Assessing the Economic Value of New Utility-Scale Renewable Generation Projects

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Overview

- Levelized cost of energy (LCOE) has been used by planners, analysts, policymakers, advocates and others to assess the economic competitiveness of technology options in the electric power sector
- While of limited usefulness in the analysis of "conventional" utility systems, this approach is not generally appropriate when considering "unconventional" resources like wind and solar
- EIA is developing a new framework to address the major weaknesses of LCOE analysis
  - Based on the "levelized avoided cost of energy" (LACE)
  - Provides a better basis for evaluation of both renewable and conventional generation resources

A simple definition of LCOE

- Levelized cost of energy is a stream of equal payments, normalized over expected energy production, that would allow a project owner to recover all costs, including financing and an assumed return on investment, over a predetermined financial life

- LCOE has three basic cost components:
  - Fixed costs, such as initial investment
  - Variable costs, such as operations and maintenance (O&M) and fuel
  - Financing costs, such as cost of debt and cost of capital

- Expected energy production (annual generation) is a fourth component

Uses of LCOE Analysis

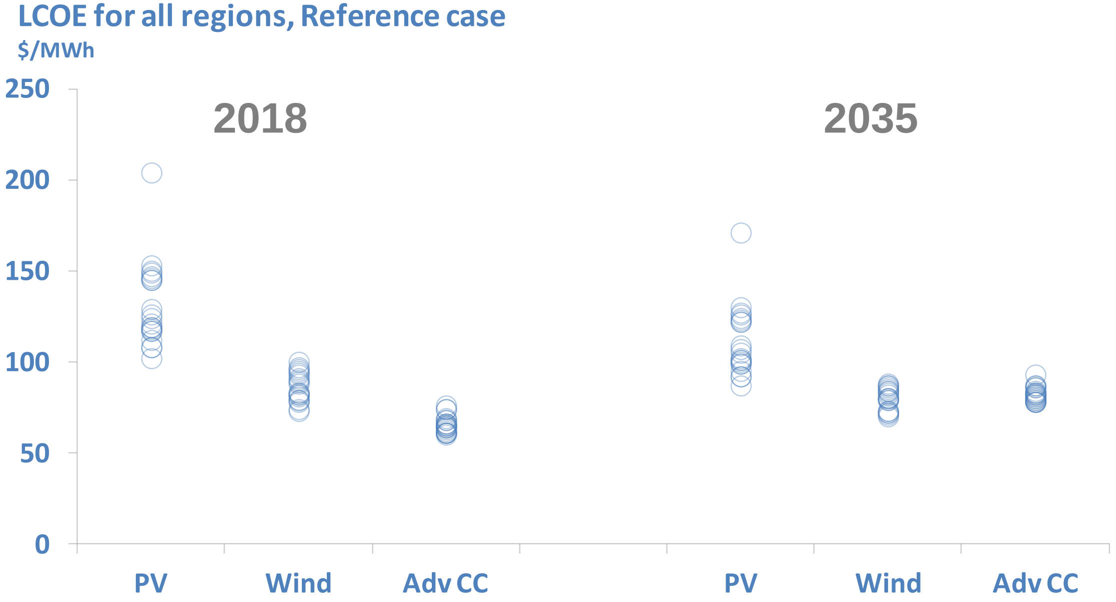
- When evaluating different capacity expansion options to meet a specific, well characterized need identified by a power producer or regulatory body, LCOE can provide a screening tool that simultaneously considers fixed and variable costs in a single metric

