CRC IB

MARKET COST OF ENERGY ANALYSIS

H2 2023

INVESTMENT BANKING FOR A LOW CARBON WORLD

CONTENTS

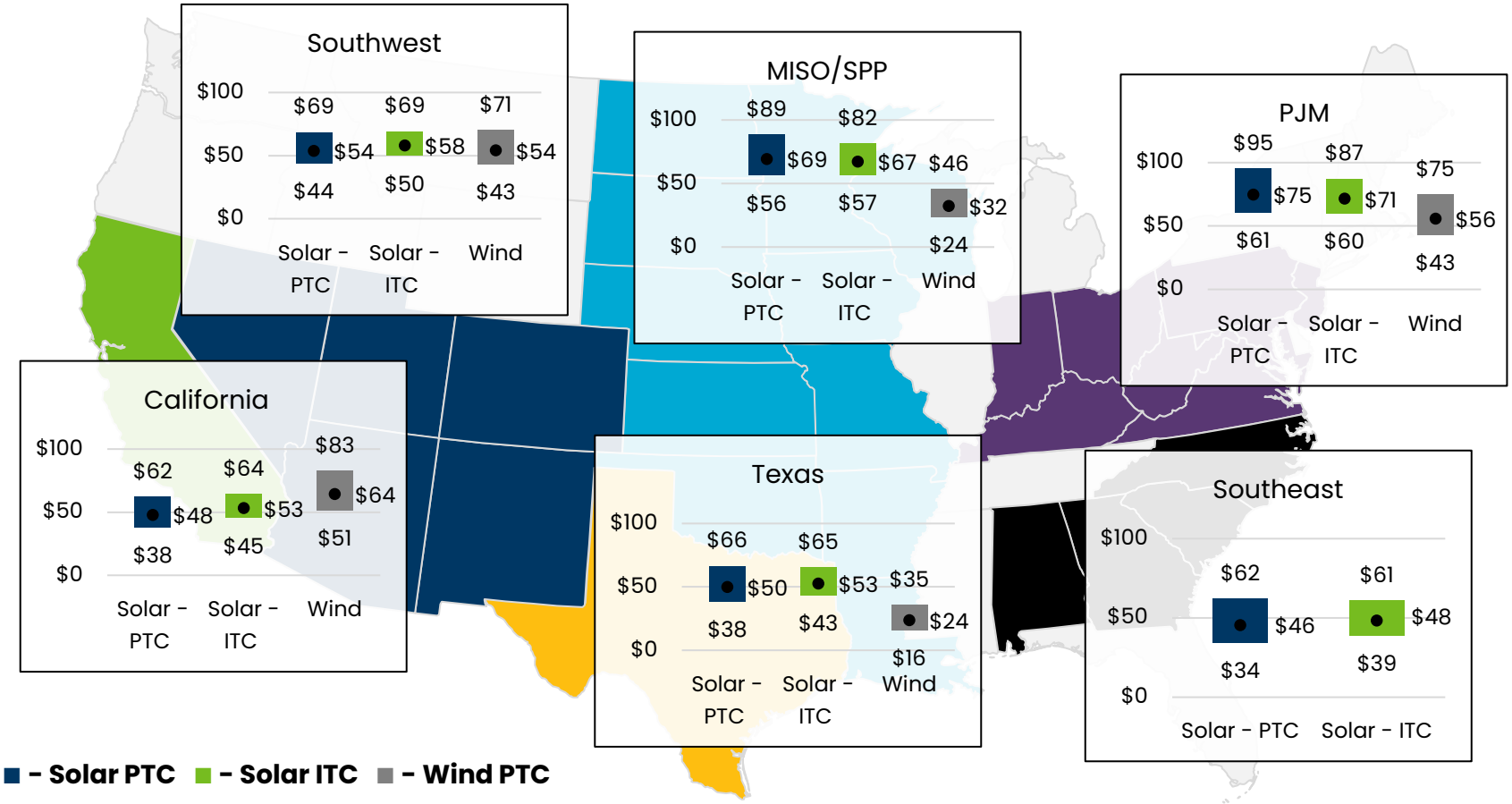
INTRODUCTION – SUMMARY OF METHODOLOGY

- **The Market Cost of Energy (MCOE) provides a more market-based metric than the Levelized Cost of Energy (LCOE).** MCOE represents a year-1 $/MWh contracted offtake rate with a creditworthy offtaker on a 15-year bundled (energy + capacity + RECs) utility-scale busbar PPA with 2% p.a. escalation.
- LCOE measures the average net percent cost of energy generation for a power plant over its lifetime. Comparatively, MCOE utilizes a market-based approach in determining the PPA price required to reach specific investor returns.
- CRC-IB analyzed 6 major US market regions: California (CAISO), the Southwest, Texas (ERCOT), PJM, MISO/SPP combined, and the Southeast (solar only).
- CRC-IB evaluated the 7-year ("Projection Period") impact of build cost trends and tax credit adders under the IRA on the relative offtake cost competitiveness of utility-scale solar and wind projects.
- External(1) and internal(2) project data on build costs, generation, capital expenditure, and operating expenditure were updated in an internal model. Tax equity and sponsor return requirements are additional inputs. See Appendix A for additional information on assumptions.

Sources: (1) Wood Mackenzie 2023 Base Case; (2) CRC-IB internal data collected from utility solar and wind projects

2023 YEAR-1 MCOE PRICE RANGES BY REGION(1)

2023 MCOE prices range from $34.2/MWh to $95.3/MWh for solar PTC, $39.2/MWh to $87.2/MWh for solar ITC, and $15.7/MWh to $82.9/MWh for wind.



(1) Highlighted states above represent approximations of the ISO/RTO regions included in this analysis. CRC-IB notes that various input data were available at different levels of detail. E.g., merchant curves were aligned with ISO/RTO regions, CAPEX data was available at the state-level, and OPEX/NCF data points were taken based on analysis of real projects in each region. CRC-IB aggregated data as needed based on industry knowledge. All figures are in $/MWh.

Sources: Wood Mackenzie 2023 Base Case; CRC-IB internal data collected from utility solar and wind projects

CHANGES FROM H1 2023 MCOE

A higher cost of capital paired with slight increases in CAPEX have offset the increase in merchant pricing. Compared to our H1 2023 analysis, mid-MCOE prices increase in every region across both solar and wind.

- We have assumed **higher tax equity return requirements** of 8.00% for solar ITC, 8.25% for solar PTC, and 8.50% for wind PTC. This is a 100-125 bps increase from our H1 2023 analysis.
- We have assumed **higher sponsor equity hurdle rates** of 8.50% for solar and 9.00% for wind. This is a 75-100 bps increase from our H1 2023 analysis.
- We have assumed a **higher spread on debt pricing of SOFR + 250bps,** an increase of 100bps since our H1 2023 analysis.
- **CAPEX has increased** on average 4% across all regions and technologies. This increase is less significant than the 21% average increase between 2022 and our H1 2023 analysis.
- **Energy prices in the merchant period (year 16+) have increased** on average 20% across all regions. More expected revenues from this period allow for lower PPA prices to achieve the same returns.

