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Electricity Technology in a Carbon-Constrained Future

UNFCCC SB-26
May 15, 2007

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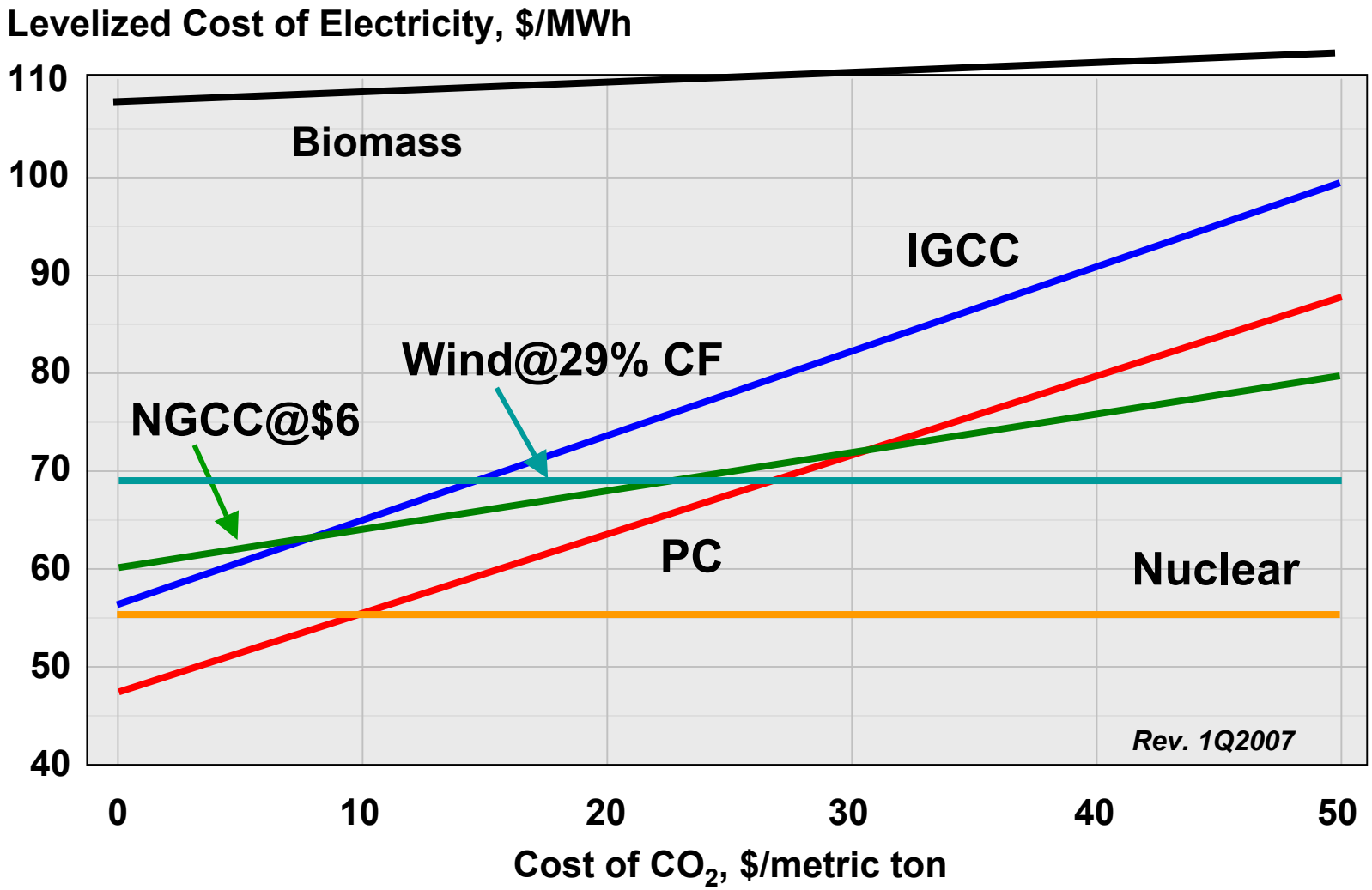
Vice President - Environment

Comparative Costs in 2010-2015



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Key Technology Challenges

Significant cost-effective CO_2 reductions from the U.S. electric sector will require ALL of the following technology advances:

1. Smart grids and communications infrastructures to enable end-use efficiency and demand response, distributed generation, and PHEVs.

