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Cost and Performance of Generation Technologies

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Energy and Climate Change Research Seminar
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Integrated Generation Technology Options Report Overview

- Annual report published under EPRI's Strategic Energy Analysis work
- EPRI's public cost and performance numbers
  - Based on more detailed engineering and economic evaluations conducted at EPRI
  - Feeds into other EPRI analyses
- Overview of each technology
- Overview of trends in the electricity industry

EPRI report 1026656 available for download at www.epri.com

Levelized Cost of Electricity Analysis – Objectives

- Utilize EPRI capital cost data and methodologies to calculate levelized costs of electricity (LCOEs) in constant 2011 $
  - Incorporate key assumptions needed for calculations – capital cost, fuel cost, fixed and variable O&M, fuel type and energy content, capacity factor, cost of money
- Provide a generic basis for comparison of technologies for baseload and renewable generation
- Evaluate sensitivities of LCOE to potential CO_2 costs and other parameters

Levelized Cost of Electricity Analysis – Capital Cost Estimate Basis

- Capital costs are reported as Total Capital Required
  - Includes Total Plant Cost, Owner's Costs, and Interest During Construction
- Mercury*, SO_x/H_2S, NO_x, and particulate matter removal are included in PC and IGCC technologies; NO_x removal is included in NGCC technology
- All thermal plant cost and performance estimates assume closed-cycle wet cooling tower

* New source Mercury and Air Toxics Standards (MATS) currently under review are not explicitly addressed.

Levelized Cost of Electricity Analysis – Capital Cost Estimate Basis (cont.)

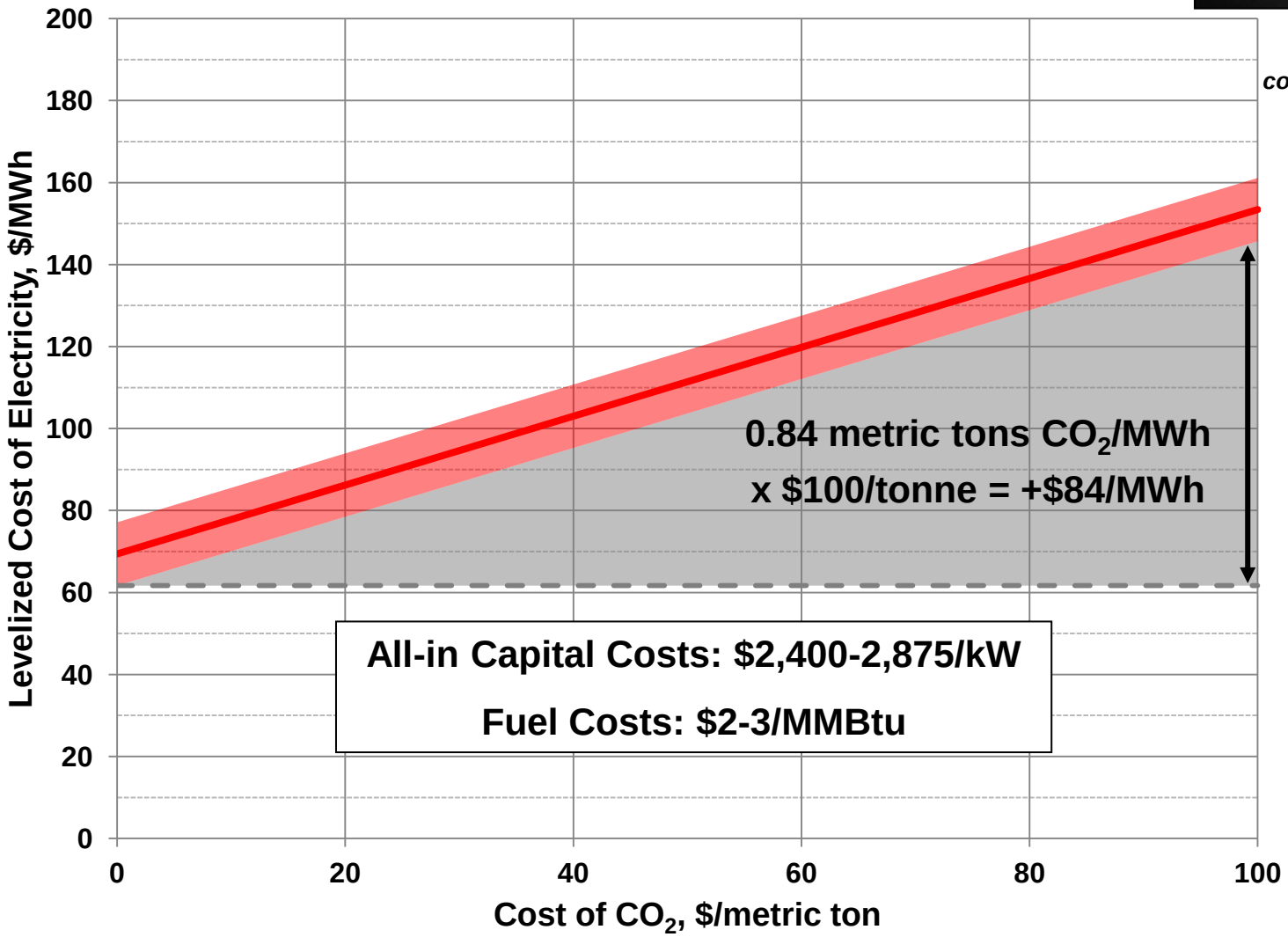
- Generic cost estimates excluding site-specific assumptions
- Cost estimate assumes mature technology
  - Plant is assumed to operate as designed (no allowance for field modifications)
  - Extra costs for 1st-of-a-kind demonstration not included
- Cost ranges represent a range of potential plant configurations and equipment types included in EPRI studies and are not intended to indicate an uncertainty range

Levelized Cost of Electricity Analysis – Assumptions

- All baseload technologies are assumed to have an 80% capacity factor, except for nuclear which has a 90% capacity factor.
- Non-dispatchable renewables assume a range of capacity factors based on a range of resource availability assumptions.
- No production or investment tax credits assumed for any technologies.
- No integration costs (e.g. costs associated with additional reserves, balancing, conventional generation cycling, etc.) included for non-dispatchable technologies.

Near-Term: 2015

Pulverized Coal (PC) – 2015



All costs are in constant Dec 2011$

LCOE is shown for high level comparison purposes. Actual plant investment decisions are affected by a number of other project specific considerations and caution should be used when comparing technologies based on LCOE. See Appendix A of report 1026656 for more details.

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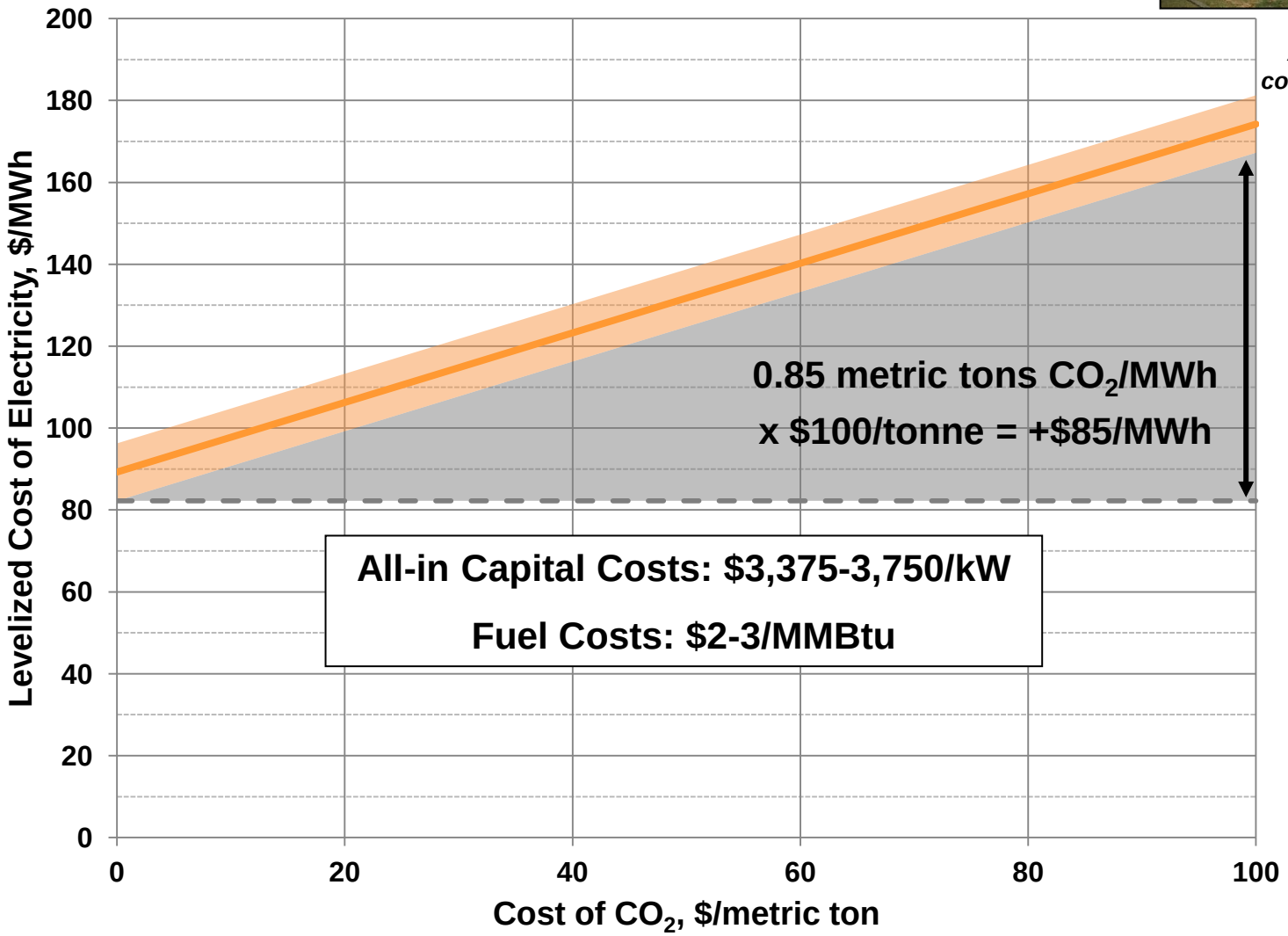
Integrated Gasification Combined Cycle (IGCC) – 2015