2023 Year-1 PPA Price, H2 2023 Forecast vs. H1 2023 Forecast ($/MWh)

		California	Southwest	PJM	MISO / SPP	Texas	Southeast*
Solar ITC	**H2 2023**	53.28	57.97	71.50	67.33	52.63	48.38
	H1 2023	49.10	52.91	66.28	61.23	49.81	46.57
	% Change	9%	10%	8%	10%	6%	4%
	# Change	4.18	5.06	5.21	6.11	2.82	1.81
Solar PTC	**H2 2023**	47.95	53.86	74.78	69.42	49.92	45.51
	H1 2023	42.17	47.19	67.27	60.88	45.36	42.19
	% Change	14%	14%	11%	14%	10%	8%
	# Change	5.78	6.67	7.51	8.55	4.56	3.32
Wind PTC	**H2 2023**	64.38	54.24	55.84	32.42	23.63	
	H1 2023	56.14	44.79	49.66	27.03	19.50	
	% Change	15%	21%	12%	20%	21%	
	# Change	8.24	9.45	6.18	5.39	4.13	

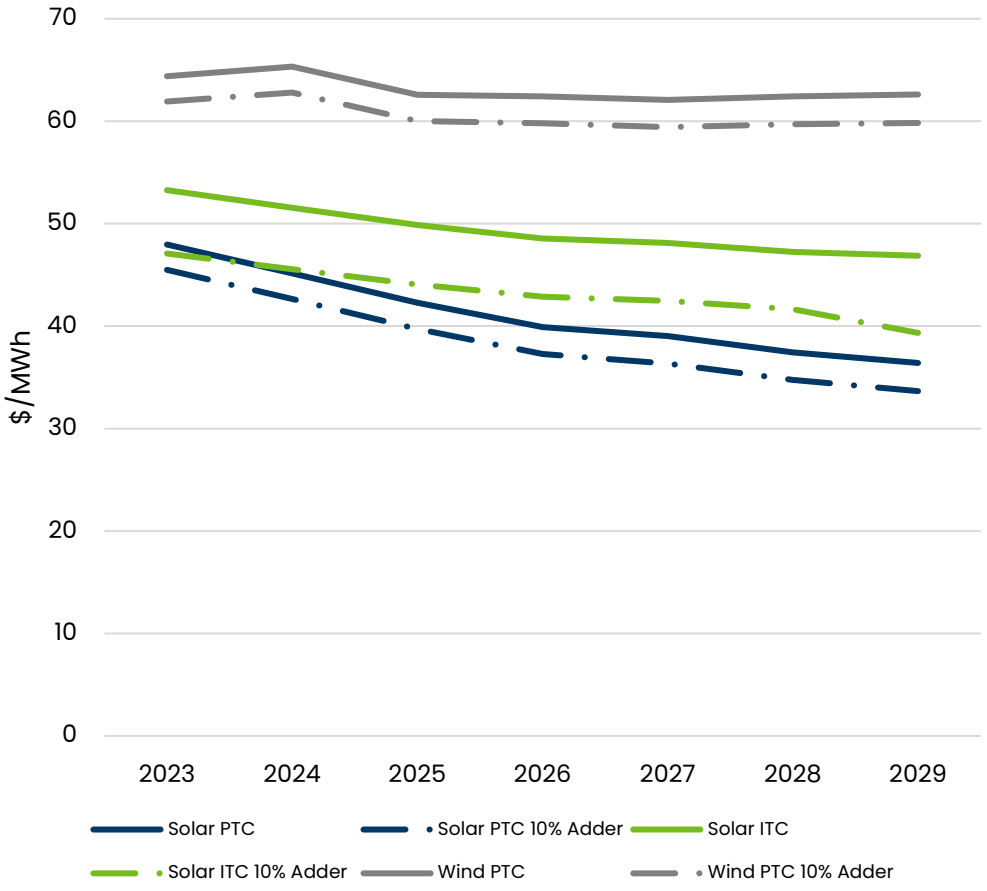
Sources: Wood Mackenzie 2023 Base Case and 2022 Base Case - Update; CRC-IB internal data collected from utility solar and wind projects

*Wind resource in the Southeast is so low that there is effectively no market for onshore wind. Therefore, it has not been assessed in our MCOE analysis

MCOE IMPACT OF 10% ADDER ITC/PTC

Provisions of the IRA allow projects to qualify for tax credit adders of up to 30%. Our analysis examines the effect of a single 10% adder on year-1 PPA price.

Year-1 PPA Price: ITC/PTC vs ITC/PTC With 10% Adder (California)



- The 10% adder can reduce overall projected year-1 PPA price by 4-16% depending on sector technology, tax credit selected, and geographic region.
- The tax credit tends to have the biggest impact on the solar ITC scenarios given the ITC is mostly realized in the first year. A greater return in the first year allows for greater reduction in year-1 PPA prices.
- **10% adder impacts in California.** California was chosen to illustrate the impact of a 10% adder to year-1 PPA prices. Similar impacts can be seen in most other markets.

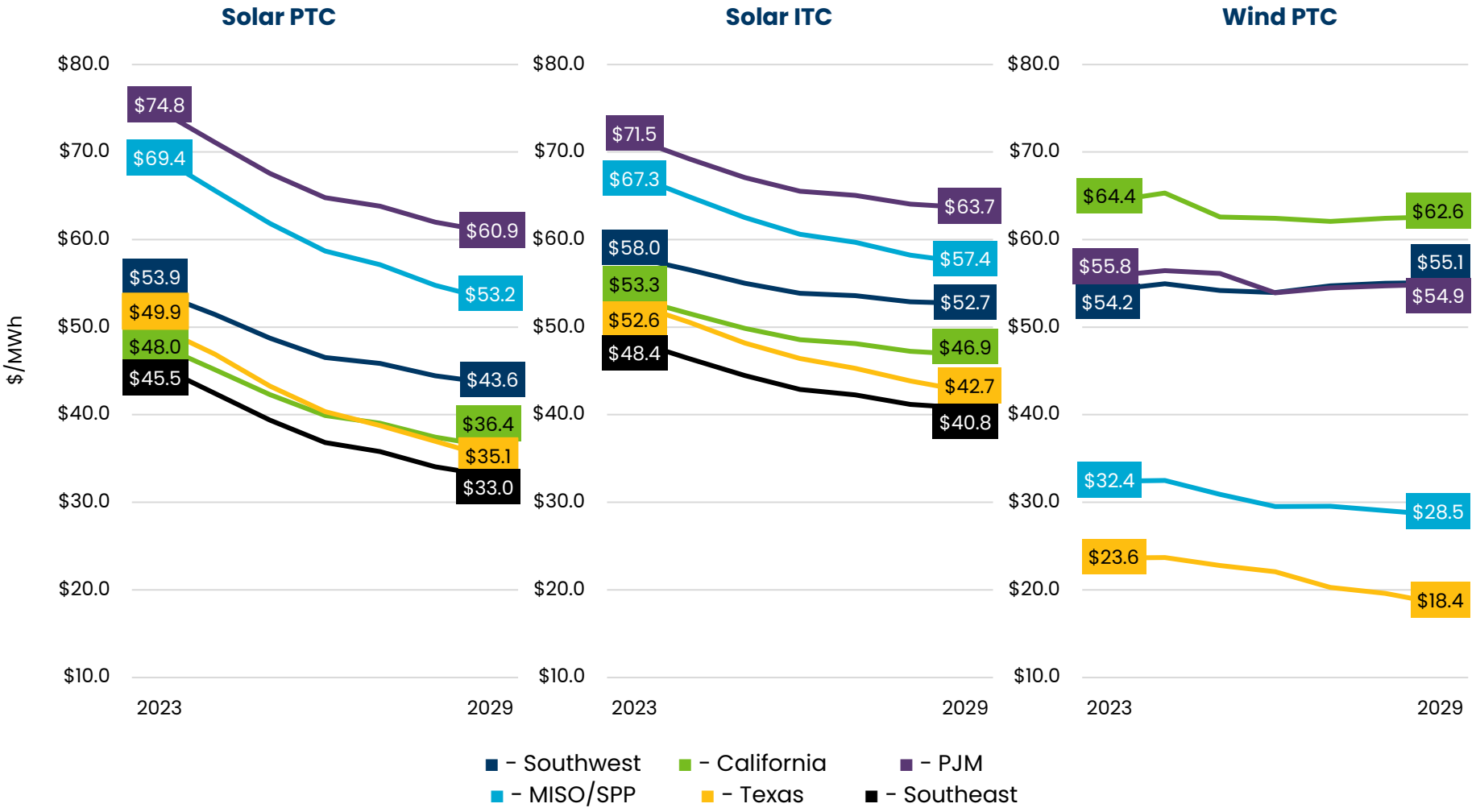
  Between 2023 – 2029 in California:

