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CO₂ Capture from Coal-Fired Power Plants

John Wheeldon (jowheeld@epri.com)

McIlvaine Hot Topic Hour Webcast

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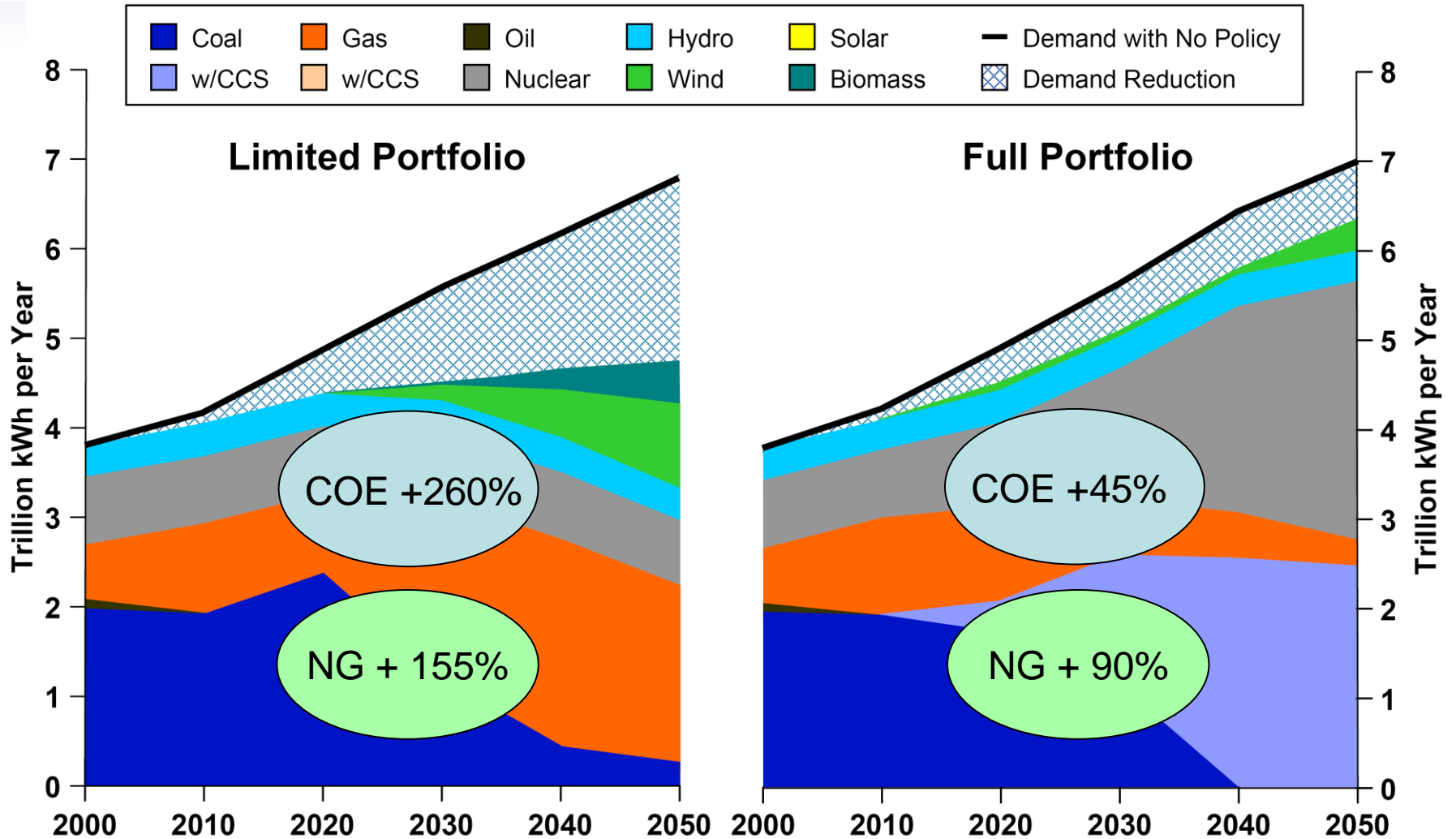