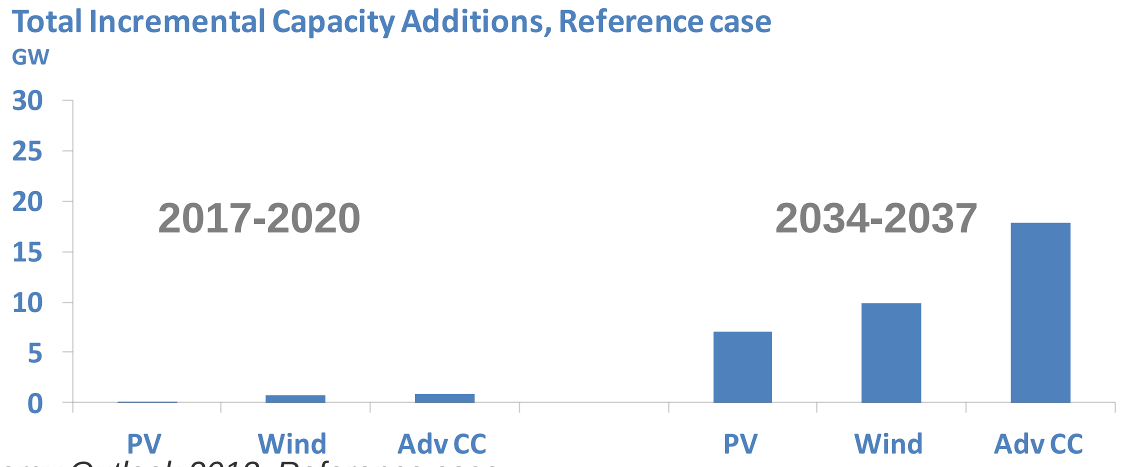
- However, even in this narrow application, care must be taken not to over-sell the usefulness and importance of a metric that doesn't consider a host of other important economic and technical evaluation factors

What LCOE is not

- LCOE is not an estimate of selling price
- LCOE is not a useful tool to compare the cost of different generation options, unless the options being compared have substantially similar operational profiles and system value
  - By extension, it generally isn't a useful measure of "grid parity" or broad economic competitiveness
- LCOE is not used by EIA to project new capacity builds, dispatch, or electricity prices
  - While published levelized costs are based on the same cost parameters used in the model, the model accounts for factors that LCOE analysis cannot, like time-of-day and seasonal value for energy, value for capacity, and so forth
  - EIA publishes these estimates because they are frequently requested, but we felt the need to provide a better indicator of economic competitiveness