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Natural Gas Combined Cycle (NGCC) Fuel Cost Sensitivity Comparison – 2015

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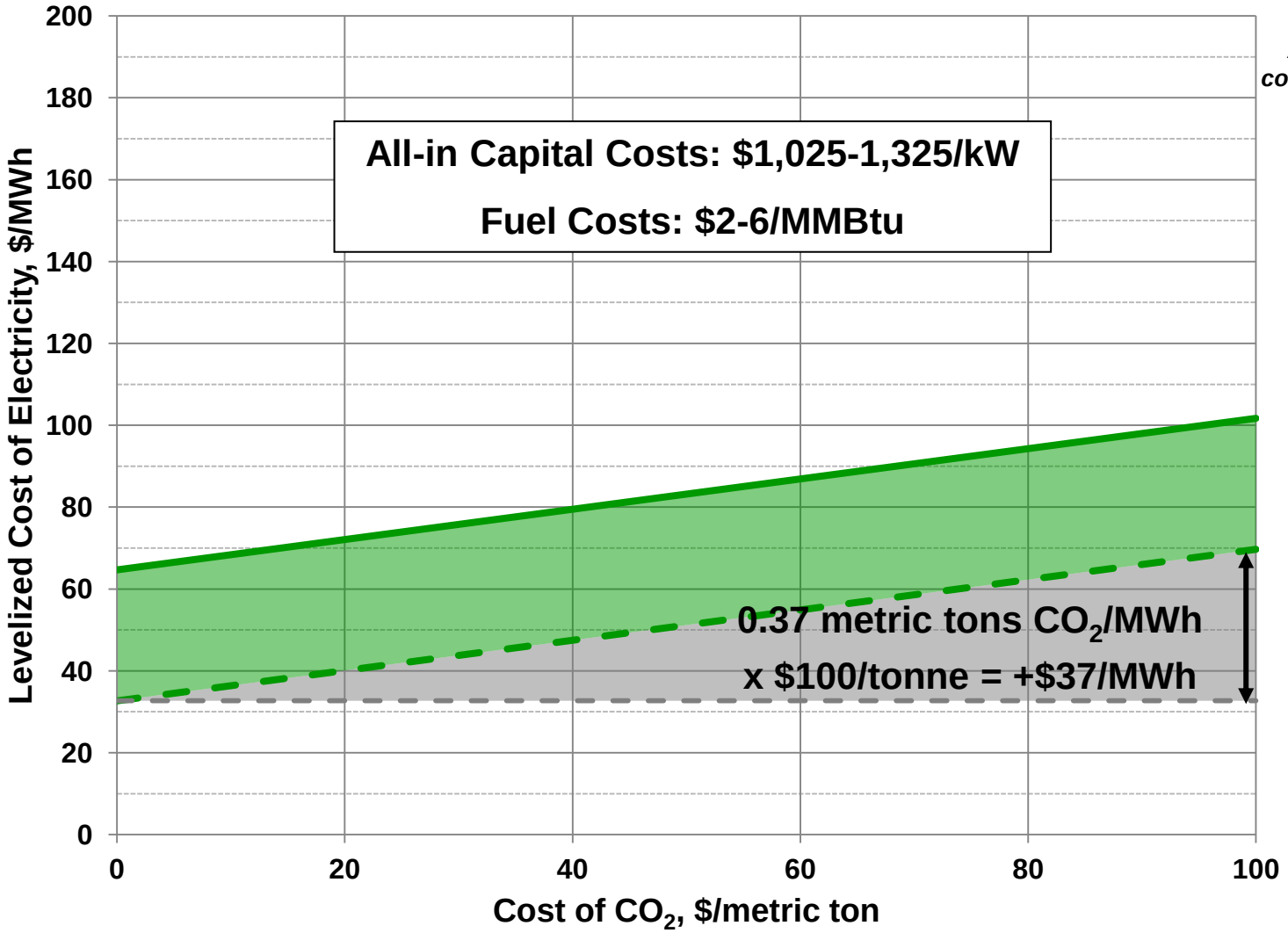

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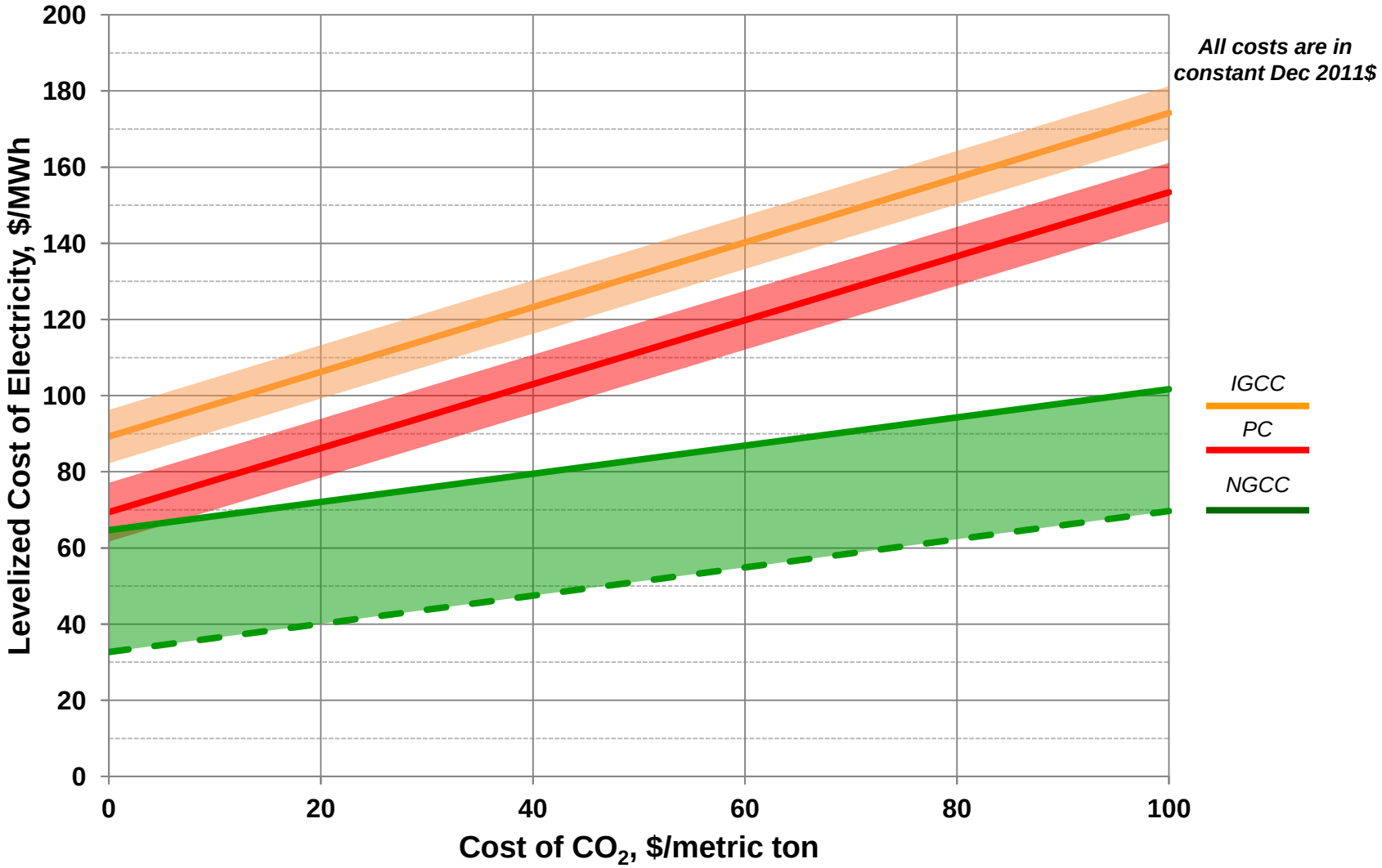
PC, IGCC, NGCC Comparison – 2015





