Power and Renewables

Consulting

PJM solar forecast 2019

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TC Maslin, Associate Director, +1 202 286 0904, tc.maslin@ihsmarkit.com

Solar PV forecasting methodology

IHS Markit solar photovoltaic (PV) power forecasting methodology

Analytical framework

The IHS Markit outlook(s) for solar power take(s) into account multiple drivers and inhibitors that reflect the maturity of the market and its growth potential for solar.

Key components considered in assessing market attractiveness for solar are

- Solar economics relative to wholesale and retail price
- State renewable policy (including renewable portfolio standard [RPS], net energy metering [NEM], community solar, and renewable corporate policies)
- Regulatory incentives
- Solar resources
- Site approval
- Grid access and offtake

Short-term data points

In the short term (one to four years), the planning forecast is based primarily on existing policies, the late-stage project pipeline, and the status of procurement and equipment orders.

Key data inputs collected and assessed by IHS Markit energy analysts include

- Project announcements
- Utility requests for proposal (RFPs), auctions, and tenders
- Existing mandates and incentives
- Project development track record
- Reported costs and pricing
- Supply chain announcements and equipment orders

Longer-term assumptions

In the longer term (5–15 years), our forecast draws upon rigorous bottom-up research and on economic fundamentals, energy prices, and macroeconomic factors.

Key data inputs and assumptions include

- Policy and regulatory trends
- Power demand growth, capacity retirements, and expectations for repowering
- Annual and hourly solar power pricing forecasts
- Power prices
- Transmission and grid infrastructure
- Relative economics

Source: IHS Markit

Key assumptions

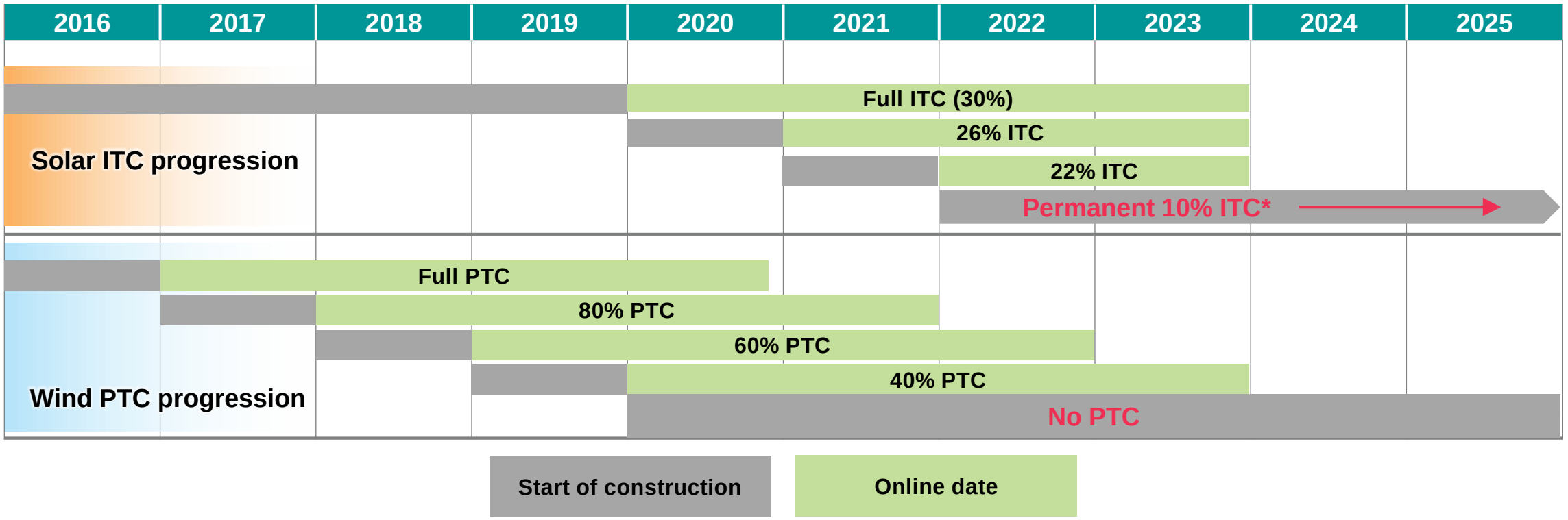
Solar forecast scenario overview			
Assumptions	**Scenario 1: "NEM continuity"**	**Scenario 2: "NEM reform" (base case/planning case)**	**Scenario 3: "Lower-cost solar"**
Federal policy support	Current ITC schedule (see slide 4)	Current ITC schedule	Current ITC schedule
NEM policies and retail rate structures	Current retail rate structures are maintained, and NEM continues to be offered at full retail rates; existing NEM caps are consistently increased (as they have been in a number of states to date)	From 2020 to 2025, utilities enact (and regulators approve) changes to NEM and retail rate structures, which result in a more cost-based approach to customer-sited solar compensation (see slide 5); current detailed state NEM policy (see slides 6–8)	Current retail rate structures and NEM are maintained for three years beyond the reform timeline in Scenario 2; they are then reformed in a similar manner
Solar costs ($/kW)	Solar costs decline by 18–23% in nominal terms from 2019 to 2035 (see slide 7)	Solar costs decline by 18–23% in nominal terms from 2019 to 2035	Solar costs decline by 35–45% in nominal terms from 2019 to 2035, driven by a combination of faster technology advancements and additional policy incentives
State policy support	Current RPS policies and state-level incentives are maintained (see slide 6)	Current RPS policies and state-level incentives are maintained	Current RPS policies and state-level incentives are maintained

Note: ITC = Investment Tax Credit.

Source: IHS Markit

Current ITC schedule

Evolution of tax credits by under-construction deadline and online date



Note: PTC = Production Tax Credit. Assumes that solar projects may be completed within two years of qualifying for the tax credit via start of physical construction or "safe-harbor" provisions. *ITC applied to residential taxes terminates for projects that start construction after 2021.
Source: IHS Markit

Options for NEM and retail rate reform

IHS Markit is not predicting specific changes to state or utility NEM policies or rate structures as part of this work. Instead, we assume that states will choose from a variety of options that reduce the compensation for customer-sited solar but maintain sufficient compensation for a moderate pace of additions.

