ELECTRIC POWER RESEARCH INSTITUTE

Electricity Technology in a Carbon-Constrained Future

February 2007

Steven Specker
President and CEO

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???

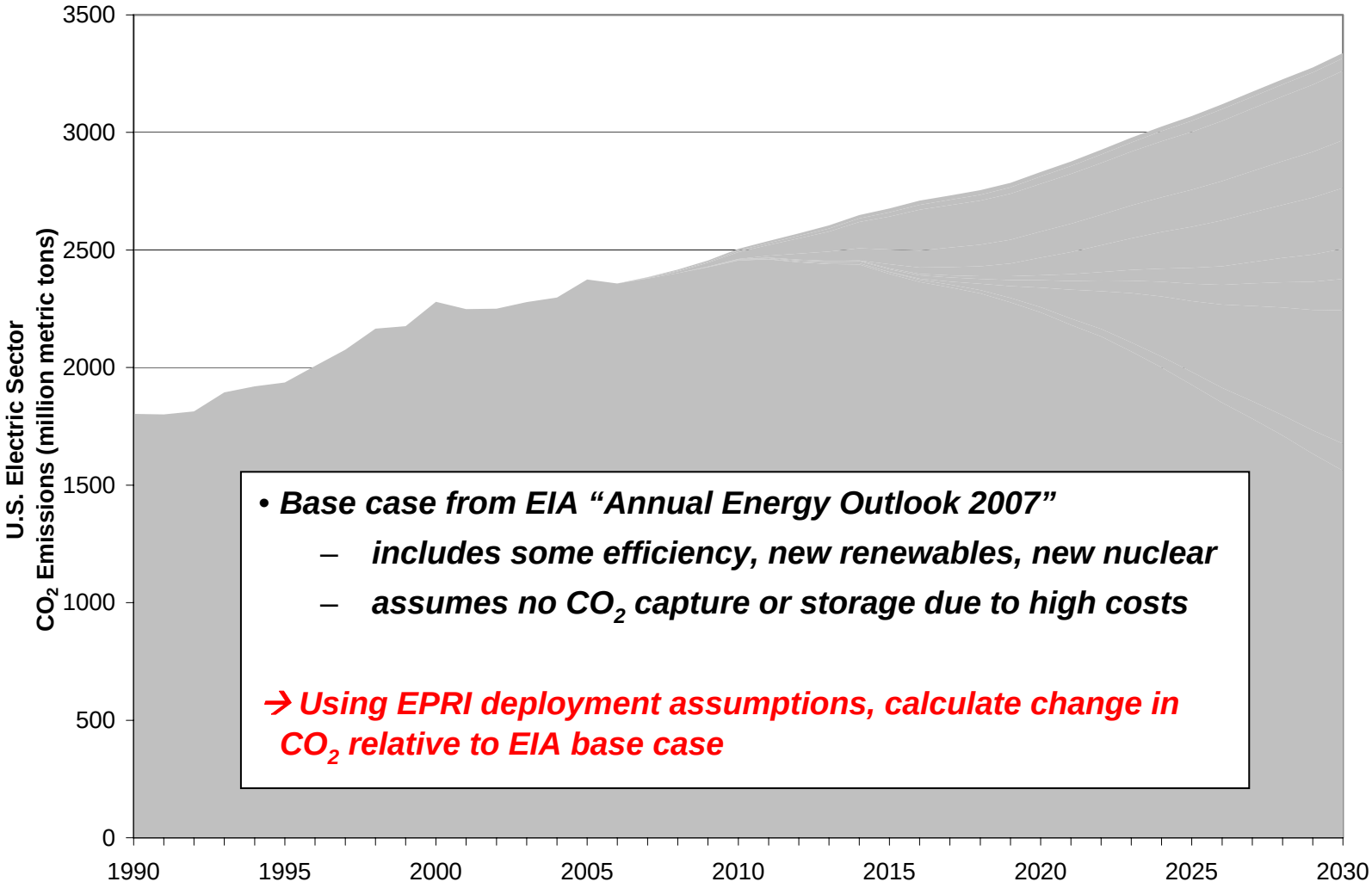
Approach

- At the request of its Board of Directors, EPRI was asked to estimate the technical potential for CO_2 emissions reductions from the U.S. electricity sector.