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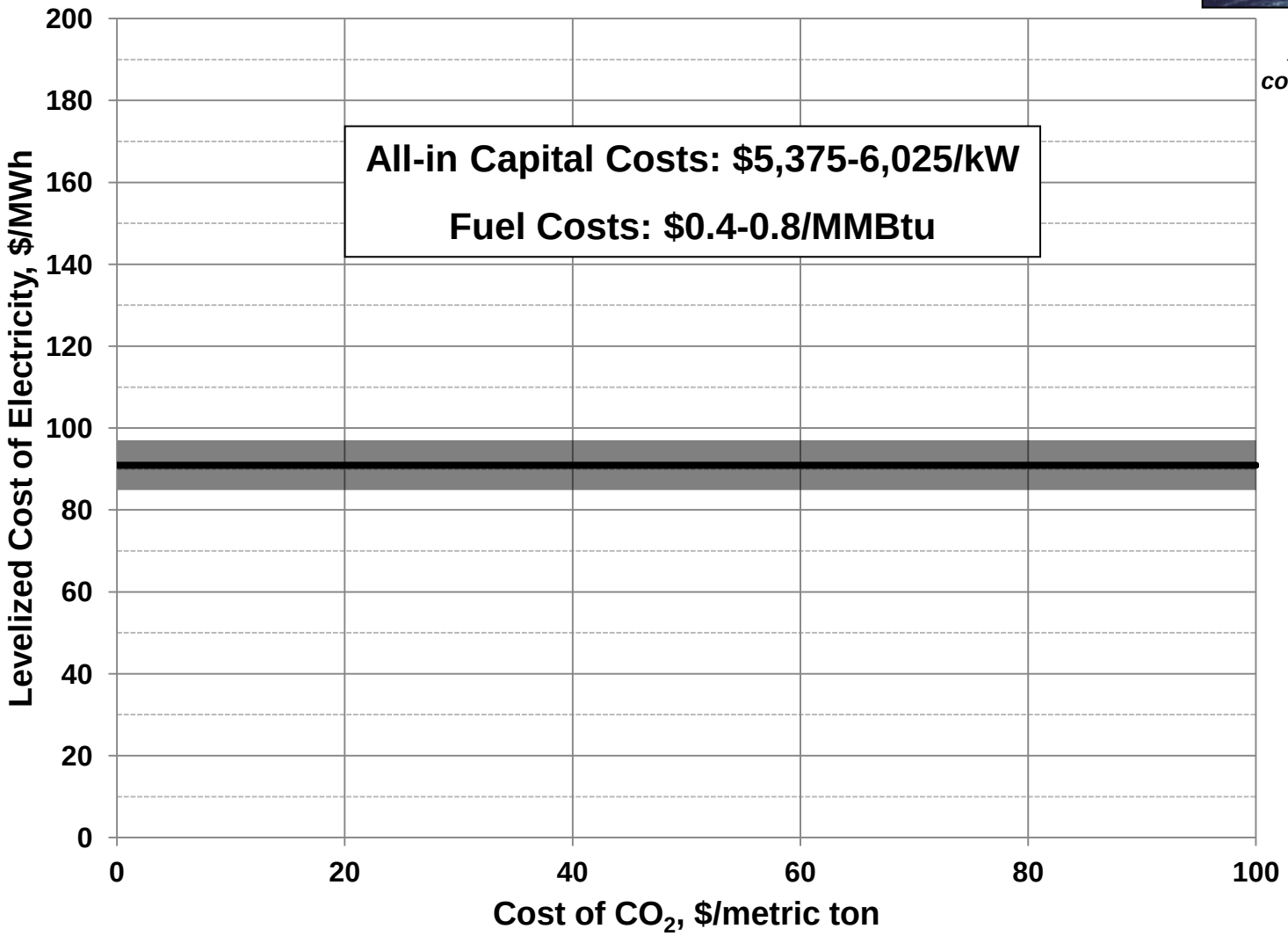
Nuclear – 2015



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Biomass – 2015

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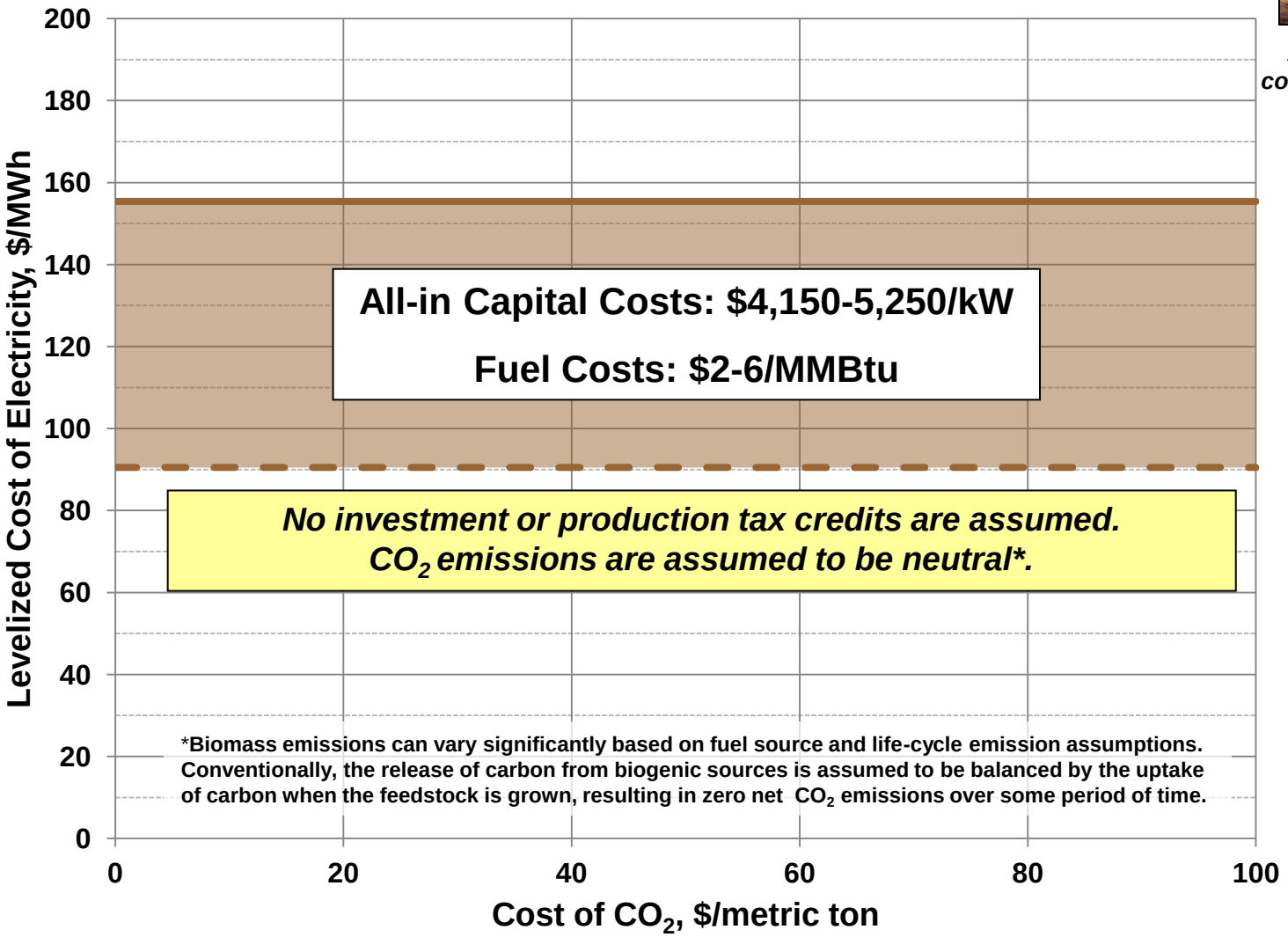

