

IGCC Comparative Economics

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LEVITAN & ASSOCIATES, INC.

MARKET DESIGN, ECONOMICS AND POWER SYSTEMS

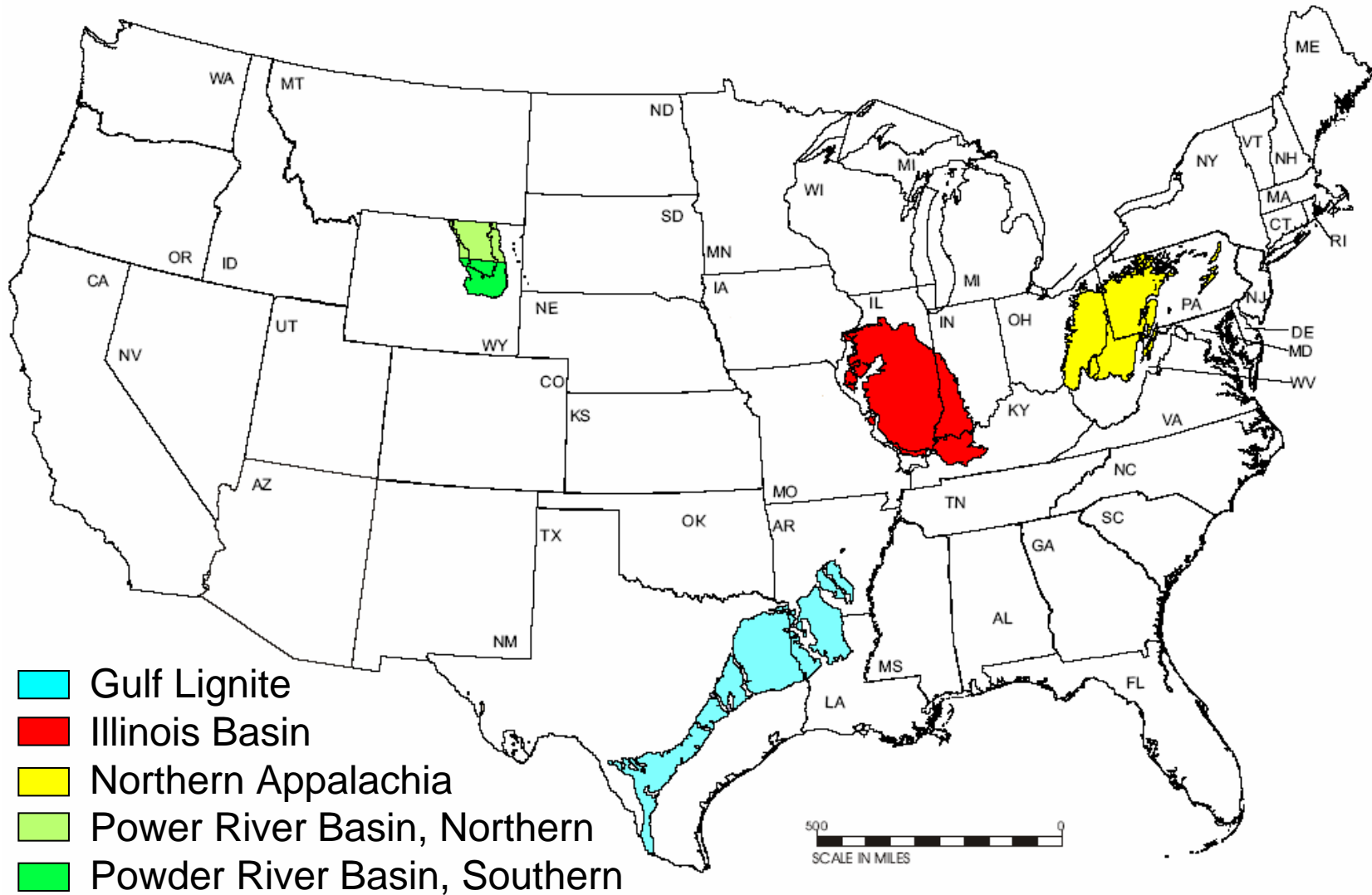


SYNGAS Refiner

Presentation Overview

- Coal Supply Sources
 - Northern Appalachia (NAPP)
 - Illinois Basin (ILL)
 - Powder River Basin (PRB)
 - Gulf Coast Lignite (TX LIG)
- Fuel Price Forecasts
 - Basin Specific Coal Prices
 - Natural Gas
 - WTI Crude Oil
- Comparative Economics
 - IGCC v. Super Critical Pulverized Coal & Natural Gas Combined Cycle (NGCC)
- Primary Variables Affecting Economics
- Summary & Observations

Coal Supply Regions



Source: EIA

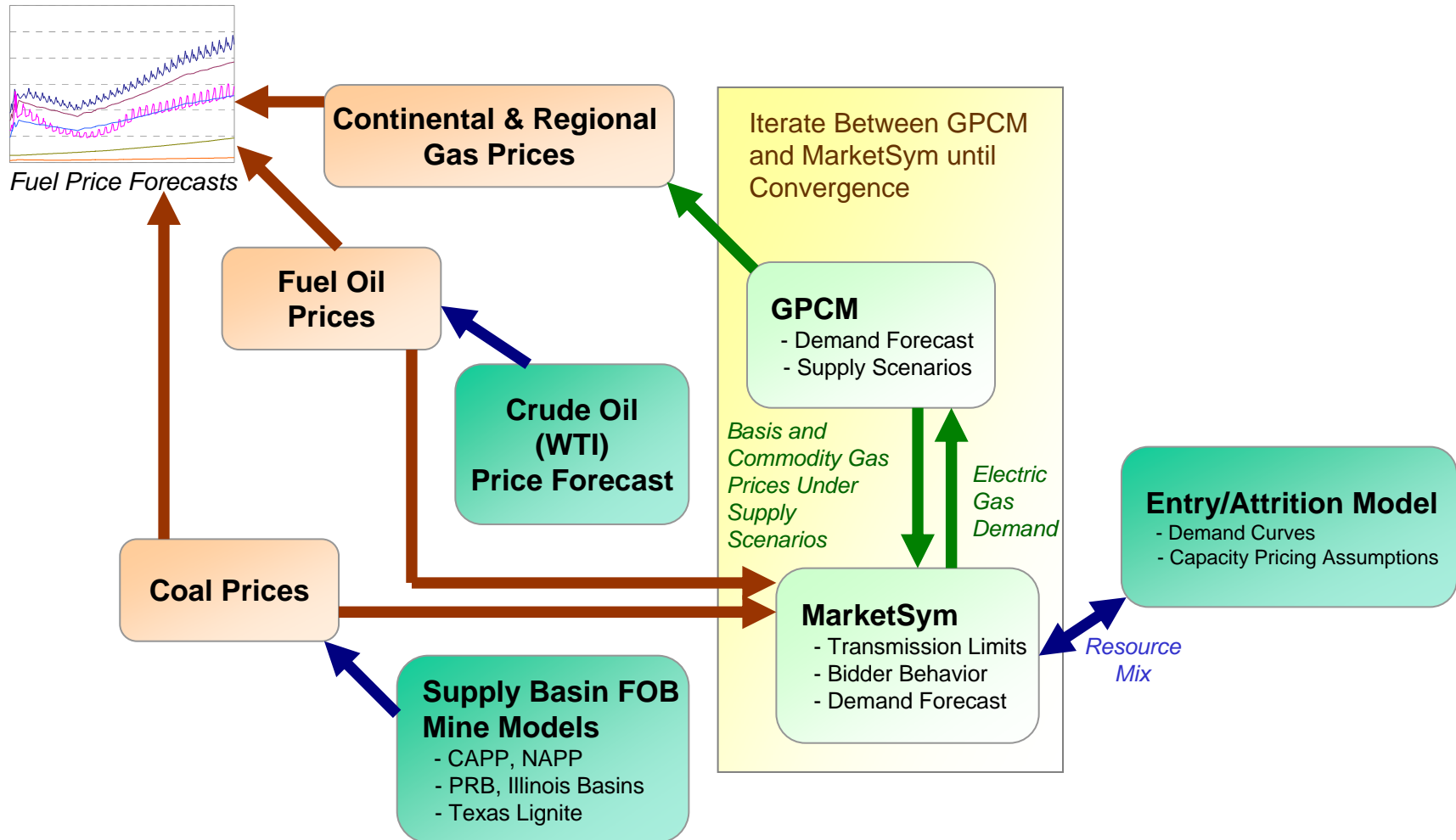
Coal Feed: Representative Characteristics

(As Received)

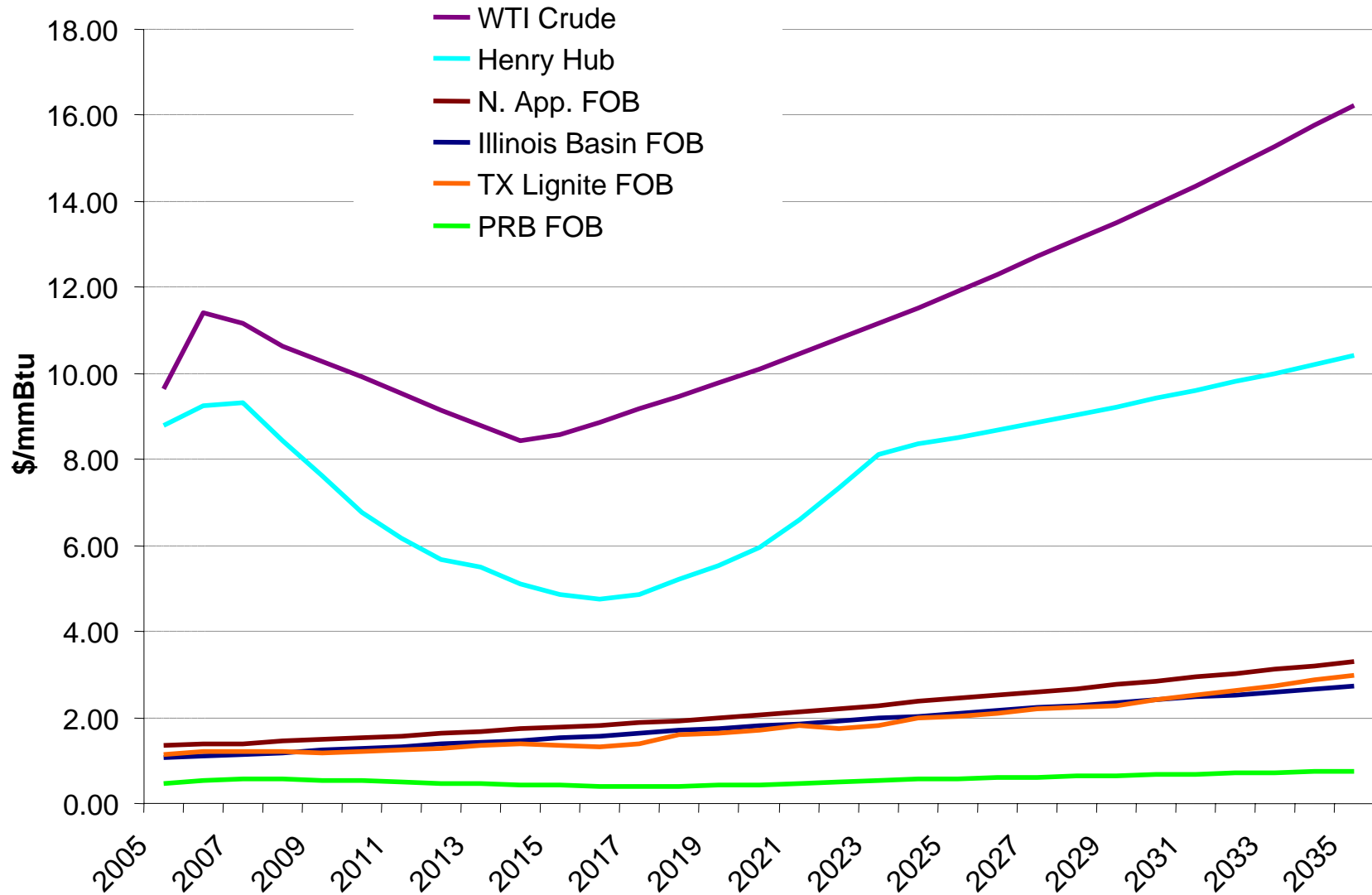
	<u>N. Appalachian</u>	<u>Illinois Basin</u>	<u>Powder River Basin</u>	<u>Texas Lignite</u>
HHV (Btu/lb.)	13,000	11,000	8,600	6,950
Analysis (Wt. %)				
Carbon	73.8	61.0	50.7	43.0
Hydrogen	4.9	4.3	3.5	3.8
Sulfur	2.1	3.3	0.3	1.1
Oxygen	5.4	6.9	12.0	11.5
Ash	7.1	11.0	5.3	11.0
Moisture	5.2	12.3	27.4	30.0