- Holistic rate reform options for all residential customers: lower volumetric (dollars per kilowatt-hour) price in favor of higher
  - Minimum (fixed) bill charge
  - Peak-demand (dollars per kilowatt) charge

- Narrowly tailored NEM reform options:
  - Reduce bill credits for all solar generation exported to the grid in real time (may require new meters)
  - Add “standby” or similar charges for NEM customers only

- NEM replacement options:
  - Value-based tariff (adjusted periodically to account for changes in wholesale power markets, transmission and distribution costs, etc.)
  - Competitive process (for example, rolling tenders or RFPs)

RPS and NEM policy assumptions by state

Current RPS and NEM policy by state

State	RPS target (% of retail sales)*	Solar carve-out (% of retail sales)	NEM cap (% or capacity)	NEM system size limits by segment (MW)
DE	24% by 2026	3.5% by 2026	5% of aggregated customer peak demand (utility can increase the cap)	0.025 (residential), 2 (Delmarva nonresidential), 0.5 (DEC nonresidential)
DC	100% by 2032	10% by 2041	N/A	1 (single meter), 5 (community renewables)
MD	50% by 2030	14.5% by 2030	1,500 MW	2, or 200% of customer load
NJ	50% by 2030*	5.1% by 2021	5.8% of retail sales	100% of customer load
OH	8.5% by 2026**	-	N/A	Not to exceed 120% of customer annual average load
PA	8% by 2021	0.5% by 2021	N/A	0.050 (residential), 3 (nonresidential), 5 (microgrids)
WV	-	-	3% of peak demand during previous year	0.025 (residential), 2 (industrial for large IOUs), 0.500 (commercial for large IOUs), 0.050 (C&I for small IOUs)
IN	-	-	1% of utility's summer peak load	1
IL	25% by 2025***	1.5% by 2025***	5% of utility's peak load in prior year	2
KY	-	-	1% of utility's peak load in prior year	0.03
MI	35% by 2025****	1% by 2025	0.75% of prior-year peak load	0.15
NC	12% by 2021*****	0.2% by 2020*****	N/A	1
VA	-	-	1% of state's peak load for prior year	0.020 (residential), 1 (nonresidential)
TN	-	-	N/A	N/A

Note: IOU = investor-owned utility; C&I = commercial and industrial; DEC = Delaware Electric Cooperative. *RPS includes solar carve-outs. **NEM remuneration is a tariff structure under which the utility pays customers for excess generation, up to a given amount. The most common arrangement is "full retail rate NEM," in which excess generation is paid the same volumetric price that the customer pays for electricity; so, exports are effectively netted against grid consumption over a given period (typically one year). Net energy generation (NEG) over that period is sometimes paid at a lower rate, often based on the utility's avoided cost. ***New Jersey RPS target only includes Class I renewable technologies and the solar carve-out. ****Illinois solar carve-out requires that 50% of the solar procurements must be from distributed/community solar. RPS mandates at least 75% of the standard come from wind and solar. *****Utilities in Michigan have more ambitious renewables goals. ******RPS compliance in North Carolina can be achieved through energy efficiency and renewable energy credits (RECs) from any state. The primary drivers for solar development include the existing Public Utility Regulatory Policies Act (PURPA) policy, planned RFPs, solar resources, solar costs, and the previous state tax credit.

Source: IHS Markit

RPS and NEM policy assumptions by state (continued)

Current RPS and NEM policy by state

State	NEM remuneration for on-site use or export generation**	NEG remuneration**	Community solar
DE	Retail	Retail	Virtual net metering
DC	Retail	Carries over at retail rate indefinitely, at generation rate for systems over 100 kW	Virtual net metering
MD	Retail	Credited to customer's next bill at retail rate; reconciled annually in April at the commodity energy supply rate	Pilot program
NJ	Retail	Retail	Pilot program
OH	Less than retail	Credited to next bill at unbundled generation rate	None
PA	Retail	Credited at retail rate for a year, then any leftover excess is credited at generation and transmission portion of the retail rate, but not the distribution	None
WV	Retail	Retail	Virtual net metering
IN	Less than retail after 2022	Less than retail after 2022	None
IL	Retail	Credited to next bill at retail rate, excess at end of year is granted to utility	Virtual net metering
KY	Less than retail	N/A	Utility-run program
MI	Less than retail	Less than retail	None
NC	Retail	Carries over at retail rate, granted to utility at beginning of summer billing period	Utility-run program
VA	Retail	Retail	Utility-run program
TN	N/A	Retail	None

*RPS includes solar carve-outs. **NEM remuneration is a tariff structure under which the utility pays customers for excess generation, up to a given amount. The most common arrangement is "full retail rate NEM," in which excess generation is paid the same volumetric price that the customer pays for electricity; so, exports are effectively netted against grid consumption over a given period (typically one year). NEG over that period is sometimes paid at a lower rate, often based on the utility's avoided cost. ***New Jersey RPS target only includes Class I renewable technologies and the solar carve-out. ****Illinois solar carve-out requires that 50% of the solar procurements must be from distributed/community solar. RPS mandates at least 75% of the standard come from wind and solar. *****Utilities in Michigan have more ambitious renewables goals. ******RPS compliance in North Carolina can be achieved through energy efficiency and RECs from any state. The primary drivers for solar development include existing PURPA policy, planned RFPs, solar resources, solar costs, and the previous state tax credit.

Source: IHS Markit

RPS and NEM policy assumptions by state (continued)

