

DOE OFFICE OF INDIAN ENERGY

Levelized Cost of Energy (LCOE)



U.S. DEPARTMENT OF
ENERGY

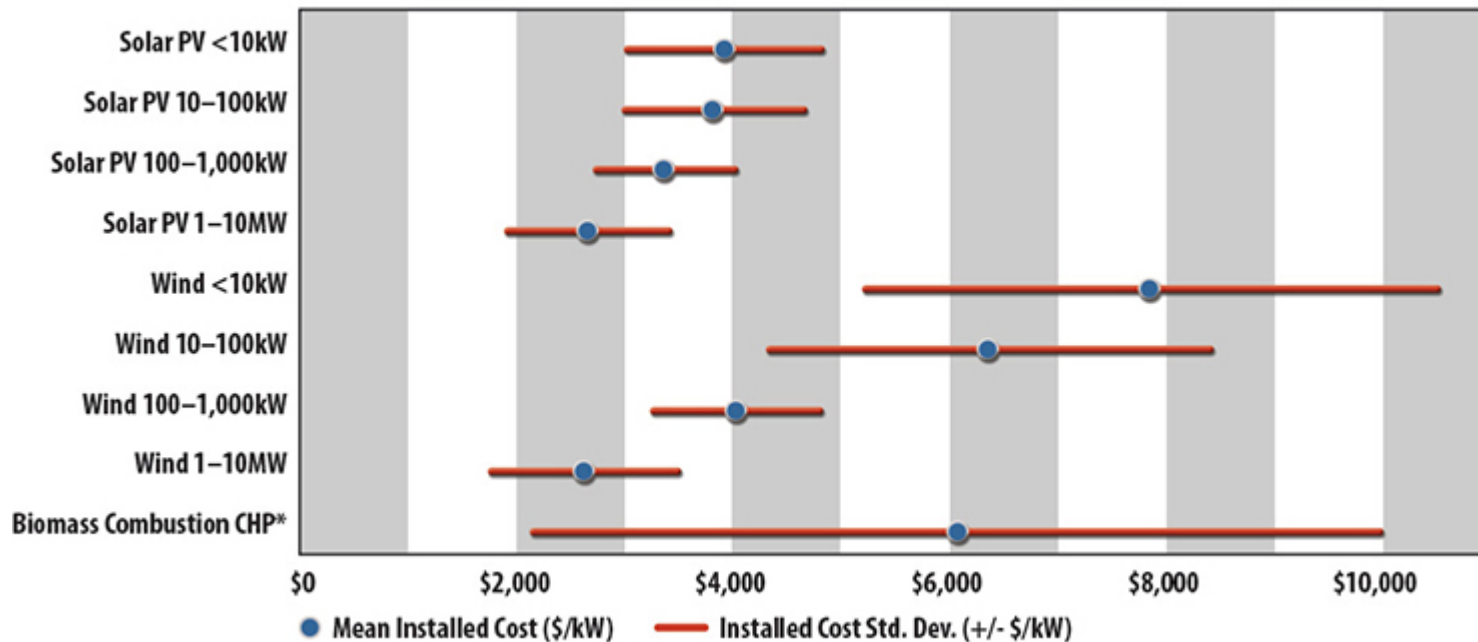
Office of
Indian Energy

Upfront Capital Costs for Renewables



Upfront costs do not paint a complete picture

Installed Costs



* Unit cost per unit of the electrical generator, not the boiler heat capacity

Last updated: September 2013

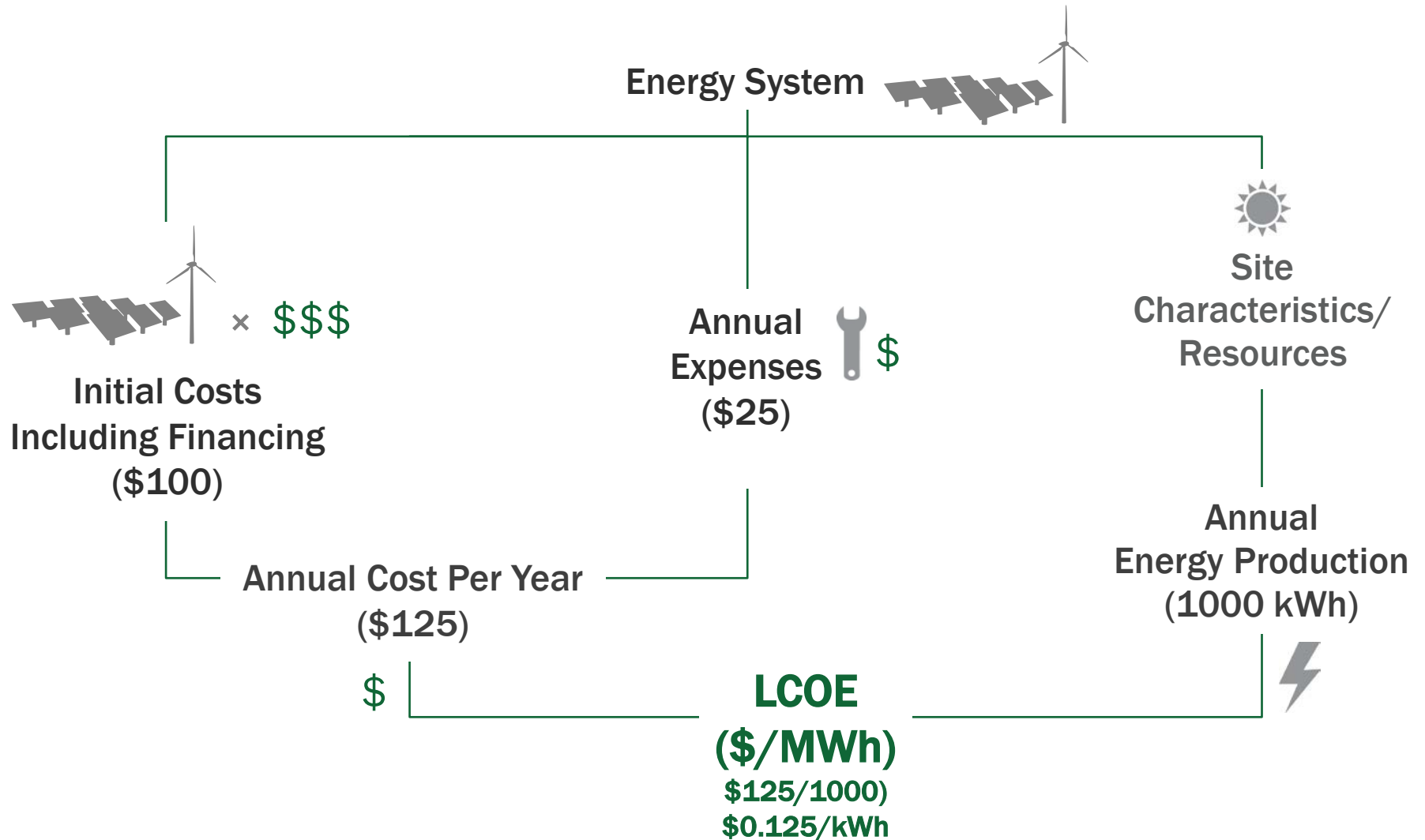
Key Concept: Levelized Cost of Energy (LCOE)