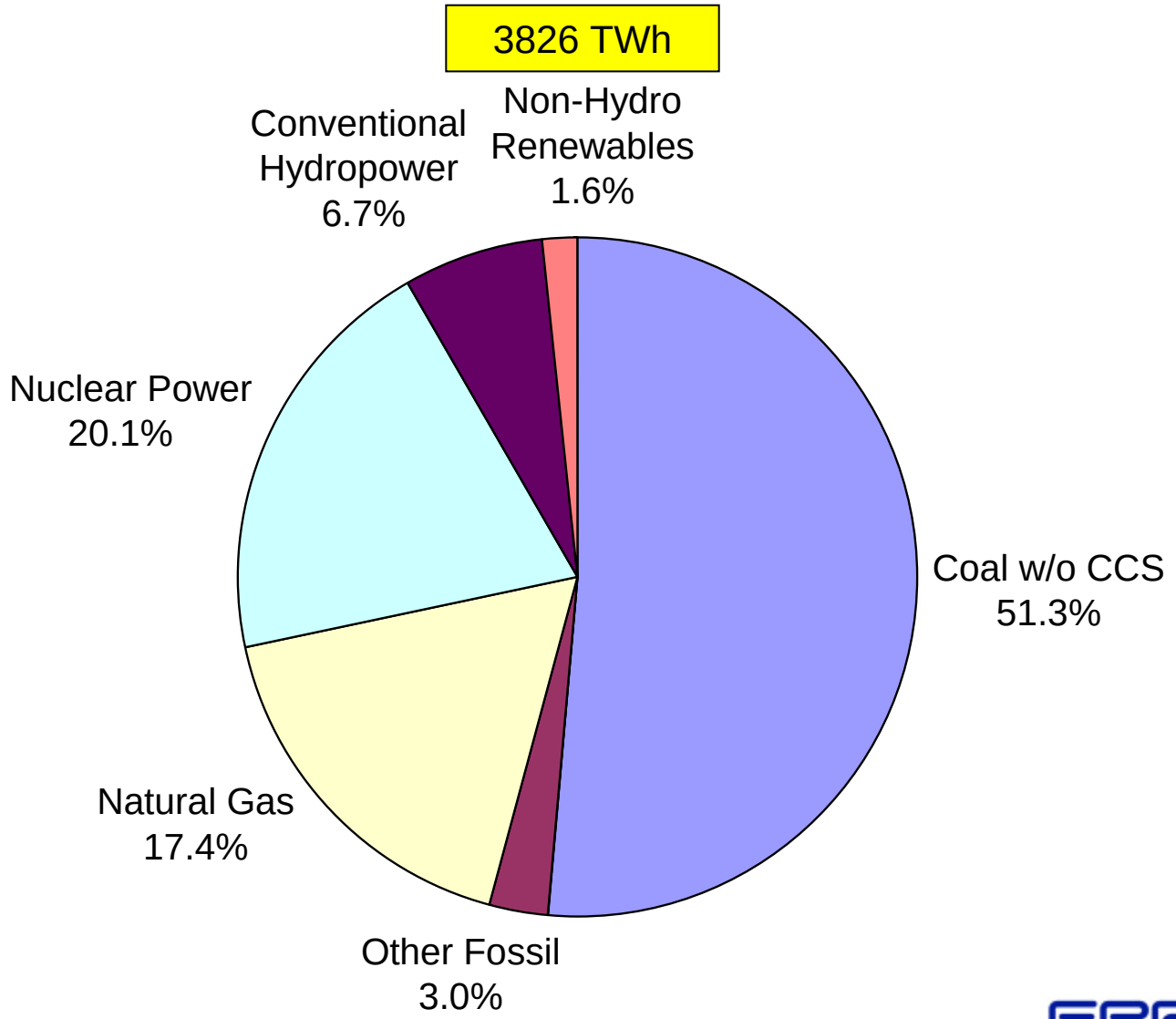
- EPRI developed 7 aggressive but potentially feasible technology deployment targets and estimated the CO_2 reductions that could result between now and 2030.
  - Potential regulatory and siting constraints were not considered.
  - Economic modeling of these targets is currently being conducted.

- **Conclusions:**
  - The technical potential exists for the U.S. electricity sector to significantly reduce its 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.