Current RPS and NEM policy by state

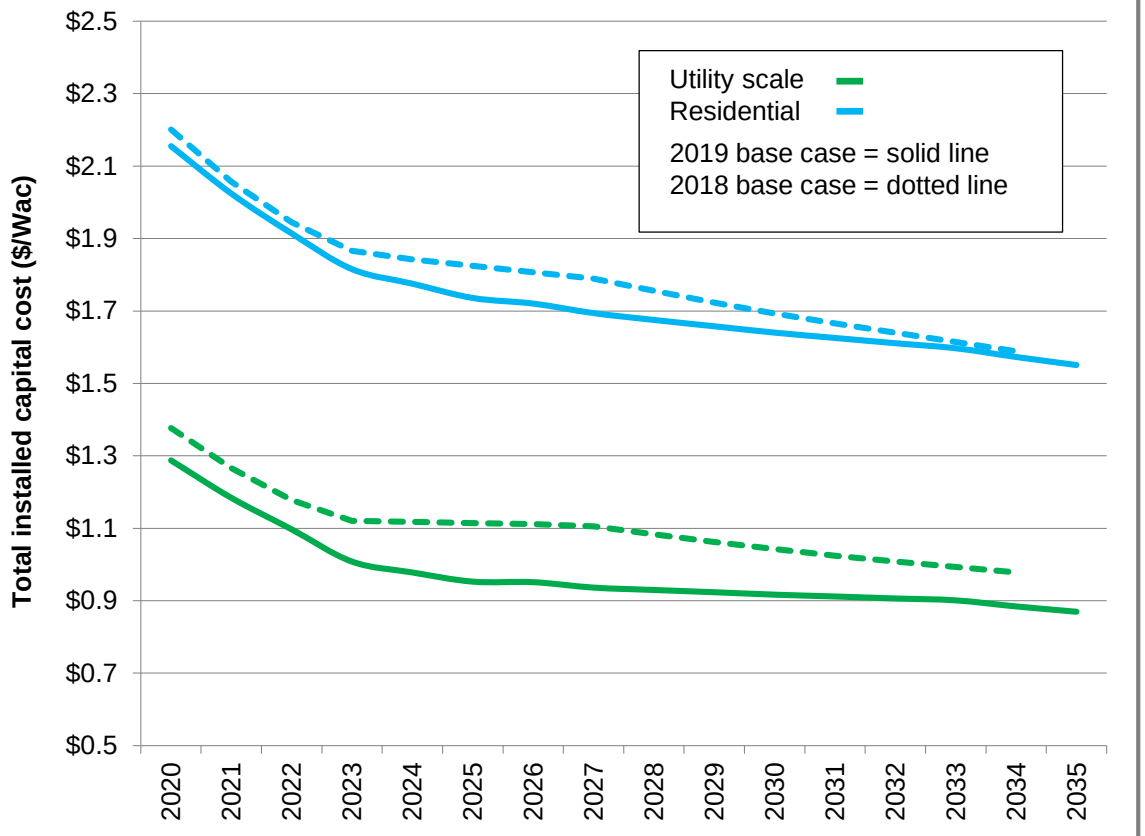
State	Unbundled energy attribute certificates	Virtual power purchasing allowed	Renewable energy offerings from utilities or electric suppliers/green tariff	Production for self-consumption—net metering
DE	Allowed		Retail choice	Up to 2 MW
DC	Allowed		Retail choice	Up to 1 MW
MD	Allowed	Allowed	Retail choice	Up to 2 MW
NJ	Allowed	Allowed	Retail choice	Cannot exceed on-site load
OH	Allowed	Allowed	Retail choice	No size limit
PA	Allowed	Allowed	Retail choice	Up to 3 MW
WV	Allowed	Allowed	-	Up to 2 MW
IN	Allowed	Allowed	-	Up to 1 MW
IL	Allowed	Allowed	Retail choice	Up to 2 MW
KY	Voluntary		-	Up to 30 kW
MI	Allowed		-	Up to 150 kW
NC	Allowed		Green tariff in development	Up to 1 MW
VA	Allowed	Allowed	Green tariff enabled	Up to 1 MW
TN	Voluntary		-	-

Note: Green tariffs only include programs where utilities build new renewables on behalf of corporate customers.