Sources: EIA, USGS, Louisiana Geological Survey, TXU, NETL

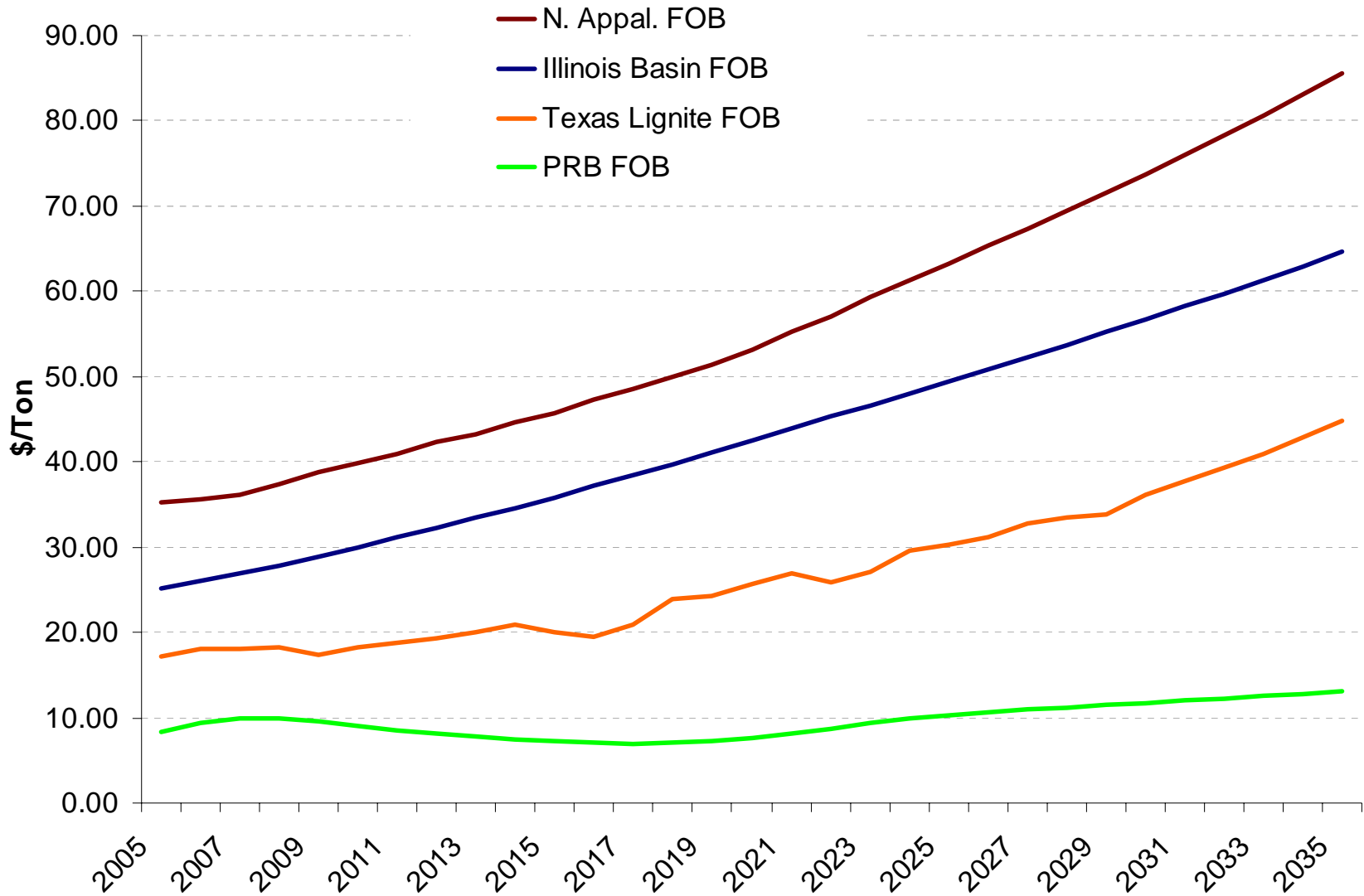
Fuel Price Forecasting Methodology



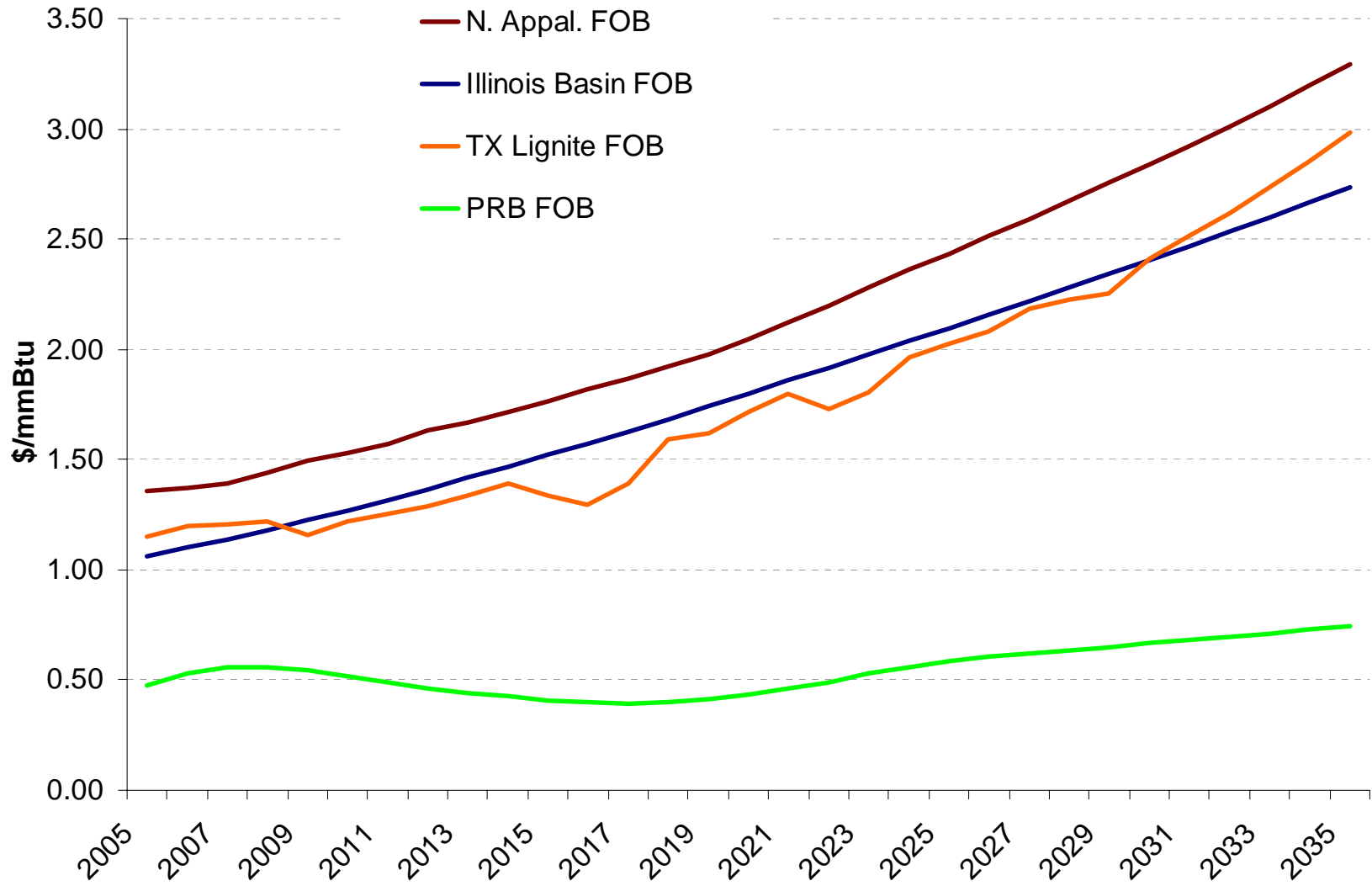
Fuel Price Forecast



Coal FOB Price Forecast (\$/Ton)



Coal FOB Price Forecast (\$/mmBtu)



Comparative Economics – Assumptions

- ❑ **New plants, commercial startup 2010**
- ❑ **25 Years**
- ❑ **50% Debt Financing**
- ❑ **IGCC and Pulverized Coal Plants located in the coal supply basin**
- ❑ **NGCC located in the market area**
 - Natural Gas Pricing Points
 - N. APP – DTI South Point
 - ILL Basin – Chicago Citygate
 - PRB – Opal, WY
 - TX LIG – Henry Hub