U.S. Electricity Sector CO_2 Emissions



Total U.S. Electricity Generation: 2005 EIA

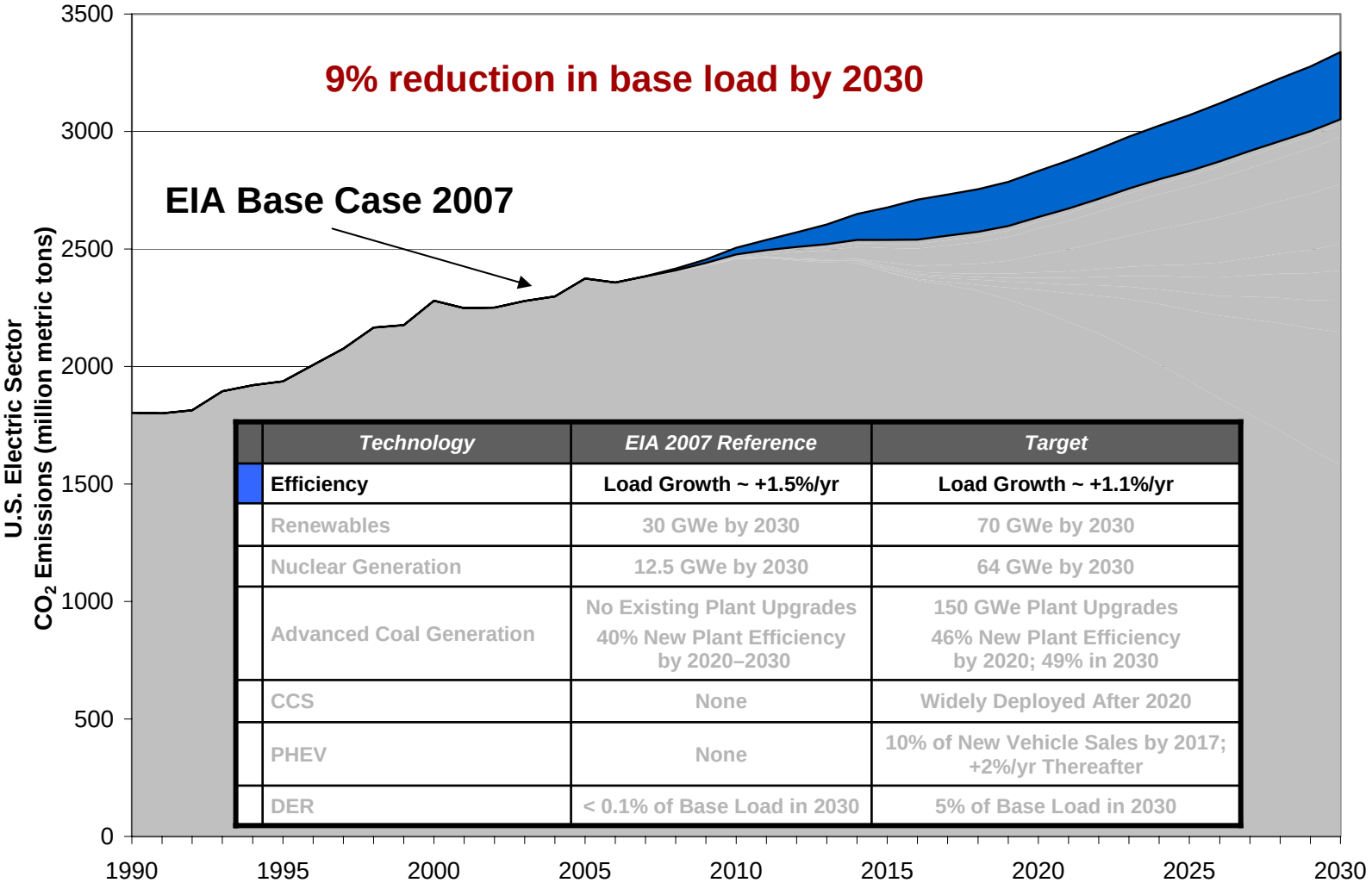


Technology Deployment Targets

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 potential regulatory and siting constraints. Additional economic modeling in progress

Benefit of Achieving Efficiency Target



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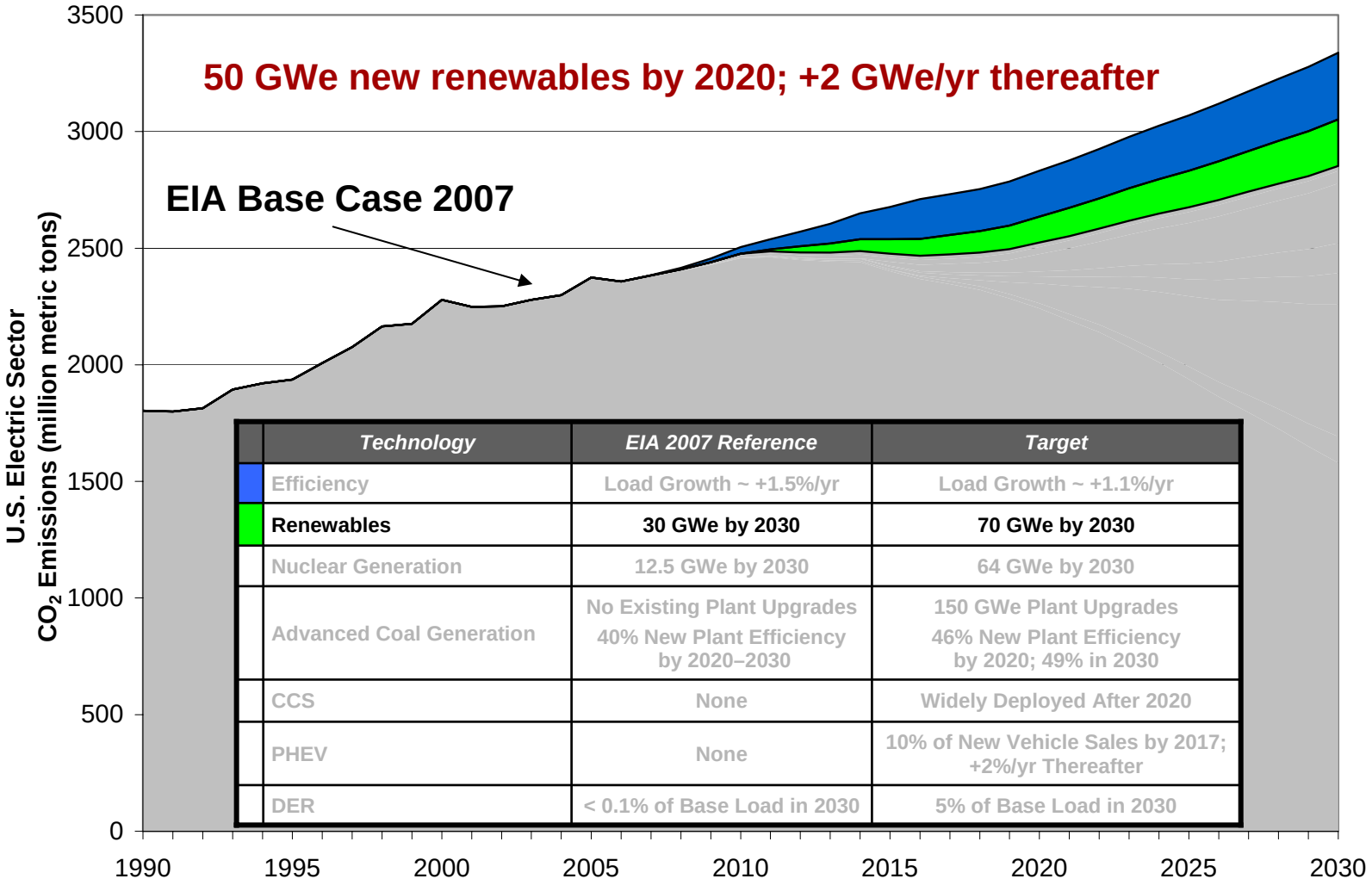
Benefit of Achieving Renewables Target