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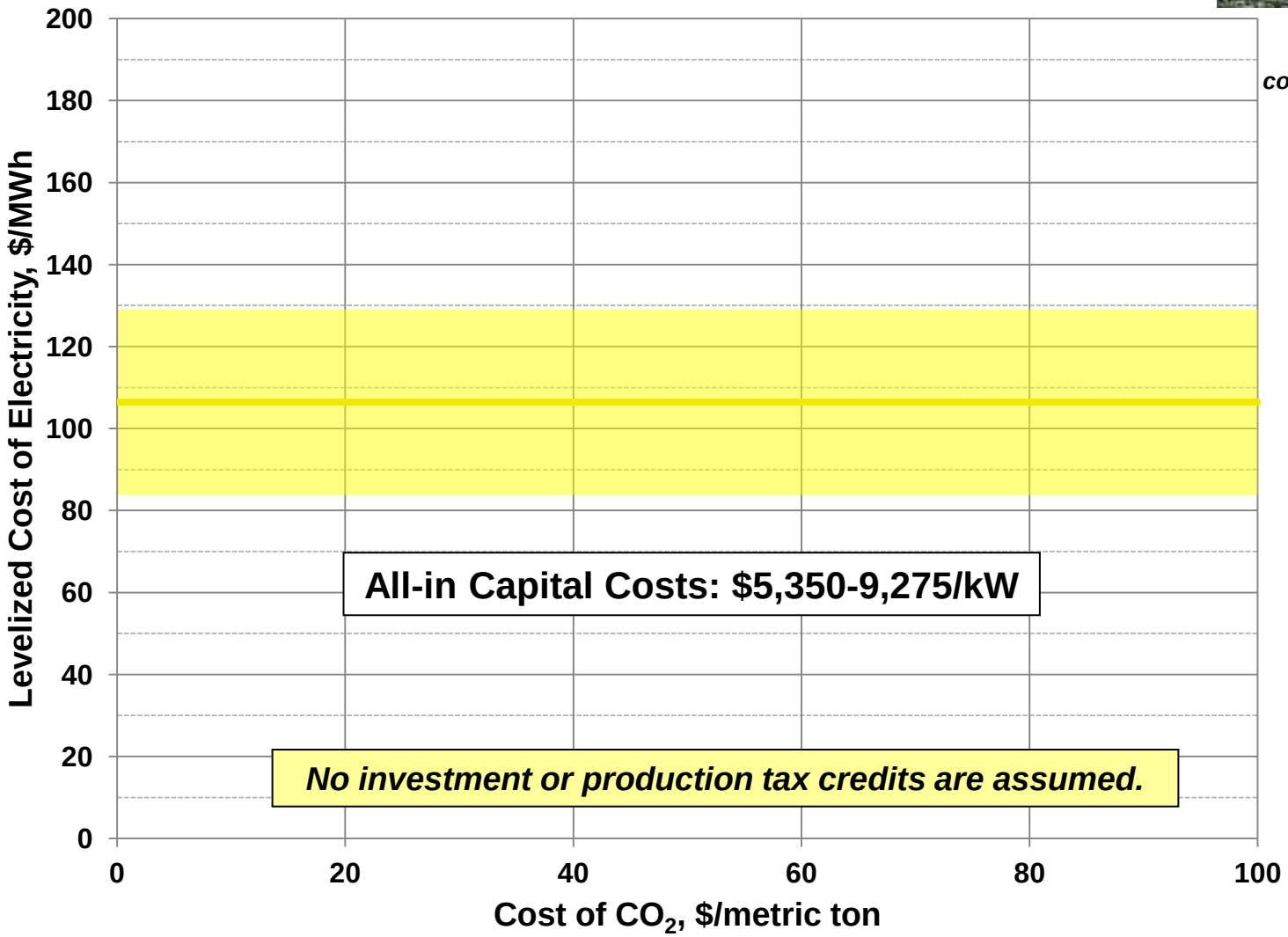
Geothermal – 2015



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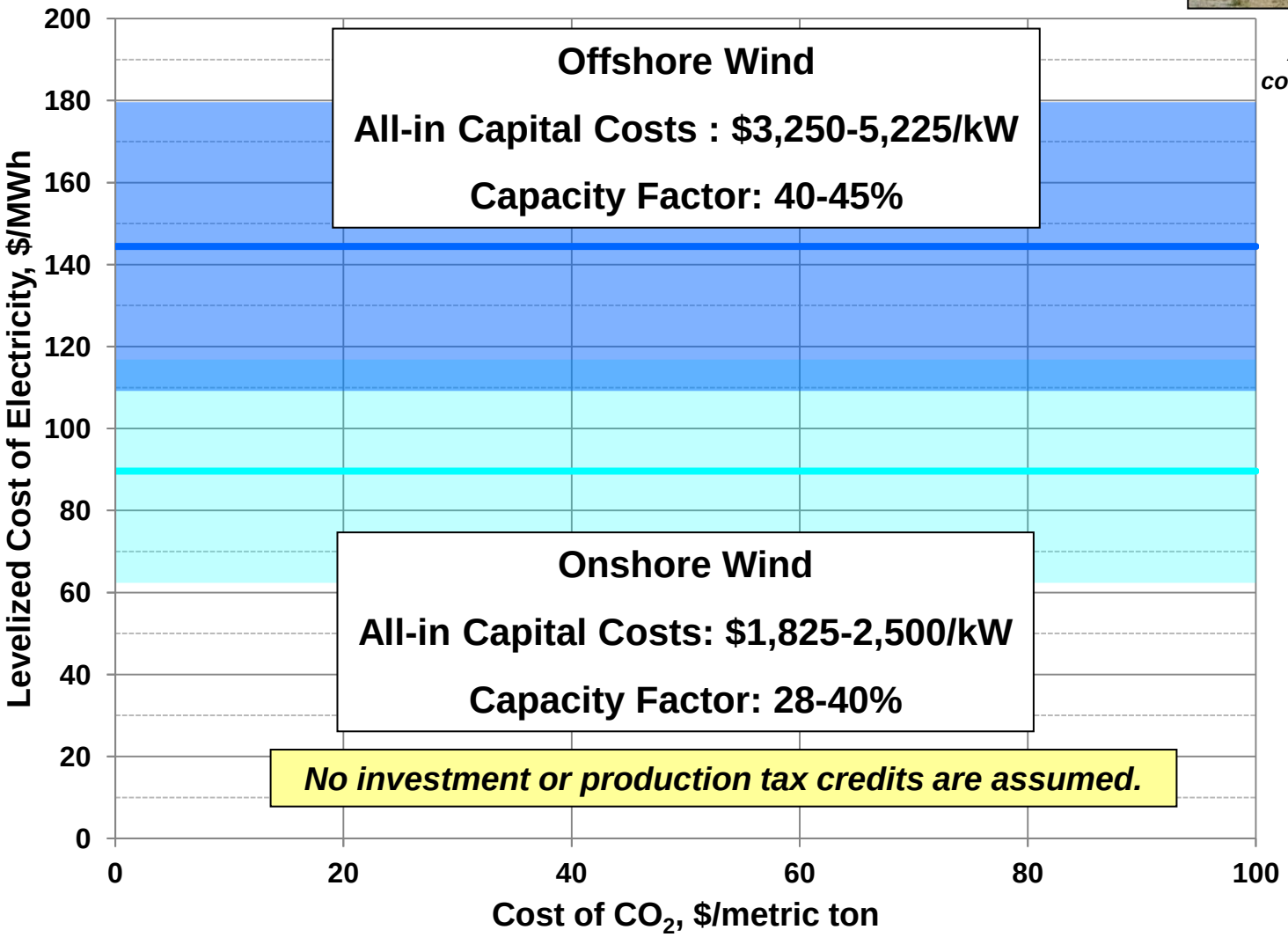
Wind – 2015