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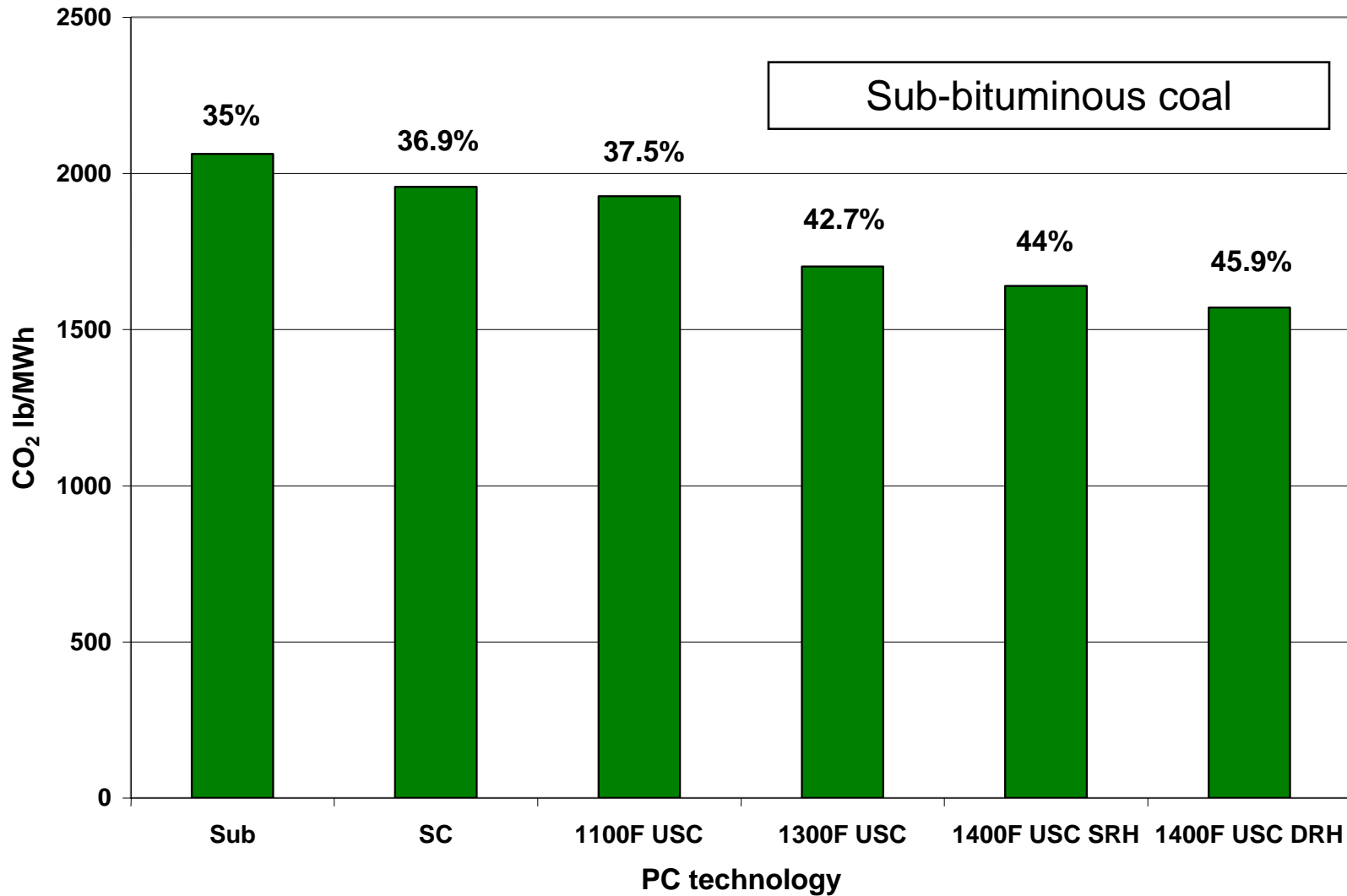
The Challenge

- Coal-fired plants are becoming increasingly difficult to permit primarily because of concerns over CO₂ emissions
 - New plants made carbon neutral by closing down older coal plants: some plan to convert coal-fired boilers to gas-fired
 - Increased conservation and efficiency measures with move to NGCC and wind turbines for generation.
- EPRI analysis shows that coal with CO₂ capture and storage (CCS) is essential to keeping electricity affordable.
- CCS technology not yet commercially available and must evolve quickly if the dual objectives of limiting CO₂ emissions and sustaining economic well being are to be achieved.