Source: IHS Markit

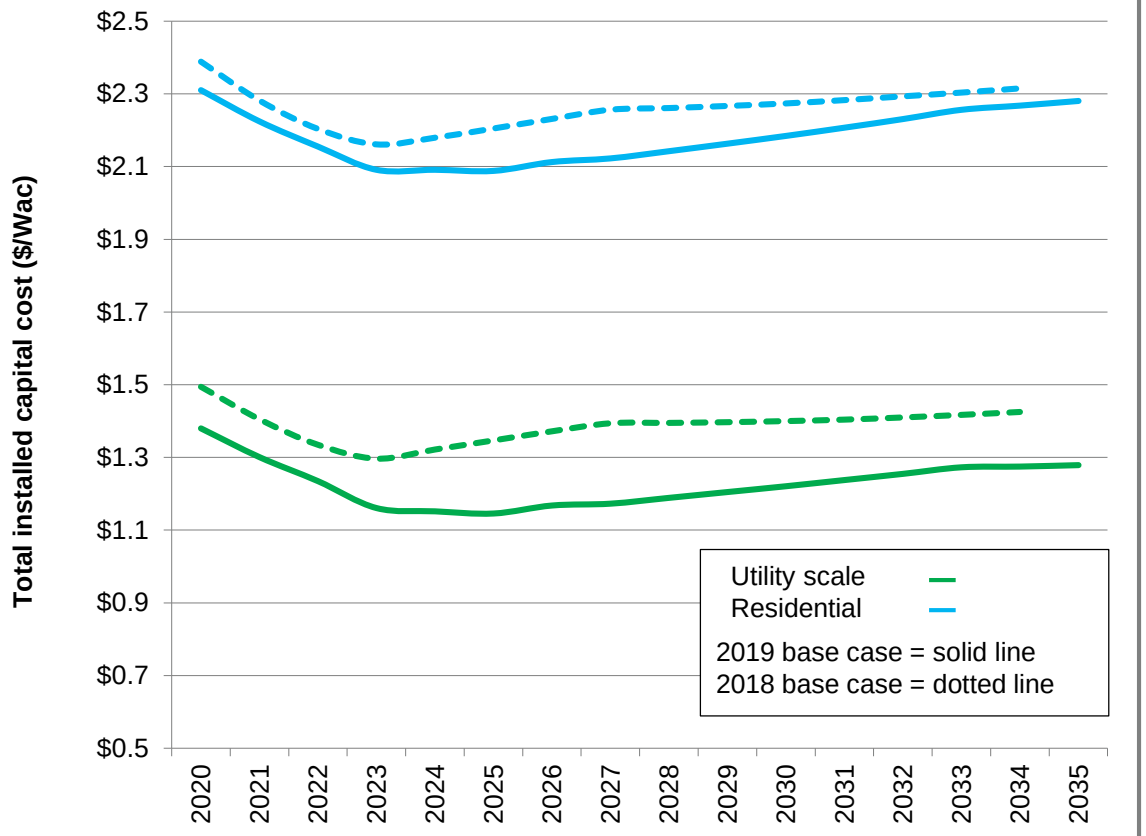
PJM solar capital costs

PJM solar capital costs, real



Source: IHS Markit

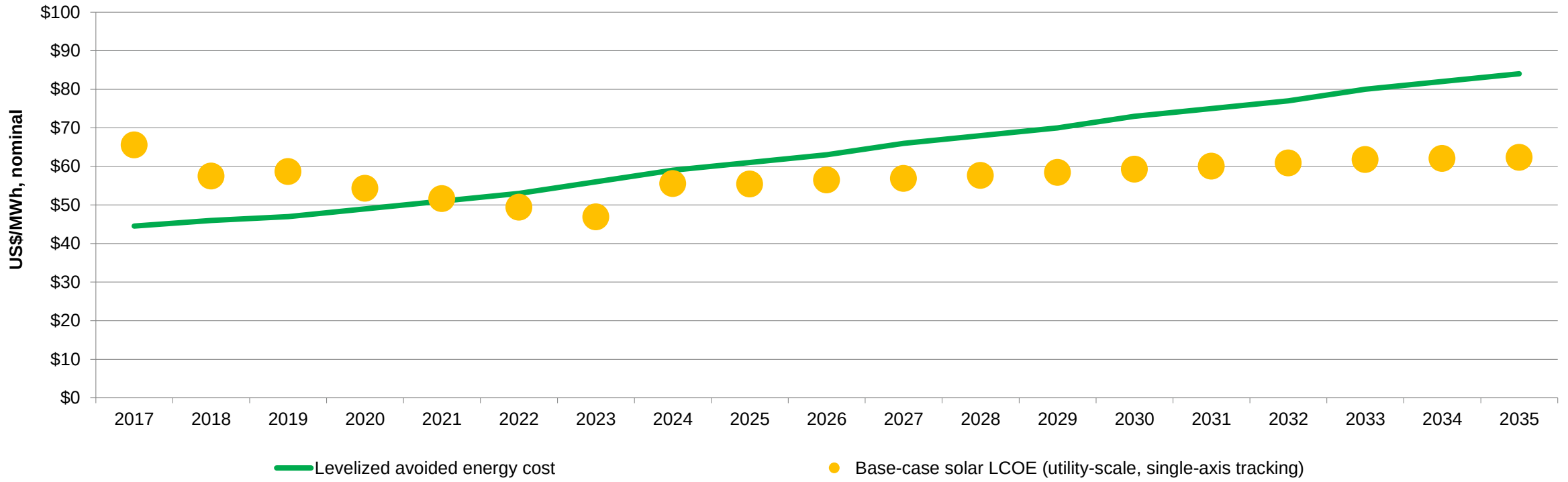
PJM solar capital cost, nominal



Source: IHS Markit

Utility-scale solar economics

PJM utility solar economics

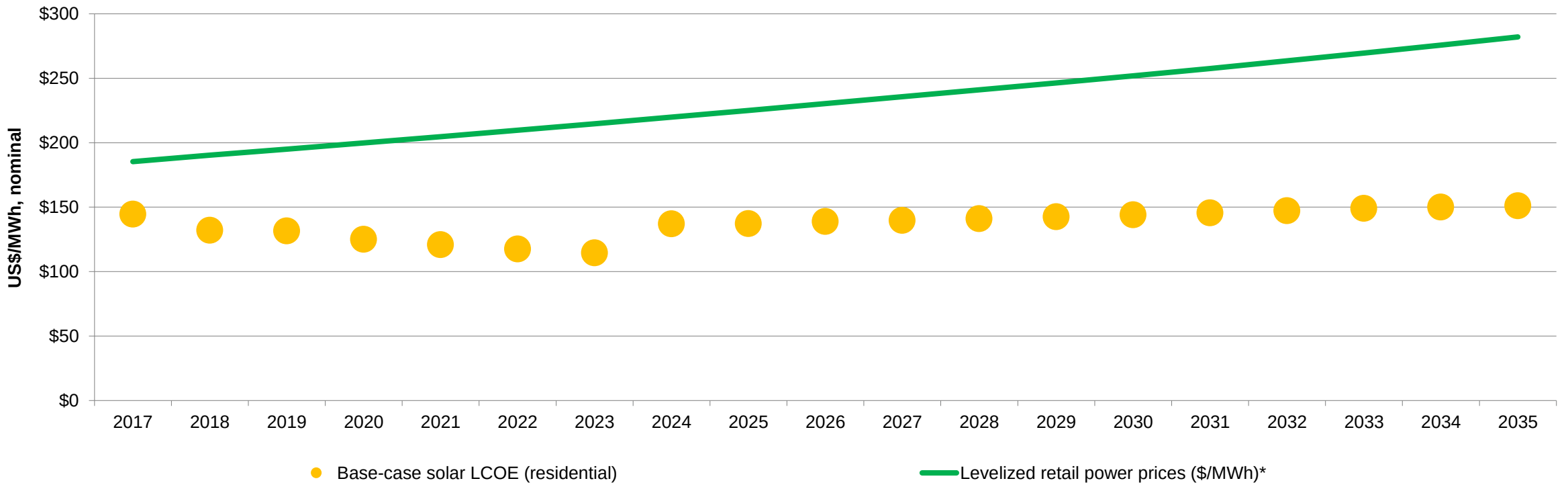


Note: LCOE = levelized cost of electricity. *Levelized avoided capacity value represents the levelized annual PJM capacity market revenue ($/kW-year) multiplied by a 19% capacity credit for solar to conservatively account for solar's coincidence with peak-load hours.
Source: IHS Markit

Solar cost improvements lead to economic deployment of utility-scale solar PV after 2021.