LCOE can't explain capacity additions





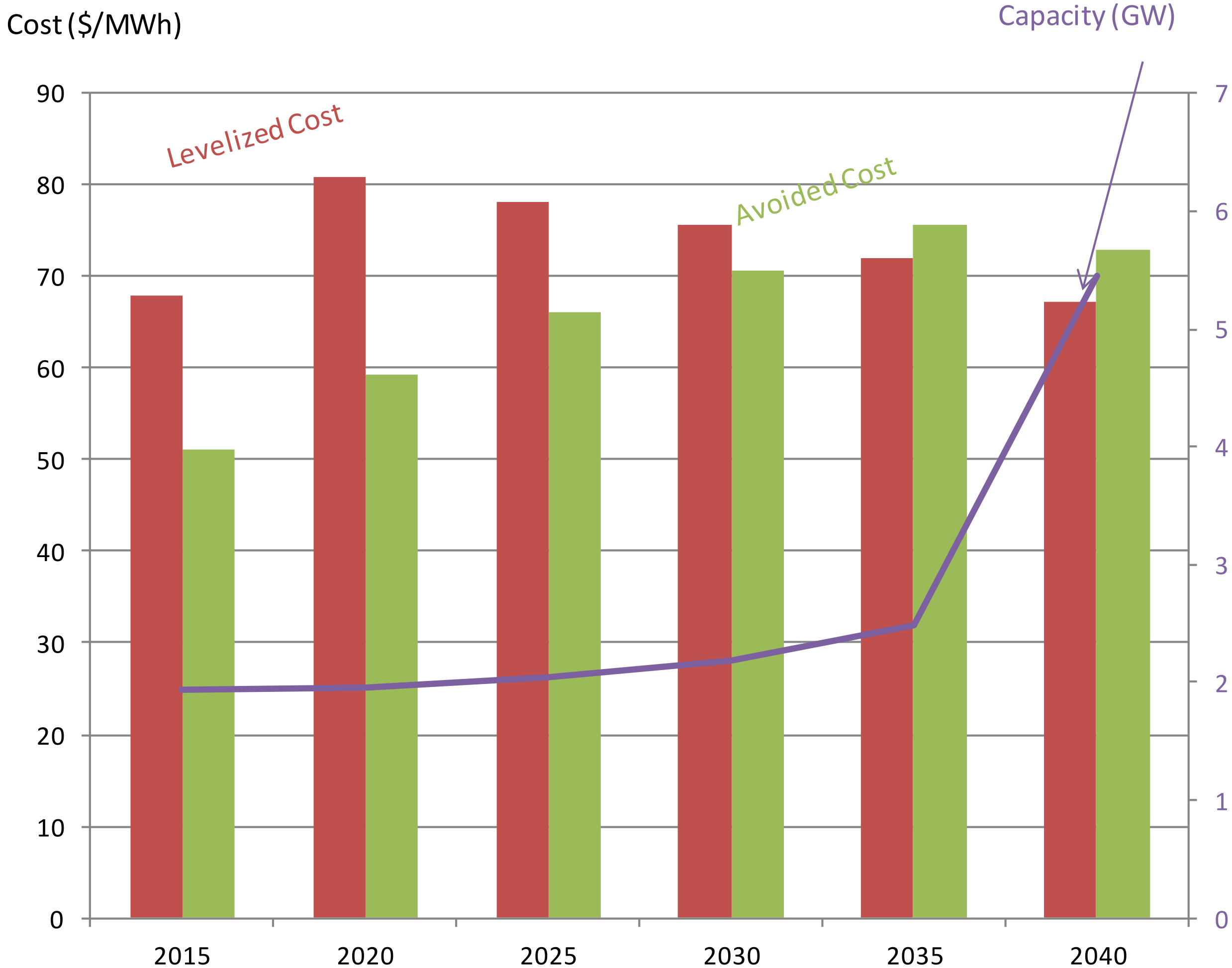
Source: Annual Energy Outlook 2013, Reference case

EIA has developed a metric to provide a more useful tool for comparative analysis

- The “levelized avoided cost of energy” or LACE is based on the system value of a generation resource
  - Derived from the “avoided cost” or cost of displaced energy and capacity
  - Presented in “levelized” terms; that is on average cost per MWh of generation,
- Much like LCOE is an estimate of the revenue *requirements* for a given resource; LACE is an estimate of the revenues *available* to that resource
  - Generation displaced, on a time-of-day and seasonal basis
  - Need for additional generation or capacity resources
- Comparison of LCOE to LACE for any given technology provides a quick, intuitive indicator of economic attractiveness
  - Projects have a positive net economic value when LACE is greater than LCOE