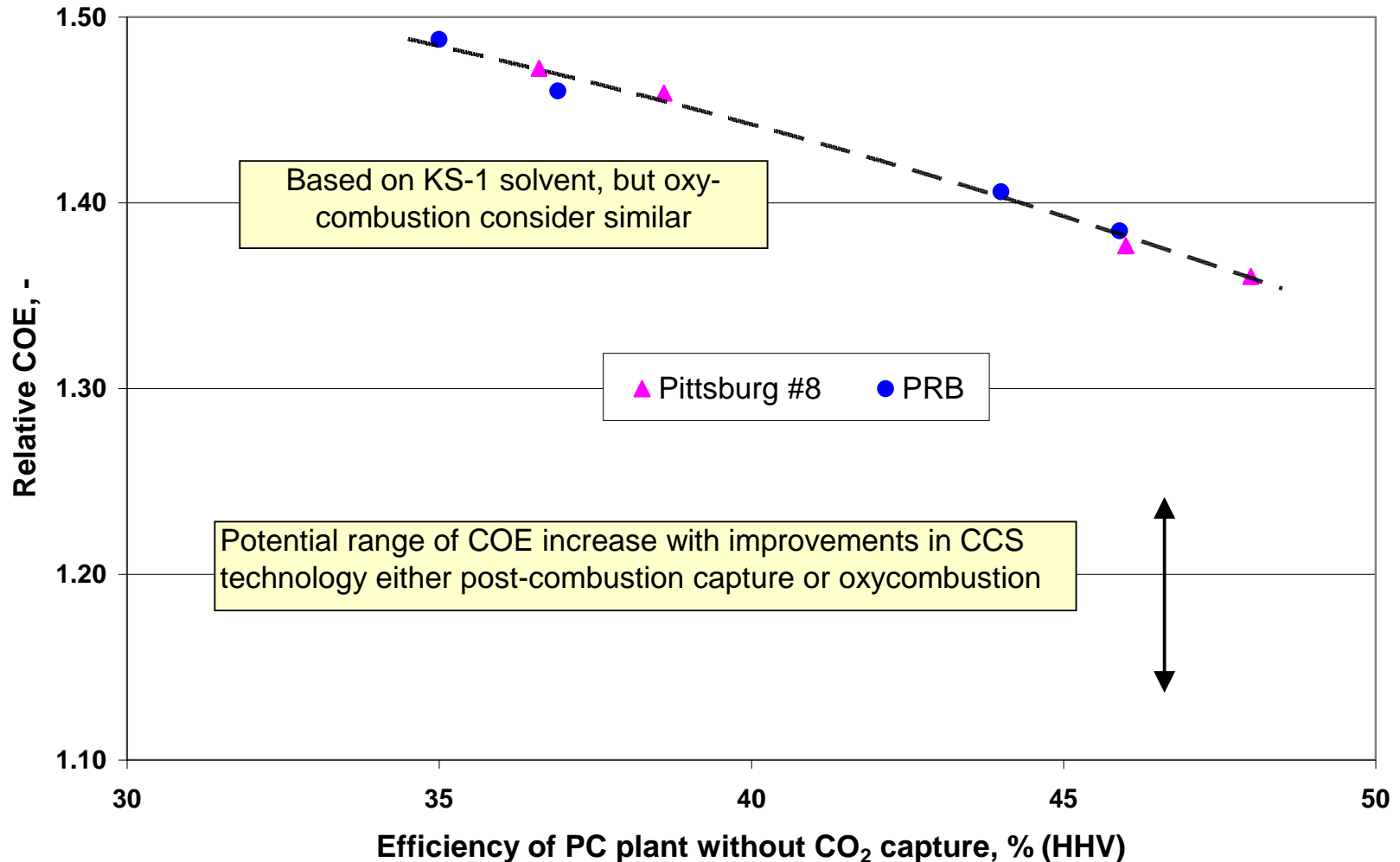
EPRI Merge Analysis: Effect on Energy Costs



Two Percent Increase in Efficiency Results in Five Percent Decrease in CO₂ Emissions