2. A grid infrastructure with the capacity and reliability to operate with 20-30% intermittent renewables in specific regions.

3. Significant expansion of nuclear energy enabled by continued safe and economic operation of existing nuclear fleet; and a viable strategy for managing spent fuel.

4. Commercial-scale coal-based generation units operating with 90+% CO_2 capture and storage in a variety of geologies.

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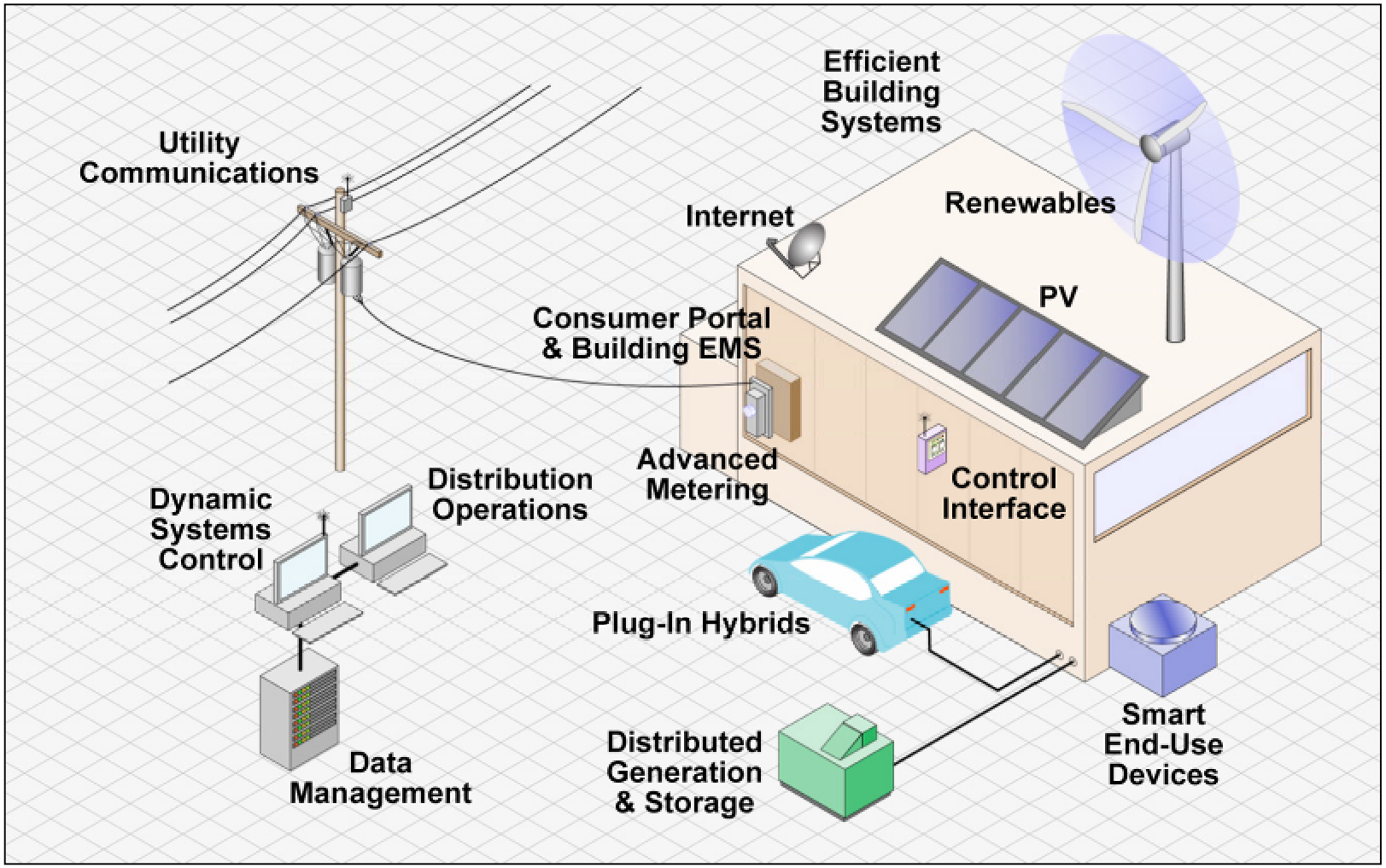
Example: Dynamic Energy Management



