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USEA Dialogue on Promoting Energy Efficiency Through Deploying Combined Heat & Power Systems

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Revis James

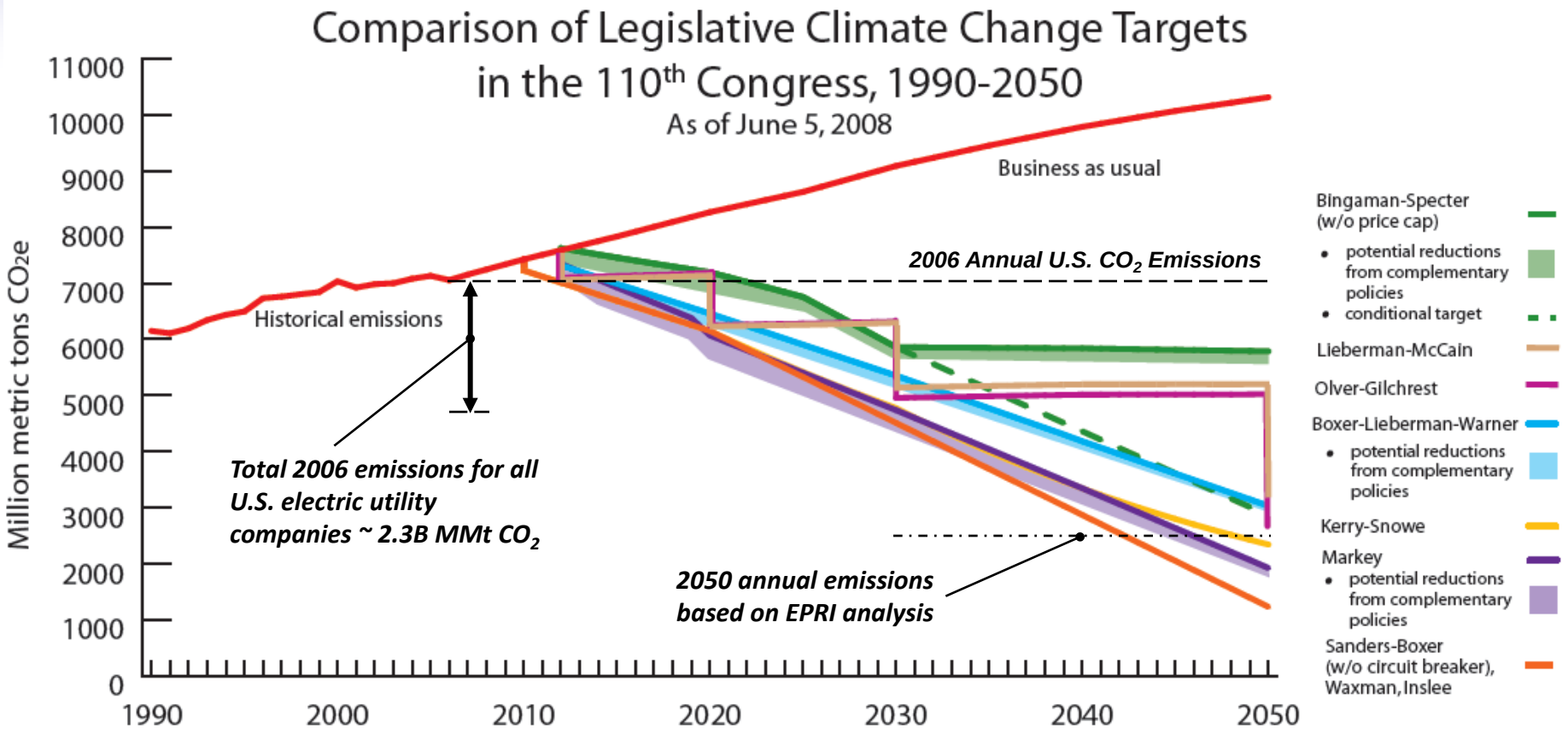
Director, Energy Technology Assessment Center

Dan Rastler

Program Manager, Distributed Energy Resources

Electric Power Research Institute

The Scale of Emissions Reductions



Source: World Resources Institute, "COMPARISON OF LEGISLATIVE CLIMATE CHANGE TARGETS", June 18, 2008, www.wri.org/usclimatetargets