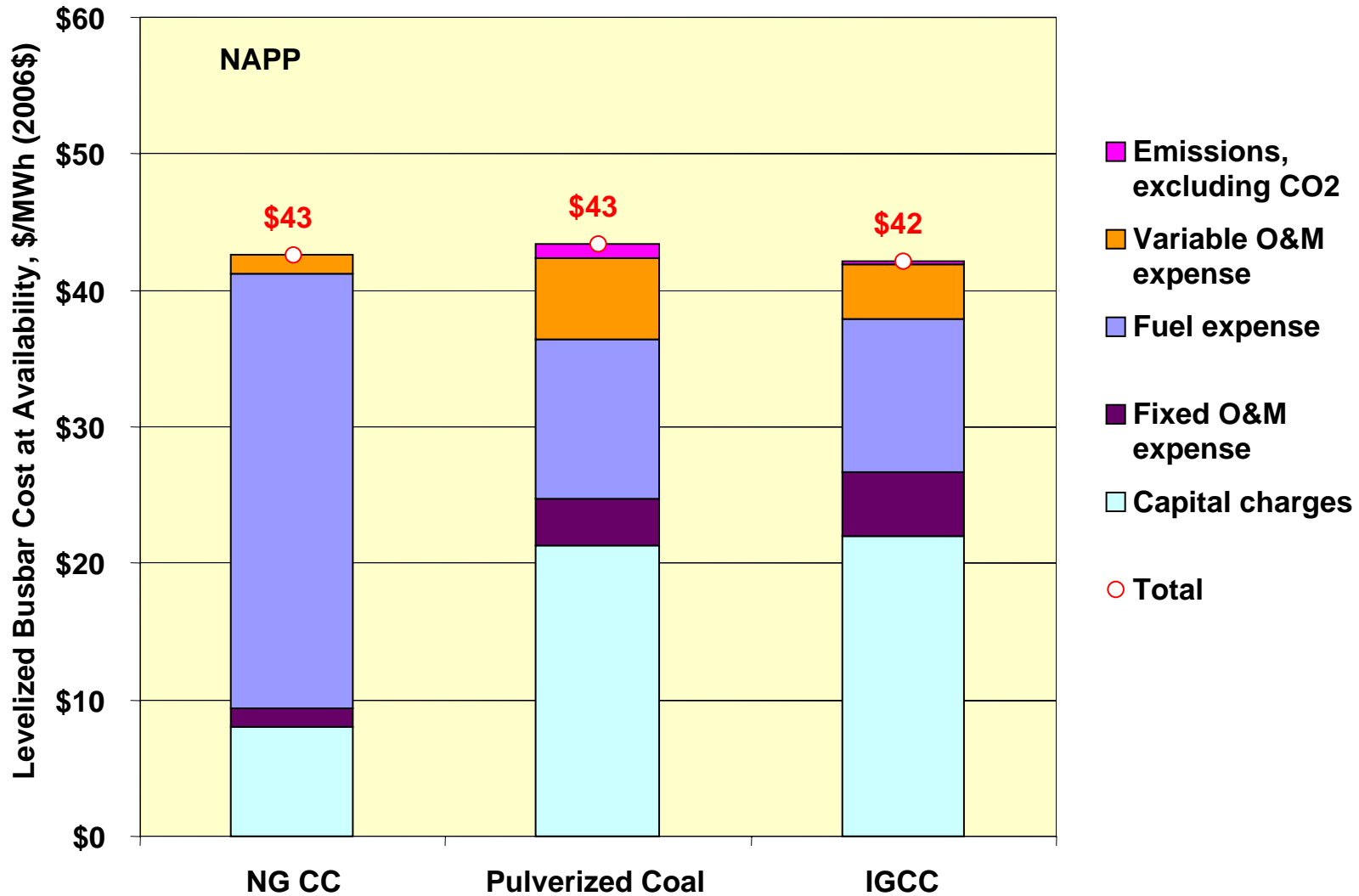
Comparative Economics – Assumptions (cont'd)

	<u>NGCC</u>	<u>IGCC</u>				<u>Pulverized Coal¹</u>			
		<u>NAPP</u>	<u>ILL</u>	<u>PRB</u>	<u>Tx Lig.</u>	<u>NAPP</u>	<u>ILL</u>	<u>PRB</u>	<u>Tx Lig.</u>
Capacity (MW)	600	600	600	600	600	600	600	600	600
Capital Cost (\$/kW)	600	1,445	1,520	1,570	1,750	1,350	1,410	1,515	1,630
Fixed O&M (\$/kW-Yr)	11.80	33.51	33.35	36.41	40.58	25.56	26.70	28.69	30.87
Non-fuel Variable O&M (\$/MWh)	1.35	4.00	4.00	4.25	4.50	6.00	6.25	6.50	6.75
Avg. Full Load Heat Rate (Btu/kWh)	6,700	8,300	8,800	9,379	9,960	8,600	8,815	9,116	9,460
Availability (%)	92	82	82	82	82	85	85	85	85

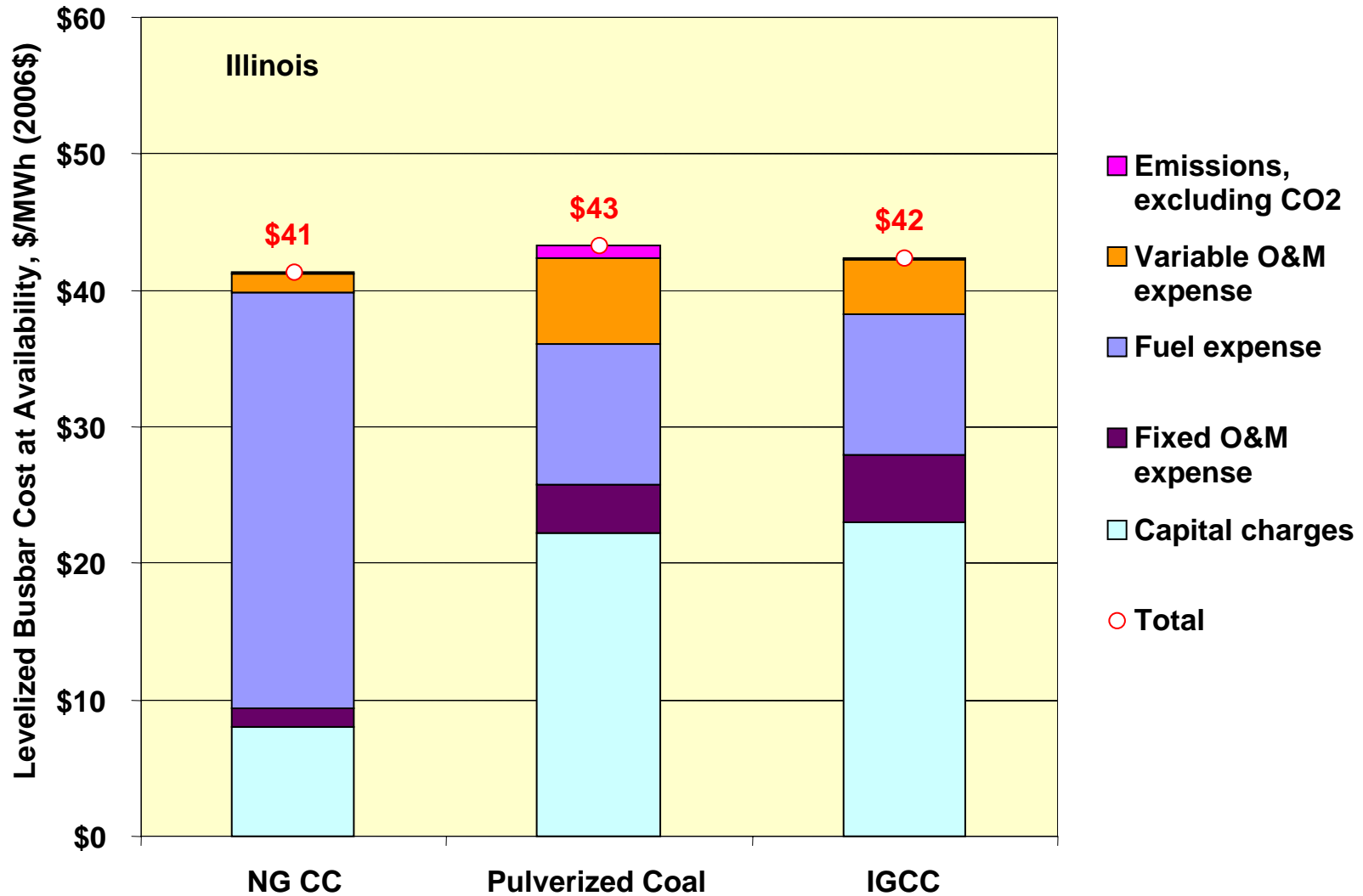
¹ Pulverized coal plants include FGD, SCR and ACI