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Average Annual Funding R&D Gap

million $/yr

	2007-2011	2012-2016	2017-2021	2022-2026	2027-2031	Avg
ENABLE ENERGY EFFICIENCY & DER Smart grids and communications infrastructures to enable end-use efficiency and demand response, DER (i.e. Solar PV) and PHEVs. Improve equipment efficiency.	$310	$290	$240	$140	$120	$220
GRID INTEGRATION WITH RENEWABLES A grid infrastructure with the capacity and reliability to operate with 20-30% intermittent renewable generation in specific regions.	$400	$370	$330	$300	$300	$340
NUCLEAR Significant expansion of nuclear energy enabled by continued operation of the existing nuclear fleet and a viable strategy for managing spent fuel. Includes new RD&D for ALWR deployment support.	$170	$170	$170	$100	$100	$140
ADVANCED COAL, CO_2 CAPTURE and STORAGE Commercial-scale coal-based generation units operating with ~90% CO2 capture and storage in a variety of geologies.	$830	$800	$800	$620	$400	$690
Total	$1710	$1630	$1540	$1160	$920	$1390

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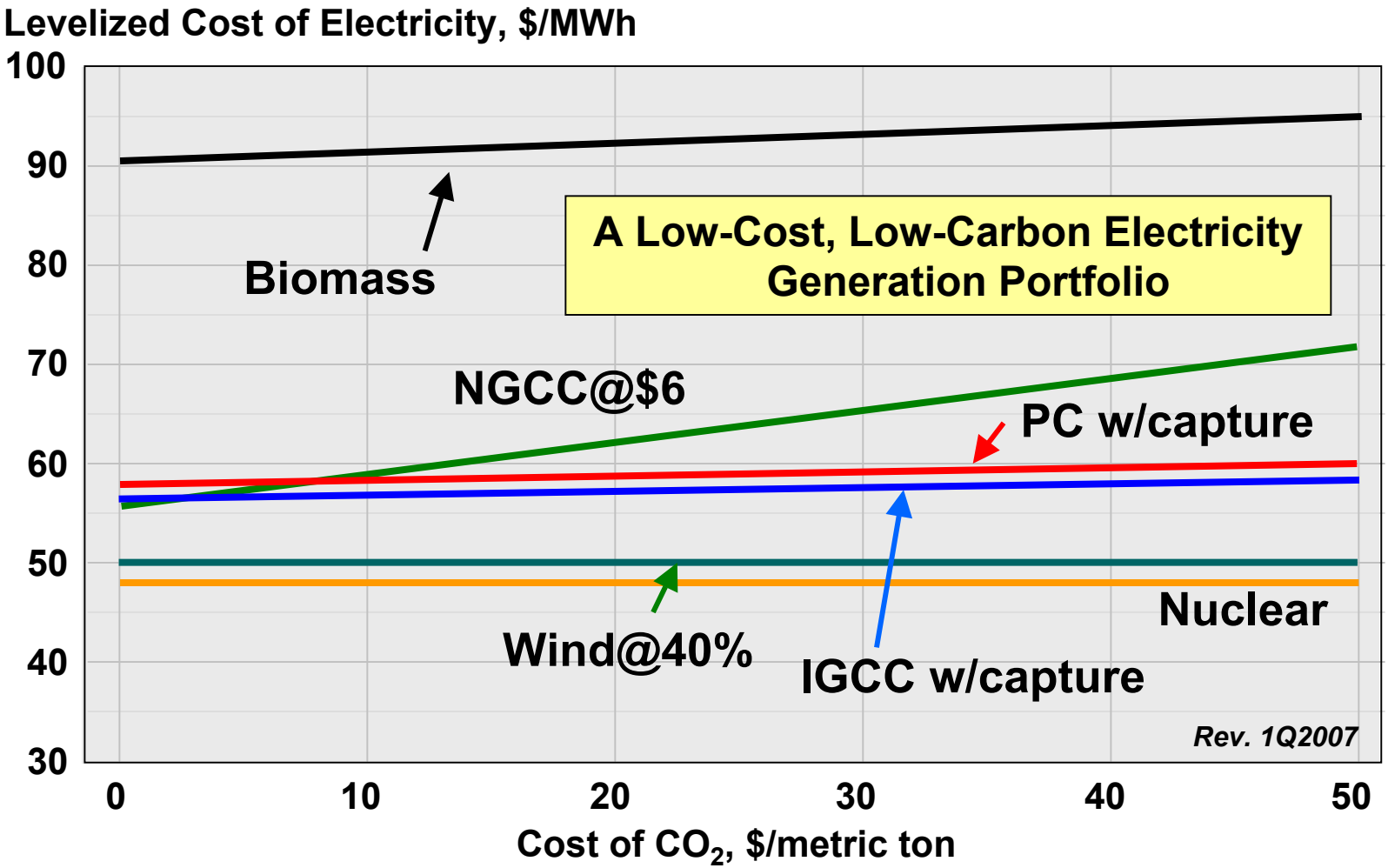
Comparative Costs in 2020-2025



