382
Wind	241,187	330,799	287,439	131,553	490,066	290,697
Solar	18,371	19,623	22,140	17,456	28,788	21,717
Value Measures	Present Value in 2010, $ million					
Customer Bill	3,760,011	3,936,798	4,058,318	3,713,560	4,564,617	3,888,061
Producer Surplus	1,290,016	1,330,024	1,420,724	1,233,737	1,577,824	1,349,396
Price in 2050	$/MWh					
Electricity Price	**93.74**	**115.97**	**118.14**	**92.18**	**189.69**	**106.44**

Scenario Matrix – Covers Natural Gas Price & CO_2 Cost Uncertainties

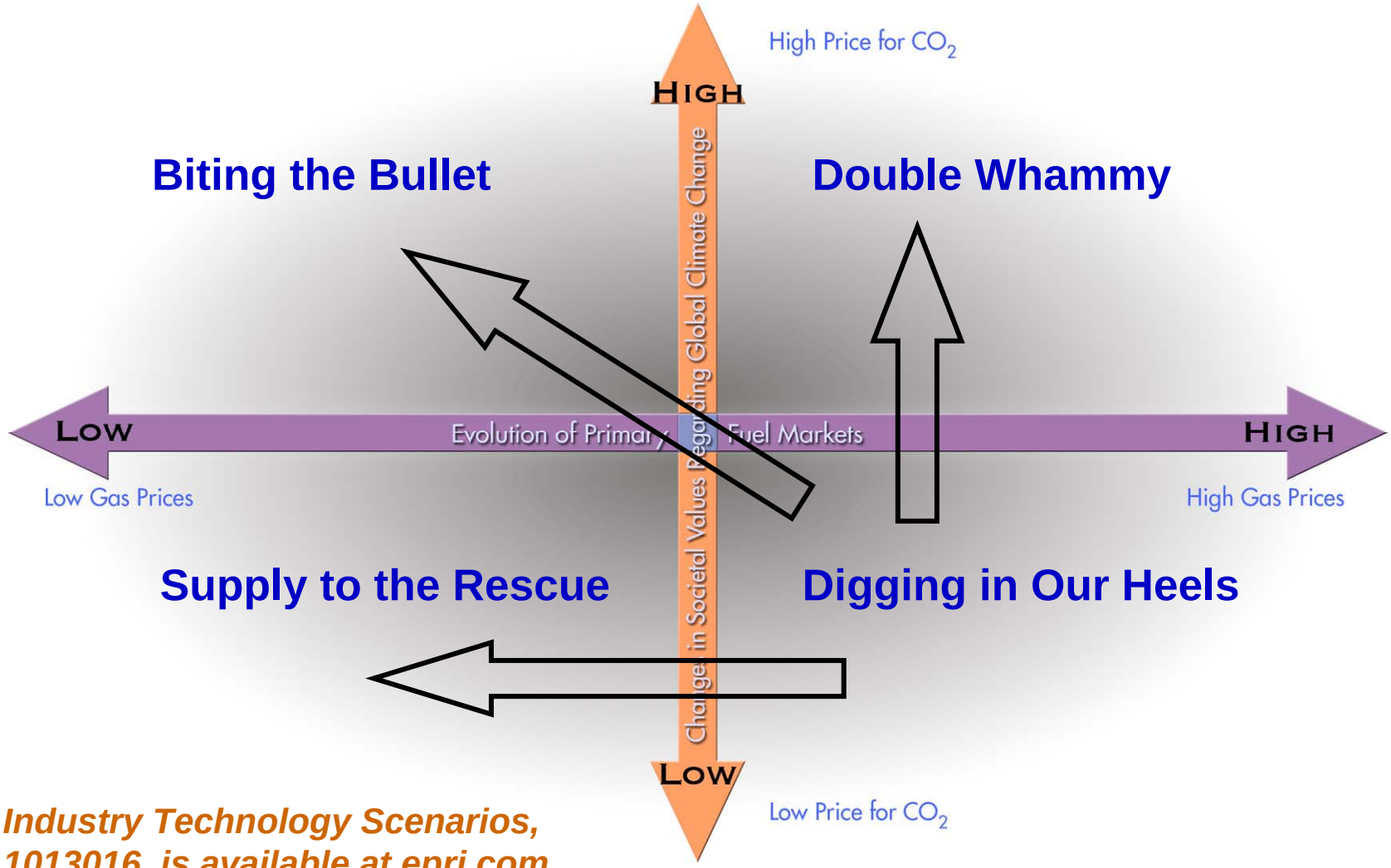


Industry Technology Scenarios, 1013016, is available at epri.com

Where are we today?



