

DOE OFFICE OF INDIAN ENERGY

Levelized Cost of Energy (LCOE)

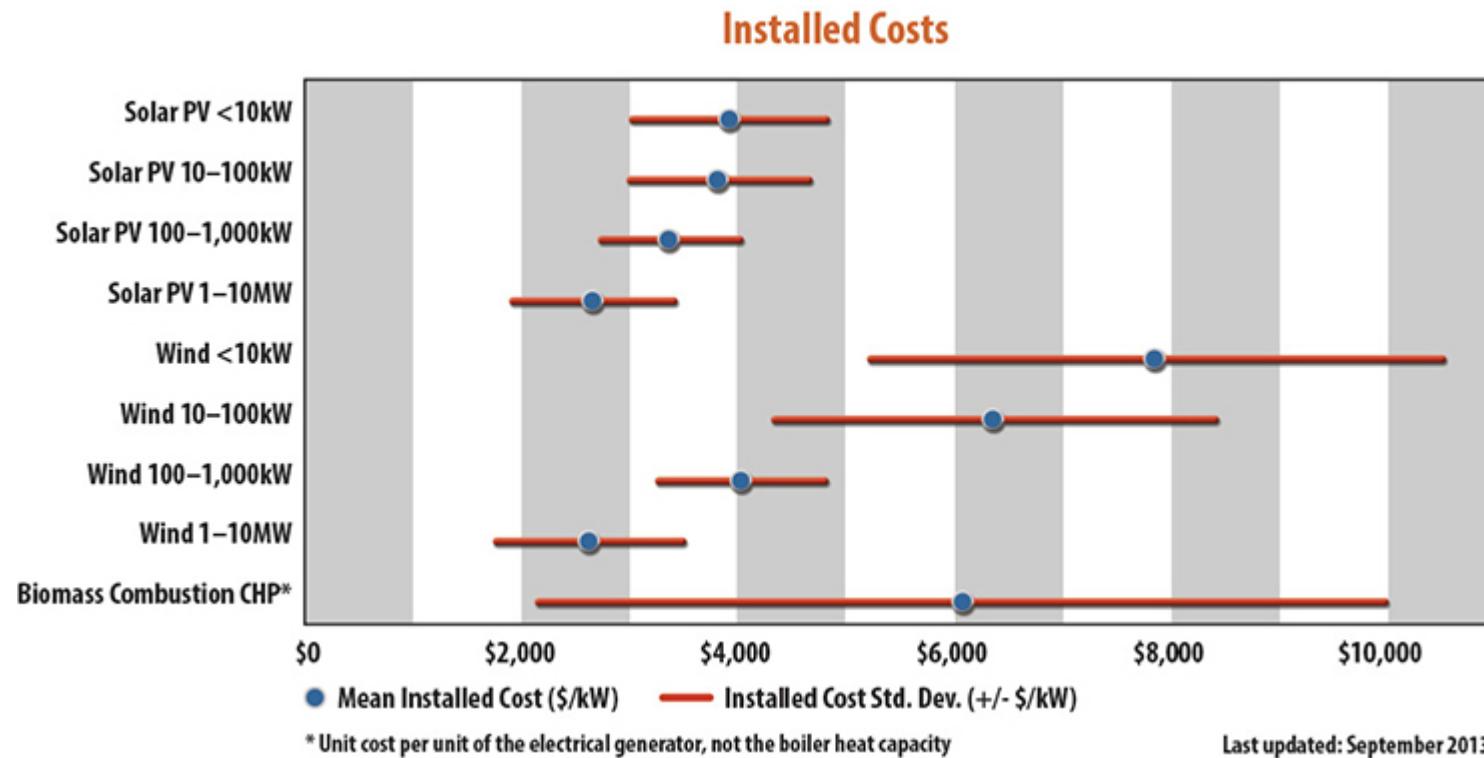


U.S. DEPARTMENT OF
ENERGY
Office of
Indian Energy

Upfront Capital Costs for Renewables



Upfront costs do not paint a complete picture



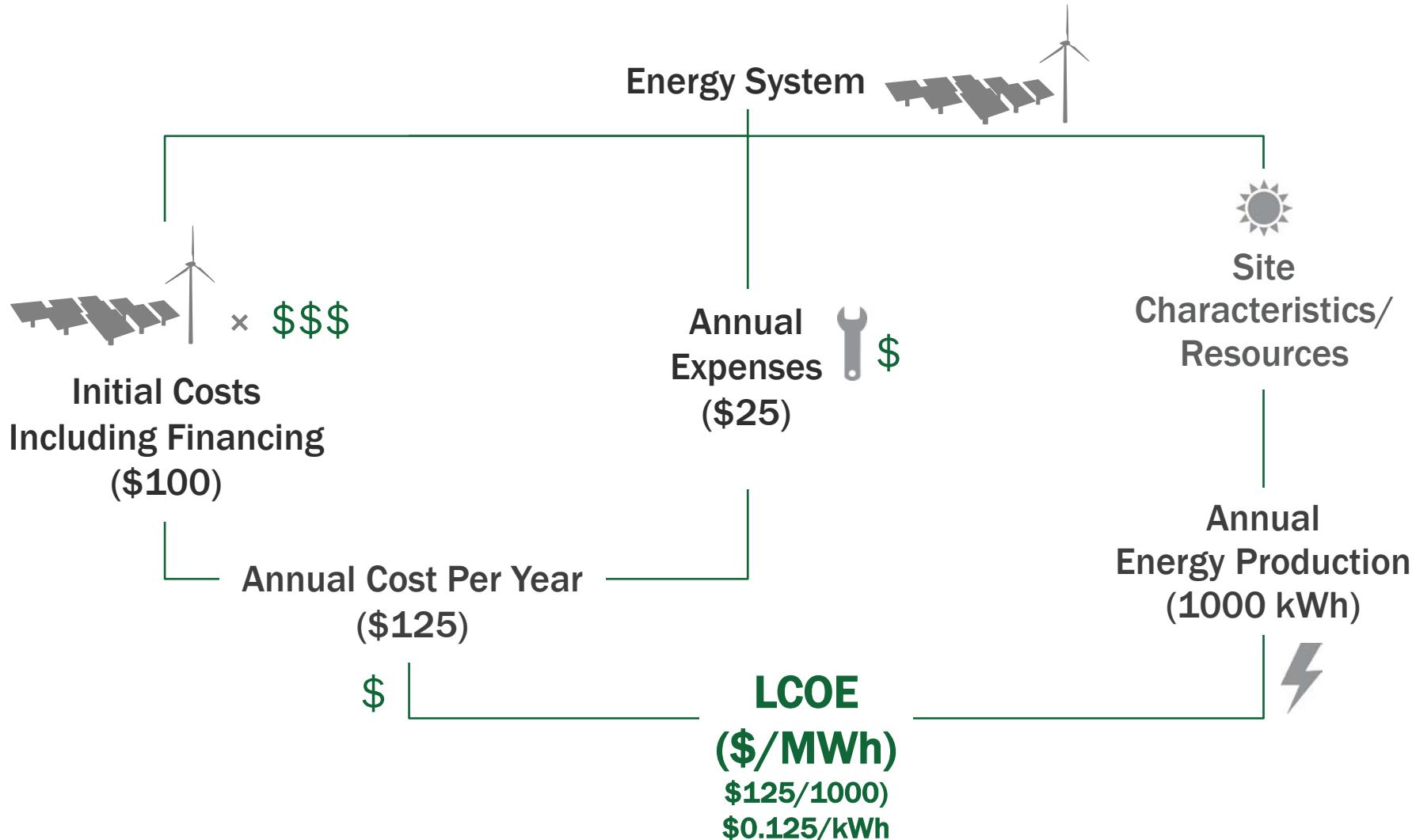
Key Concept: Levelized Cost of Energy (LCOE)



- Measures lifetime costs divided by energy production
- Calculates present value of the total cost of building and operating a power plant over an assumed lifetime.
- Allows the comparison of different technologies (e.g., wind, solar, natural gas) of unequal life spans, project size, different capital cost, risk, return, and capacities

Critical to making an informed decision to proceed with development of a facility, community or commercial-scale project

Simple LCOE Concept



Adapted from European Wind Energy Association, "Economics of Wind Energy,"

http://www.ewea.org/fileadmin/ewea_documents/documents/00_POLICY_document/Economics_of_Wind_Energy_March_2009_.pdf

Simplified LCOE Calculation

$$\frac{\sum_{t=1}^n \frac{I_t + M_t + F_t}{(1+r)^t}}{\sum_{t=1}^n \frac{E_t}{(1+r)^t}}$$

I_t = Investment expenditures in year t (including financing)