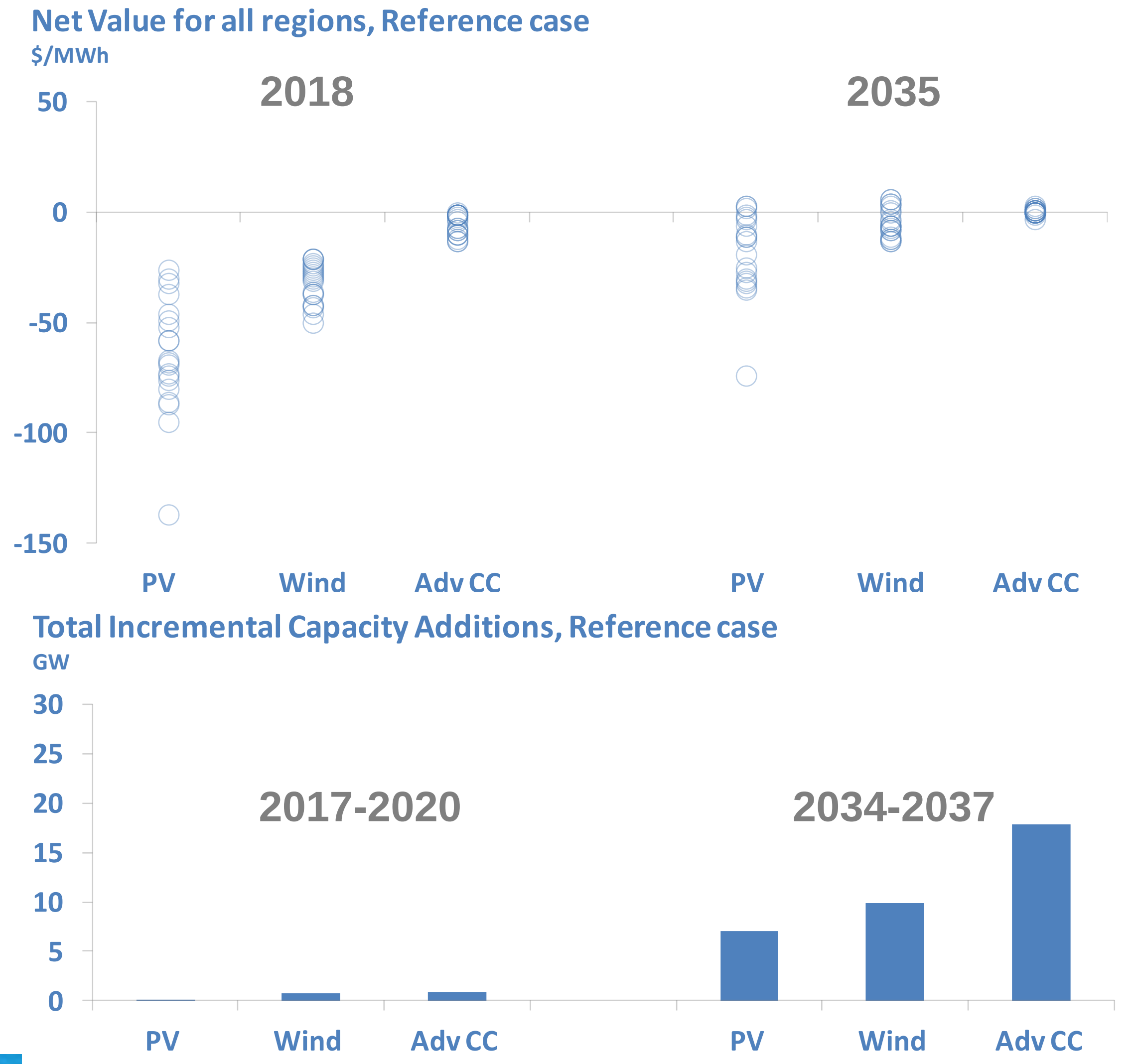
Example of LACE technique – wind capacity is built when LACE approaches and exceeds its LCOE