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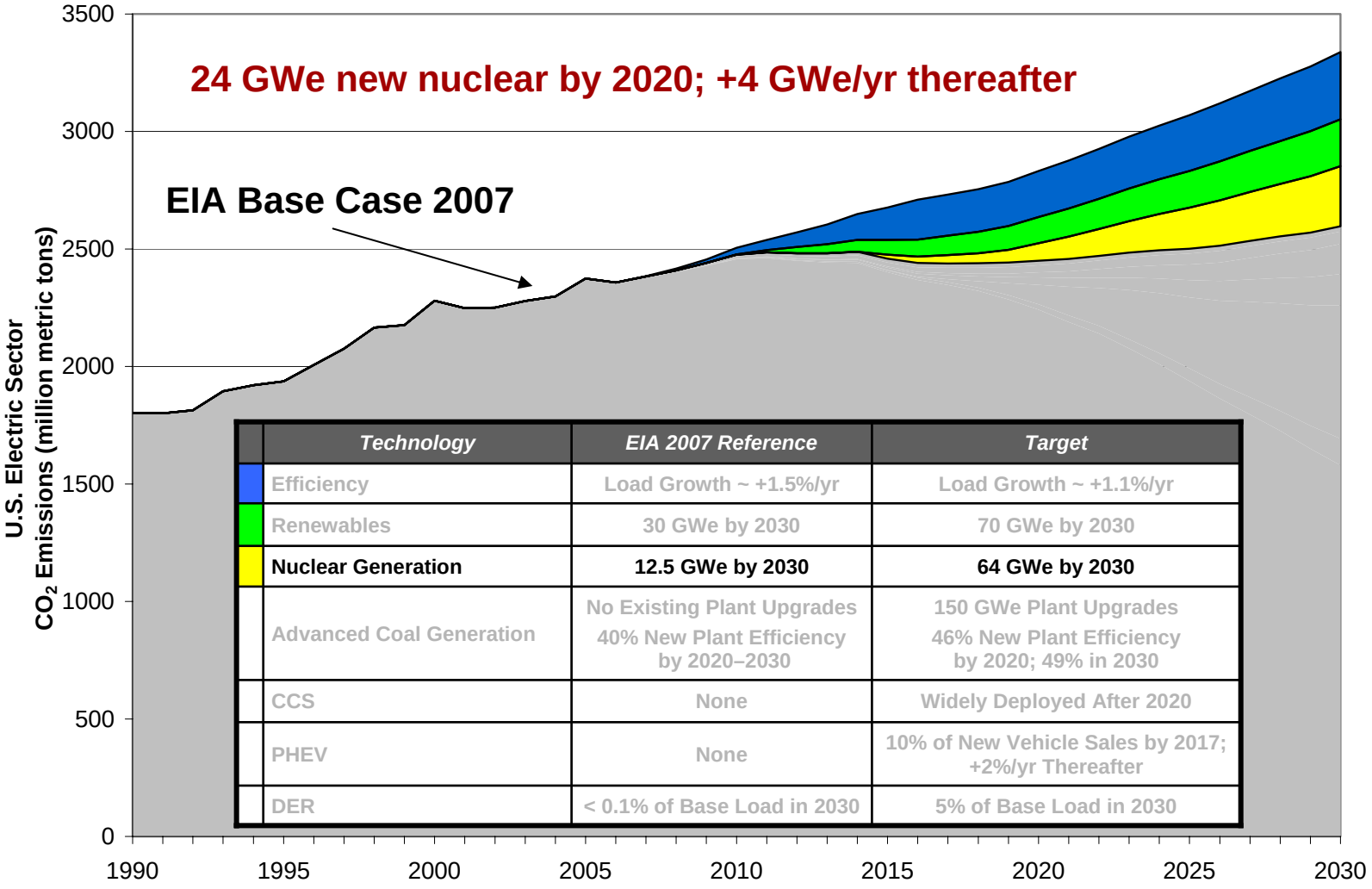
Benefit of Achieving Nuclear Generation Target