Sources: EPRI, NETL, DOE, GTC, ConocoPhillips, GE, Bechtel

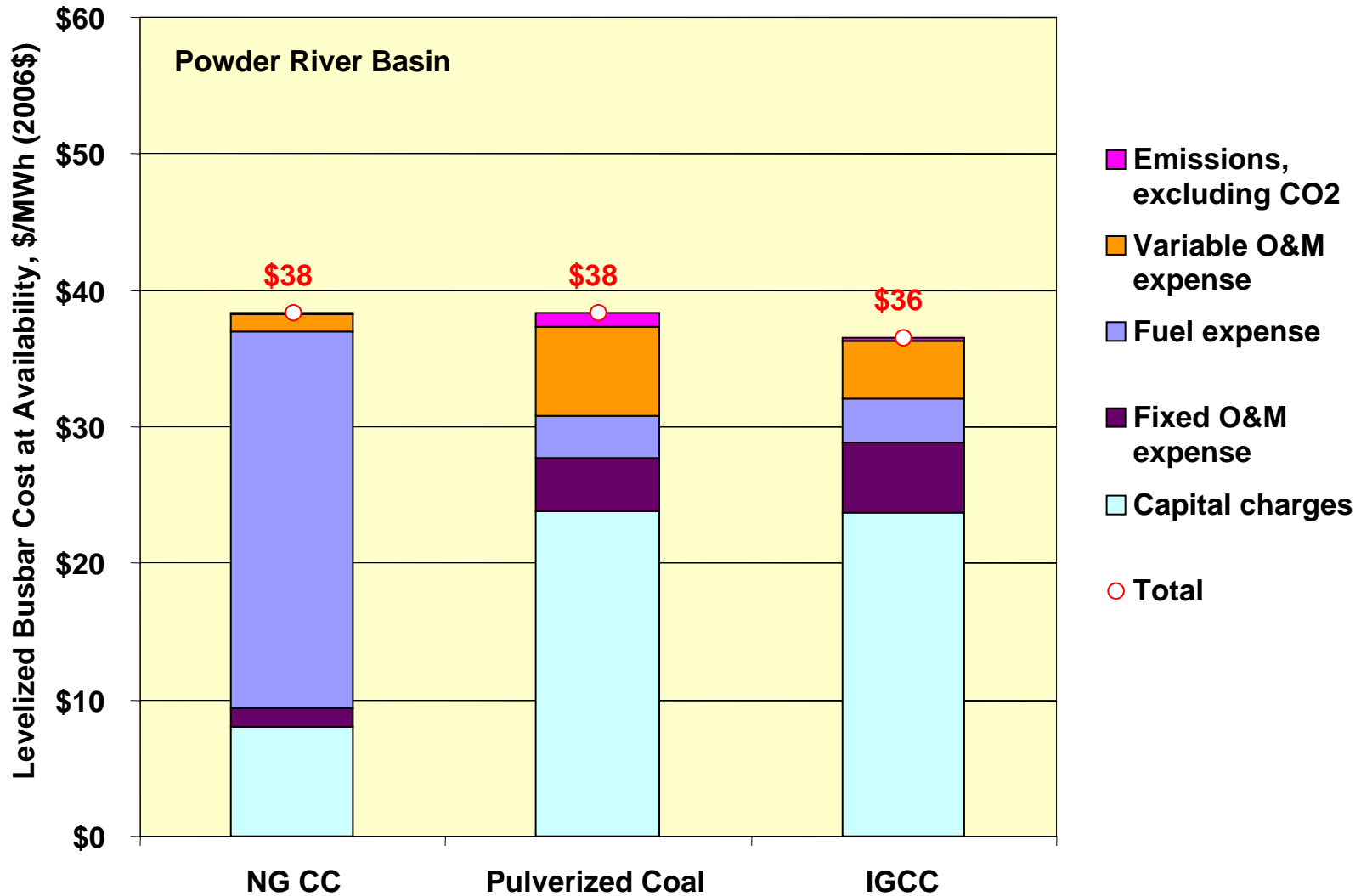
Levelized Cost at Busbar – NAPP



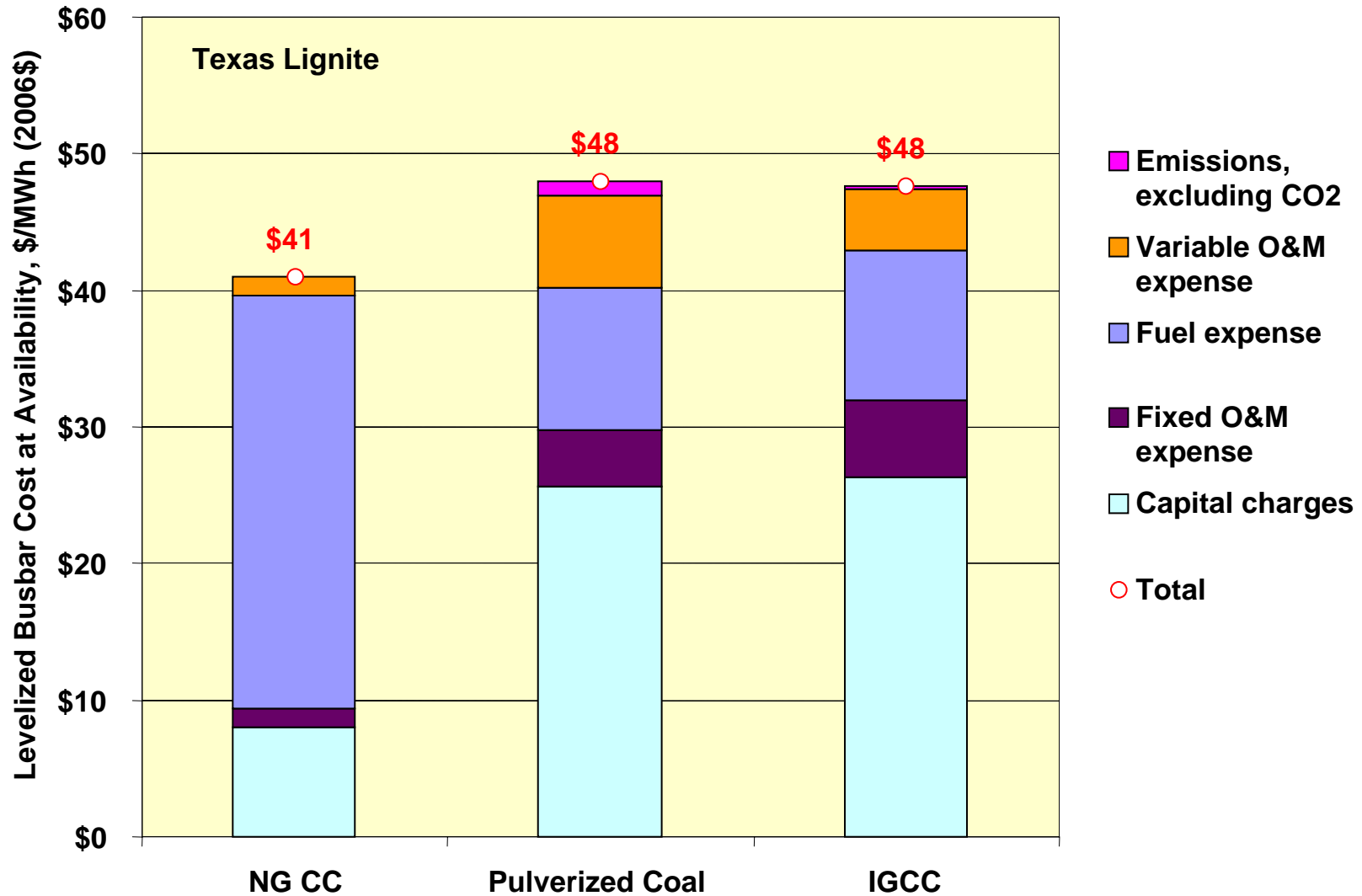
Levelized Cost at Busbar – Illinois Basin



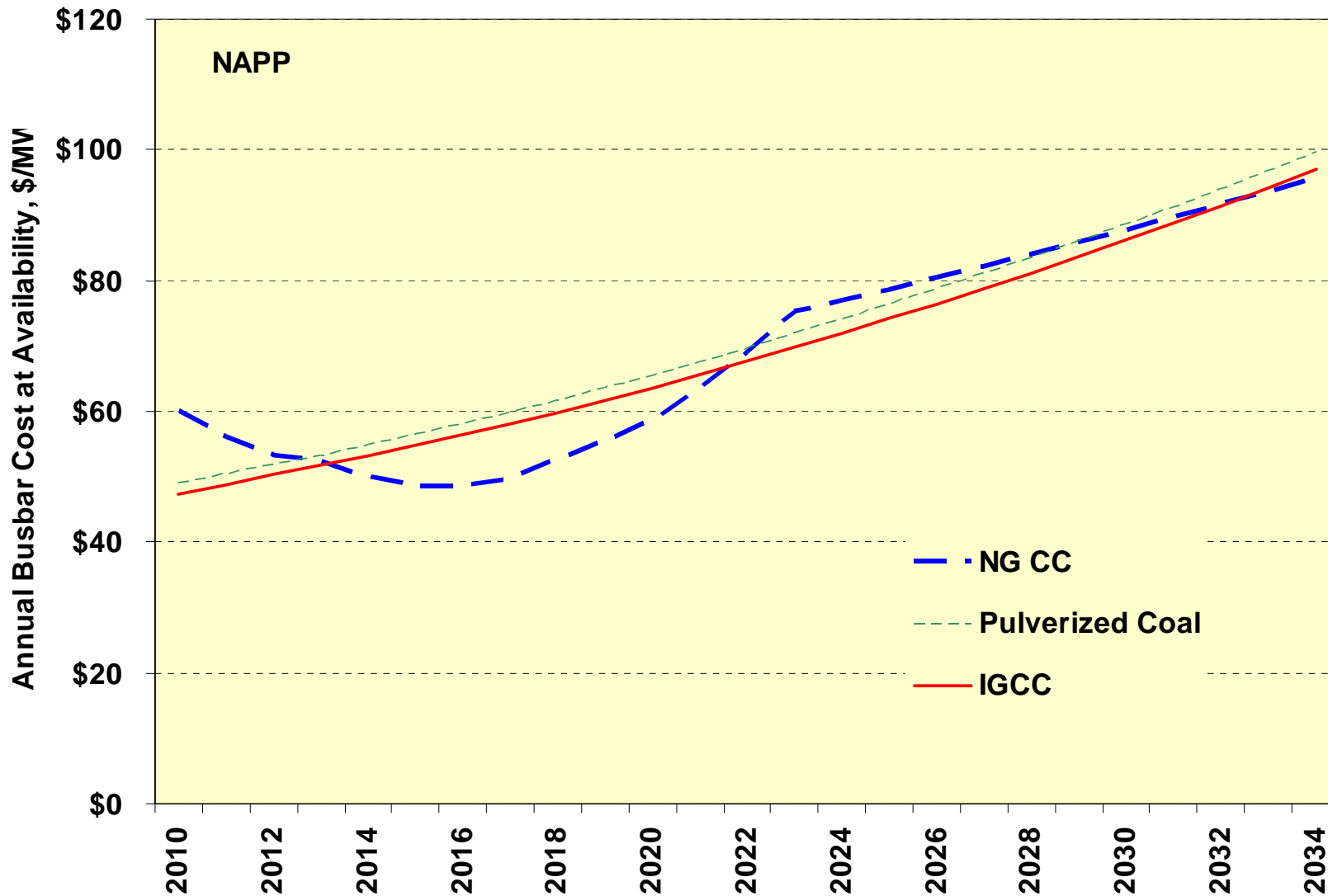
Levelized Cost at Busbar – Powder River Basin



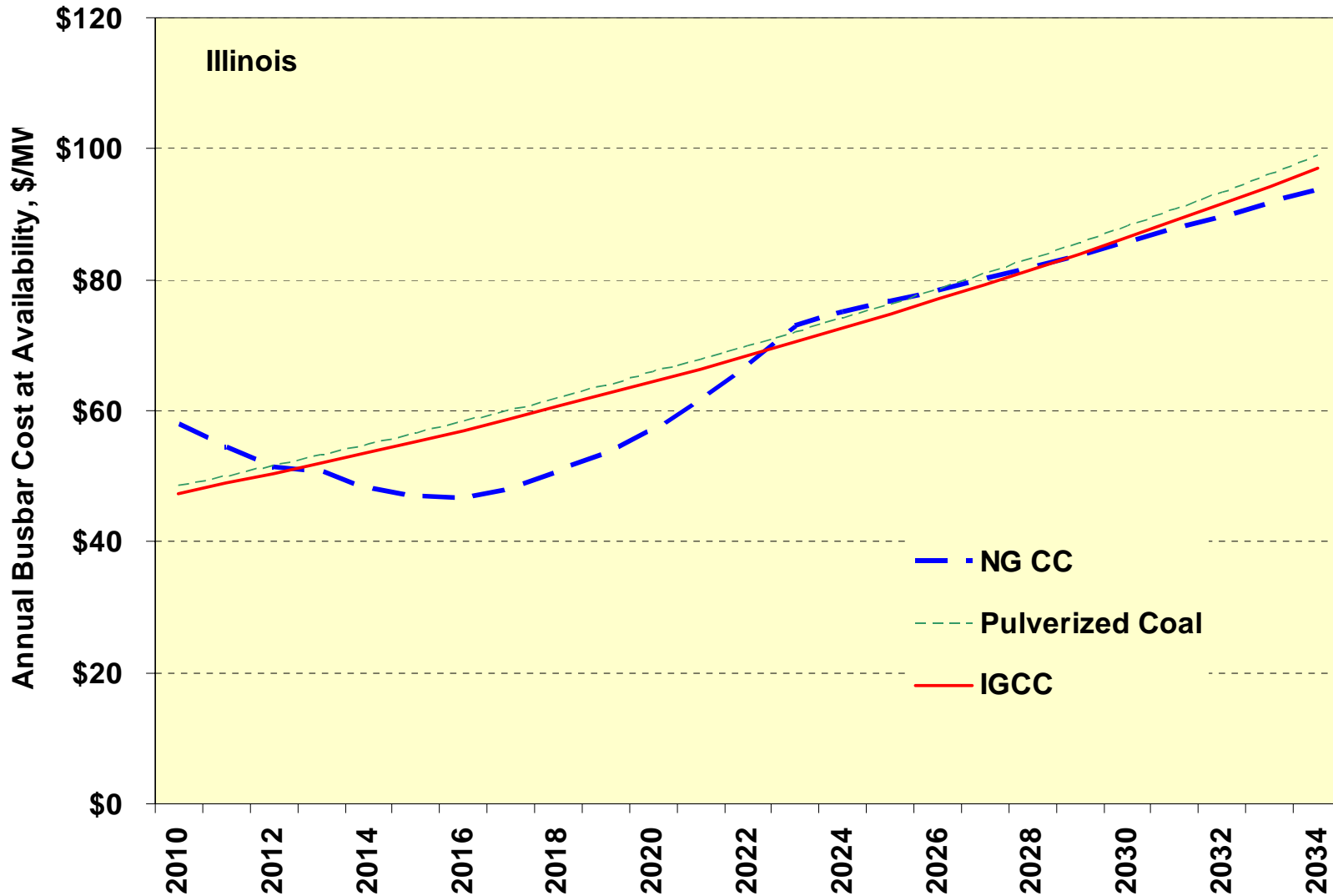
Levelized Cost at Busbar – Texas Lignite