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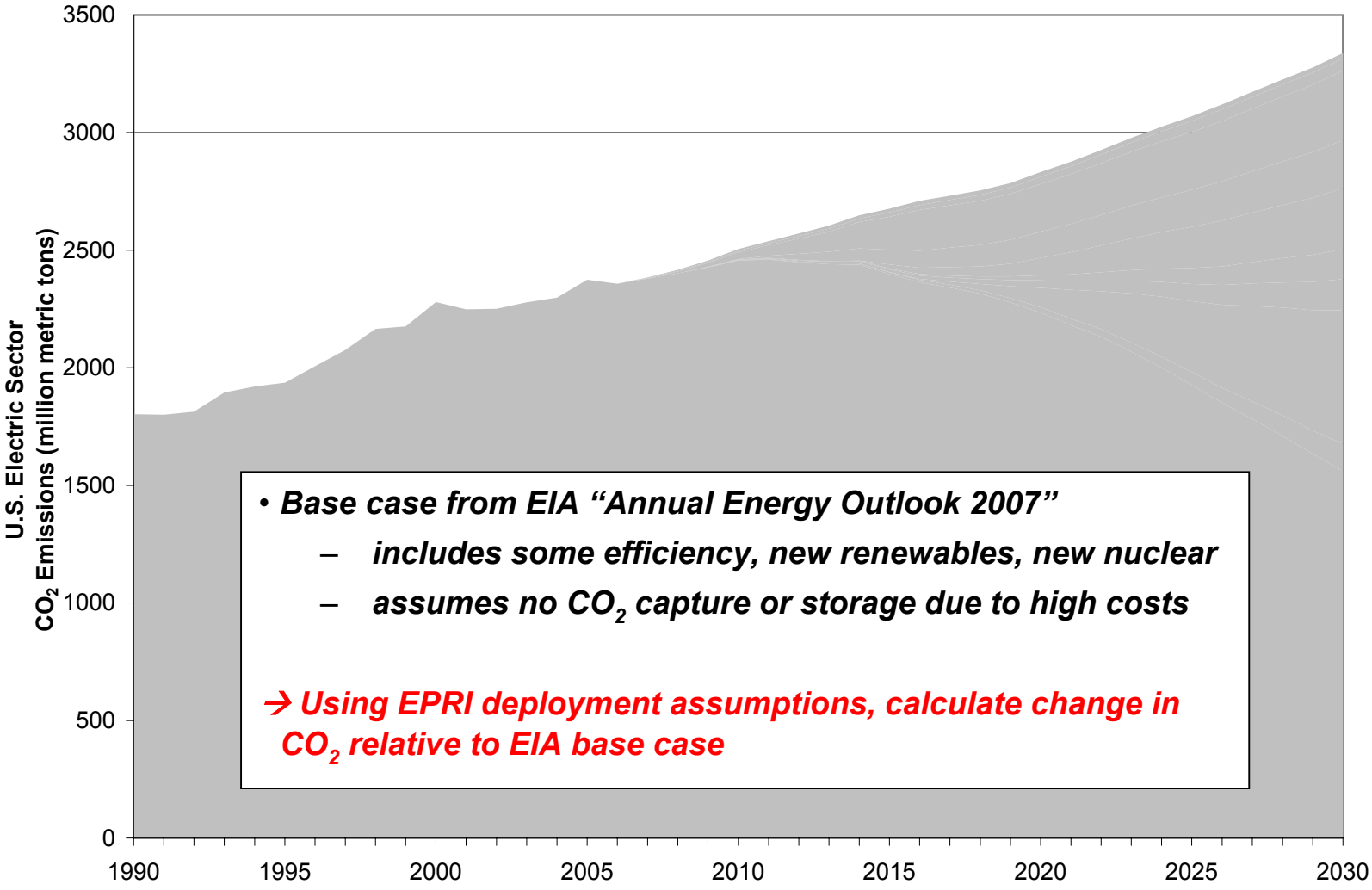
U.S. Electricity Sector CO_2 Emissions