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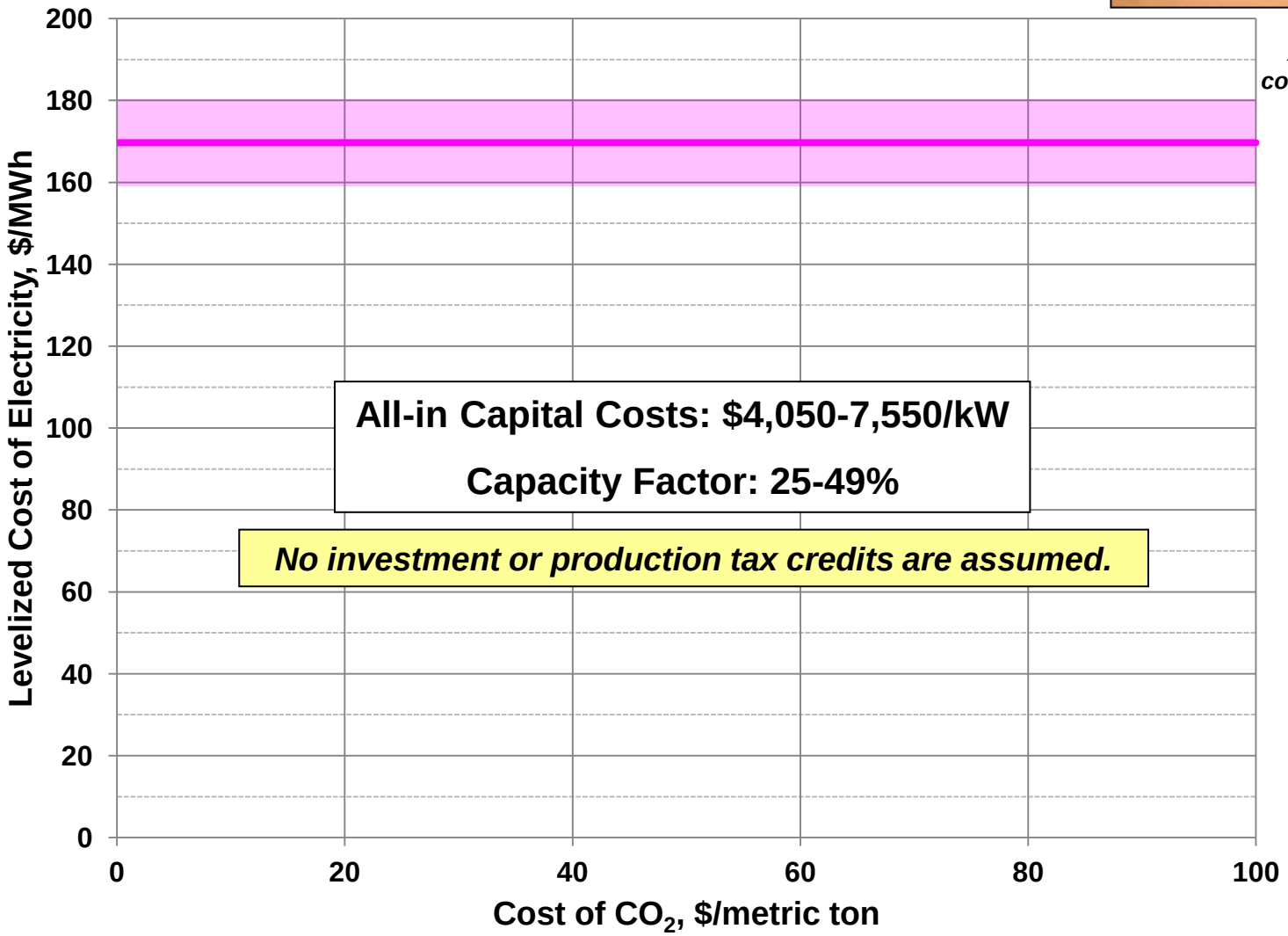
Concentrating Solar Thermal Power (CSP) – 2015



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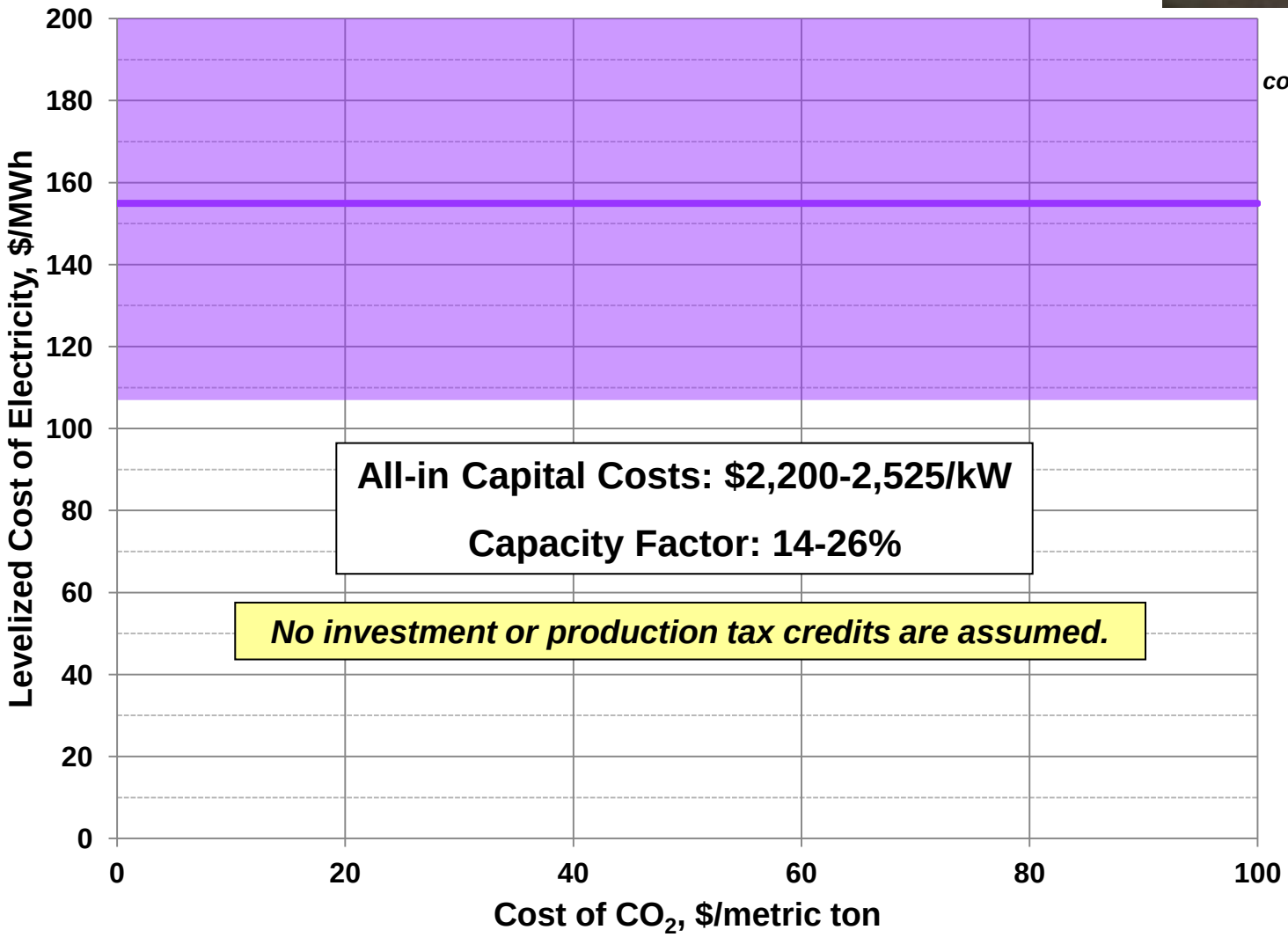
Solar Photovoltaic (PV) – 2015