Onshore wind LACE, LCOE, and installed capacity - Reference case



Source: Annual Energy Outlook 2013, Reference case

Net Value (LACE minus LCOE) provides more insight into capacity expansion

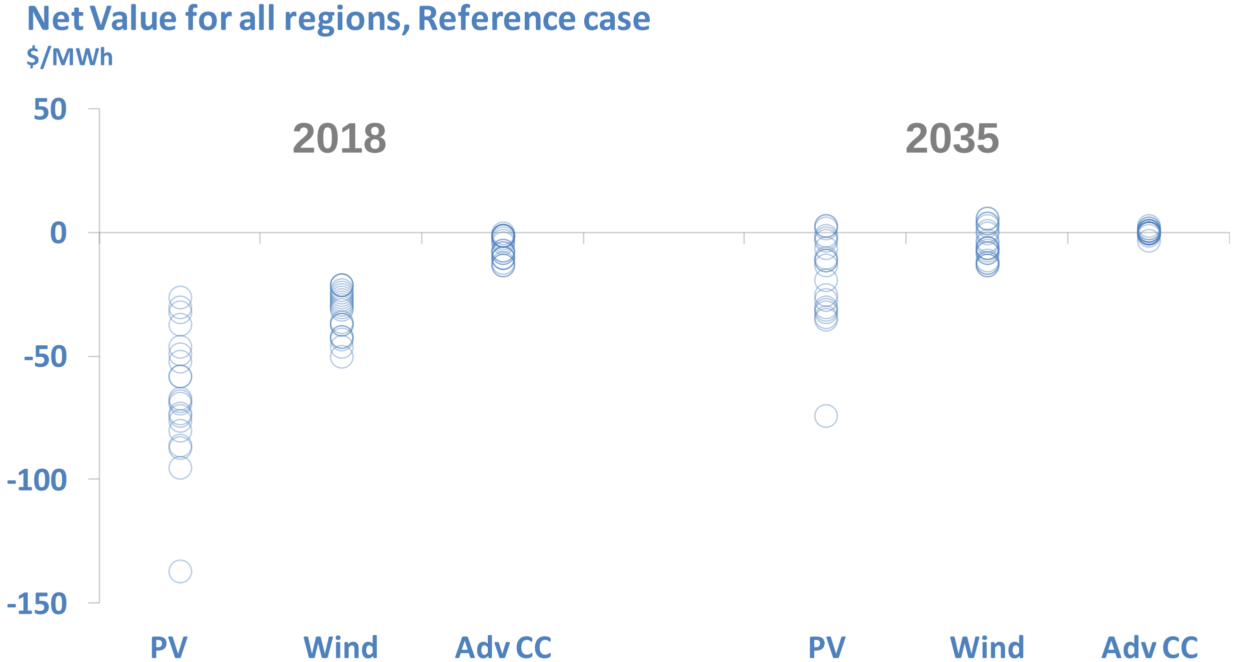


Source: Annual Energy Outlook 2013, Reference case

Key Findings

In the near-term, the estimated net value of onshore wind and solar PV projects is below that of Adv CC

- However, the net economic value of onshore wind and solar PV projects improves significantly over the projection period.
- By 2035, the economic value of onshore wind is positive in 6 regions, and in 3 regions for solar PV