  - 10% adder to solar PTC provides for a ~$2.46-2.75 reduction in PPA price.
  - 10% adder to solar ITC provides for a $5.59-7.53 reduction in PPA price.
  - 10% adder to wind PTC provides for a $2.47-2.78 reduction in PPA price.

Sources: Wood Mackenzie 2023 Base Case; CRC-IB internal data collected from utility solar and wind projects

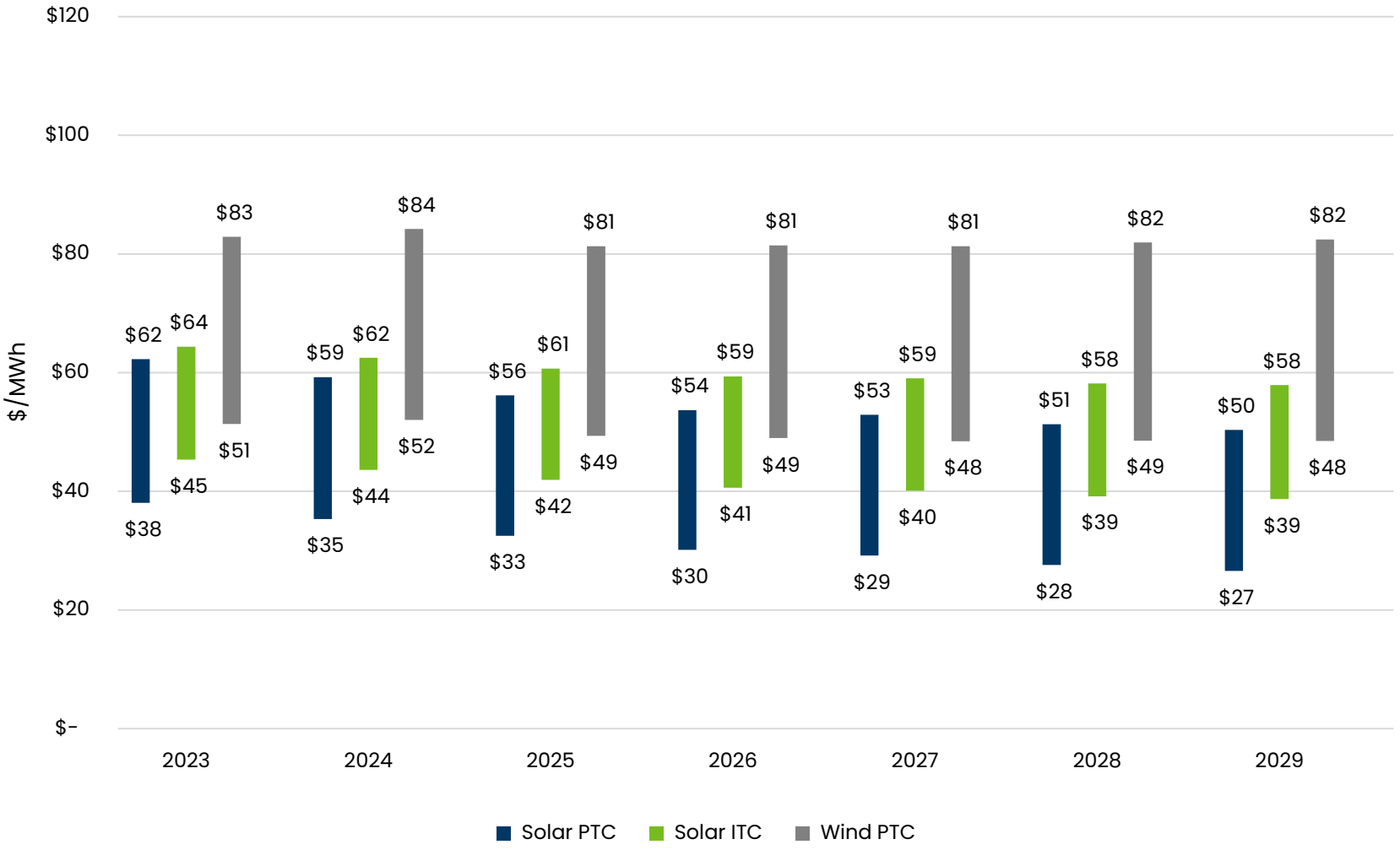
REGIONAL MCOE MIDPOINTS COMPARISON

Though MCOE has increased since last analysis, decreases in CAPEX, technology improvements, increased battery attachment rates, and stabilizing inflation and interest rates are a few of the factors contributing to lower year-1 PPA prices over time.