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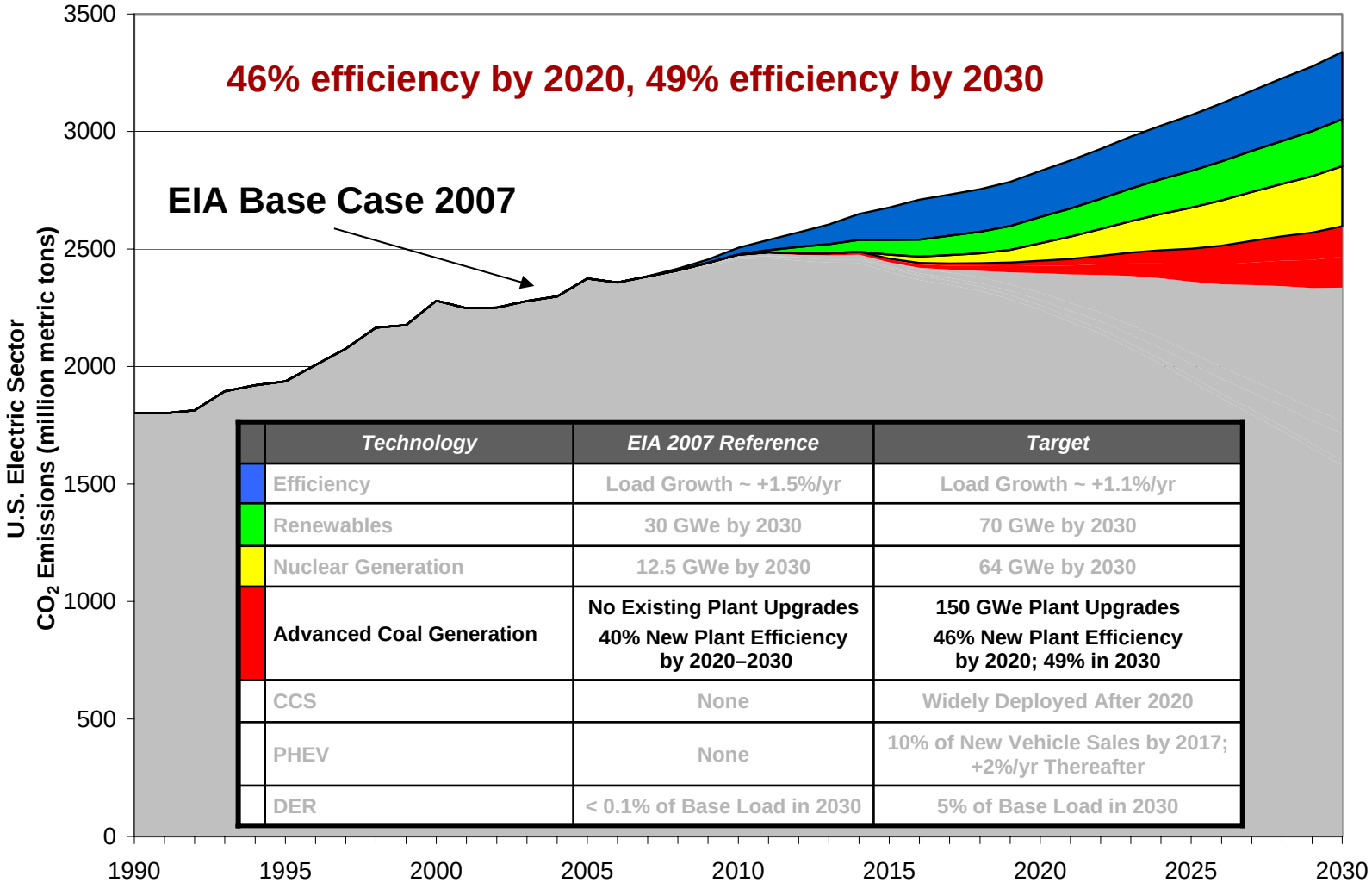
Benefit of Achieving Advanced Coal Generation Target



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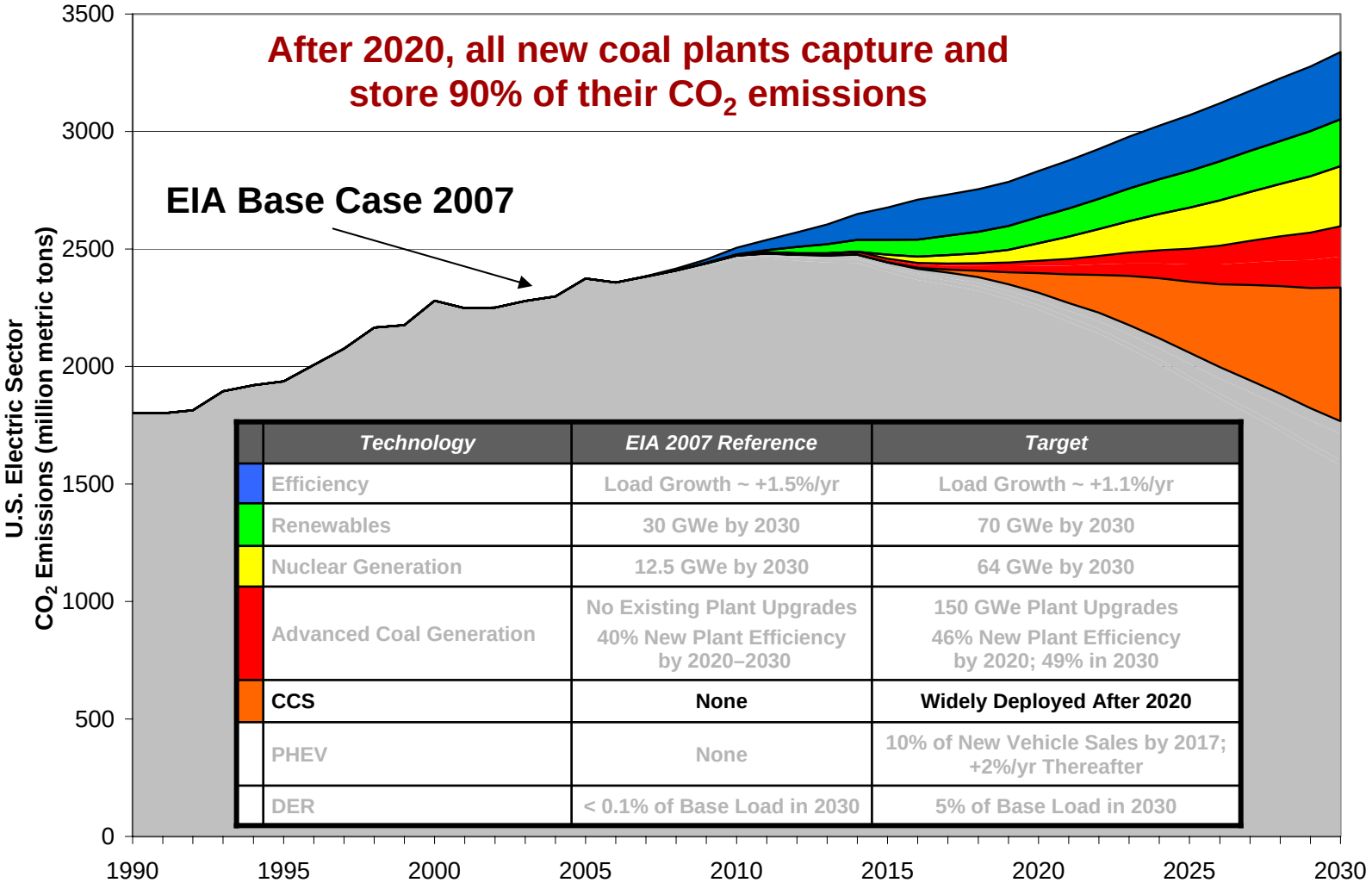
Benefit of Achieving the CCS Target