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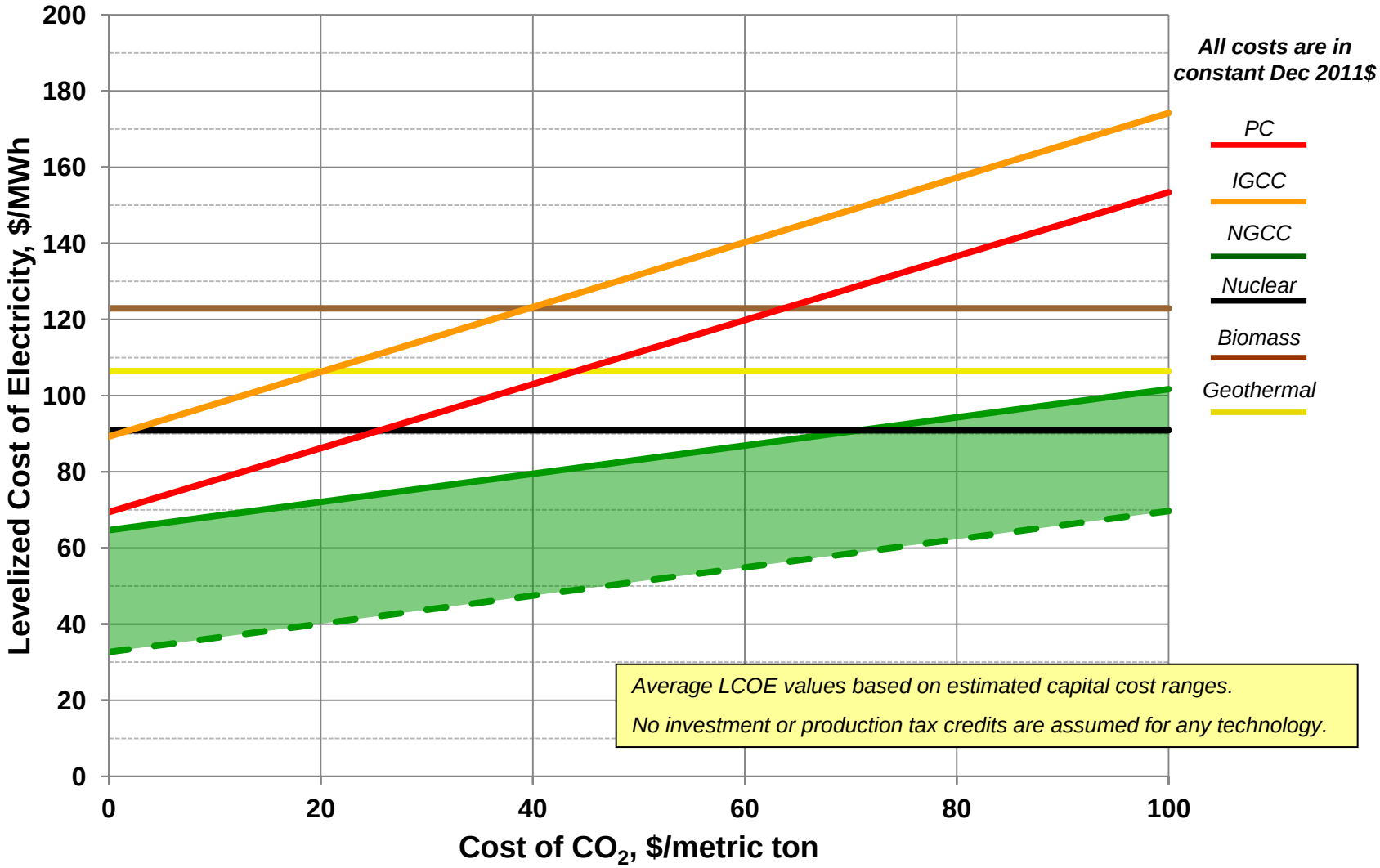
Comparative Levelized Costs of Electricity of Dispatchable Technologies – 2015



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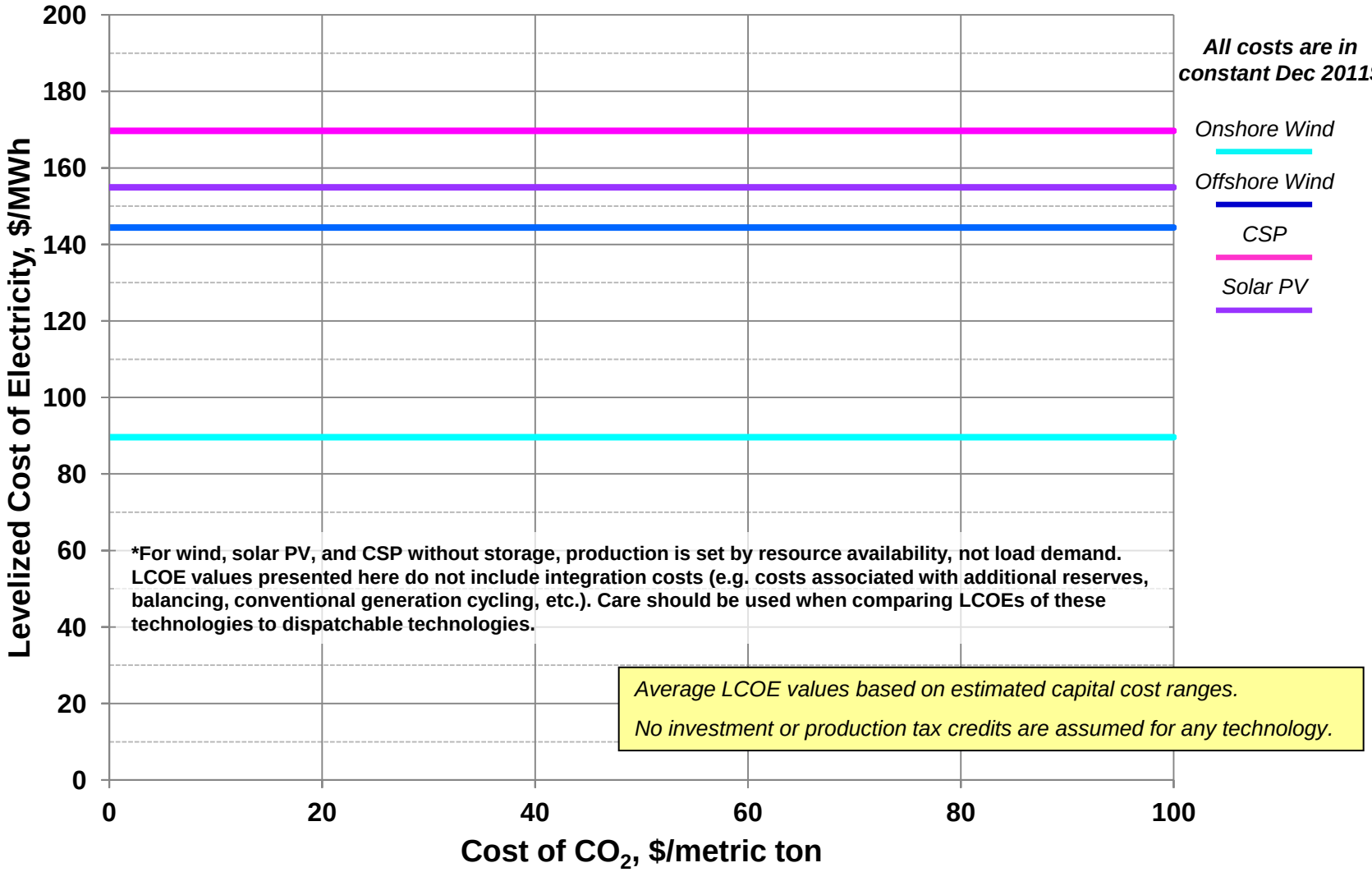
Comparative Levelized Costs of Electricity of Non-Dispatchable Technologies* – 2015



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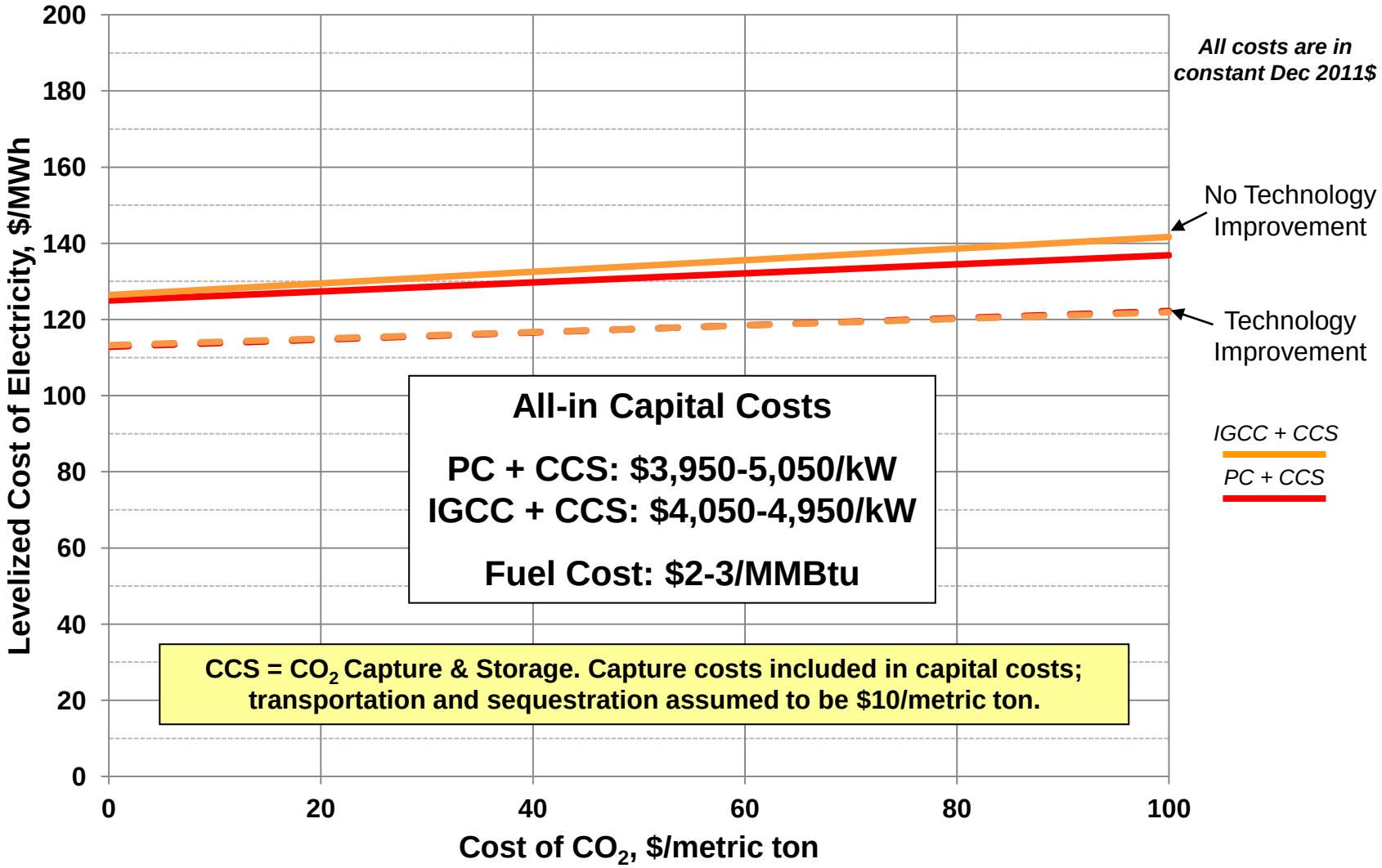
Longer-Term: 2025