When CO₂ Capture Included Higher PC Efficiency Lowers COE

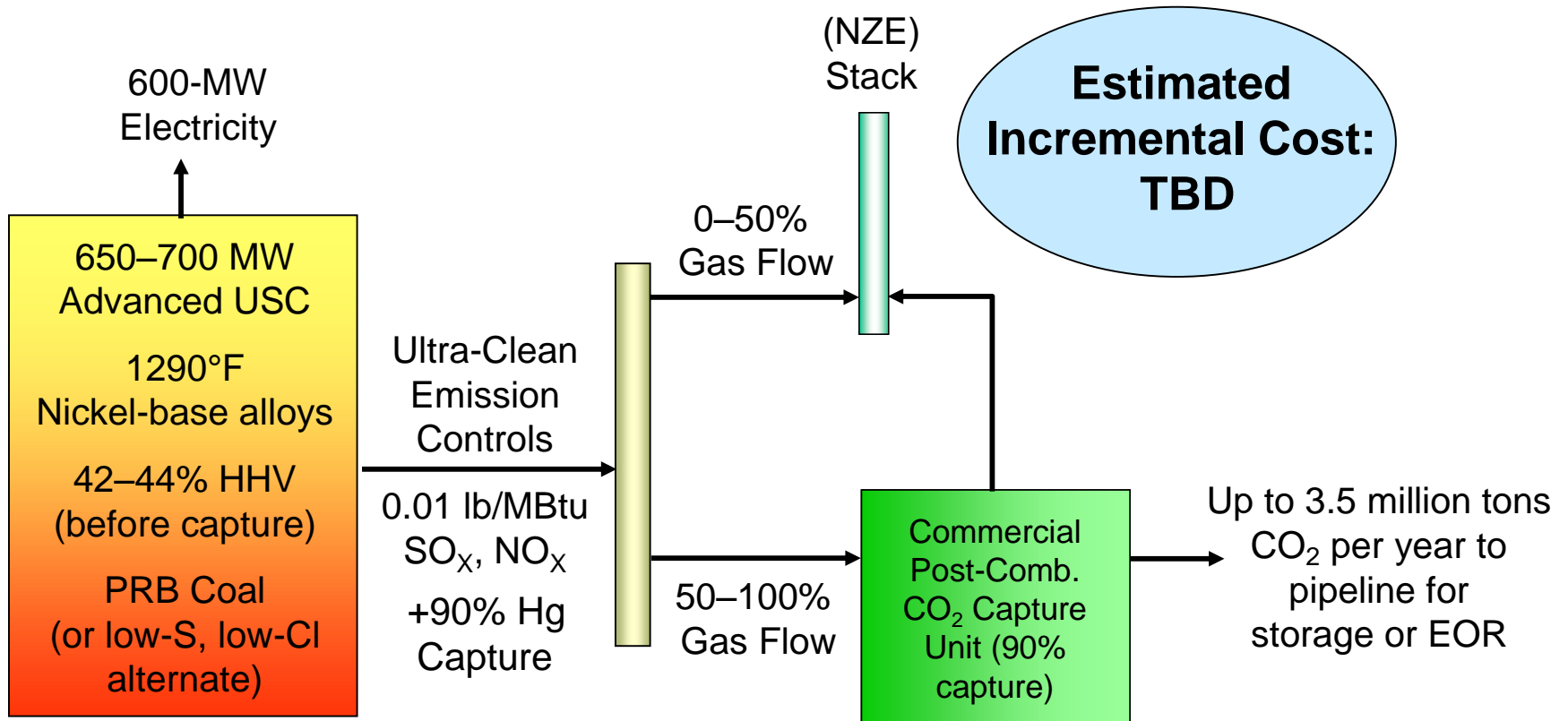


Capture only. No allowance for transportation and storage

Progressing to Higher Steam Conditions

- Main steam temperatures perhaps as high as 1160 F can be accommodated using ferritic steels
 - To go beyond 1160 F will require high nickel alloys.
- AD700 project in Europe has qualified materials and components for use in a USC PC plant operating at 1290 F (700 C)
 - Design in progress and construction may start 2010.
- DOE supporting a similar program in support of USC PC plant operating at 1400 F (760 C)
 - No plant currently proposed.
- EPRI has proposed UltraGen Initiative to accelerate USC technology development with near-zero emissions of SO₂ and NO_x and integrated with CCS.
 - UltraGen I (1120°F), UltraGen II (1290°F), UltraGen III (1400°F)