Residential solar economics

PJM residential solar economics

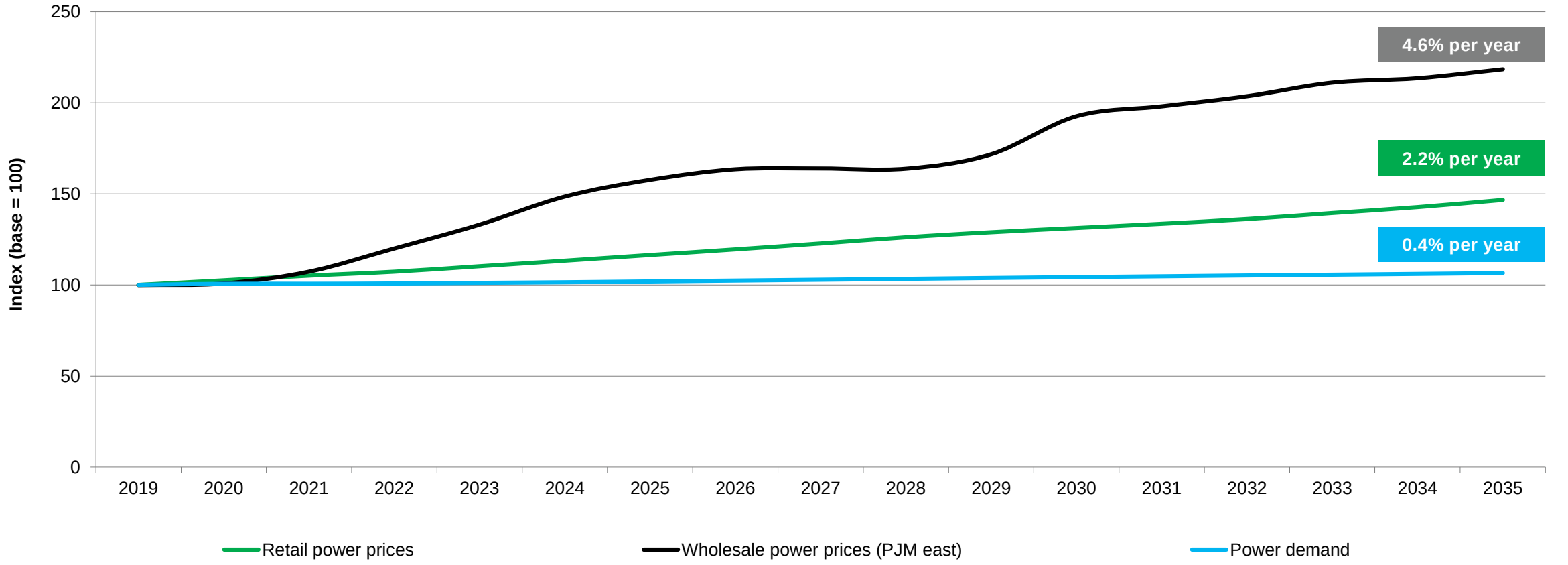


*Average of Maryland, New Jersey, and Pennsylvania.
Source: IHS Markit, Energy Information Administration

Retail solar is more economically advantaged than utility scale because of the disparity in retail prices.

Key power market assumptions (all scenarios)

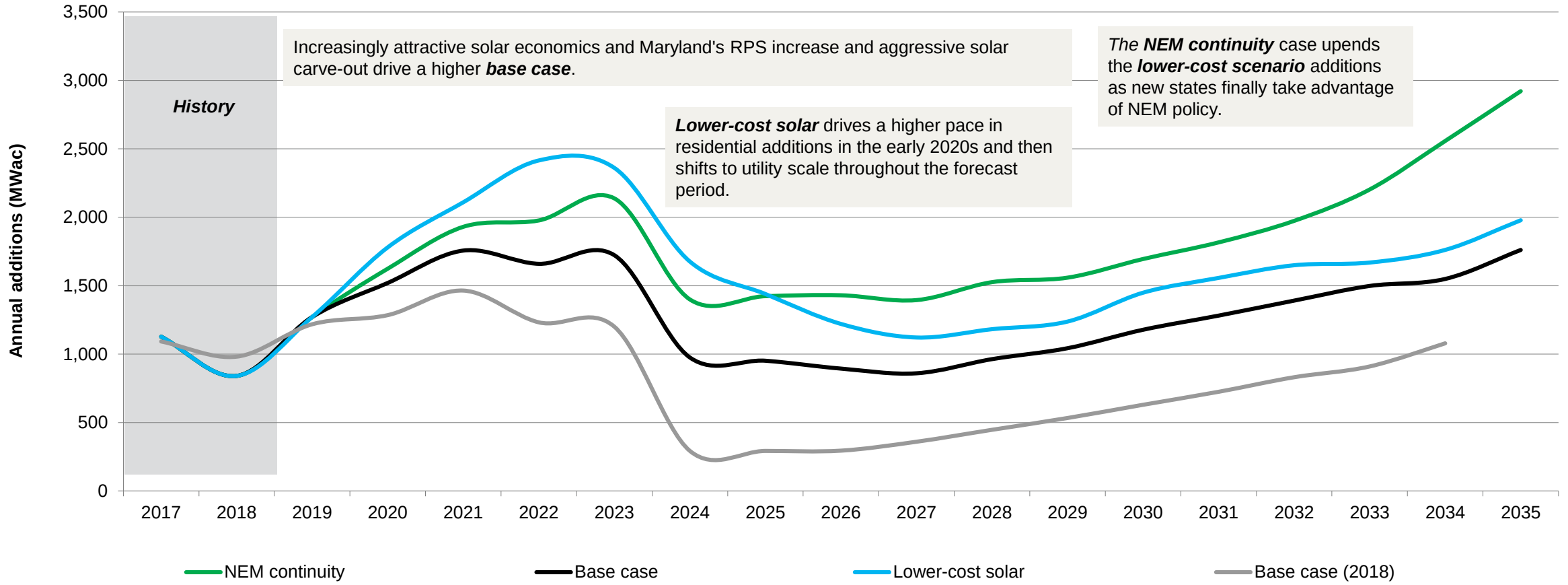
Key power market assumptions (all scenarios)



Note: Power price growth rates are in nominal terms. Power demand reflects demand at the customer level, including load that is served by behind-the-meter (BTM) solar.
Source: IHS Markit