Coal, 2025 – Impact of CO_2 Capture & Storage and Technology Improvements on Levelized Cost of Electricity



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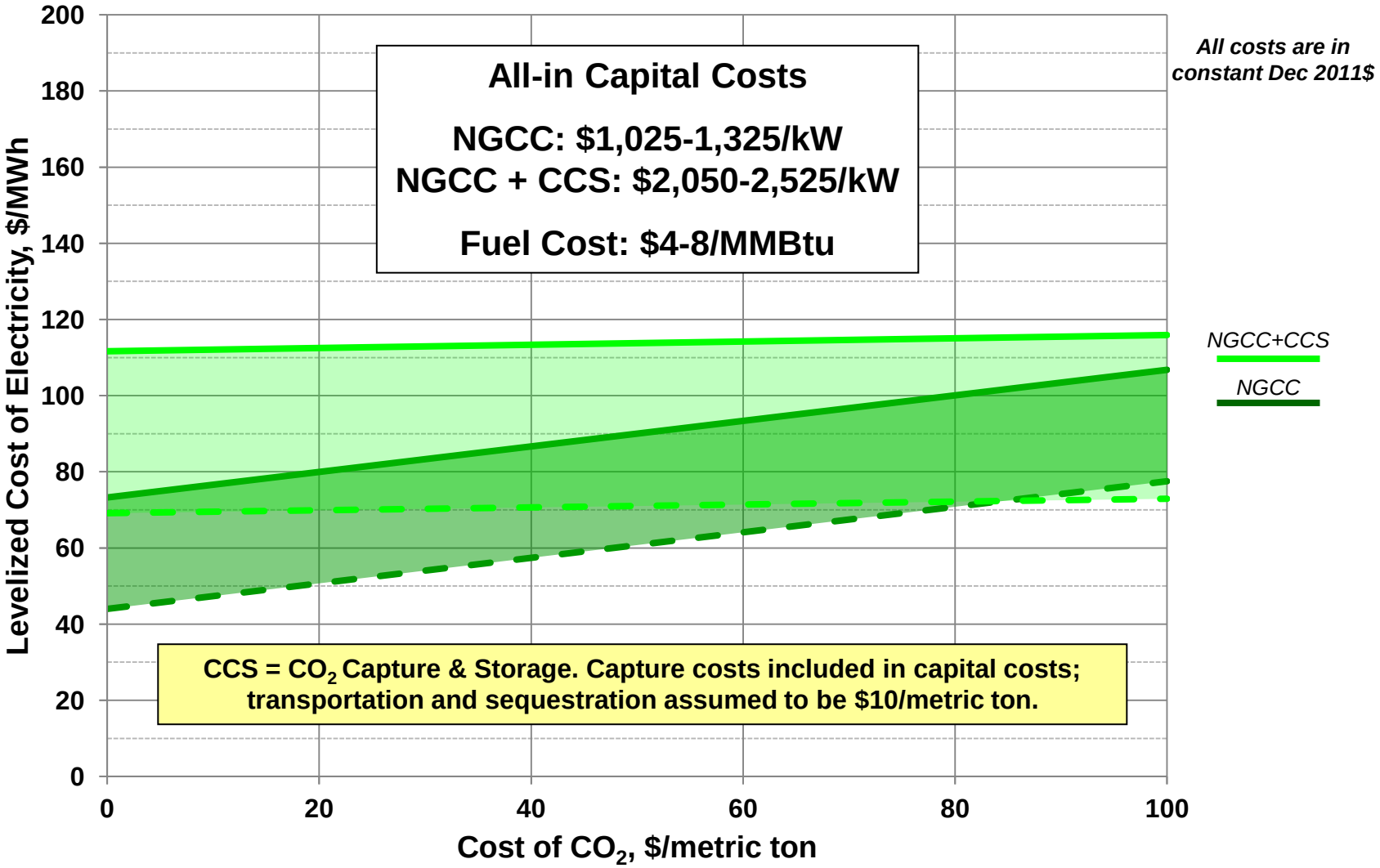
NGCC, 2025 – Impact of CO_2 Capture & Storage on Levelized Cost of Electricity



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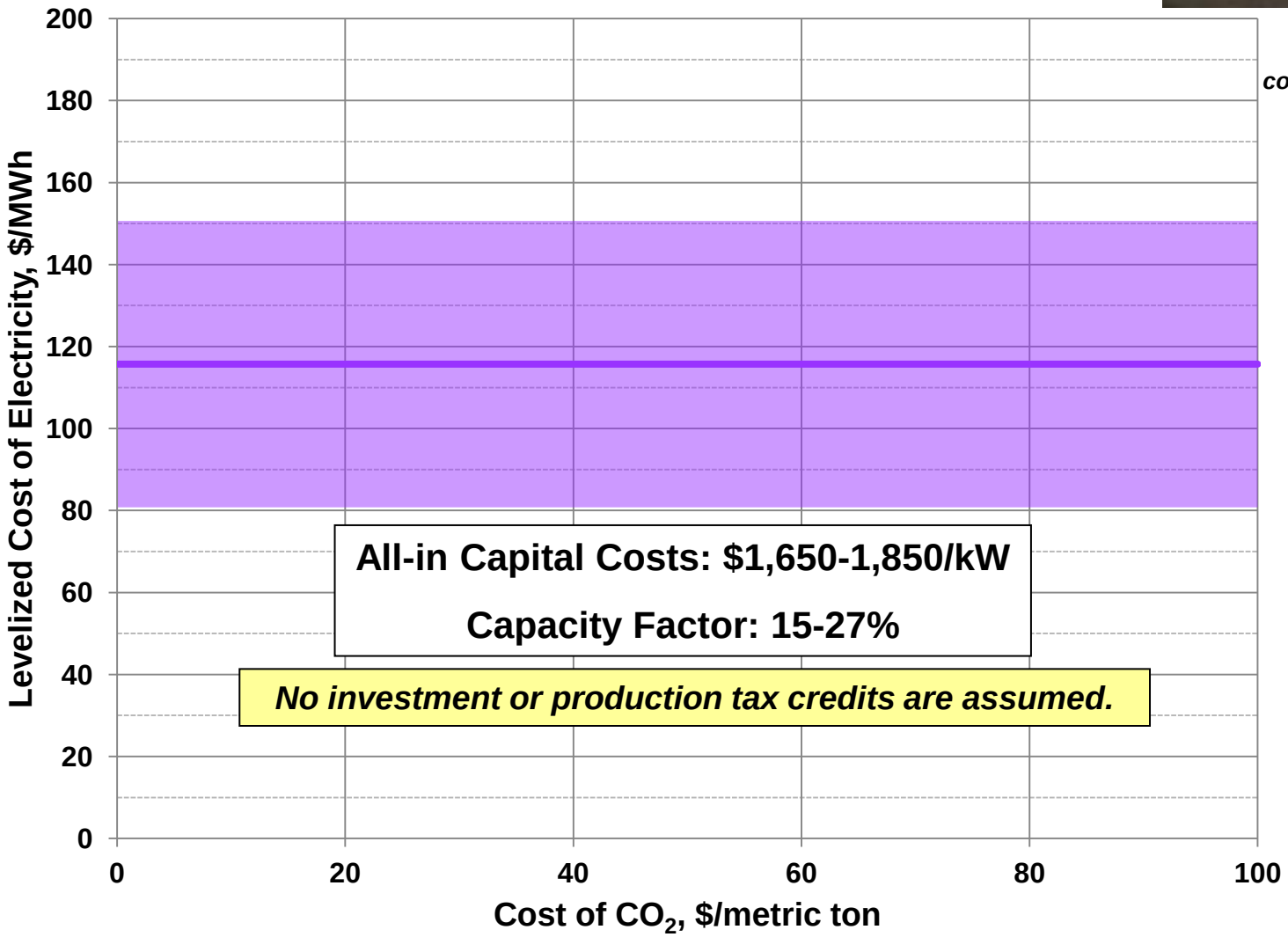