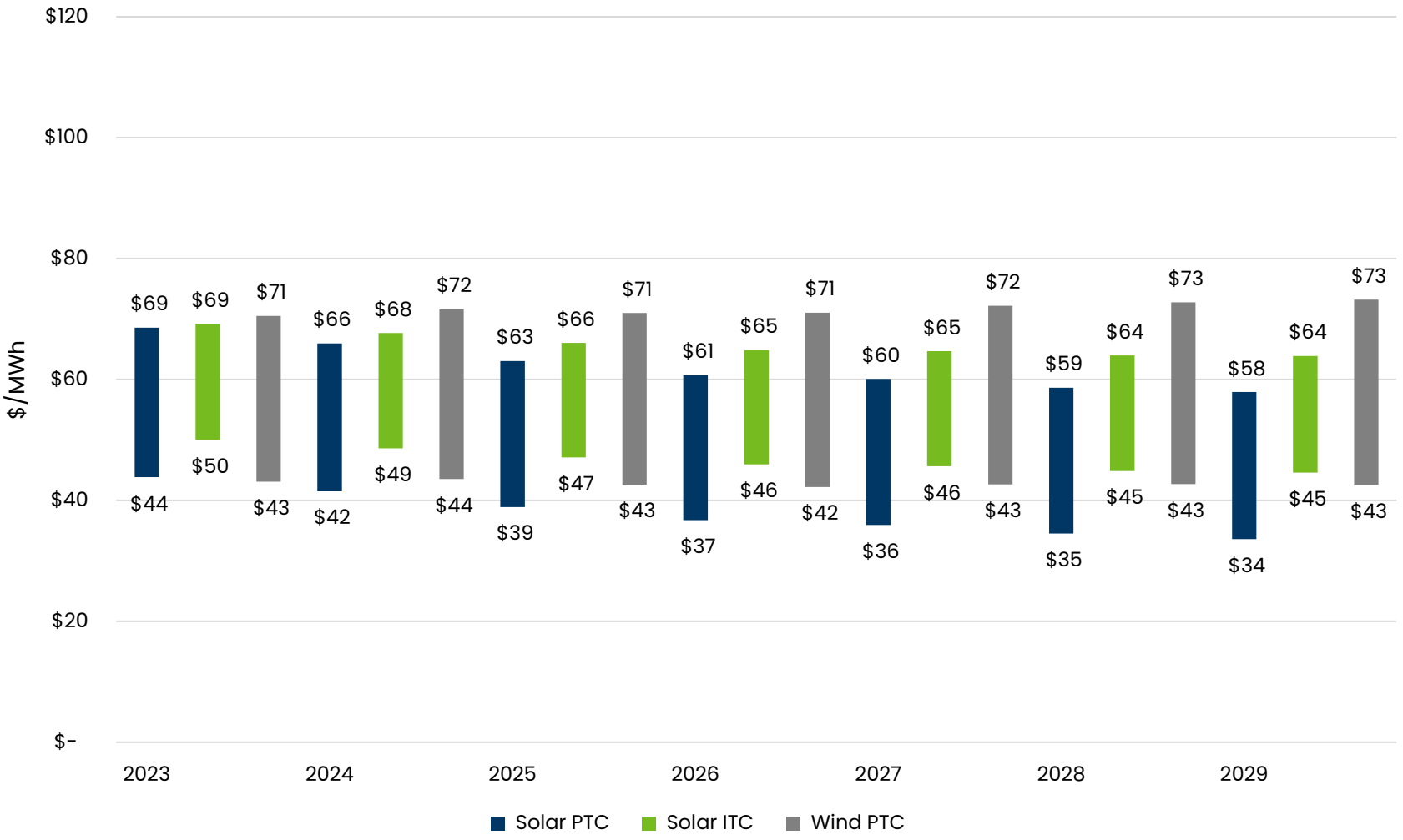
Sources: Wood Mackenzie 2023 Base Case; CRC-IB internal data collected from utility solar and wind projects

MCOE RESULTS: CALIFORNIA (CAISO)



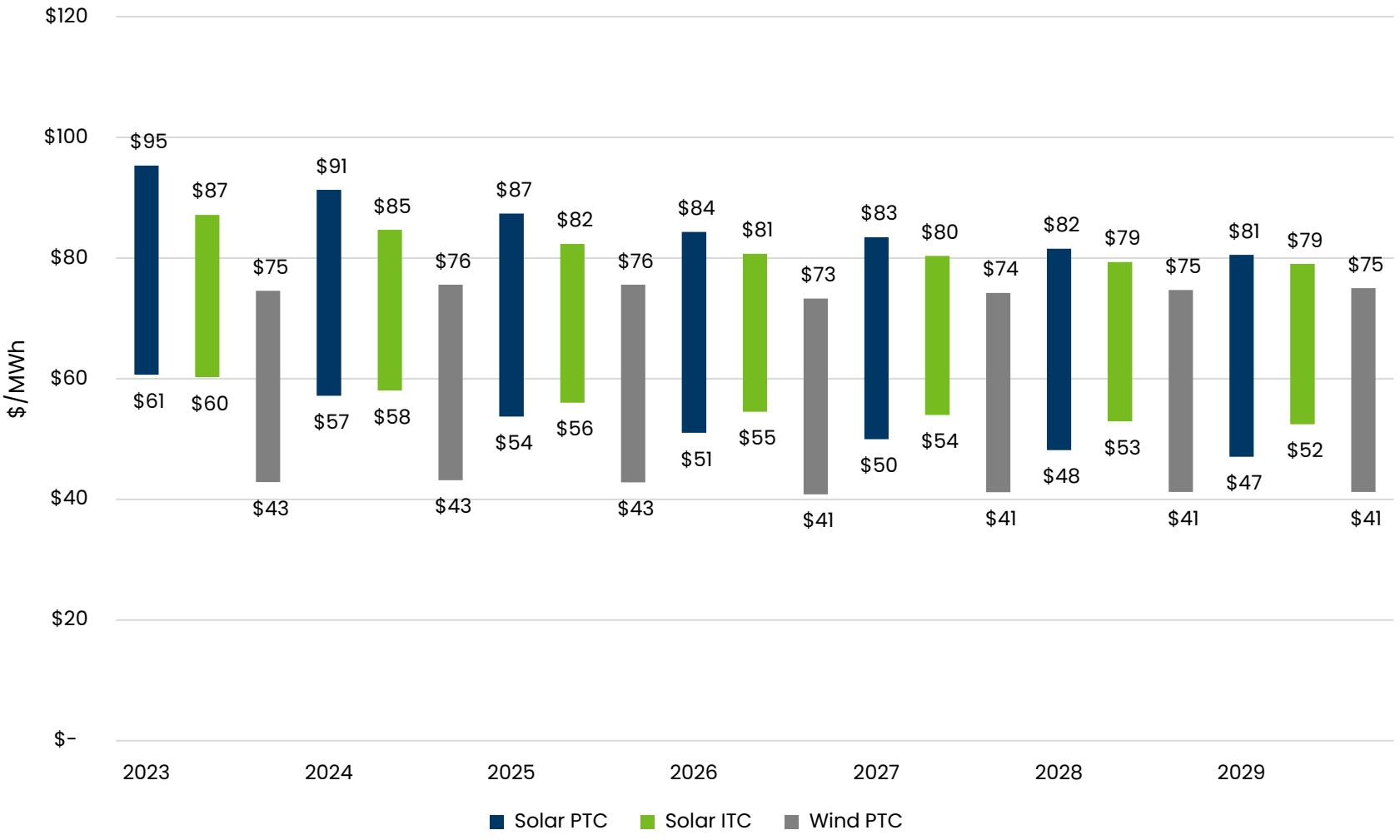
Sources: Wood Mackenzie 2023 Base Case; CRC-IB internal data collected from utility solar and wind projects