UltraGen II



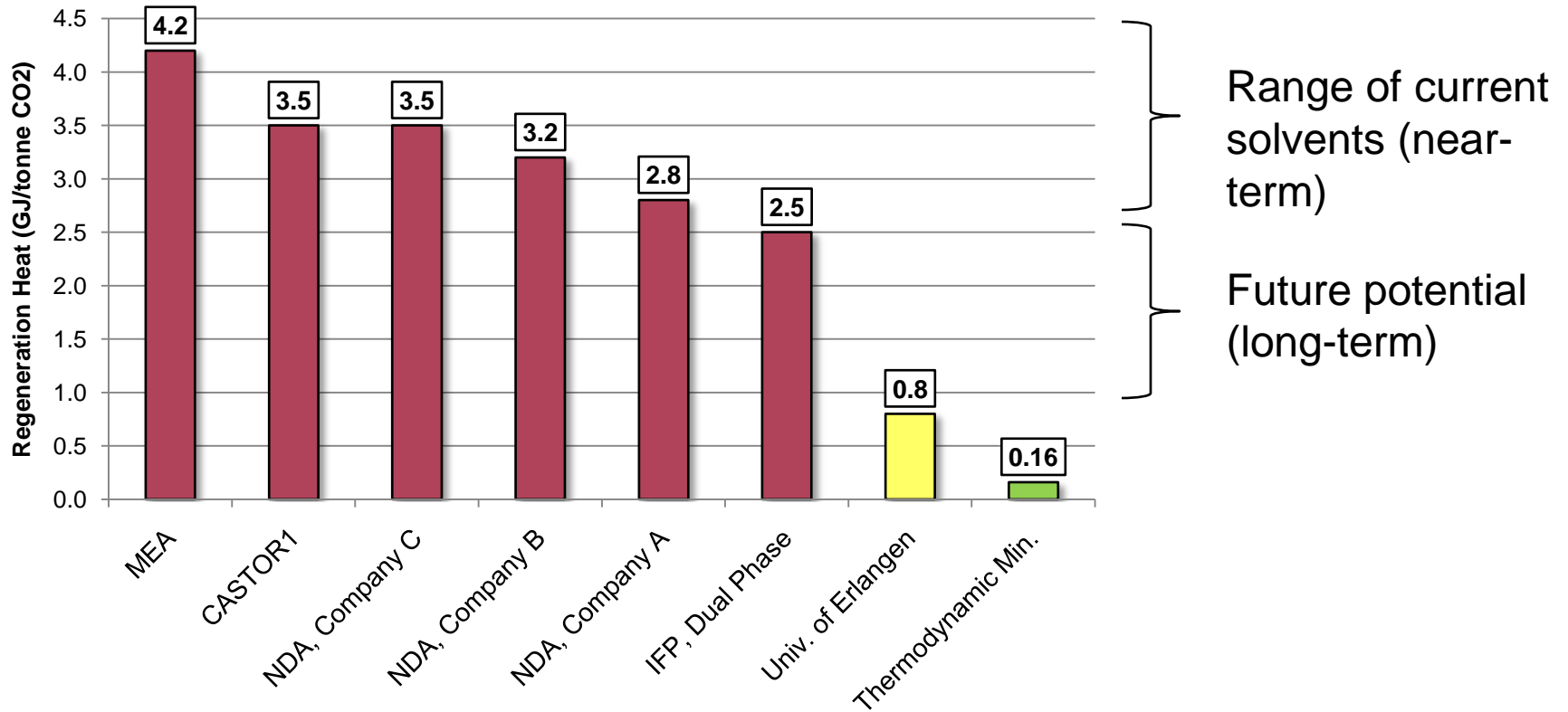
50% capture results in CO₂ emissions of around 900 lb/MWh

Improvements to CO₂ Capture Technologies

- Post combustion capture
 - Amines: MEA, MHI's KS-1, Cansolv, TNO Coral
 - Ammonia: Powerspan ECO2, chilled ammonia
 - Others: ionic liquids
 - Also research into improved gas-liquid contactors.
 - Solid absorption: RTI sodium carbonate, Toshiba lithium silicate
 - Biological fixation producing algae
 - Membrane technology
 - Cryogenic: “Frosting” CO₂
- Oxy-combustion
 - Process under development for PC and CFB
 - More effort to lower cost and energy consumption of oxygen production:
 - Alternatives to ASU include Air Product's Ion Transport Membrane and Praxair's Oxygen Transport Membrane but more options required

EPRI Analysis of Relative Solvent Performance

Ranges of Regeneration Energy



Closing Comments

- There is no single solution to achieving cost-effective CCS
 - Technologies still evolving stimulated by societal demands
 - Combustion-based technologies will play a significant role
 - Potential to retrofit CCS to older units
 - Gasification not the universal solution it was once thought to be.
- Coal type, plant location, and power producer's business model are all shown to influence technology selection
 - Power producers need options allowing selection of the most appropriate technology for their specific circumstances.
- Oxy-combustion and post-combustion capture are evolving rapidly and efficiency and cost improvements are being identified
 - Demonstration projects for both technologies needed to prove commercial performance.



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