What is our Energy Future?



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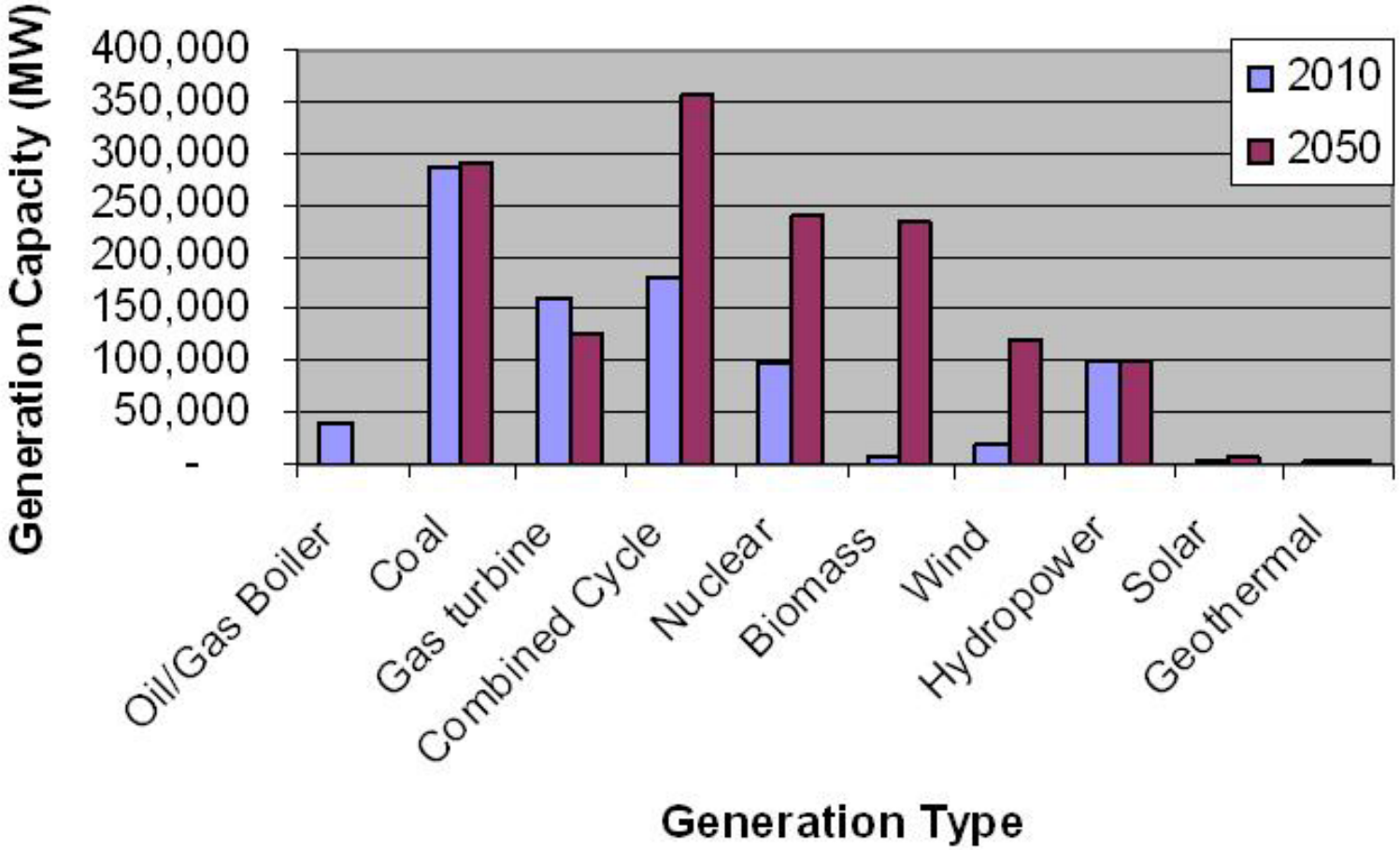
"Double Whammy" Change in Generation Capacity Mix from 2010 through 2050 (preliminary study results)