MCOE RESULTS: SOUTHWEST



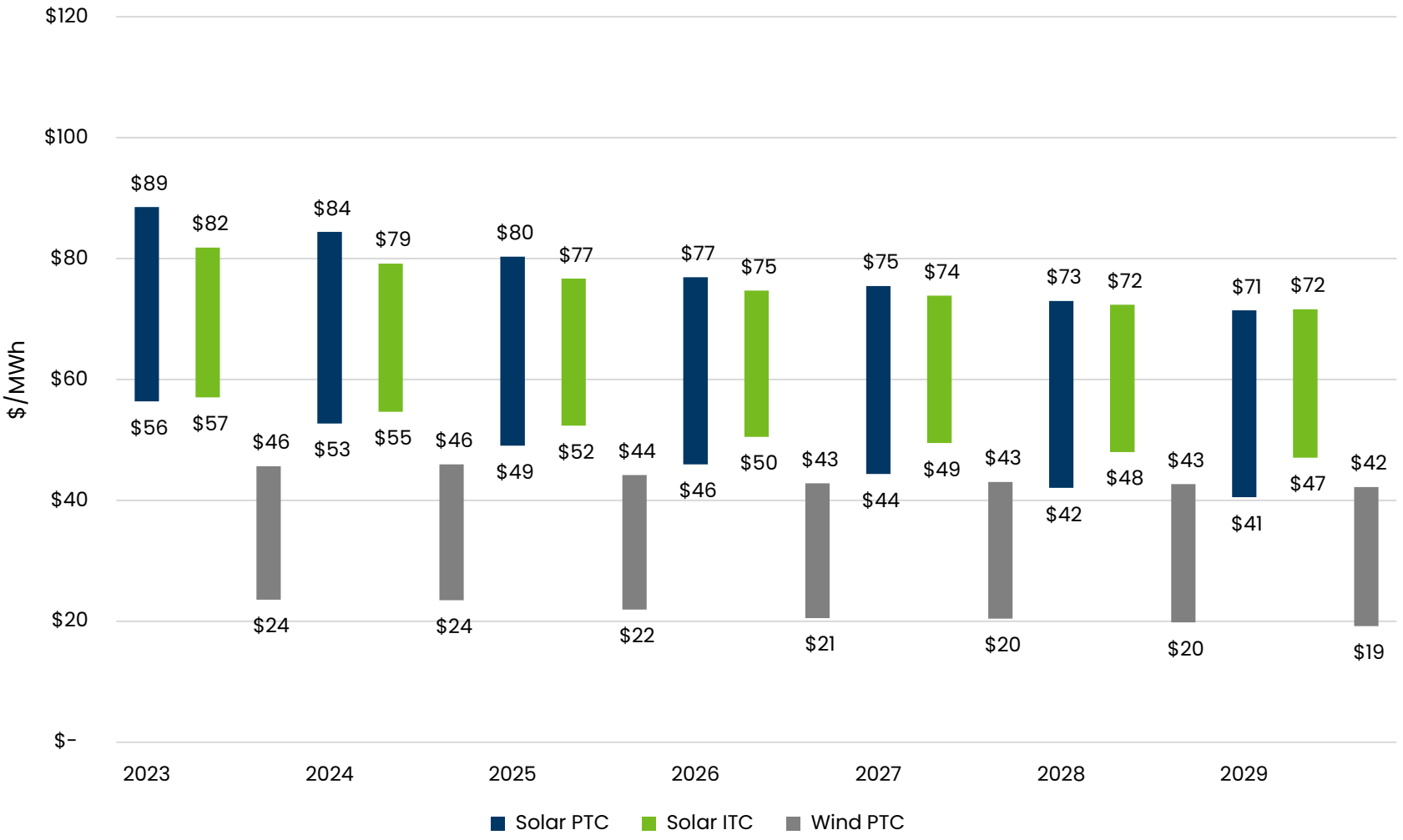
Sources: Wood Mackenzie 2023 Base Case; CRC-IB internal data collected from utility solar and wind projects

MCOE RESULTS: PJM



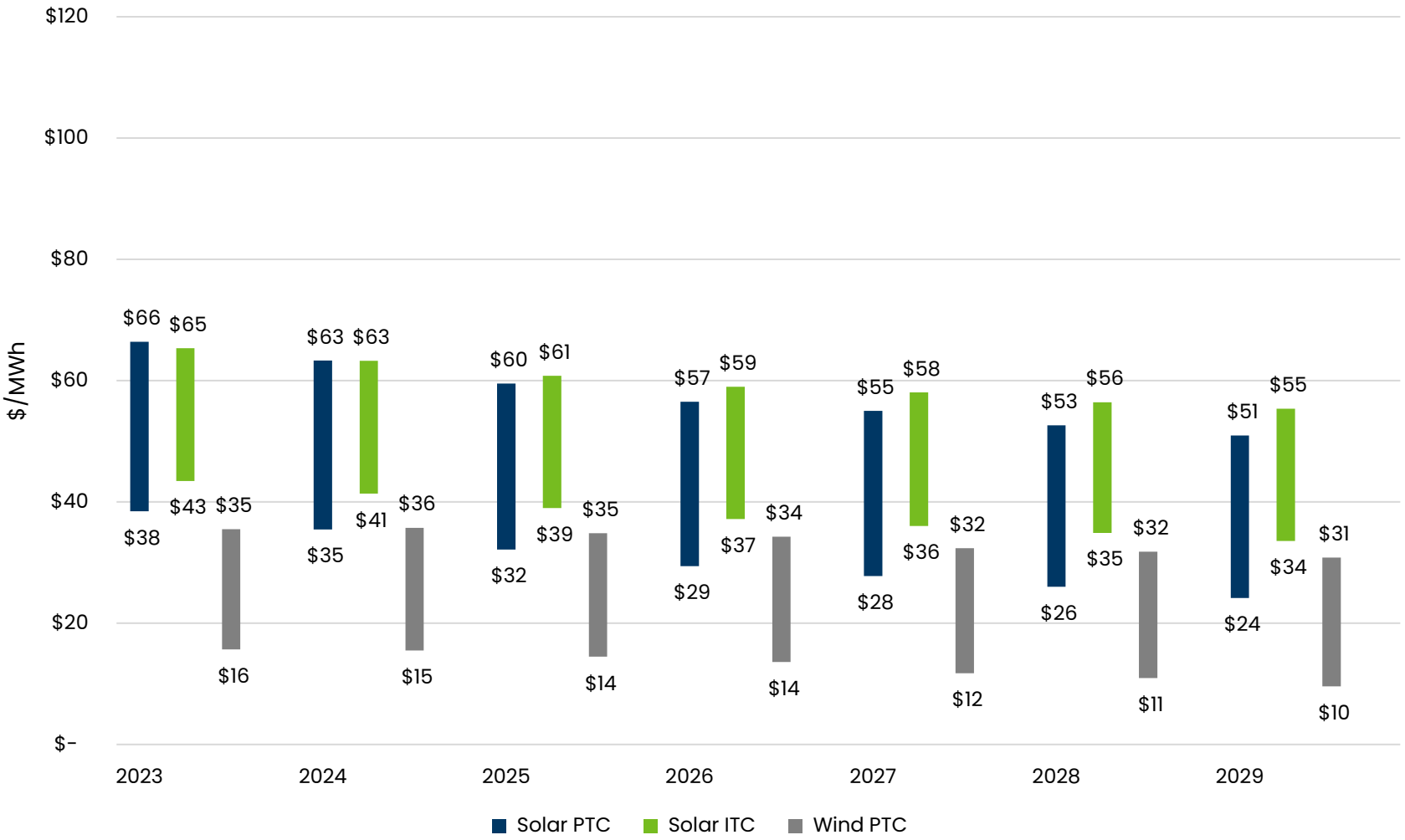
Sources: Wood Mackenzie 2023 Base Case; CRC-IB internal data collected from utility solar and wind projects