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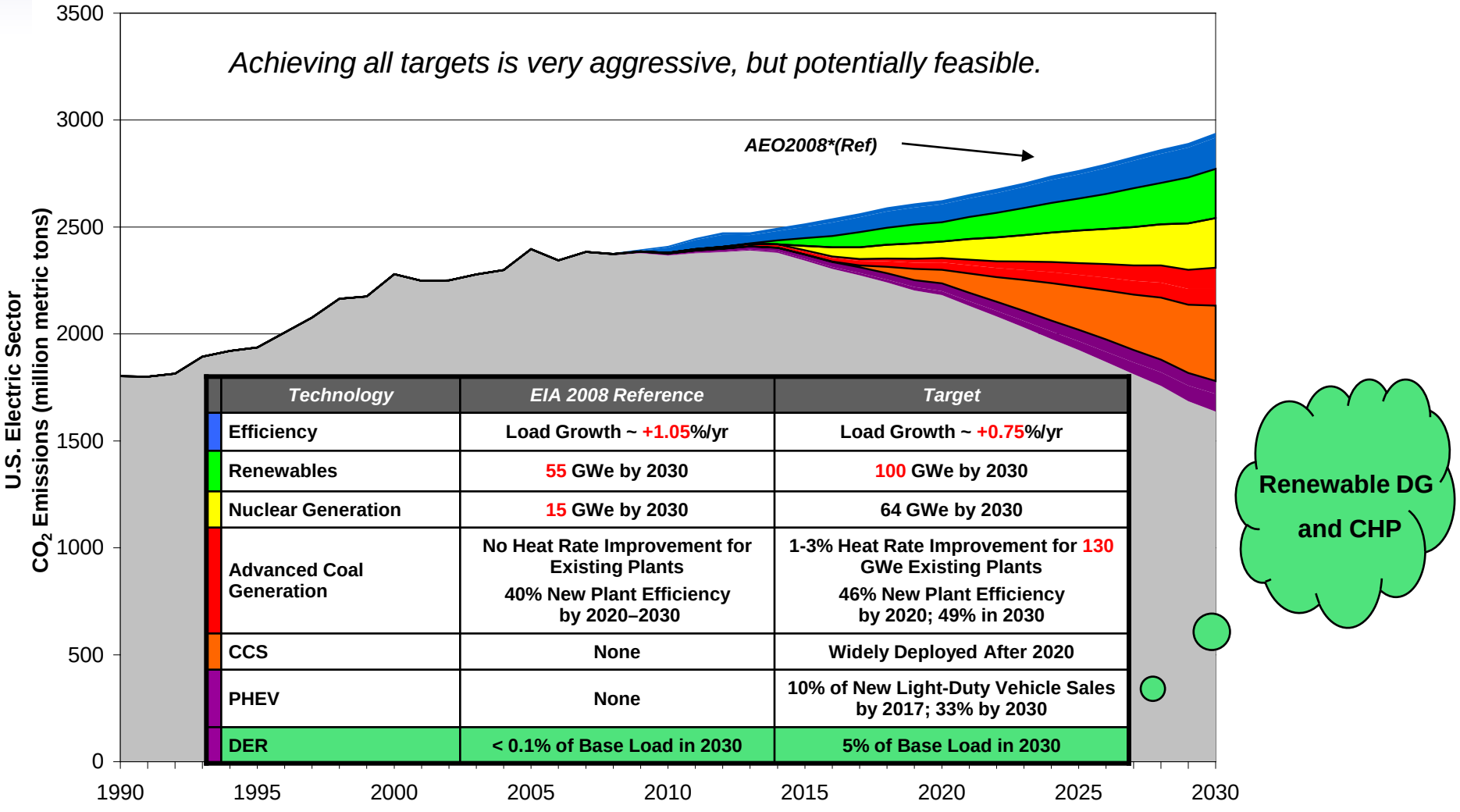
EPRI PRISM Analysis

A Full Portfolio of Options is Needed to Reduce the Electric Sector's Carbon Foot Print



Technology	EIA 2008 Reference	Target
Efficiency	Load Growth ~ +1.05%/yr	Load Growth ~ +0.75%/yr
Renewables	55 GWe by 2030	100 GWe by 2030
Nuclear Generation	15 GWe by 2030	64 GWe by 2030
Advanced Coal Generation	No Heat Rate Improvement for Existing Plants 40% New Plant Efficiency by 2020–2030	1-3% Heat Rate Improvement for 130 GWe Existing Plants 46% New Plant Efficiency by 2020; 49% in 2030
CCS	None	Widely Deployed After 2020
PHEV	None	10% of New Light-Duty Vehicle Sales by 2017; 33% by 2030
DER	< 0.1% of Base Load in 2030	5% of Base Load in 2030

**Energy Information Administration (EIA) Annual Energy Outlook (AEO)*

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Implications for CHP

- PRISM analysis assumes that 5% of total electricity consumption in 2030 will be met by distributed energy resources (DER).
  - Roughly 230 TWh of generation
  - Comparable to 2006 consumption of Florida (3rd highest in U.S.)

- By 2030 avoids annual emissions of roughly 60 million metric tons of CO_2.
  - Offsets ~75% of added emissions created by PHEVs.
  - Comparable to benefit from assumed heat rate improvements for existing coal plants.

System Insights Regarding CHP

- CHP has the potential to create much-needed flexibility in grid operations
  - For example, 5% distributed generation helps offset narrowing margins between capacity and peak loads.
  - Flexibility to shift between grid and distributed generation for large loads typically served by CHP.