Renewable capacity expansion from 36GW in 2010 to 360GW in 2050

And 155 GW in 2030



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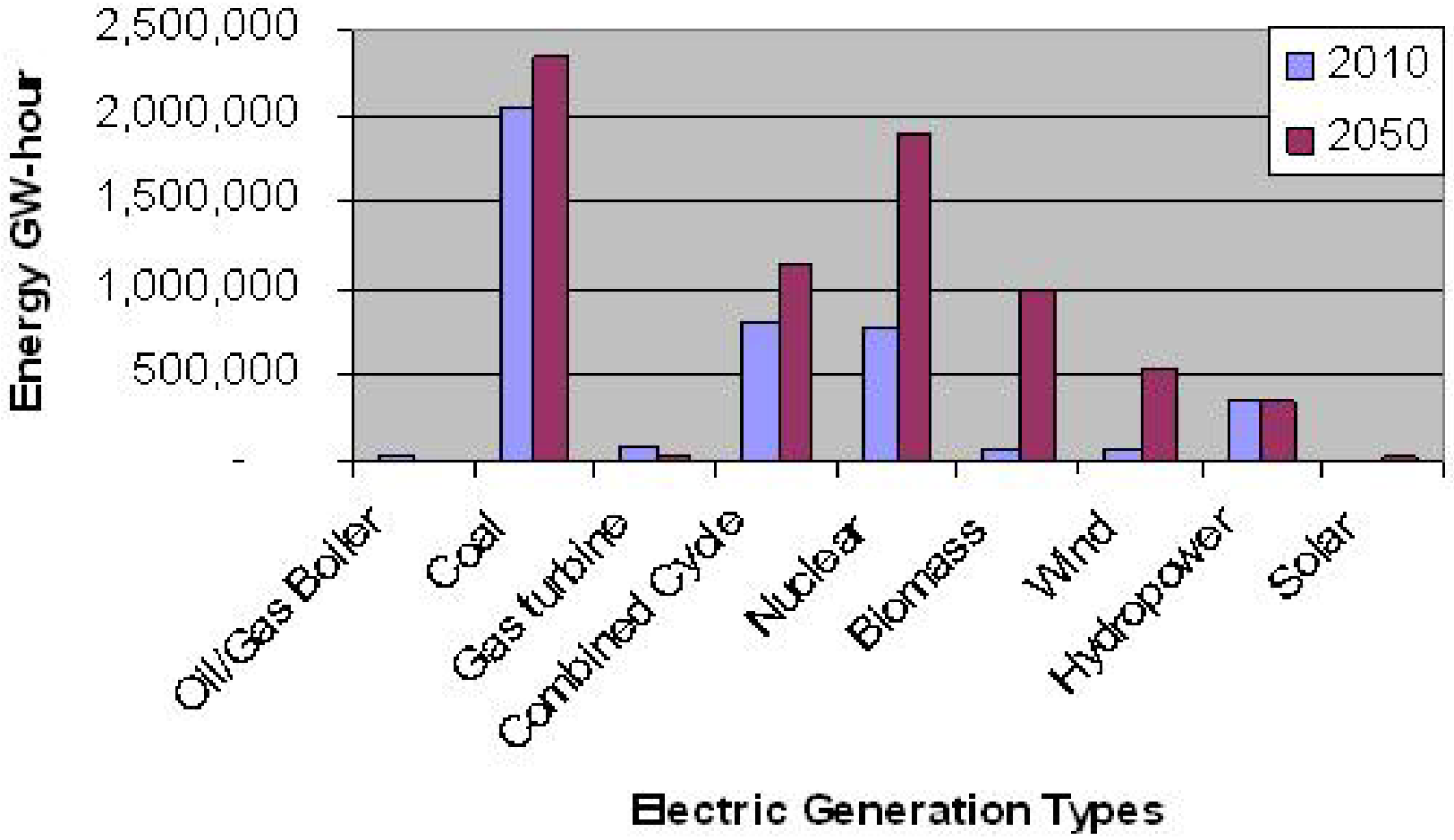
"Double Whammy" Changes in Utility Generation Mix based on Energy (preliminary study results - 2006)

Renewables Generate 16% by 2030, and, as much as 25% by 2050



EPRI Model Results: Uncertainty in Capacity Expansion

Parameter	New Coal	IGCC – Short Term	IGCC w/ CCS	Gas-Fired	Nuclear	Advanced Nuclear	Bio-mass	Wind	Solar
	Total in MW								
Average Capacity Addition	72,615	89,661	71,531	522,444	129,163	95,675	120,931	245,994	17,179
Standard Deviation in Capacity	23,295	29,154	12,930	83,915	17,450	15,429	12,568	49,539	2,952
Maximum Capacity Addition	145,792	178,170	117,370	774,410	175,659	139,613	156,377	337,288	24,588
Minimum Capacity Addition	36,049	43,508	43,671	355,920	85,803	58,083	83,561	117,039	9,948

What to expect in our electric energy future?

- The challenge of changing requirements,
- Extraordinary opportunity for new technology,
- Growing need for collaborations,
- Uncertainty and surprises.

Although the exact path for electricity is uncertain, there is clearly a renewable role that will benefit any sustainable generation portfolio

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