MCOE RESULTS: MISO / SPP



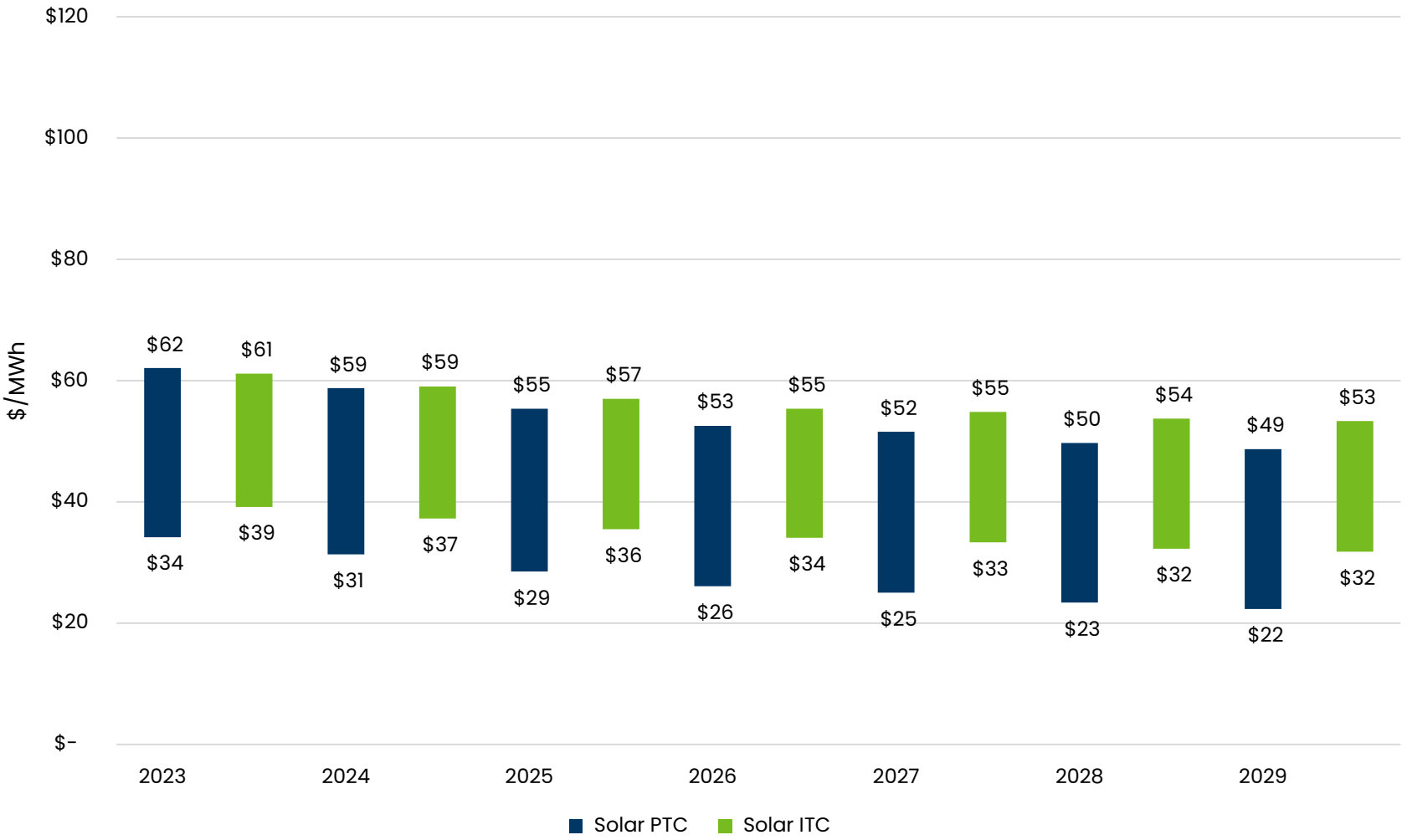
Sources: Wood Mackenzie 2023 Base Case; CRC-IB internal data collected from utility solar and wind projects

MCOE RESULTS: TEXAS (ERCOT)



Sources: Wood Mackenzie 2023 Base Case; CRC-IB internal data collected from utility solar and wind projects

MCOE RESULTS: SOUTHEAST

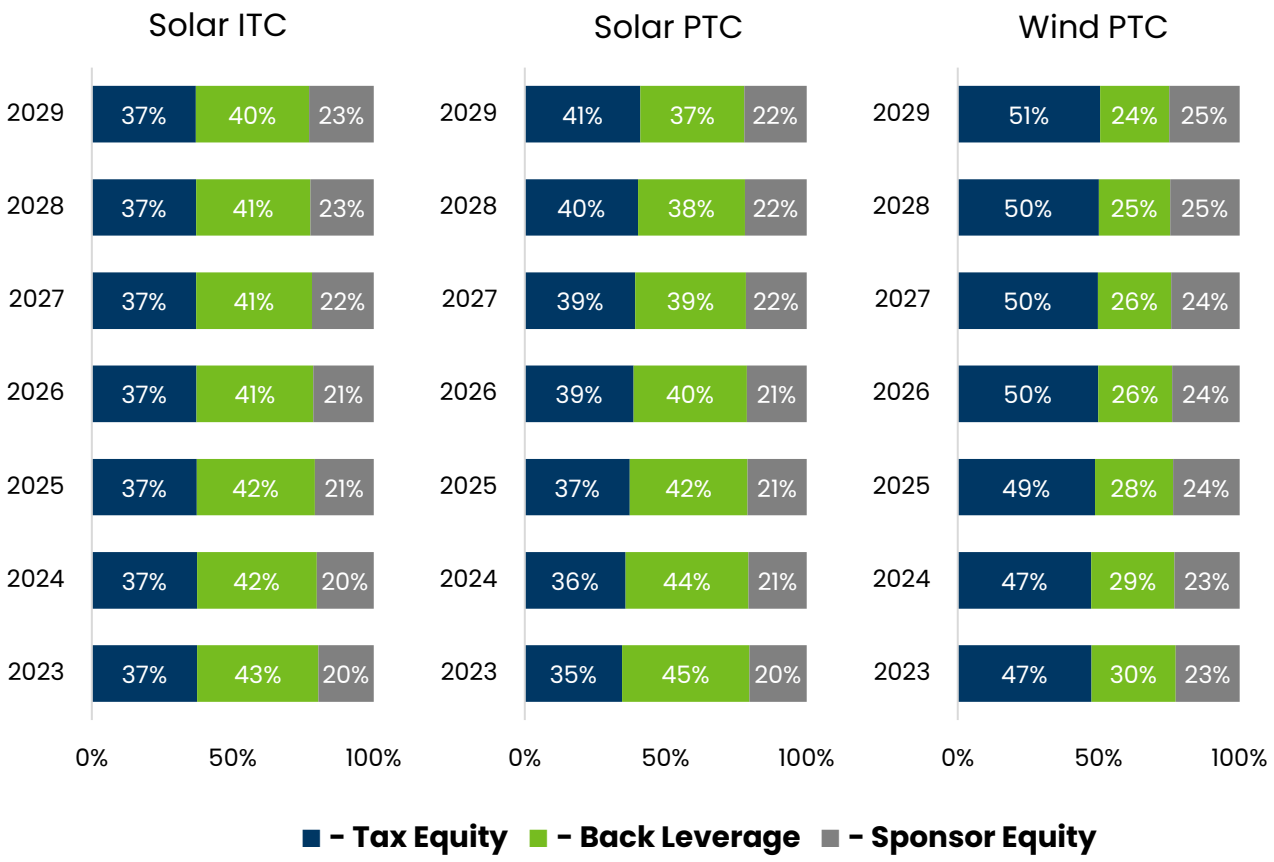


Sources: Wood Mackenzie 2023 Base Case; CRC-IB internal data collected from utility solar and wind projects

CAPITAL STRUCTURE TRENDS

Tax equity contributes 30-60% of the capital stack depending on technology and tax credit election. Net sponsor equity requirements are expected to increase because of higher financing costs.