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Technology Deployment Targets

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**

EPRI analysis targets do not reflect economic considerations, or potential regulatory and siting constraints.

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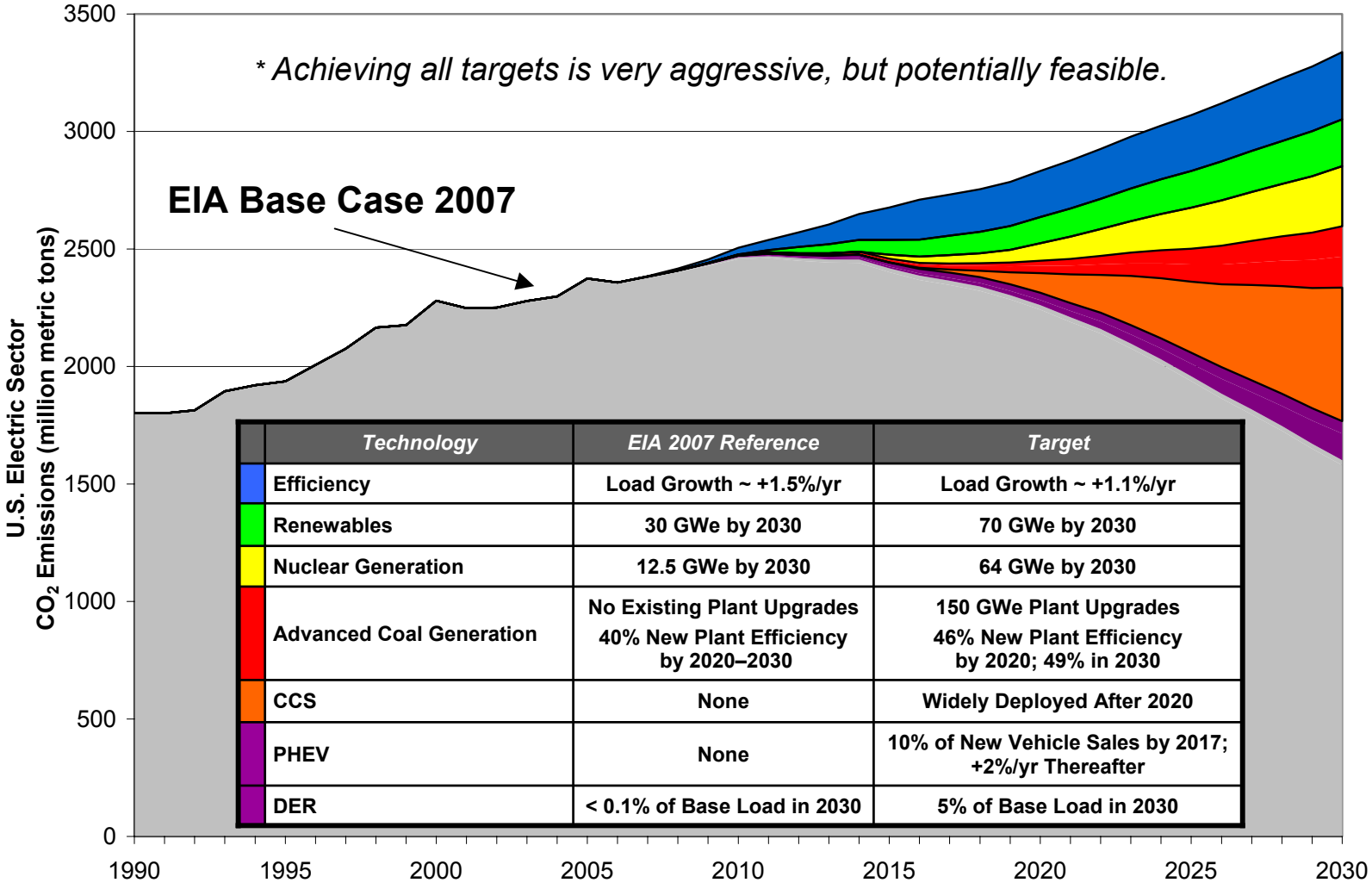