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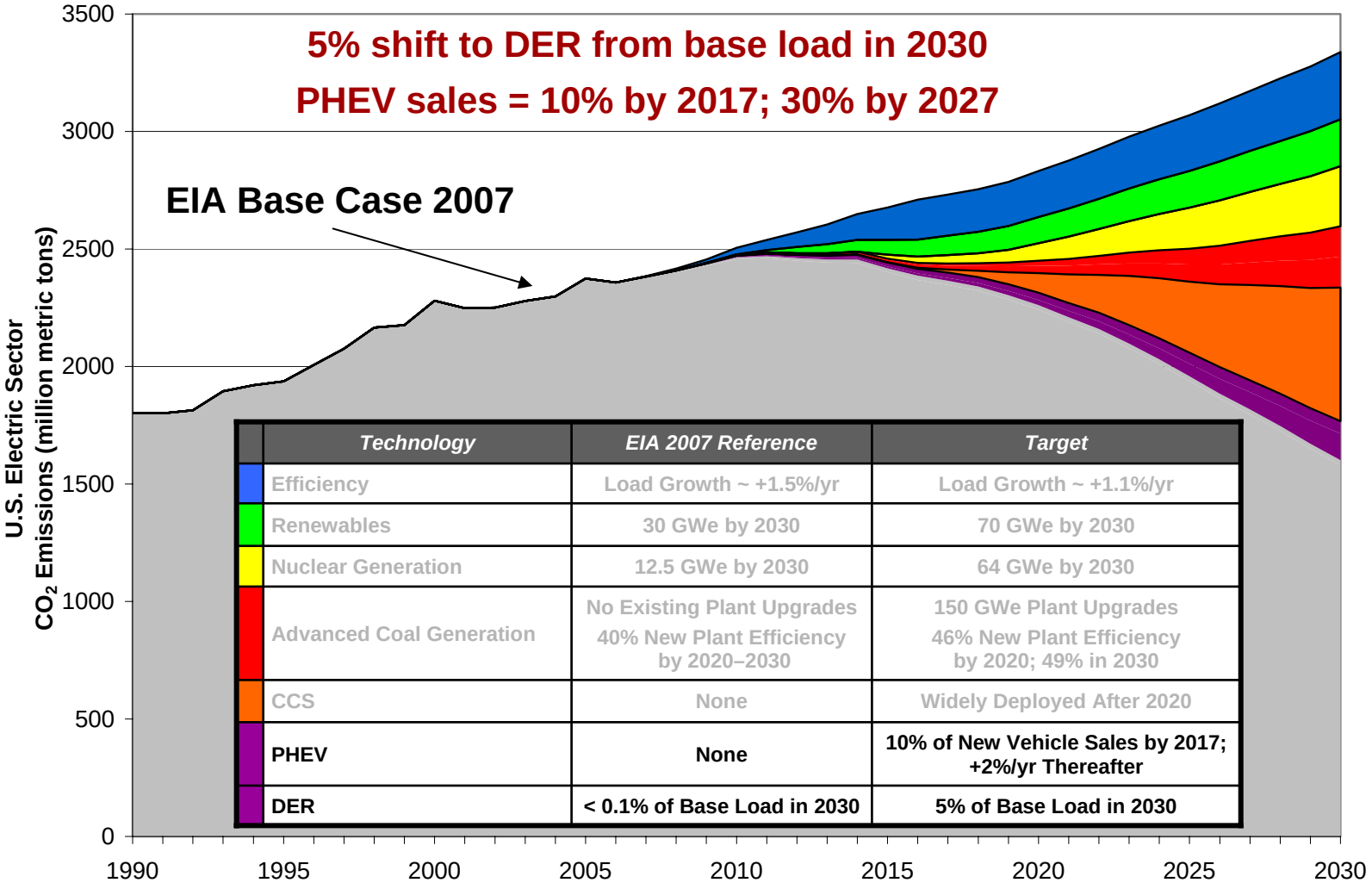
Benefit of Achieving PHEV and DER Targets