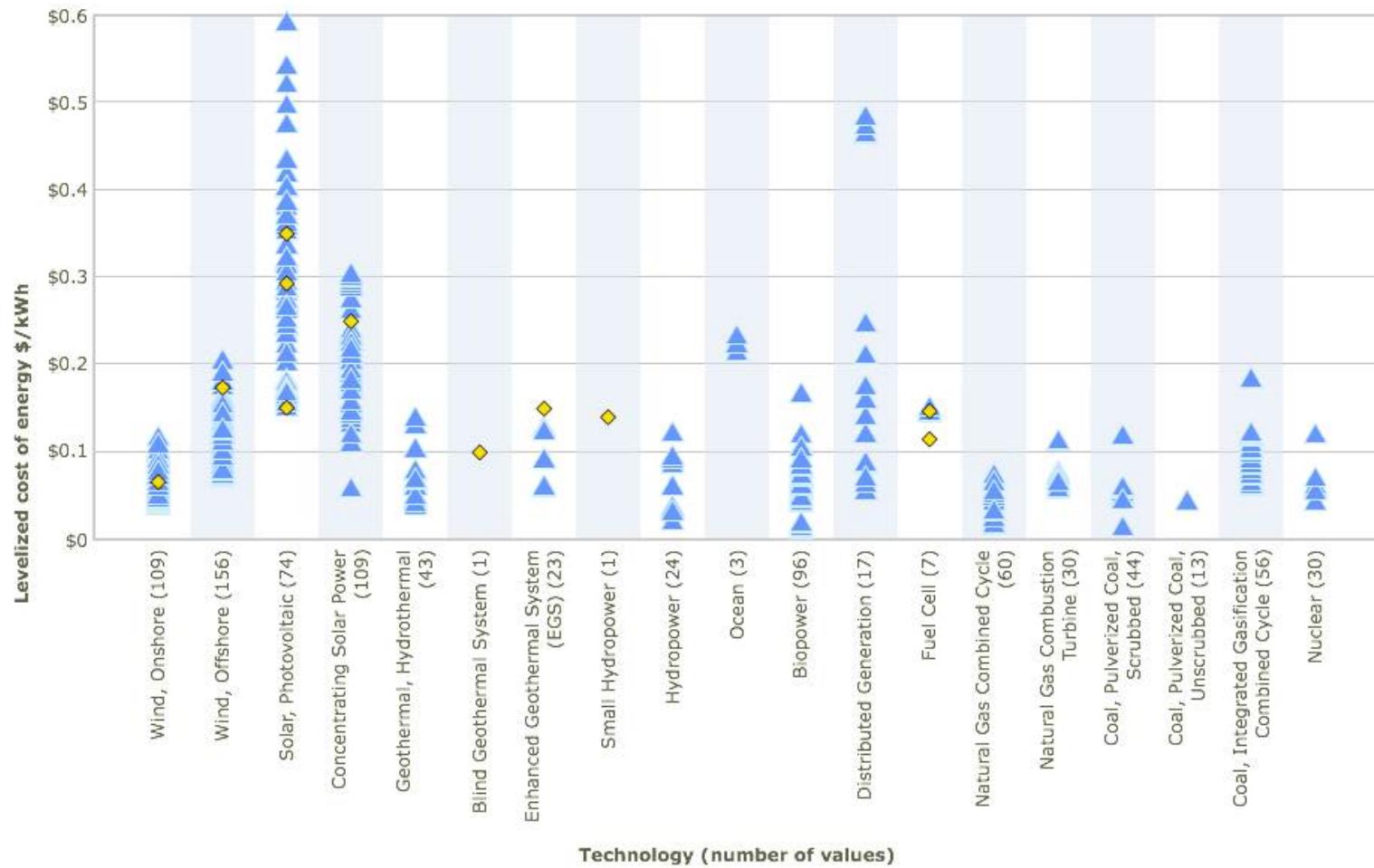
M_t = Operations and maintenance expenditures in year t