PJM distribution/BTM solar PV capacity additions by scenario

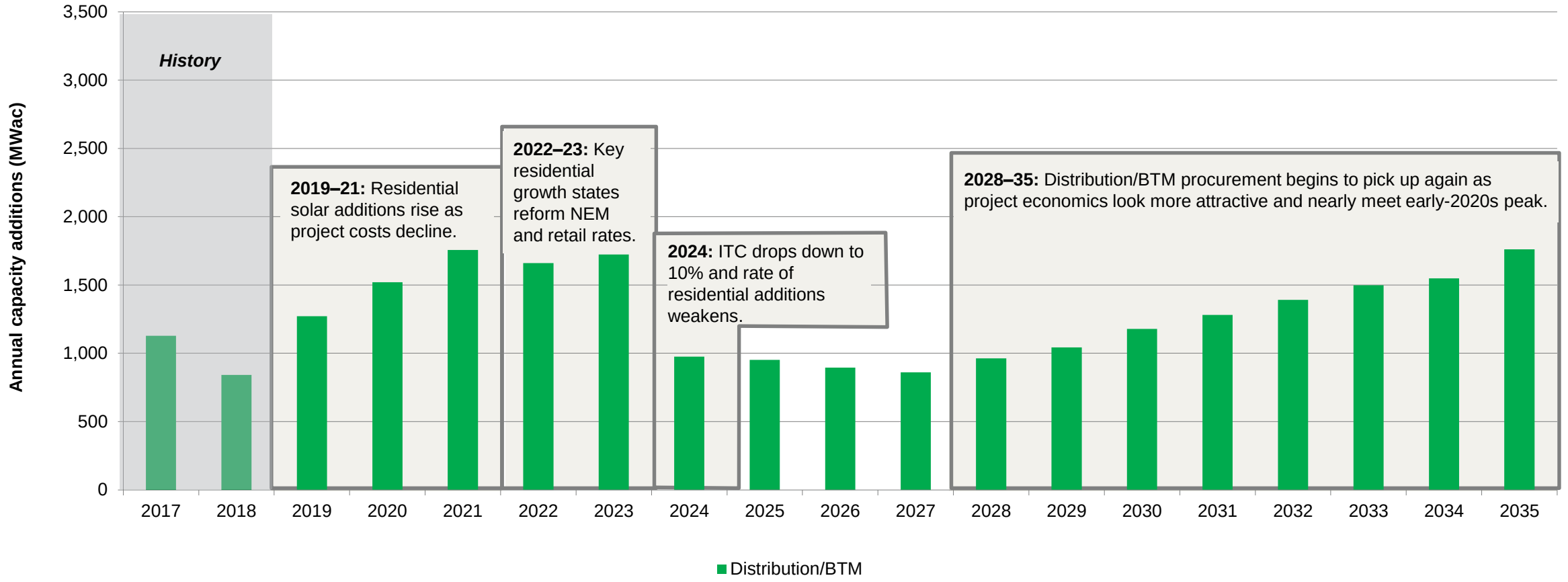
Solar capacity addition by scenario



Source: IHS Markit

Distribution/BTM solar PV capacity additions
Scenario 2: “NEM reform” (base case)

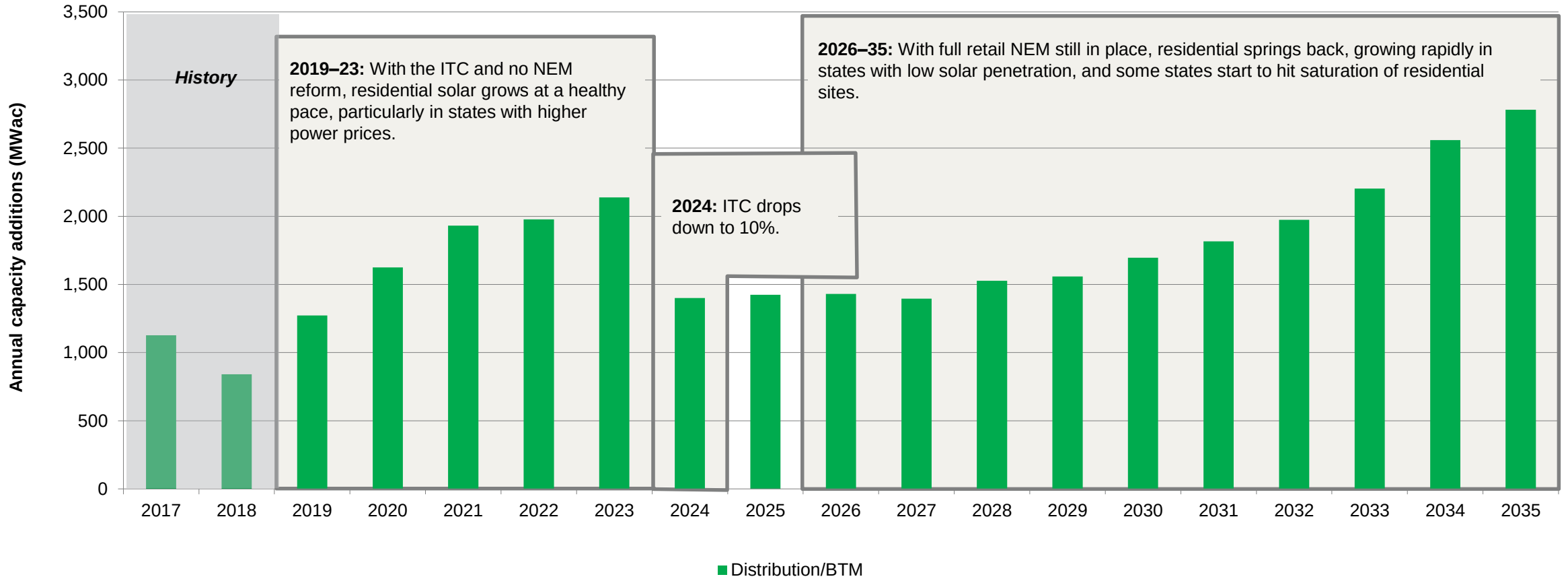
PJM annual solar PV capacity additions by segment: Scenario 2



Source: IHS Markit

Distribution/BTM solar PV capacity additions
Scenario 1: “NEM continuity”