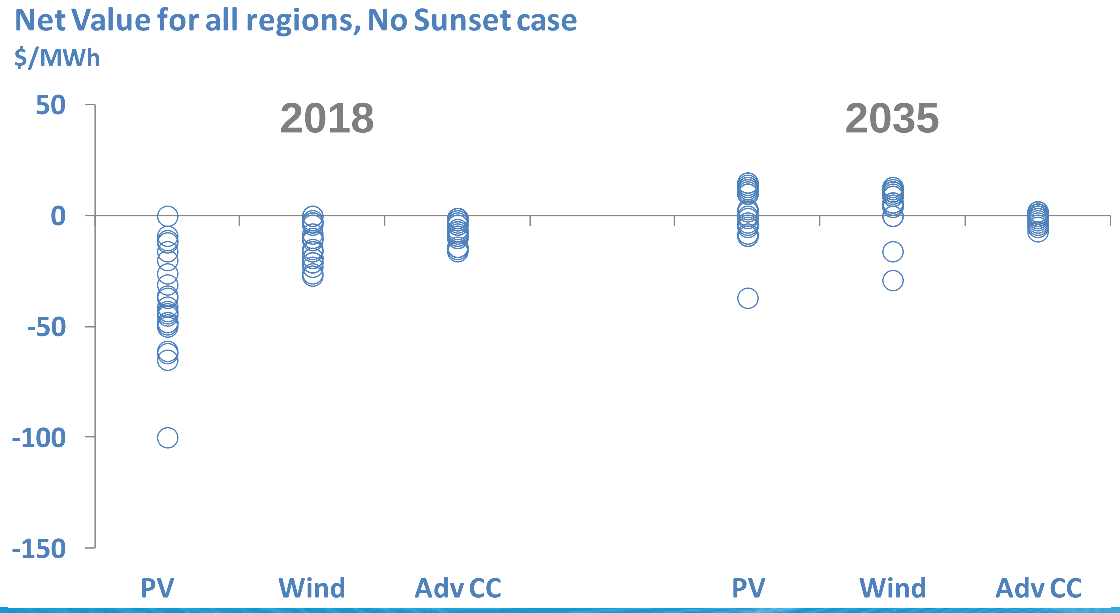


Source: Annual Energy Outlook 2013, Reference case

If the PTC and ITC are assumed to continue throughout the projection period, a lower after-tax LCOE raises the net economic value of both onshore wind and solar PV projects

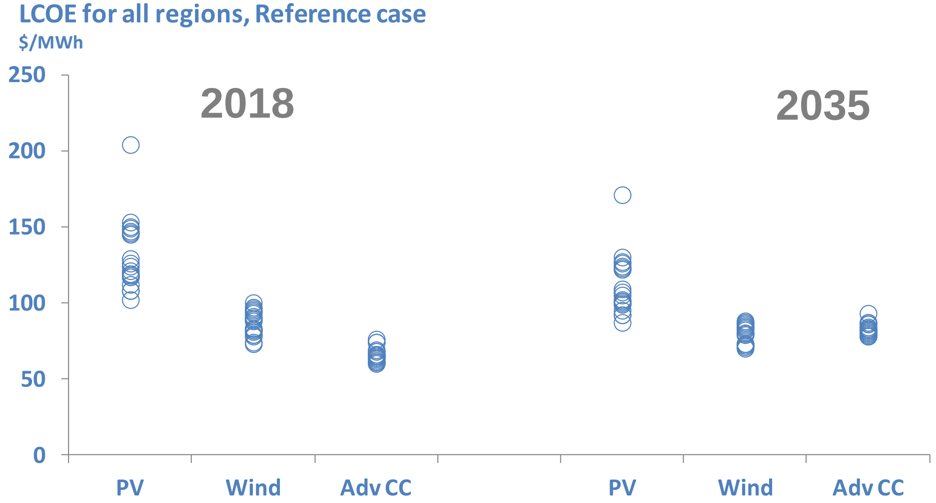
- In 2018, the value of such projects remains negative in all regions even in this case.

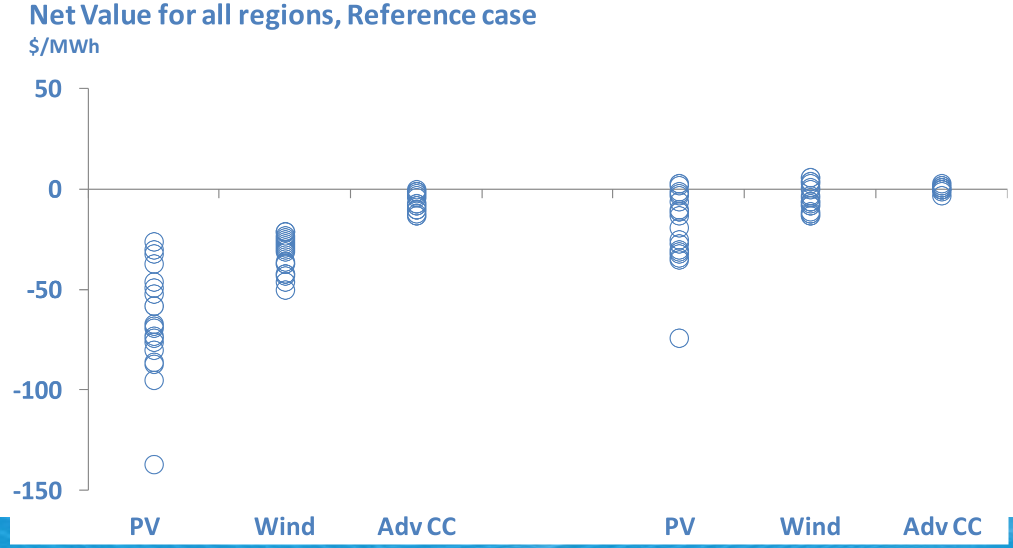
- By 2035 wind projects have a positive net economic value in all but 2 regions, while solar projects have a positive net economic value in 13 regions.