- Maximizes value of natural gas via higher overall efficiencies.

- Helps provide generation diversity which increases system security/reliability.

Energy System Modeling: CHP

- EPRI analysis using NEMS modeling system (same as that used by EIA).
- By 2030, results in CHP/DG deployment of 8-16% of capacity, depending on CHP technology development and cost assumptions.
- Cumulative avoided CO_2 emissions on the order of 600 million metric tons
  - ~8% of 2006 U.S. emissions
- These results generally consistent with International Energy Agency Analysis.

Conclusions

- The scale of technology expansion and transformation will be huge.
- Under a CO_2 emissions reduction policy, electricity production costs will increase and Gross Domestic Product (GDP) will be less.
- No one technology will be a silver bullet – a portfolio of technologies will be needed.
- CHP is likely to play a significant role in the portfolio.
- Much of the needed technology isn't available yet – substantial R&D, demonstration is required.
- A diverse, full technology portfolio
  - lowers GDP impact of CO_2 emissions constraints
  - Decarbonized electricity will play a vital role in reducing emissions outside of the electricity sector.

Together...Shaping the Future of Electricity

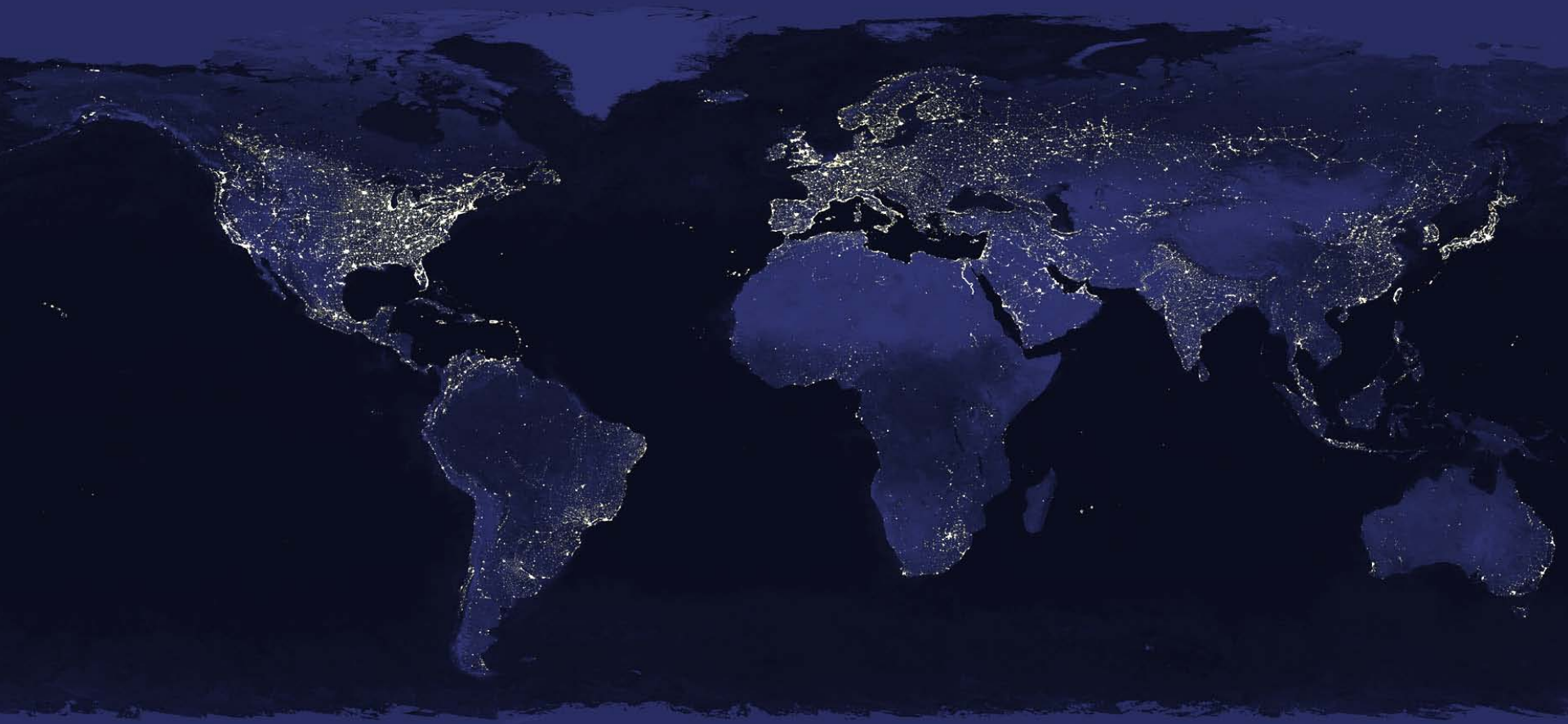

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Image courtesy of *NASA Visible Earth*