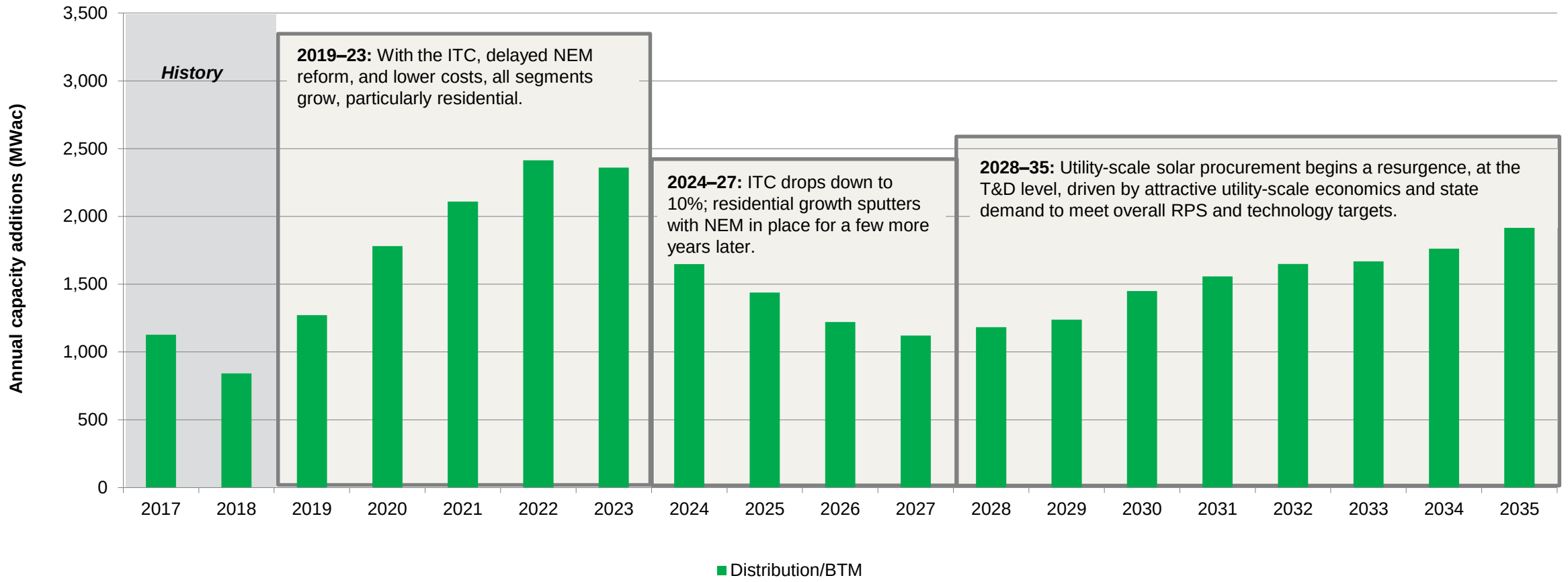
PJM annual solar PV capacity additions by segment: Scenario 1



Source: IHS Markit

Distribution/BTM solar PV capacity additions
Scenario 3: “Lower-cost solar”

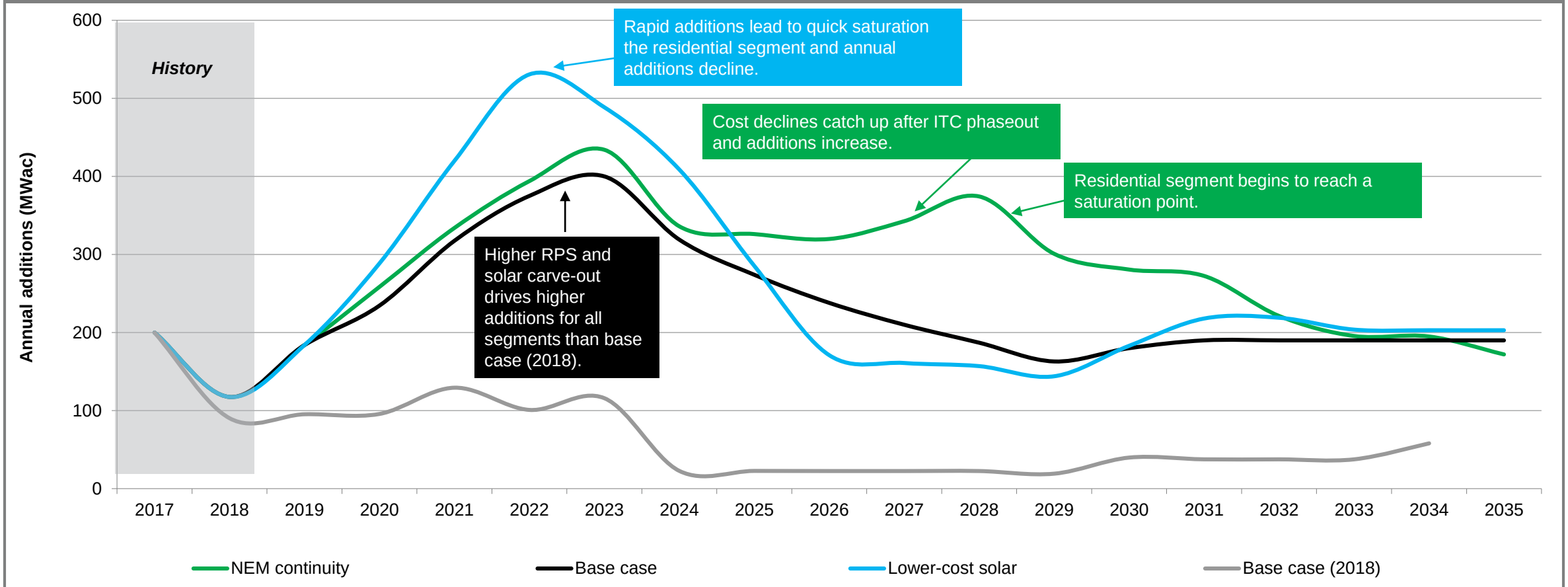
PJM annual solar PV capacity additions by segment: Scenario 3