F_t = Fuel expenditures in year t

E_t = Electricity generation in year t

r = Discount rate

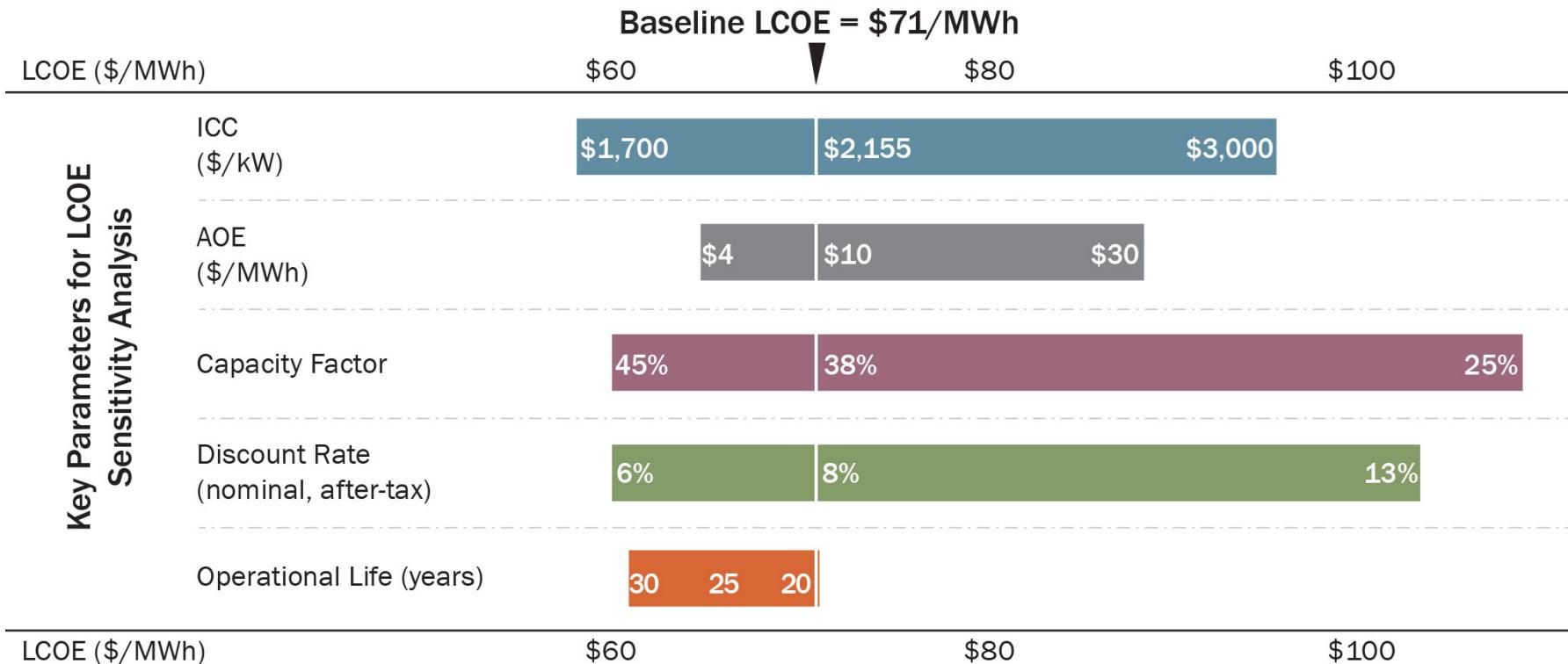
n = Life of the system



http://en.openei.org/wiki/Transparent_Cost_Database

Wind LCOE Sensitivity: What Are the Big Drivers?

Initial capital cost (ICC) and capacity factor are two critical drivers, but discount rate (financing costs) and annual operating expenses (AOE) are non-trivial. Wind LCOE example shown below:



LCOE Models

CREST

<https://financere.nrel.gov/finance/content/crest-cost-energy-models>

The screenshot shows a Microsoft Excel spreadsheet titled "Performance, Cost, Operating, Tax & Financing Inputs". It contains several data entry tables:

- Selected Technology:** Photovoltaic
- Project Size and Performance:** Generator Nameplate Capacity: 2,000; Net Capacity Factor: State Average or Custom → State Average; Net C: If "State Average" method, then select state + CO.
- Net Capacity Factor, Yr 1:** 17%; Protection, Yr 1: kWh 3,101,554; Annual Production Degradation: 0.8%; Project Useful Life: years 30.
- Capital Costs:** Total Installed Cost: \$2,000,000.
- Federal Incentives:** Investment Tax Credit (ITC) or Cash Grant: Cash Grant 30%; ITC or Cash Grant Amount: % 30%; ITC or Cash Grant: \$ 50.
- Operations & Maintenance:** Fixed O&M Expense, Yr 1: \$0/kWh 0.00; Variable O&M Expense, Yr 1: \$0/kWh 0.00; O&M Cost Inflation, initial period: % 1.0%; O&M Cost Inflation, thereafter: % 1.5%.
- State Rebates, Tax Credits and/or REC Revenue:** Select Form of State Incentive: Neither.

LCOE Calculator

http://www.nrel.gov/analysis/tech_lcoe.html

The screenshot shows a web-based calculator titled "Renewable Energy System Cost and Performance". It includes the following input fields:

- Renewable Energy System Cost and Performance:** Capital Cost (\$/kW): 1050; Capacity Factor (%): 43.6; Fixed O&M Cost (\$/kW-yr): 23; Variable O&M Cost (\$/kWh): 0.002; Heat Rate (Btu/kWh): 00000; Fuel Cost (\$/MMBtu): 8.
- Today's Utility Electricity Cost:** Electricity Price (cents/kWh): 13; Cost Escalation Rate (%): 3.0.
- Results:** Levelized Cost of Utility Electricity (cents/kWh); Simple Levelized Cost of Renewable Energy (cents/kWh).

At the bottom, it asks "Did you find what you needed? Yes No" and provides a link to "How are these numbers calculated? See documentation".

Using LCOE

Calculating and comparing LCOE can:

- Measure value across the longer term, showing projected life-cycle costs
- Highlight opportunities for Tribes to develop different scales of projects (facility, community, or commercial)
- Inform decisions to pursue projects on an economic basis, compared to utility rates

Most renewable energy projects have zero fuel costs
(with biomass being the possible exception)