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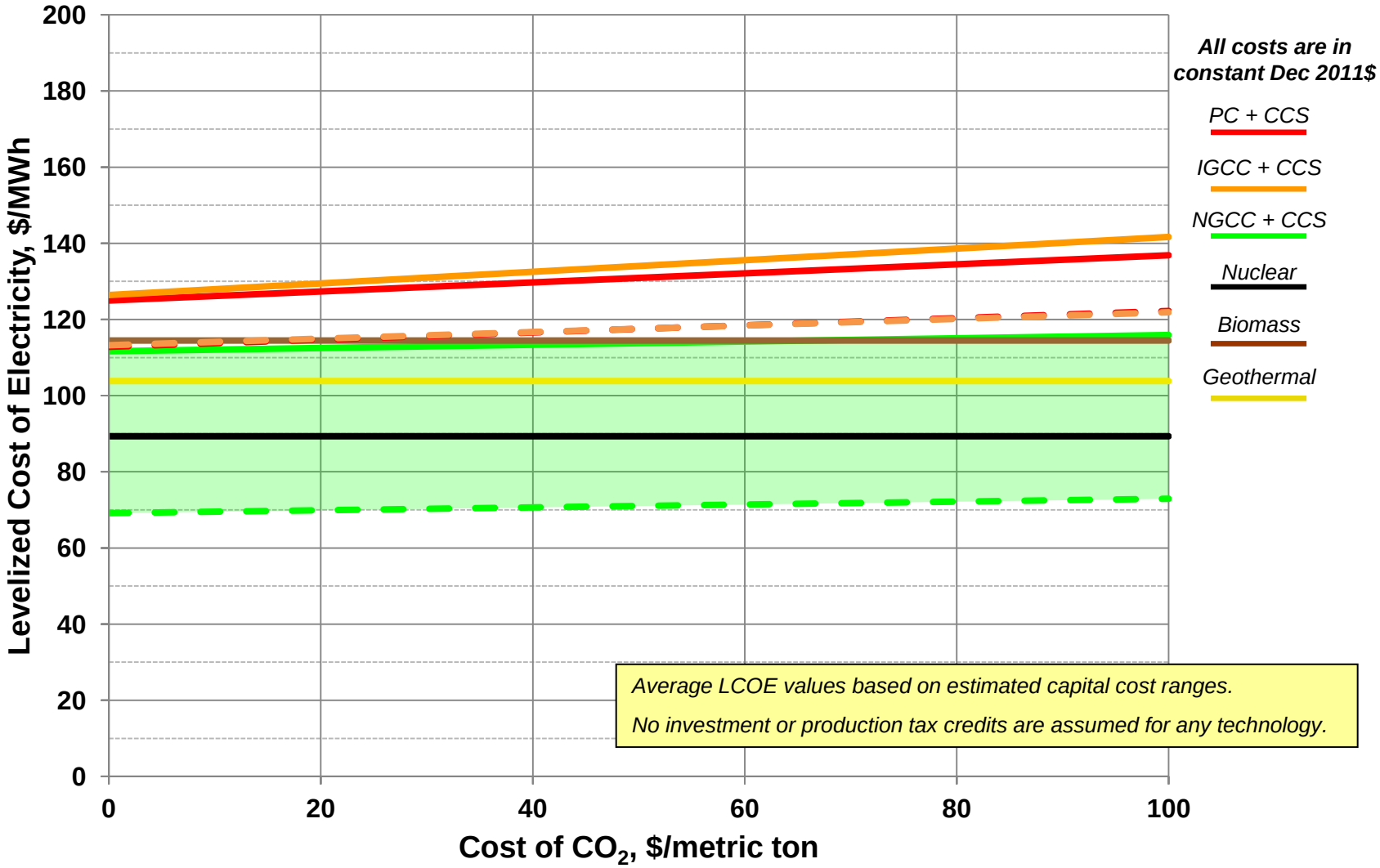
Comparative Levelized Costs of Electricity of Dispatchable Technologies – 2025



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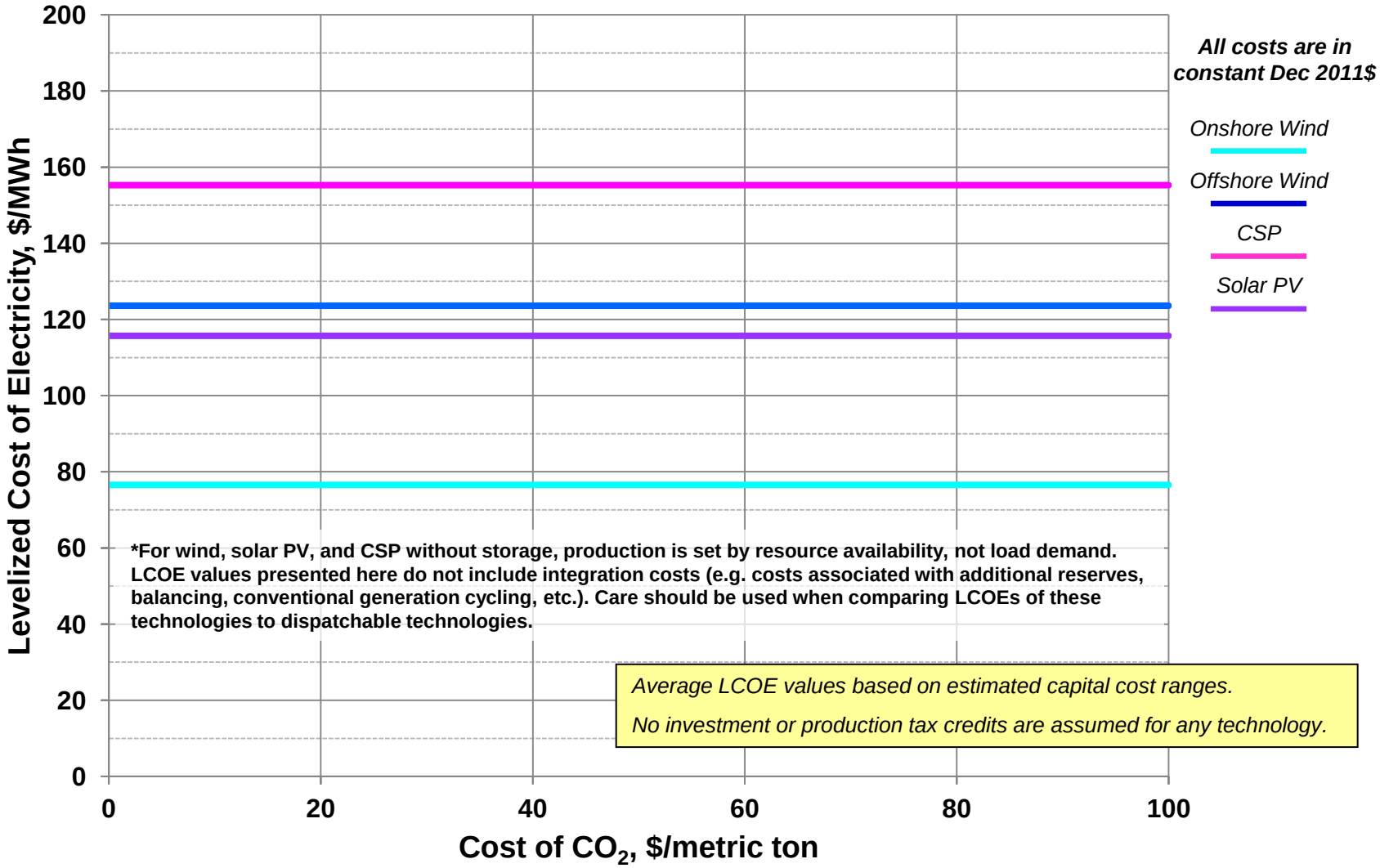
Comparative Levelized Costs of Electricity of Non-Dispatchable Technologies* – 2025



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Closing Thoughts

- Several key uncertainties impact near-term and long-term project decisions and research priorities:
  - Stringency of future CO_2 emissions reduction programs
  - Future price of natural gas (high sensitivity and variability)
  - CO_2 capture and storage technology development and costs
  - Renewable energy technology development
  - Technology-driven escalations and reductions in plant costs
- Demonstrates importance of developing and demonstrating a portfolio of low cost generation technologies.

Together…Shaping the Future of Electricity