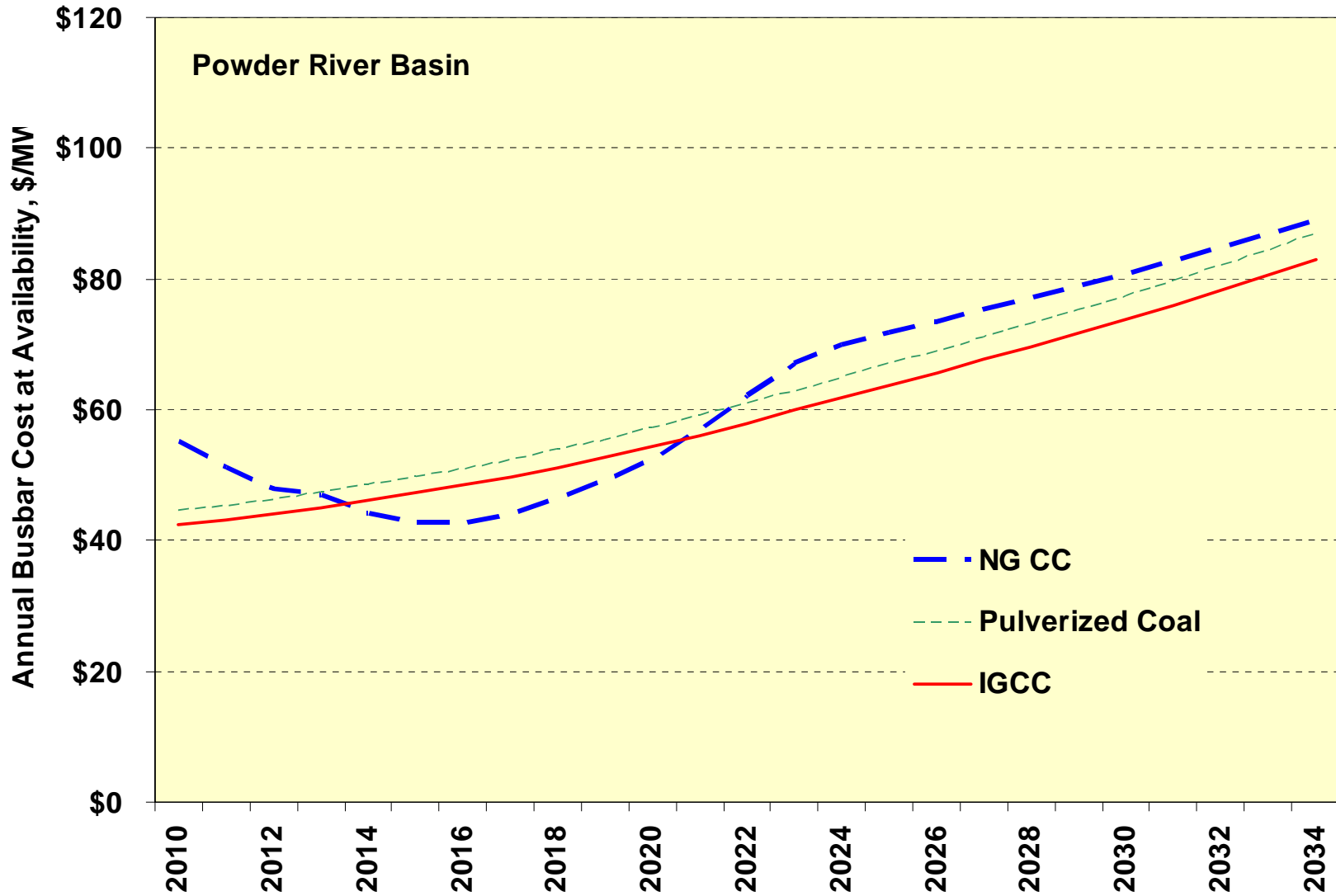
Annual Busbar Cost – NAPP



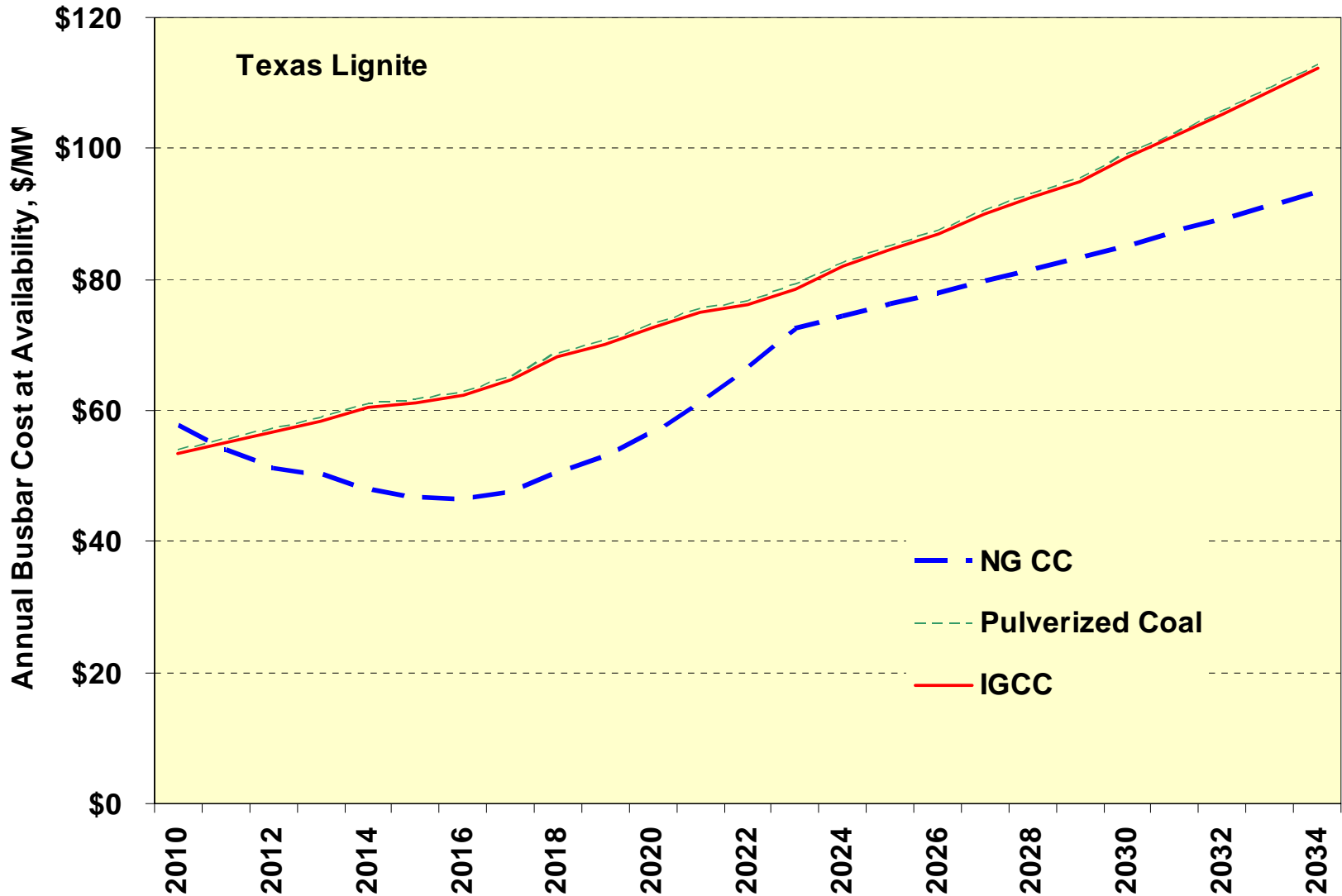
Annual Busbar Cost – Illinois Basin



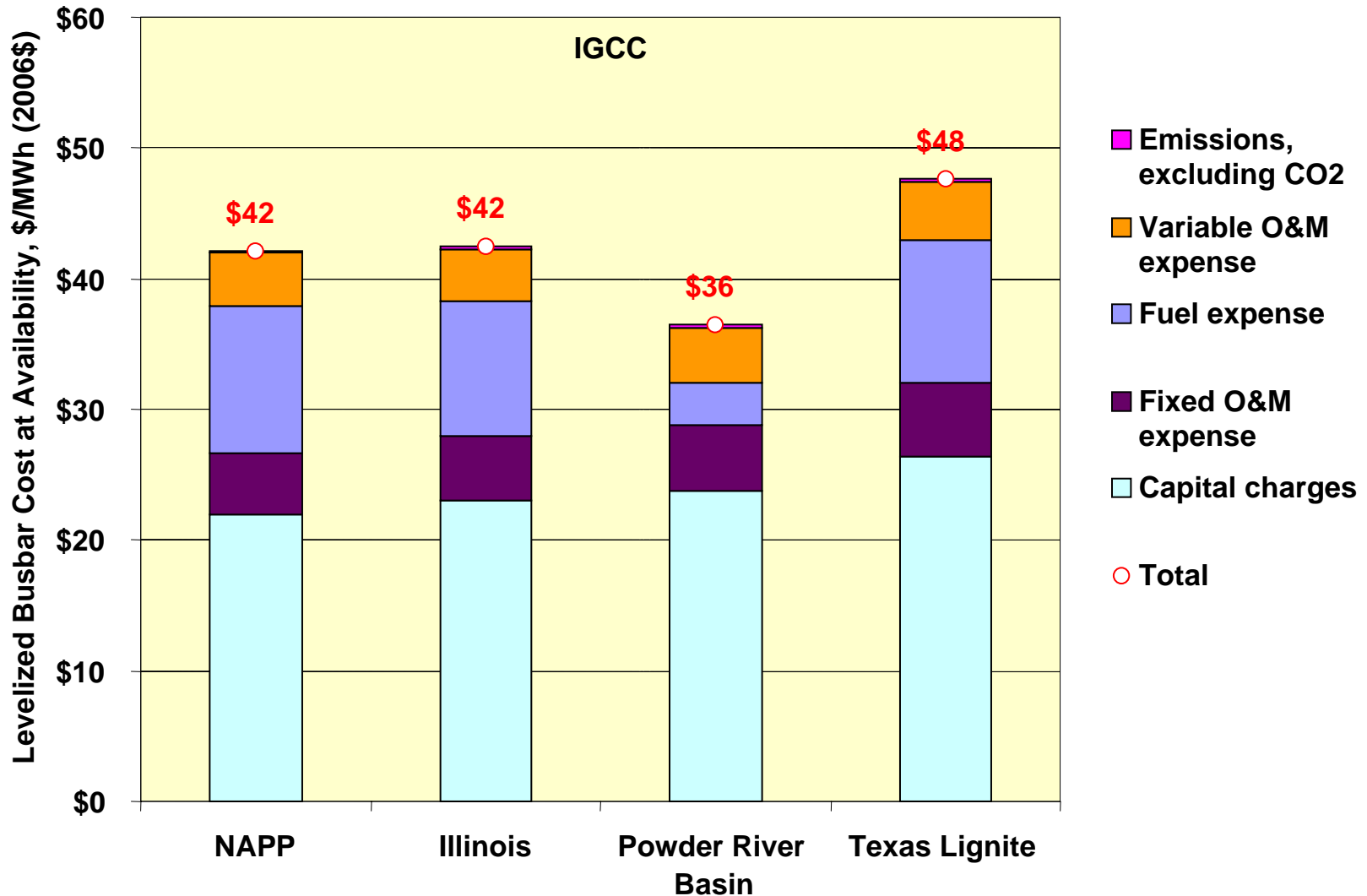