CO_2 Reductions … Technical Potential*



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CCS	None	Widely Deployed After 2020
PHEV	None	10% of New Vehicle Sales by 2017; +2%/yr Thereafter
DER	< 0.1% of Base Load in 2030	5% of Base Load in 2030

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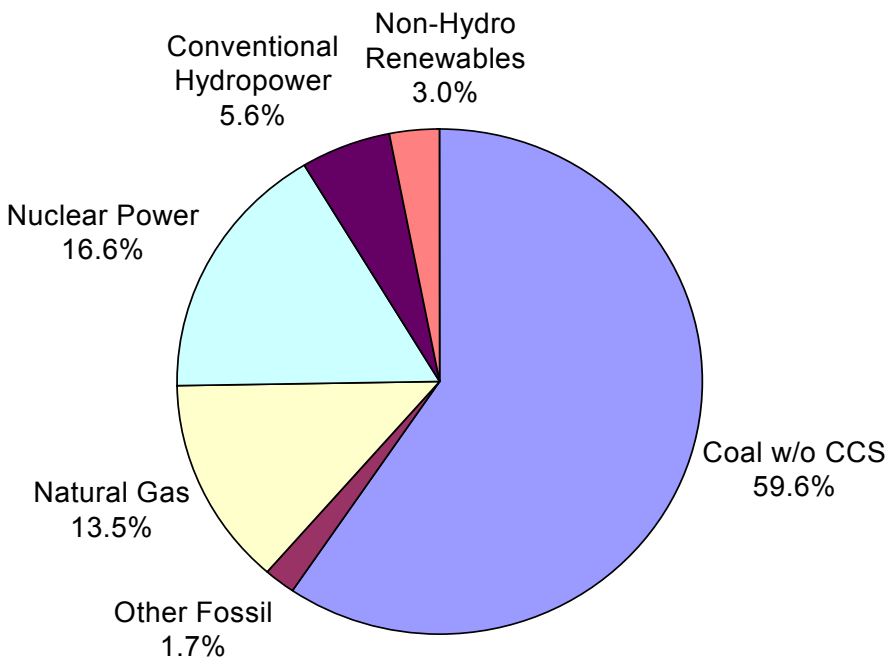
U.S. Electricity Generation: 2030