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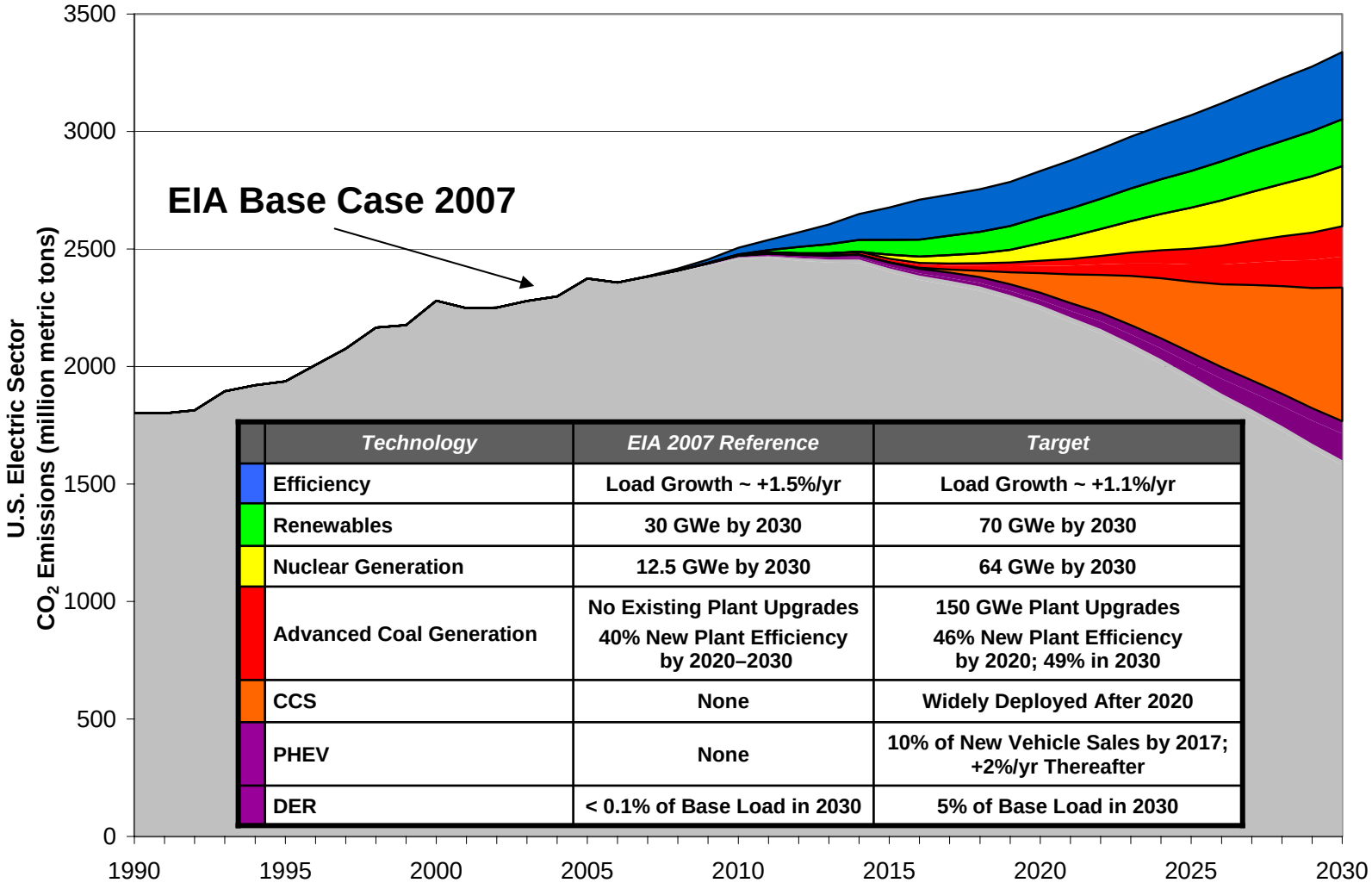
CO_2 Reductions … Technical Potential*



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** Achieving all targets is very aggressive, but potentially feasible.*