Source: IHS Markit

Maryland solar PV distribution/BTM capacity additions by scenario

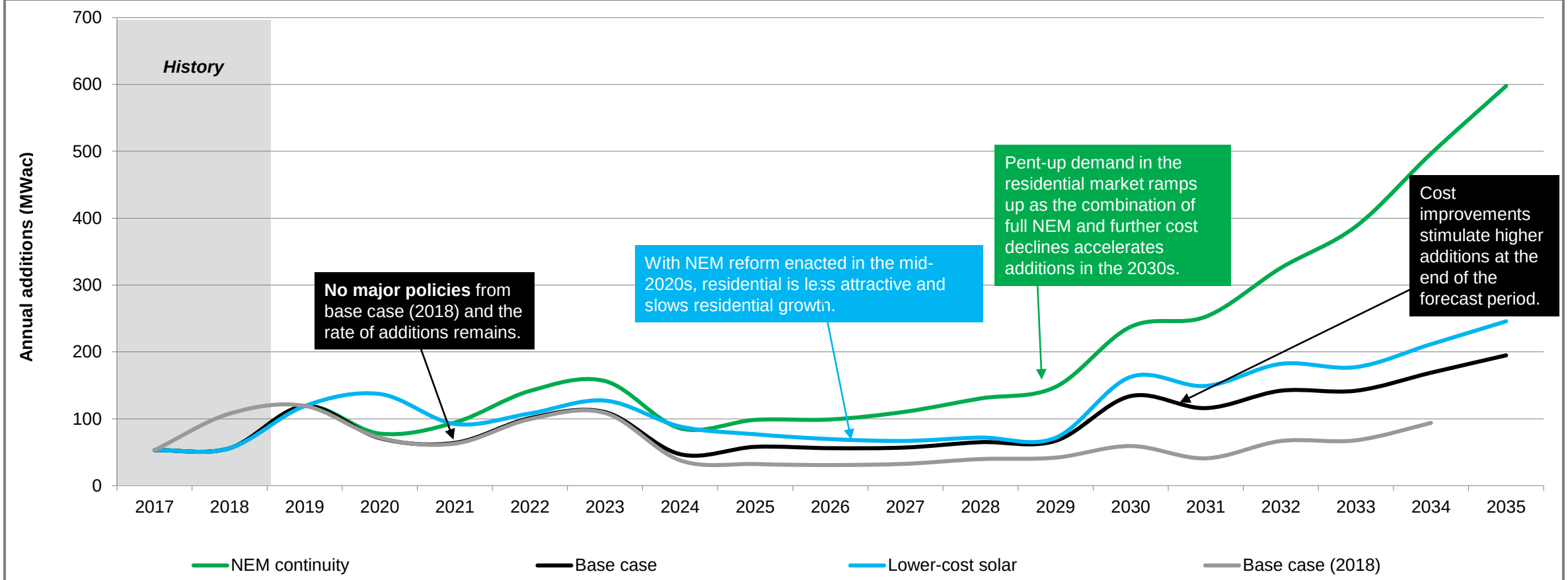
Maryland solar capacity additions by scenario



Source: IHS Markit

Pennsylvania solar PV distribution/BTM capacity additions by scenario

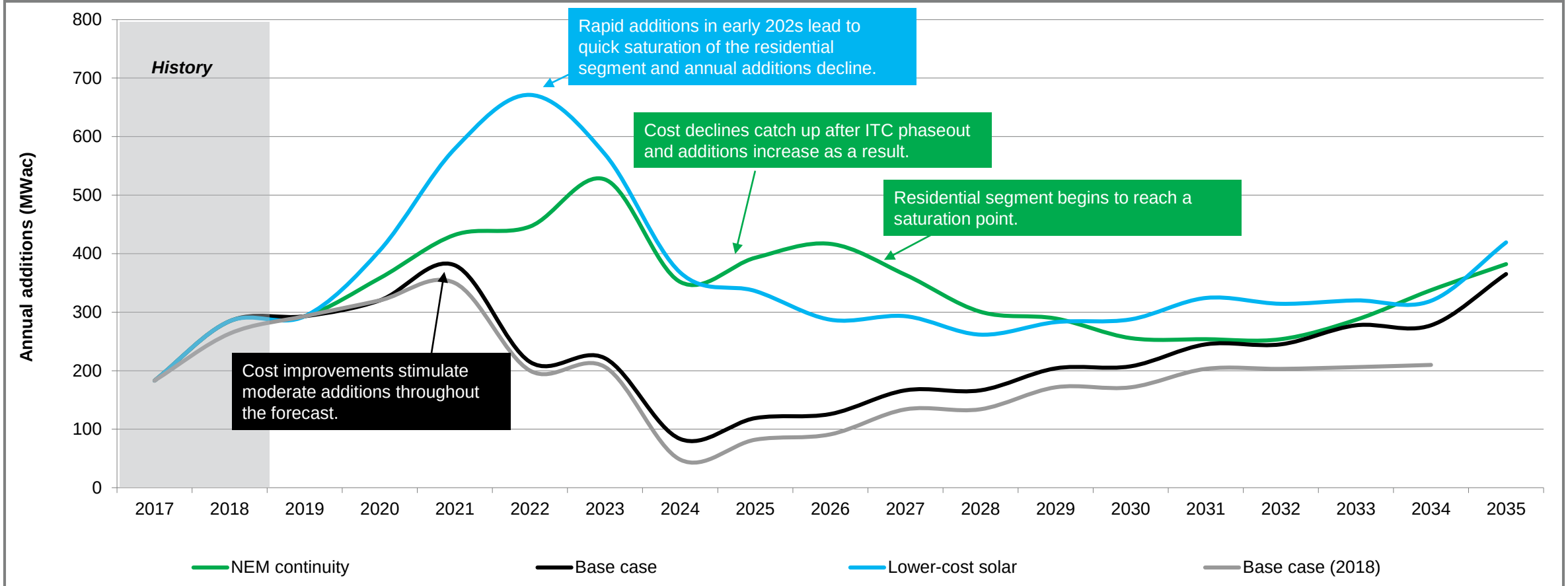
Pennsylvania solar capacity additions by scenario



Source: IHS Markit

New Jersey solar PV distribution/BTM capacity additions by scenario

New Jersey solar capacity additions by scenario



Source: IHS Markit

Conclusions (Scenario 2: Base case)

- New state RPS and technology carve-outs (such as Maryland) stimulate further solar in all segments, particularly residential in the near term.
- State full NEM policies bolster BTM growth in the next few years, making up the majority of solar capacity additions.
- IHS Markit expects states to reform NEM policies in 2020-25, dampening further additions.
- Utility-scale solar economics become attractive just as the ITC starts to phase-out but surges at the end of the forecast period.
- A few states will hit a “saturation” point in the forecast period as the low-hanging residential solar sites are gobbled up.

IHS Markit Customer Care

CustomerCare@ihsmarkit.com
Americas: +1 800 IHS CARE (+1 800 447 2273)
Europe, Middle East, and Africa: +44 (0) 1344 328 300
Asia and the Pacific Rim: +604 291 3600