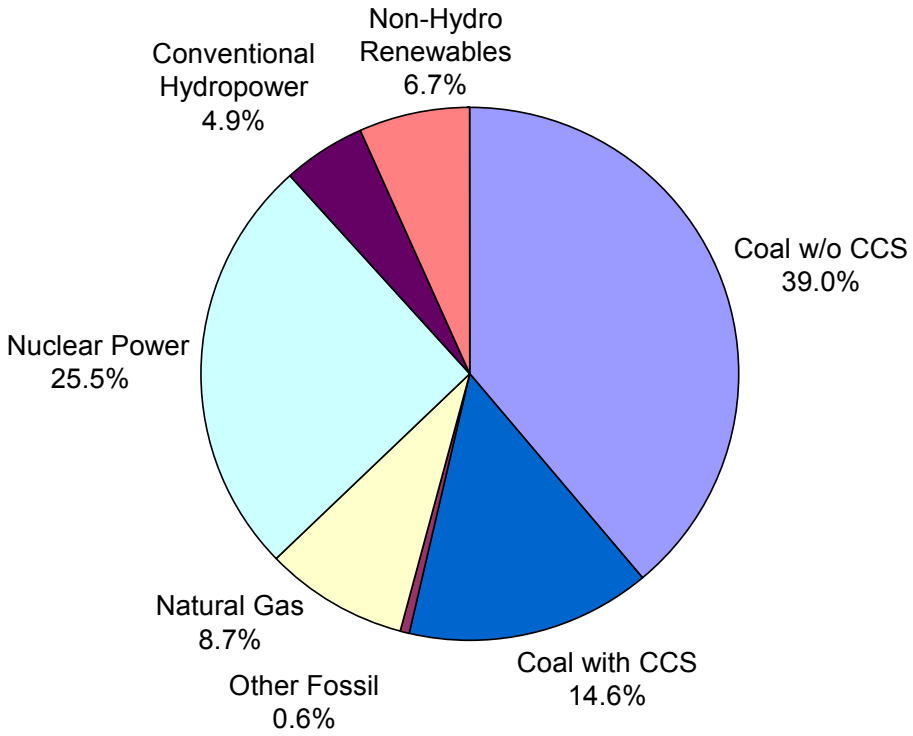
EIA Base Case*

5406 TWh



Advanced Technology Targets

5401 TWh



** Base case from EIA "Annual Energy Outlook 2007"*

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Initial Economic Results in Brief

Absent advanced electricity technologies, CO_2 constraints result in

- *Price-induced "demand destruction"*
- *Fuel switching to natural gas*
- *Higher electricity prices*
- *High cost to U.S. economy*

With advanced electricity technologies, CO_2 constraints result in

- *Growth in electrification*
- *Continued use of coal (w/CCS) and nuclear*
- *Lower, more stable electricity prices*
- *50-66% lower cost to U.S. economy*

Results insensitive to CO_2 constraints and capital cost assumptions

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CONCLUSION

Substantial reduction of GHG emissions without unreasonable costs together with reduced oil-gas dependency

IS POSSIBLE:

THE PATHWAY:
PARALLEL AND PRO-ACTIVE ACTION

1. Unleash the potential of energy efficiency
2. Develop a low-carbon electricity system by using all available options
3. Intelligent electrification of the economy
4. Consistent deployment and a market-oriented approach
5. Global cooperation on global issues