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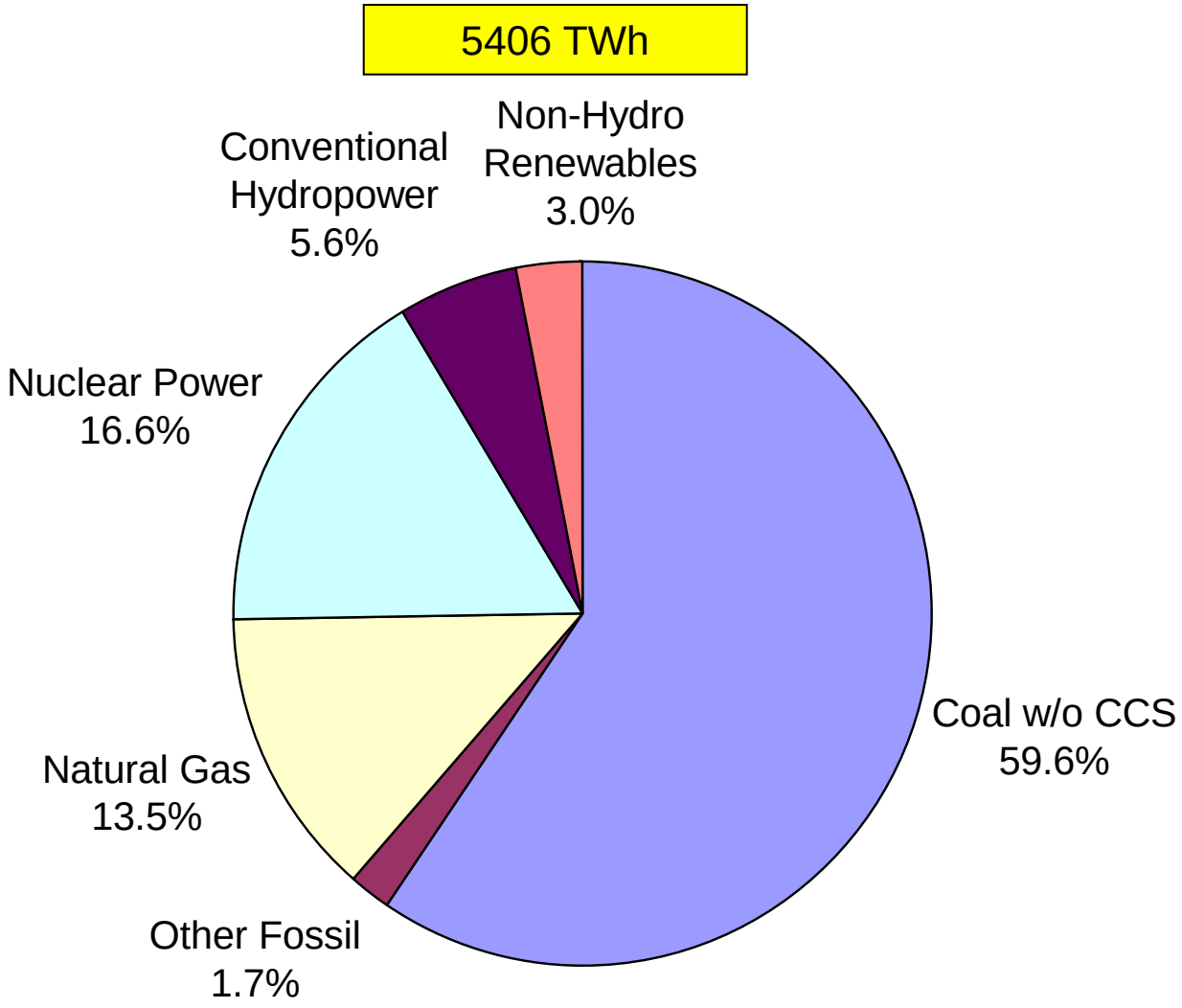
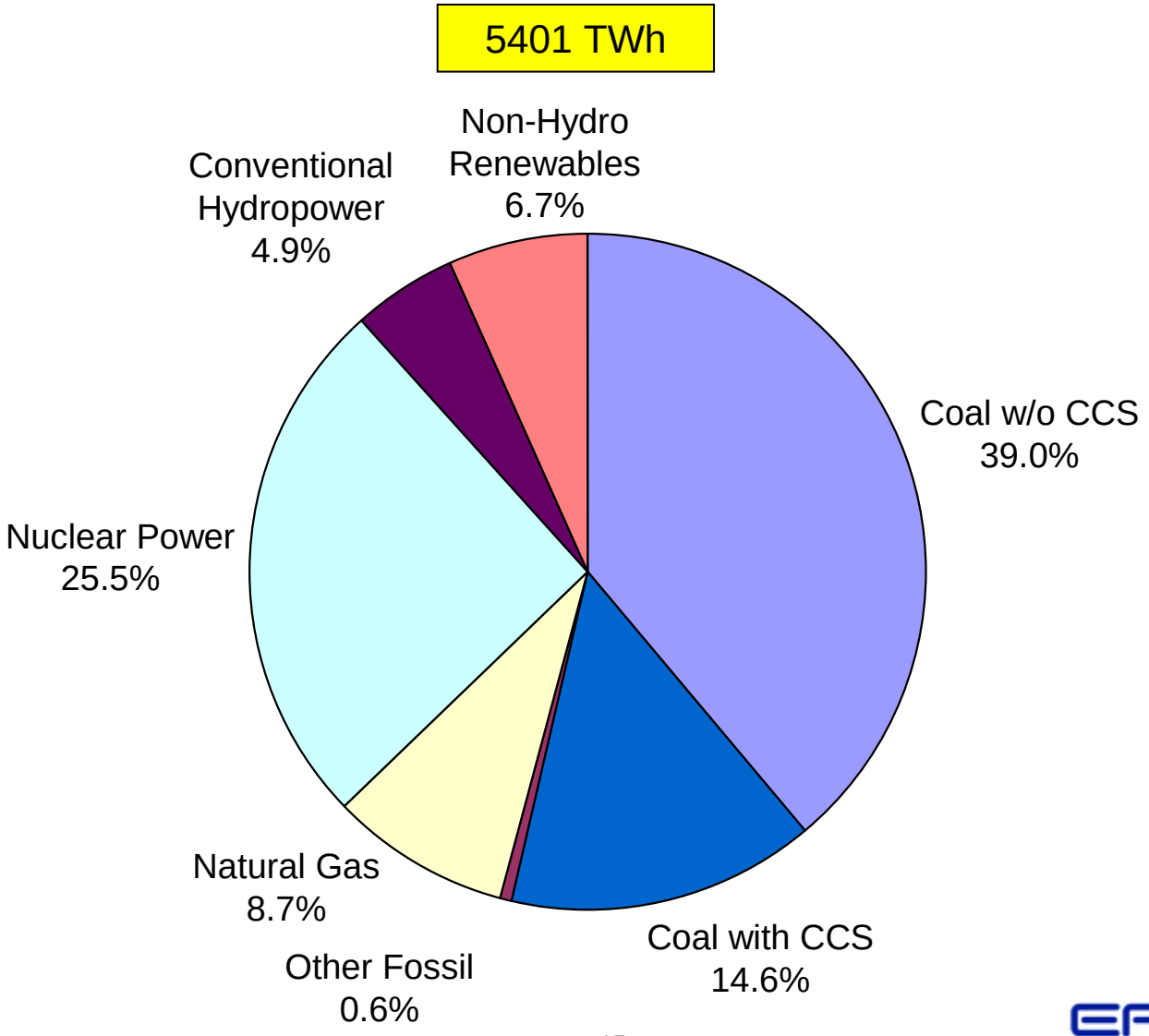
Total U.S. Electricity Generation: 2030 EIA Base Case



Total U.S. Electricity Generation: 2030 Advanced Technology Targets



Key Technology Challenges

The U.S. electricity sector will need ALL of the following technology advancements to significantly reduce CO_2 emissions over the coming decades:

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.