Source: Annual Energy Outlook 2013, No Sunset case

Direct comparison of LCOE values understates the advantage of the Adv CC relative to onshore wind while overstating the advantage of Adv CC relative to solar PV



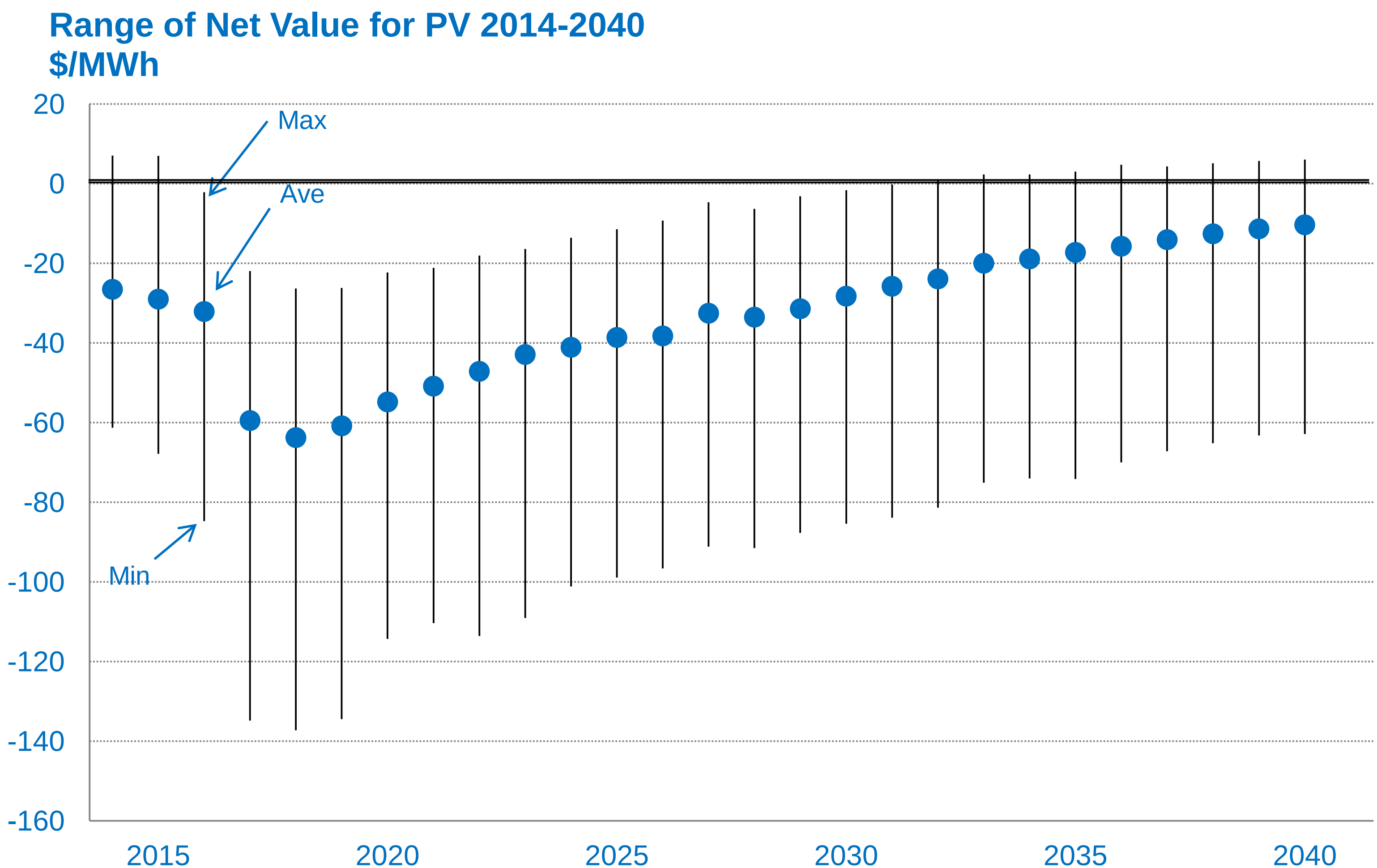


Source: Annual Energy Outlook 2013, Reference case

LACE = LCOE is a stable solution point

- Once a technology achieves a net positive economic value ("grid parity"), its net value tends to remain close to zero
  - The market, as represented in the model, tends to develop any given resource just to the point where it is no longer economic to build, having met load growth and/or displaced higher cost generation.
- Market shocks may cause a divergence between LACE and LCOE, disturbing this equilibrium
  - New technology, fuel price volatility, or policy changes can increase or decrease the net value of any given technology
  - If the net value is increased, the market will quickly work to restore equilibrium by building the high-value resource
  - If the net value goes negative, recovery could depend on slower-acting factors like load growth

Example of an external equilibrium shock from loss of the ITC for PV



Source: Annual Energy Outlook 2013, Reference case

The net value of the Adv CC technology varies less across regions and improves far more slowly over time compared to both wind and PV technologies

- In 2018, there is little demand for new capacity and Adv CC units do not have a positive net economic value in any region.
  - By 2035, growth in demand for new capacity results in a positive net economic value in 9 regions, with most of the remaining regions showing near-breakeven conditions.
- If the wind and solar tax credits are extended indefinitely, the estimated LACE for Adv CC in 2035 is reduced due to additional generation from wind and solar PV capacity with lower variable costs.