Tax Equity, Back Leverage, and Net Sponsor Equity % of Total Capital Structure – MCOE Scenarios (MISO/SPP*)



- The extension of tax credits and increase in CAPEX causes tax equity to contribute a significant portion of the capital stack.
- With higher financing costs, net sponsor equity is expected to contribute more to the capital stack.
- Consistent with historical trends, sponsors with larger balance sheets tend to achieve a more competitive cost of capital than smaller operators.

Sources: Wood Mackenzie 2023 Base Case; CRC-IB internal data collected from utility solar and wind projects

*MISO/SPP region is used to show relative differences in capital stacks across technologies and tax credits. General ratios of tax equity, back leverage, and sponsor equity should be similar in other regions.

MCOE IN CONTEXT: BROADER NEAR-TERM PPA PRICE TRENDS

The following key factors summarize several of the most important trends that are impacting PPA prices.

TOPIC	IMPACT ON PPA PRICE	DISCUSSION
Cost of Capital	↑	▪ Sponsors, tax equity providers, and lenders are all requiring higher rates of return largely because of the high interest rate and inflationary environment.
CAPEX	↑	▪ Solar CAPEX increased ~4% and Wind CAPEX increased ~3% each year 2023-2029 over the last analysis. This is primarily due to supplies and labor shortages and increased interconnection costs. While commodity pricing is cooling from recent highs, it takes time for suppliers to pass this saving to buyers.
IRA Certainty	↑	▪ The Inflation Reduction Act has provided 10+ years of renewable incentives, allowing for more lucrative projects and renewable build-out to increase.
Anti-Renewables Policy	↑	▪ Over half of U.S. states have a Renewable Portfolio Standard (RPS) in place but there remains a handful of states with expiring or no RPS. The absence of pro-renewables policy could cause prices to increase, in certain regions.
Supply Chain	–	▪ Industry-wide supply chain issues are easing from Covid-19 highs, however, forced labor laws are creating a temporary shortage of imported project equipment. Equipment pricing and supply of imports are in flux.
Stabilization of Coal Supply Issues	↓	▪ Coal supply issues that started in 2021-22 are expected to continue through 2024. However, these issues will have less of an impact and are now undercut by gas plants bidding in far cheaper than in recent past.
Cheaper Natural Gas Prices	↓	▪ Downward pressures on gas prices exist because natural gas generation remains strong and 22GW of new capacity is expected through 2027.
PPA Announcements Decreasing	↓	▪ Although supply is increasing, demand is decreasing, causing equilibrium at a lower price. Q3 2023 saw a 59% and 21% year-over-year decrease in solar and wind PPA announcements, respectively.

Sources: Wood Mackenzie: Power Prices Face Downward Pressure in the Short Term, October 2023; American Clean Power: Record Third Quarter for US Clean Energy Installations, November 2023

APPENDIX A: DETAILED ASSUMPTIONS & DATA

METHODOLOGY & KEY ASSUMPTIONS

CRC-IB modeled fully structured project economics for utility-scale solar (PTC and ITC separately) and wind projects in key U.S. markets. CAPEX, OPEX, capacity factors, and post-contracted pricing were sensitized to produce a range of year-1[(1)] PPA rates from 2023 – 2029, while applying the federal tax credit schedule under the IRA.

AREA	COMMENT
CAPEX	▪ Wood Mackenzie 2023 Base Case ($/W, by technology and market).[(2)]
OPEX	▪ Average by technology and market, based on public and internal data; escalated 2.0% p.a. through project useful life.
Capacity Factor	▪ Average P50 NCF (by technology and market) based on public and internal data.

Sponsor Equity Hurdle Rate	▪ Levered After-Tax (Inefficient) IRR:
	  ▪ **Solar ITC / PTC:** 8.50%
	  ▪ **Wind:** 9.00%

Post-Contracted Wholesale Pricing	▪ Wood Mackenzie 2023 Technology Weighted Average Prices. ▪ Post-contract assumptions impact Hurdle Rate/MCOE, reflecting how CRC-IB observes investors valuing assets in today's market (significant portion of return is derived from post-contracted period).
Financing	▪ Asset-specific tax equity and back leverage structuring with associated sizing parameters for each.
Federal Tax Credit Qualification[(3)]	▪ Full 30% on ITC and 100% on PTC assumed for projects placed in service between 2023 and 2029. ▪ Additional scenarios considered with 10% adders (energy community or domestic content).

(1) MCOE reflects value applied in first complete year of project operations, after 12/31 COD in 2023-2029

(2) For comparability across technologies, no additional developer fees or basis markups were included in project costs

(3) Federal Tax Credit Qualification was based on a 3-year start of construction to reflect safe harbor & physical work test. It is assumed that projects will satisfy the Prevailing Wage Requirement under the IRA and will comply under future treasury guidance

DETAILED ASSUMPTIONS - SOLAR

TOPIC	DISCUSSION
Project Type	▪ 200MWdc / 164MWac , Single-Axis Tracker; without storage.
Useful Life	▪ 35 years
Capital Expenditure	▪ Based on Wood Mackenzie 2023 Base Case forecast of build cost by state. ▪ Overnight Capital Cost method (CAPEX assumed to be incurred in year 0 to isolate impact of other variables on MCOE). ▪ No additional developer fees or basis markups were included in project costs.
Energy Production	▪ Average AC net capacity factors ("NCF") based on public operating plant data and internal CRC data. ▪ Average NCFs held constant across 2023-29 projections.(1) ▪ 98% annual combined availability & curtailment factor applied to solar and wind.
Energy Production (Tech-Specific)	▪ Degradation: 0.46% p.a. weighted average of thin film (0.30%) and CSPV (0.50%) by U.S. market share.
Market Cost of Energy ("MCOE")	▪ $/MWh required for sponsor equity to achieve a target Levered After-Tax Hurdle Rate. ▪ Proxy for year-1 price on a 15-year bundled (energy + capacity + (S)REC) busbar PPA with 2% p.a. escalation. ▪ Plant revenues for ancillary grid services not contemplated (e.g., smart inverter).
Sponsor Equity Hurdle Rate	▪ Levered After-Tax (Inefficient) IRR: 8.50%
Contracted / Merchant Periods	▪ 100% contracted for PPA term; wholesale price forecast applied to 100% of generation thereafter (Year-16). ▪ Post-contracted assumptions impact Hurdle Rate/MCOE, reflecting observed valuation methodology. ▪ Post-contracted wholesale pricing based on Wood Mackenzie's "2023 Technology Weighted Average Prices" using technology-specific pricing for Solar. ▪ Real pricing escalated to nominal assuming 2% long-term inflation; no haircut applied to nominal pricing for mid-MCOE.
Operating Expense	▪ Average all-in year-1 OPEX ($/W, by technology and market) based on public operating plant data and internal CRC data; escalated 2.0% p.a. through project useful life.
Operating Expense (Tech-Specific)(2)	▪ Inverter replacement $0.40/Wdc nominal future cash cost (no reserve) spread evenly from Y11-25.