Annual Busbar Cost – Powder River Basin



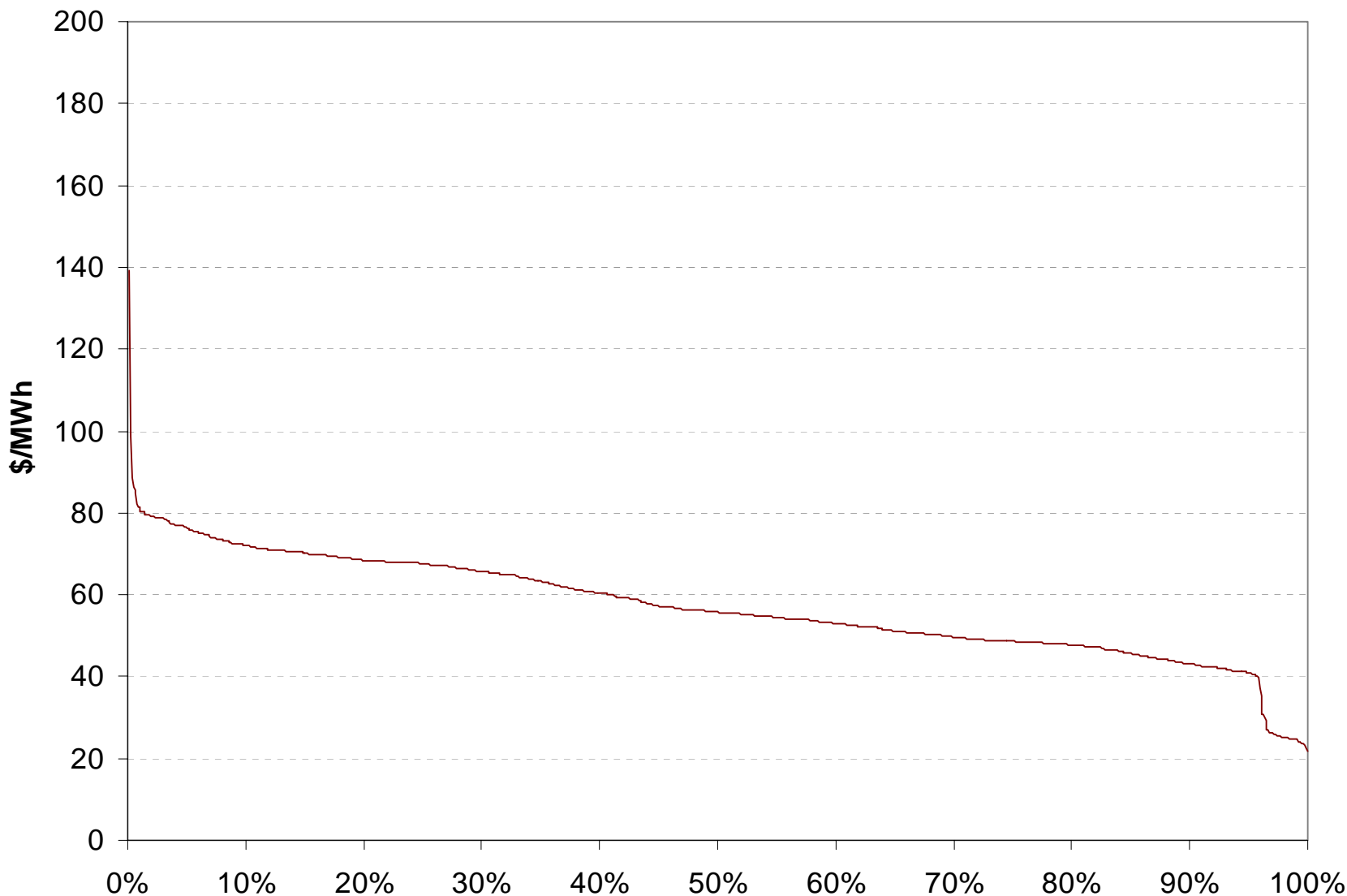
Annual Busbar Cost – Texas Lignite



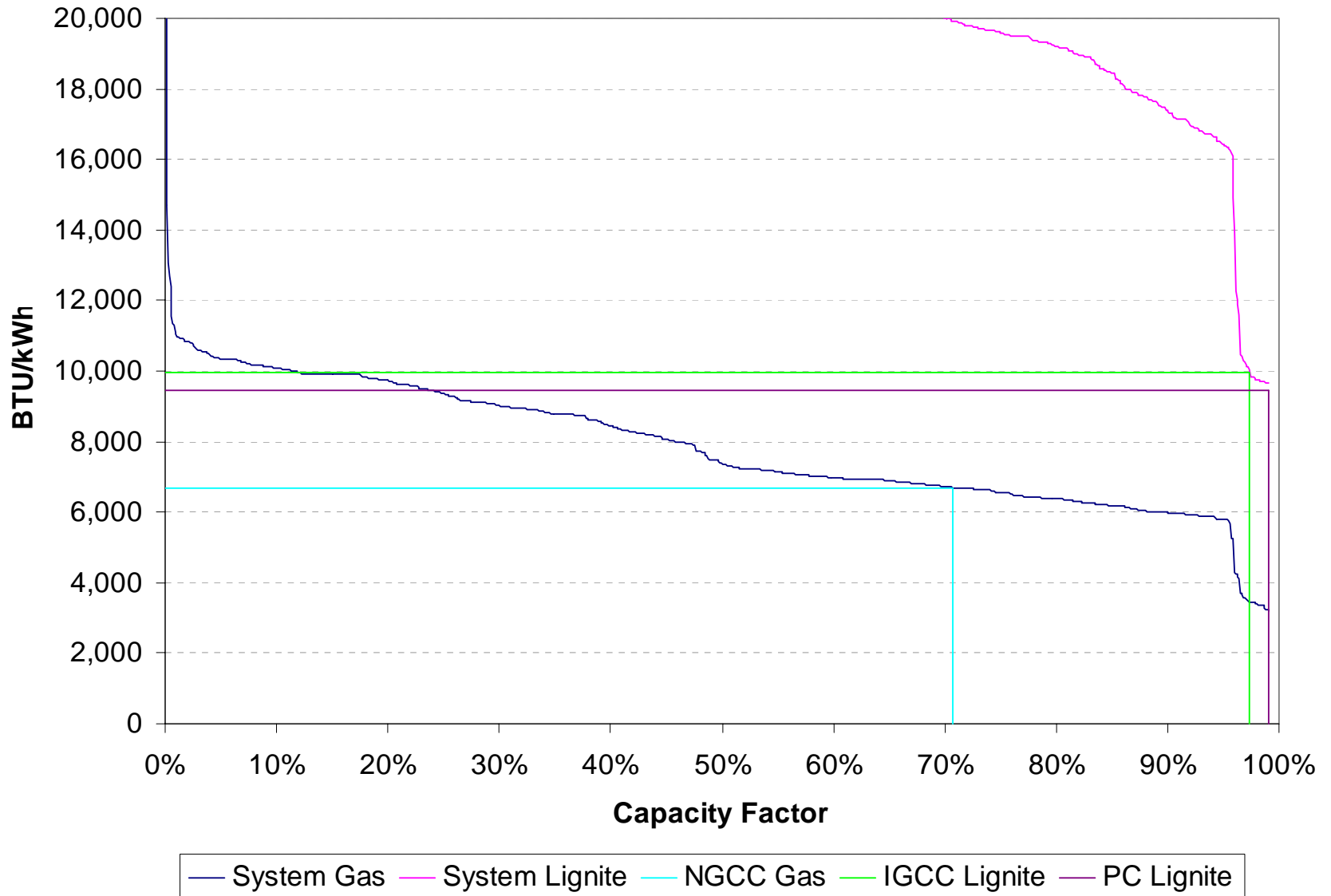
Levelized Cost at Busbar – IGCC



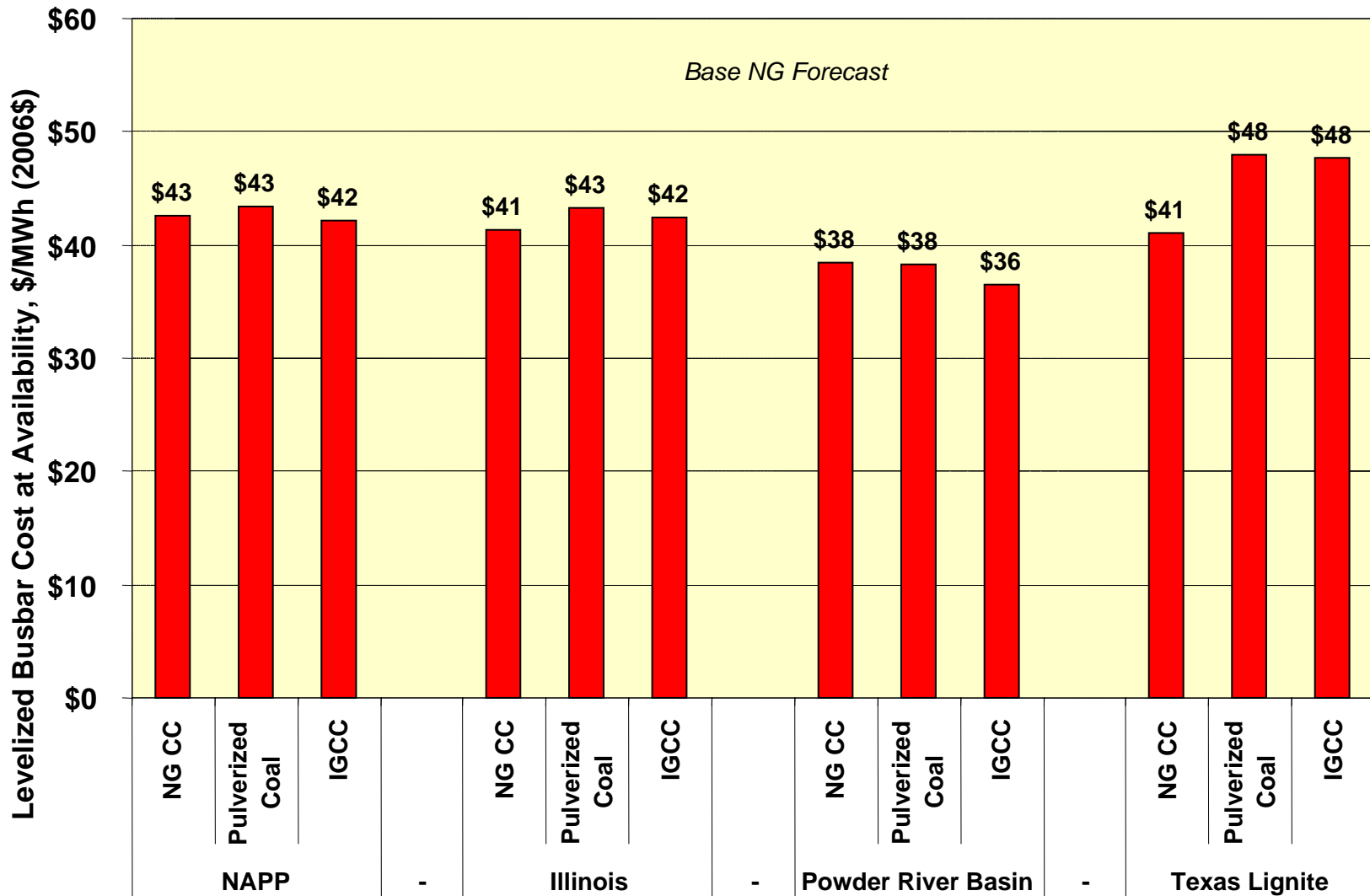