  - In this scenario, Adv CC projects have a positive net economic value in 6 regions and significantly negative values in 8 regions.

Caveats and Limitations

- Both LCOE and LACE values are estimated from NEMS internal calculations, but are only approximations of model decision making criteria
  - Similarly, NEMS itself is an approximation of real-world conditions
- Resource characteristics reflect average values for each region, and may not reflect characteristics at all locations, especially in large, geographically diverse regions.
- As implemented, secondary values like RECs are only reflected in the LACE calculation to the extent that they affect marginal dispatch prices
  - This will usually be the case

For more information

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In mathematical form

$$lev\ cost = \frac{(fixed\ charge\ factor * capital\ costs + fixed\ O\&M)}{annual\ expected\ generation\ hours} + variable\ O\&M + fuel$$

Where:

$$AnnualExpectedGen = CapacityFactor * 8760$$

$$FixedChrgeFactor = DiscountRate + \frac{DiscountRate}{(1 + DiscountRate)^{FinancialLife} - 1}$$

Note that this is in simplified form, published EIA calculations are considerably more complicated

LACE in mathematical form

$$lace = \frac{\sum_{t=1}^{y}(marginal\ gen\ price_t * dispatched\ hours_t) + (cap\ payment * cap\ credit)}{annual\ expected\ generation\ hours}$$

Where:

Annual expected generation hours = annual capacity factor * 8760 hours
Dispatched hours = number of hours resource operates in timeslice t
Capacity payment = payment provided to participate in reliability reserve
Capacity credit = measure of resource contribution to reliability reserve

Note that this is in simplified form, EIA calculations are considerably more complicated

Net Value = LACE - LCOE