(1) NCFs expected to increase with technology improvements; however, assumption is held constant through time in our analysis to isolate build cost and tax credit impacts on MCOE

DETAILED ASSUMPTIONS - WIND

TOPIC	DISCUSSION
Project Type	▪ 200MW with Tier-1 turbine OEM; without storage.
Useful Life	▪ 30 years
Capital Expenditure	▪ Based on Wood Mackenzie 2023 Base Case forecast of build cost by state. ▪ Overnight Capital Cost method (CAPEX assumed to be incurred in year 0 to isolate impact of other variables on MCOE). ▪ No additional developer fees or basis markups were included in project costs.
Energy Production	▪ Average AC net capacity factors ("NCF") based on public operating plant data and internal CRC data. ▪ Average NCFs held constant across 2023-29 projections.(1) ▪ 98% annual combined availability & curtailment factor applied to solar and wind.
Energy Production (Tech-Specific)	▪ Additional 2% congestion curtailment applied to Texas wind.
Market Cost of Energy ("MCOE")	▪ $/MWh required for sponsor equity to achieve a target Levered After-Tax Hurdle Rate. ▪ Proxy for year-1 price on a 15-year bundled (energy + capacity + (S)REC) busbar PPA with 2% p.a. escalation. ▪ Plant revenues for ancillary grid services not contemplated (e.g., smart inverter).
Sponsor Equity Hurdle Rate	▪ Levered After-Tax (Inefficient) IRR: 9.00%
Contracted / Merchant Periods	▪ 100% contracted for PPA term; wholesale price forecast applied to 100% of generation thereafter (Year-16). ▪ Post-contracted assumptions impact Hurdle Rate/MCOE, reflecting observed valuation methodology. ▪ Post-contracted wholesale pricing based on Wood Mackenzie's "2023 Technology Weighted Average Prices" using technology-specific pricing for Wind. ▪ Real pricing escalated to nominal assuming 2% long-term inflation; no haircut applied to nominal pricing for mid-MCOE.
Operating Expense	▪ Average all-in year-1 OPEX ($/W, by technology and market) based on public operating plant data and internal CRC data; escalated 2.0% p.a. through project useful life.

(1) NCFs expected to increase with technology improvements; however, assumption is held constant through time in our analysis to isolate build cost and tax credit impacts on MCOE

(2) Potentially necessary major maintenance CAPEX to support 30-year wind project useful asset life not contemplated given diversity of site-specific requirements and conditions

STRUCTURE & TAX ASSUMPTIONS

TOPIC	DISCUSSION
Federal Tax Credit Qualification	▪ Federal tax credit qualification based on qualified start of construction 3 years prior to COD. Analysis did not include entire 4-year qualification as it is unlikely that 100% of projects will safe harbor equipment or achieve continuous construction and maintain eligibility.
Depreciation & Eligible Basis	▪ Wind / Solar (ITC & PTC): 12Y Straight-Line. ▪ ITC Eligible Basis: 95% of build cost.
Interest Rates	▪ Tax equity, debt, and sponsor equity hurdle rates benchmarked to current interest rate environment. ▪ Base-case analysis does not incorporate impacts of potential financing margin compression or fluctuations in risk-free rates.
Tax Equity Structure (Solar – ITC)	▪ Flip Yield: 8.00% ▪ Flip term: 7 years post COD. ▪ 12Y Straight-Line election to manage investor DRO. ▪ Cash Allocation (Pre/Post-Flip): 25% / 5% ▪ Income (Loss) Allocation: 99% in Y1, stepping down to 67% through Y6, stepping down to 5% thereafter and post-flip.
Tax Equity Structure (Solar – PTC)	▪ Flip Yield: 8.25% ▪ Flip term: 10 years post COD. ▪ No PayGo (for consistency with solar ITC financing structure and impact of upfront TE proceeds on MCOE). ▪ 12Y Straight-Line election to manage investor DRO. ▪ Cash Allocation (Pre/Post-Flip): 20% / 5% ▪ Income (Loss) Allocation (Pre/Post-Flip): 99% / 5% ▪ Following PTC step-down to 0%, a TE partnership is still assumed to be used, with the tax investor aiming to monetize depreciation benefits.
Tax Equity Structure (Wind)	▪ Flip Yield: 8.50% ▪ Flip term: 10 years post COD. ▪ No PayGo (for consistency with solar ITC financing structure and impact of upfront TE proceeds on MCOE). ▪ 12Y Straight-Line election to manage investor DRO. ▪ Cash Allocation (Pre/Post-Flip): 20% / 5% ▪ Income (Loss) Allocation (Pre/Post-Flip): 99% / 5% ▪ Following PTC step-down to 0%, a TE partnership is still assumed to be used, with the tax investor aiming to monetize depreciation benefits.
Debt	▪ Back leverage term loan priced assuming 250bps spread on SOFR Swap (100% interest rate hedging); 25bps step-up every 4 years; 1.5% upfront fee. ▪ 20-year amortization (includes 5-year merchant tail). ▪ Contracted DSCRs: P50 – 1.40x (Wind), 1.30x (Solar ITC and PTC); P99 – 1.00x. ▪ Uncontracted DSCRs: P50 – 2.00x; P99 – 1.60x.

APPENDIX B: ABOUT CRC-IB

INDUSTRY LEADER FINANCING THE ENERGY TRANSITION

300 TRANSACTIONS **$53.8Bn** IN VALUE **115 GW**

M&A
85 GW
$13.4Bn Total Value

PROJECT FINANCE
30 GW
$14.1Bn Tax Capital
$9.0Bn Debt

CAPITAL RAISING
10 GW
$4.9Bn Capital Raised

SECTOR EXPERTISE

Solar
79 GW

Wind
31 GW

Storage
7 GW

CCUS/New Technologies
8 Active Mandates

800+ QUALIFIED RELATIONSHIPS

APEX CLEAN ENERGY · Blackstone · sunnova · OMERS · BANK OF AMERICA
Prudential · HASI · aes · Goldman Sachs · TOKYO GAS GROUP TOKYO GAS AMERICA

IMPACT IN CONTEXT

Every transaction is a catalyst for change, every closing a step toward a cleaner future.

OUR TRANSACTIONS REDUCE CARBON EMISSIONS*

179 MILLION TONS
CO2 offset

194 MILLION
Forest acres saved

This has had an equivalent impact of:

36 MILLION
Cars taken off the road

376 MILLION
Barrels of oil avoided

44
Coal plants decommissioned

*EPA Greenhouse Gas Equivalencies Calculator

Proud member of: ACORE American Council on Renewable Energy; SEIA Solar Energy Industries Association®; WRISE Women of Renewable Industries and Sustainable Energy; JiEF

FINANCIAL INNOVATORS POWERING THE ENERGY TRANSITION

Conor McKenna
PARTNER & SR. MANAGING DIRECTOR
NEW YORK

15+ YEARS

125+ sustainable energy project finance, asset sale, and M&A transactions

Nick Knapp
PARTNER & SR. MANAGING DIRECTOR
NEW YORK

15+ YEARS

80+ sustainable energy project finance and M&A transactions on both buy-side and sell-side

Gary Durden
PARTNER & MANAGING DIRECTOR
NEW YORK

15+ YEARS

5GW of sustainable energy projects for solar, onshore wind, and offshore wind

Britta von Oesen
PARTNER & MANAGING DIRECTOR
SAN FRANCISCO

15+ YEARS

$4bn+ raised for utility-scale and distributed generation solar assets

Andy Nguyen
MANAGING DIRECTOR
SAN FRANCISCO

10+ YEARS

$10bn+ of equity, debt, and tax equity raised across 10GW+ of sustainable energy projects

Michael Tatarsky
MANAGING DIRECTOR
NEW YORK

10+ YEARS

$3bn+ raised across 10GW+ of projects including wind, solar, and battery storage

Michael Yurkerwich
MANAGING DIRECTOR
WESTPORT

10+ YEARS

20+ sustainable energy project finance and M&A transactions including 45Q