ERCOT Price Duration Curve – 2010



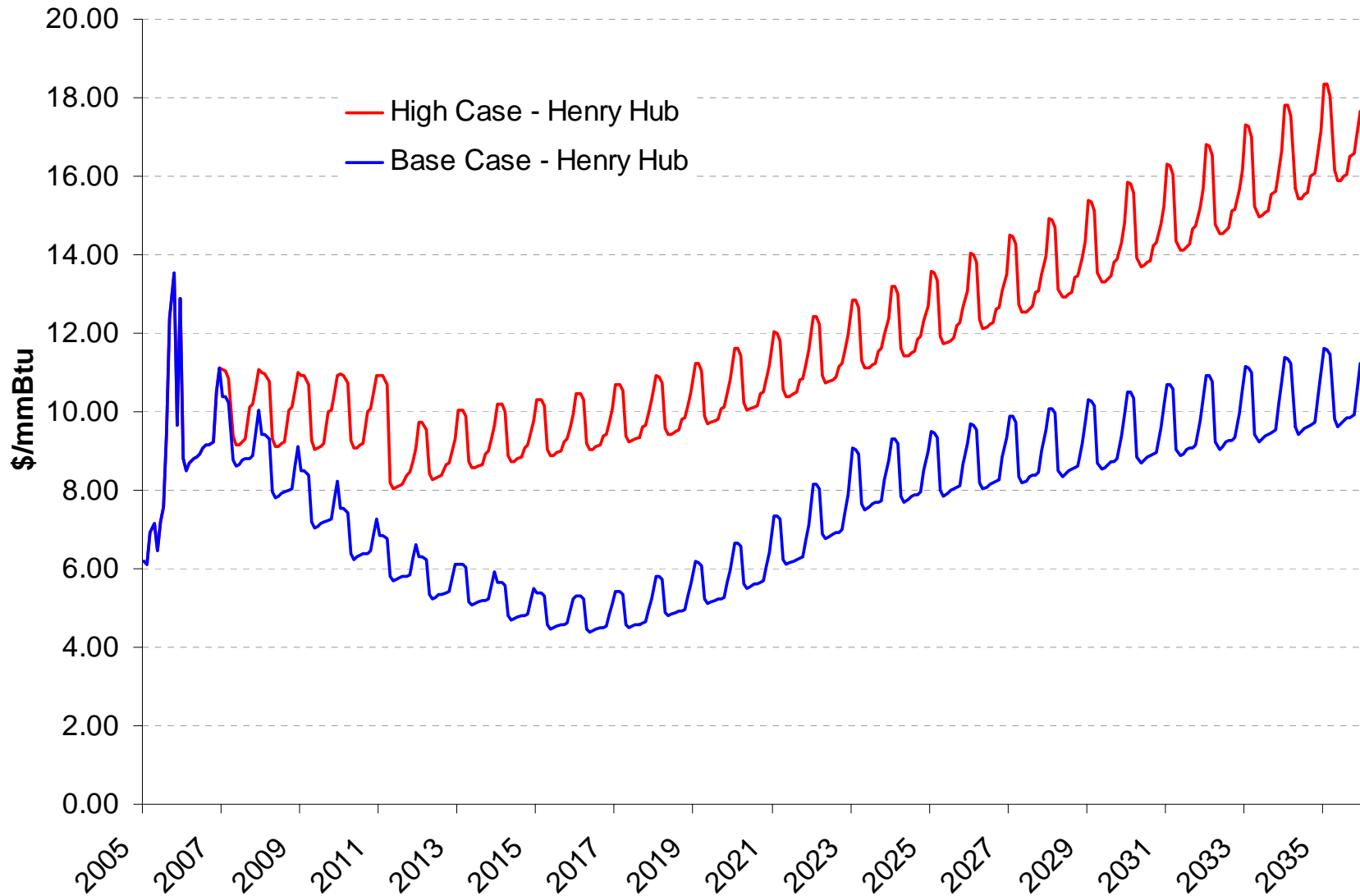
ERCOT System Heat Rate – 2010



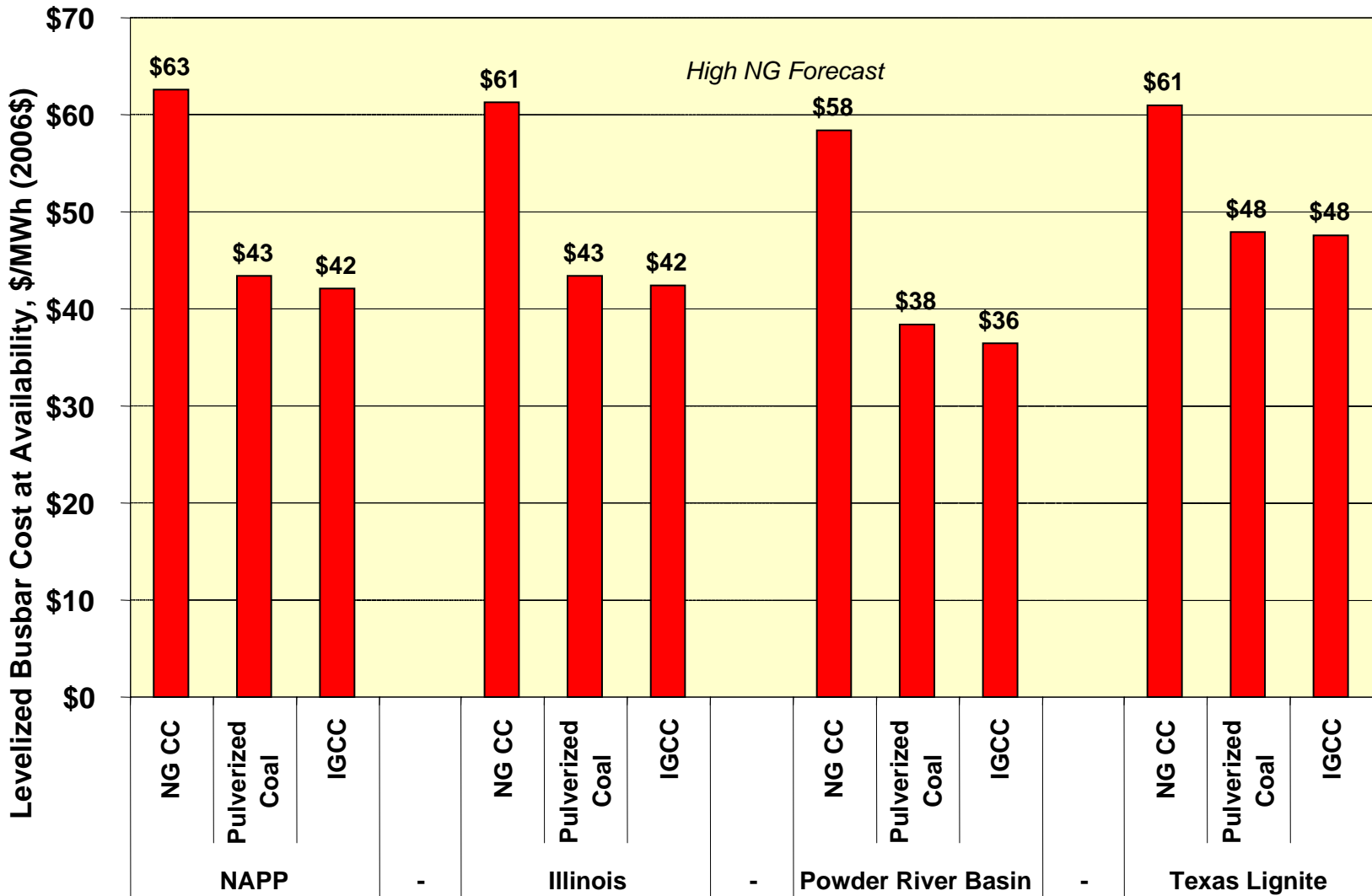
Levelized Busbar Cost – Base NG Forecast



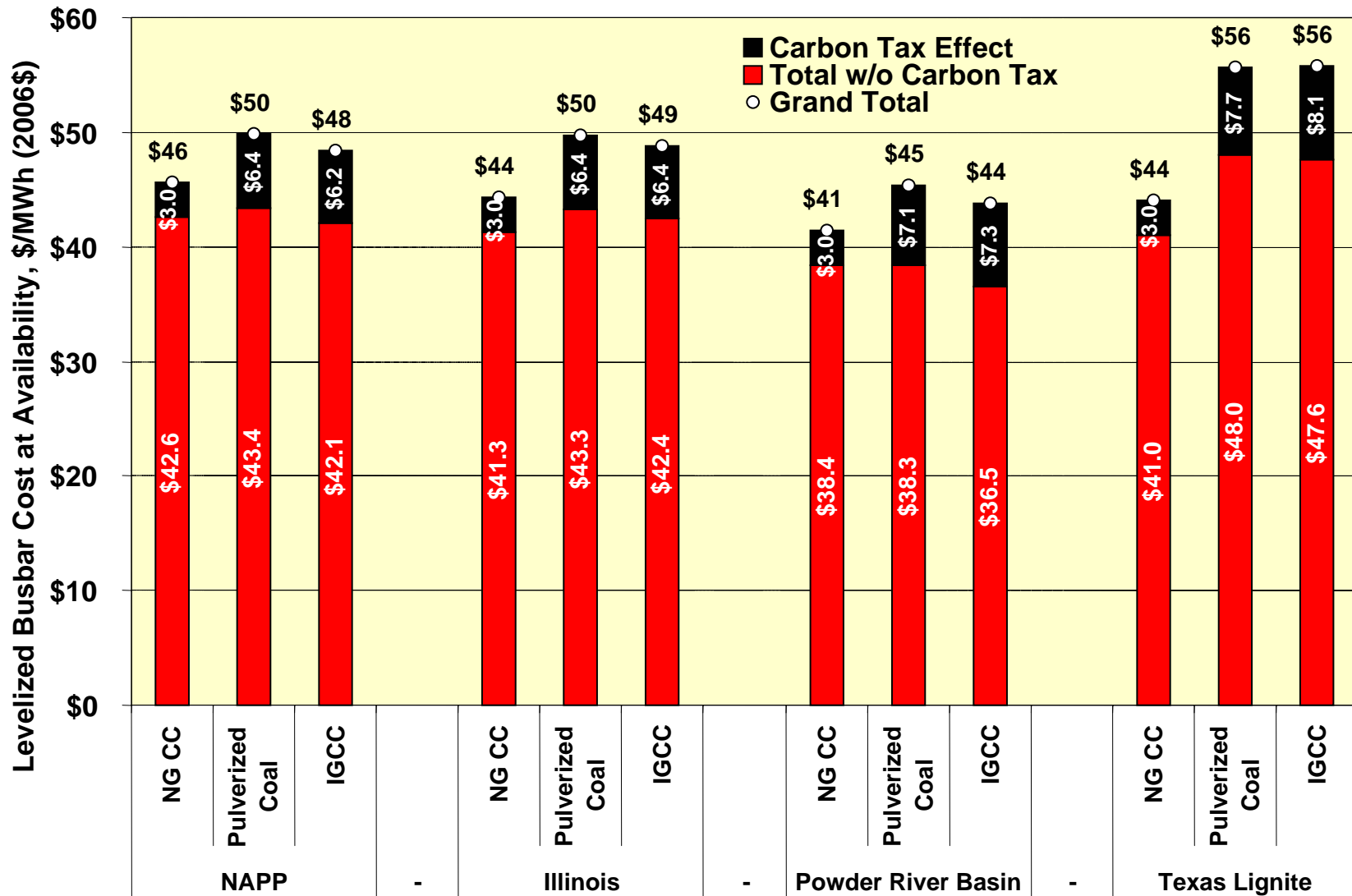
High Case Henry Hub Forecast



Levelized Busbar Cost – High NG Forecast



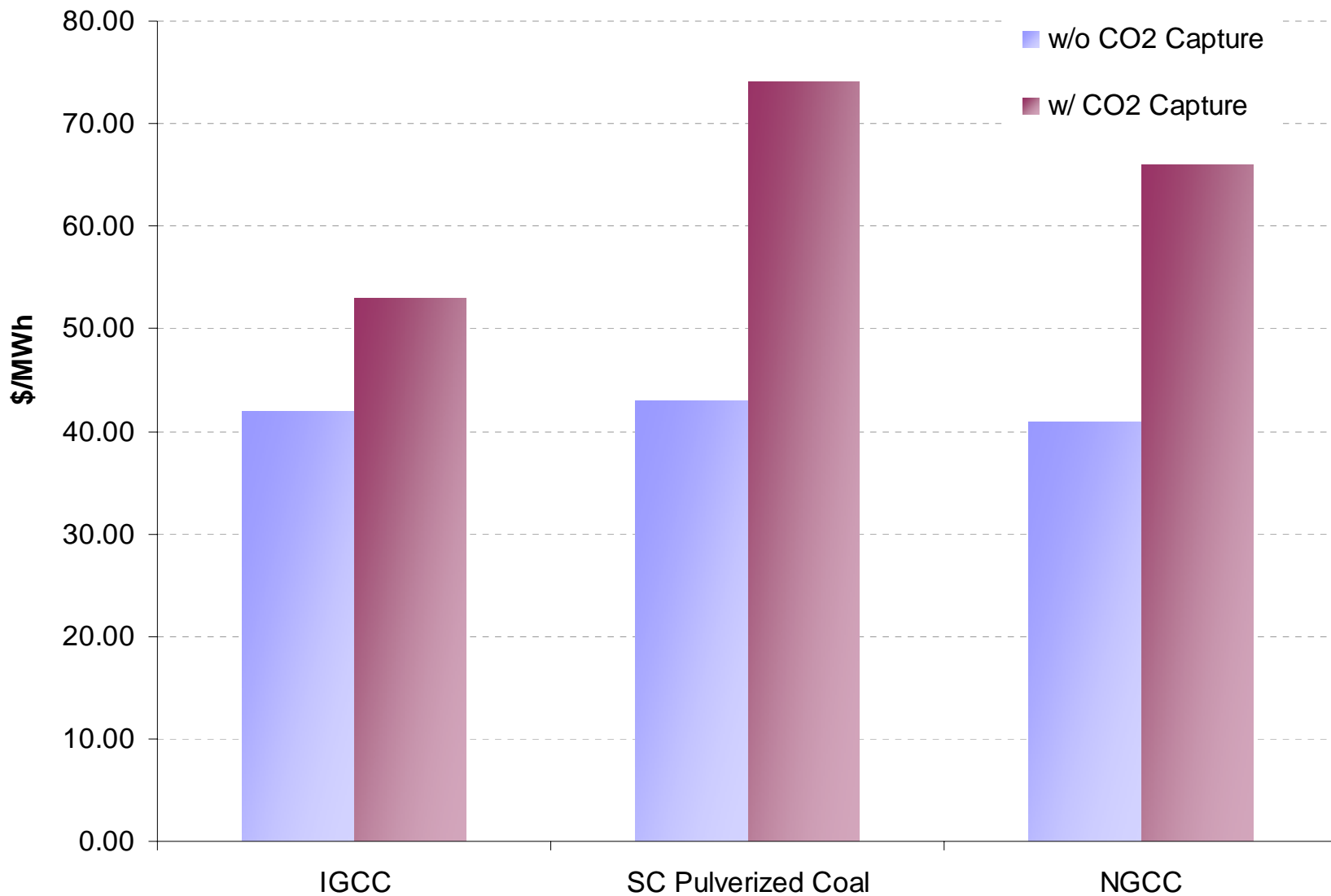
Levelized Busbar Cost – Carbon Tax Impact



Carbon Capture Impact on Electricity Cost

(Illinois Basin Coal)

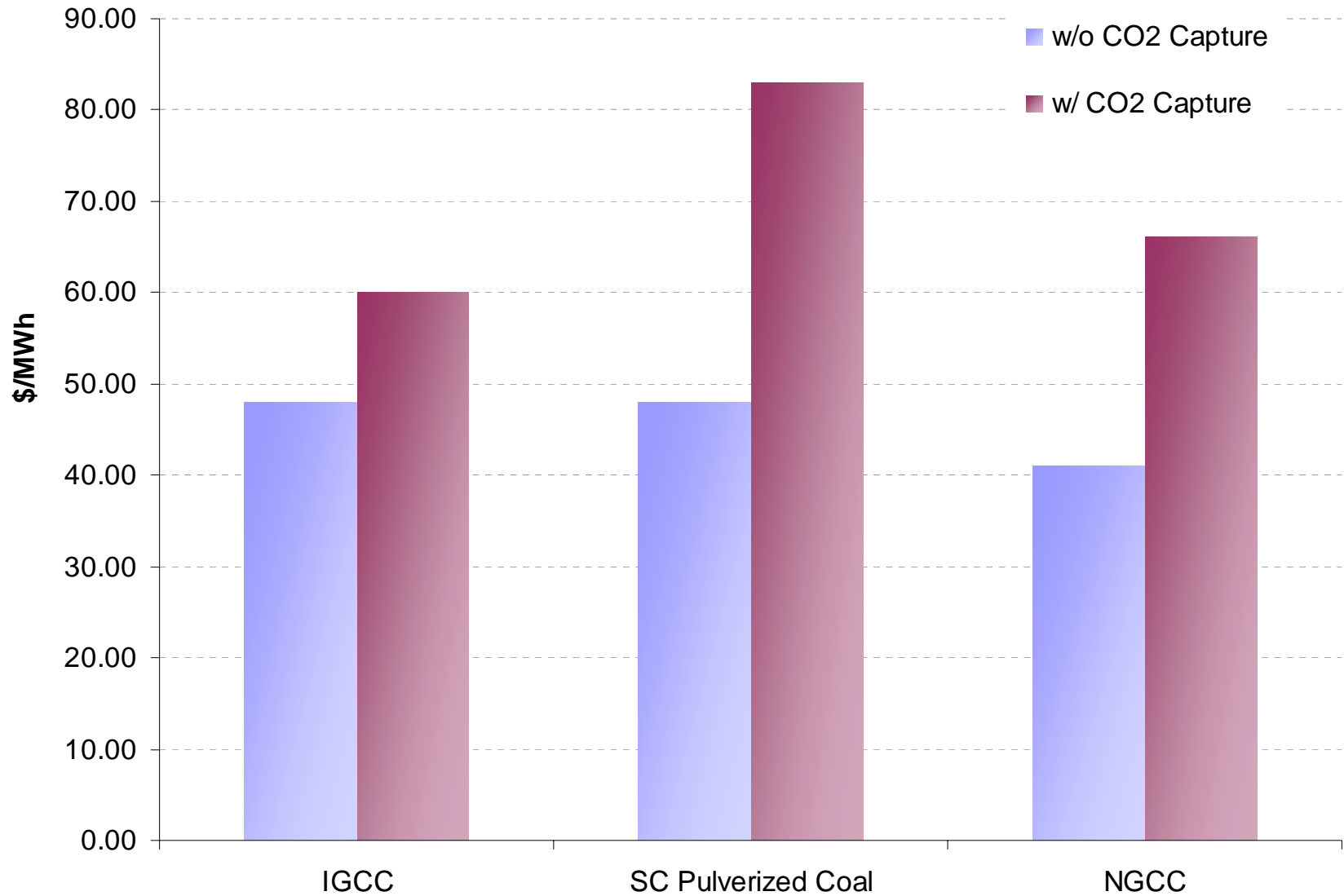
IGCC Comparative Economics



Source: NETL

Carbon Capture Impact on Electricity Cost

(Texas Lignite Coal)



Summary & Observations

- ❑ **IGCC Competitive with Pulverized Coal and NGCC in NAPP, Illinois Basin and Powder River Basin**
- ❑ **NGCC still the winner in the Gulf Coast**
- ❑ **Market dynamics can change the economics**
- ❑ **Natural gas prices and CO₂ emissions capture - two variables with the most significant impact on economics**
 - Higher gas prices favor IGCC and Pulverized Coal
 - CO₂ Tax favors NGCC
 - Carbon Capture favors IGCC