- 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)

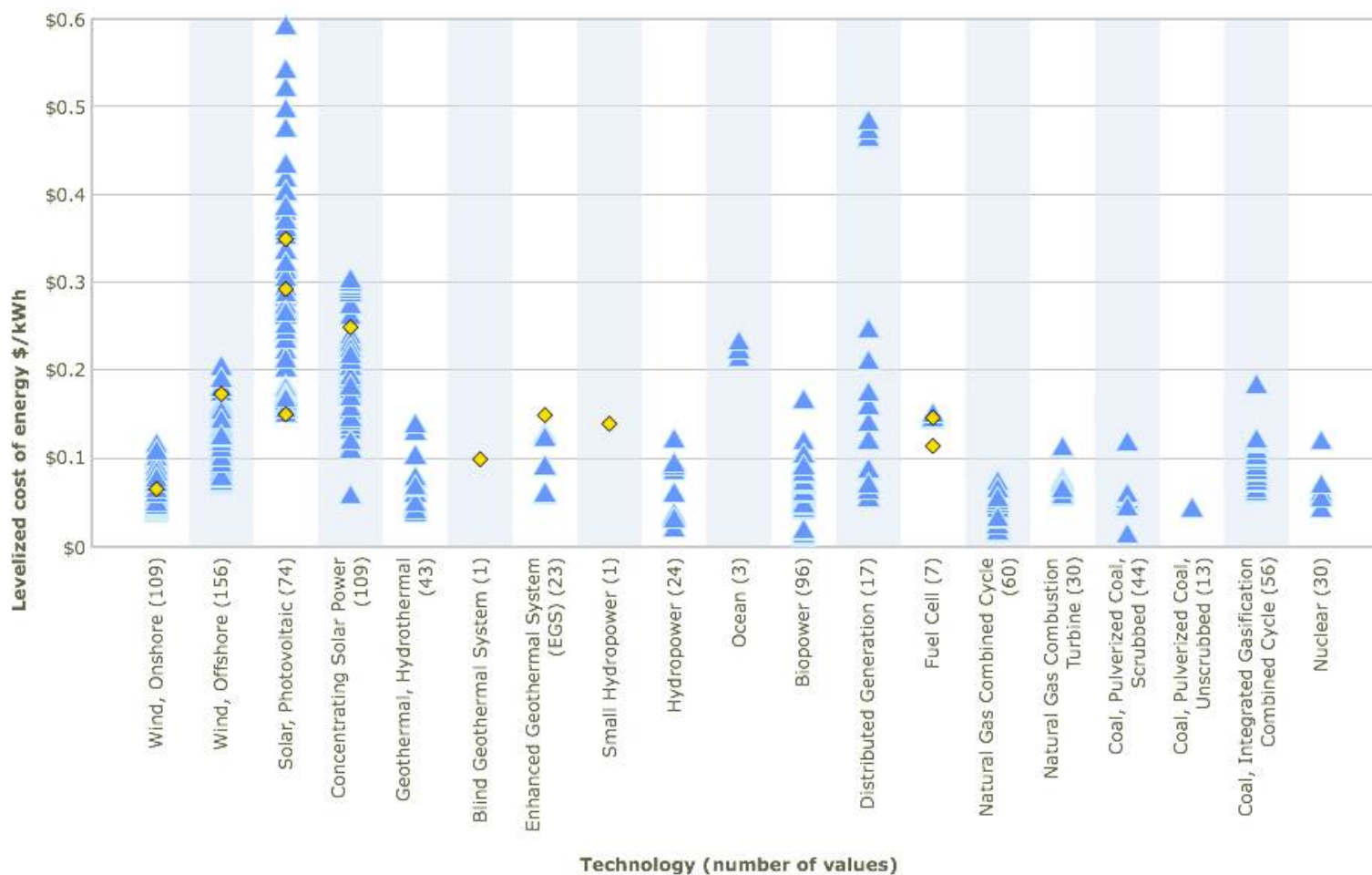
M_t = Operations and maintenance expenditures in year t

F_t = Fuel expenditures in year t

E_t = Electricity generation in year t

r = Discount rate

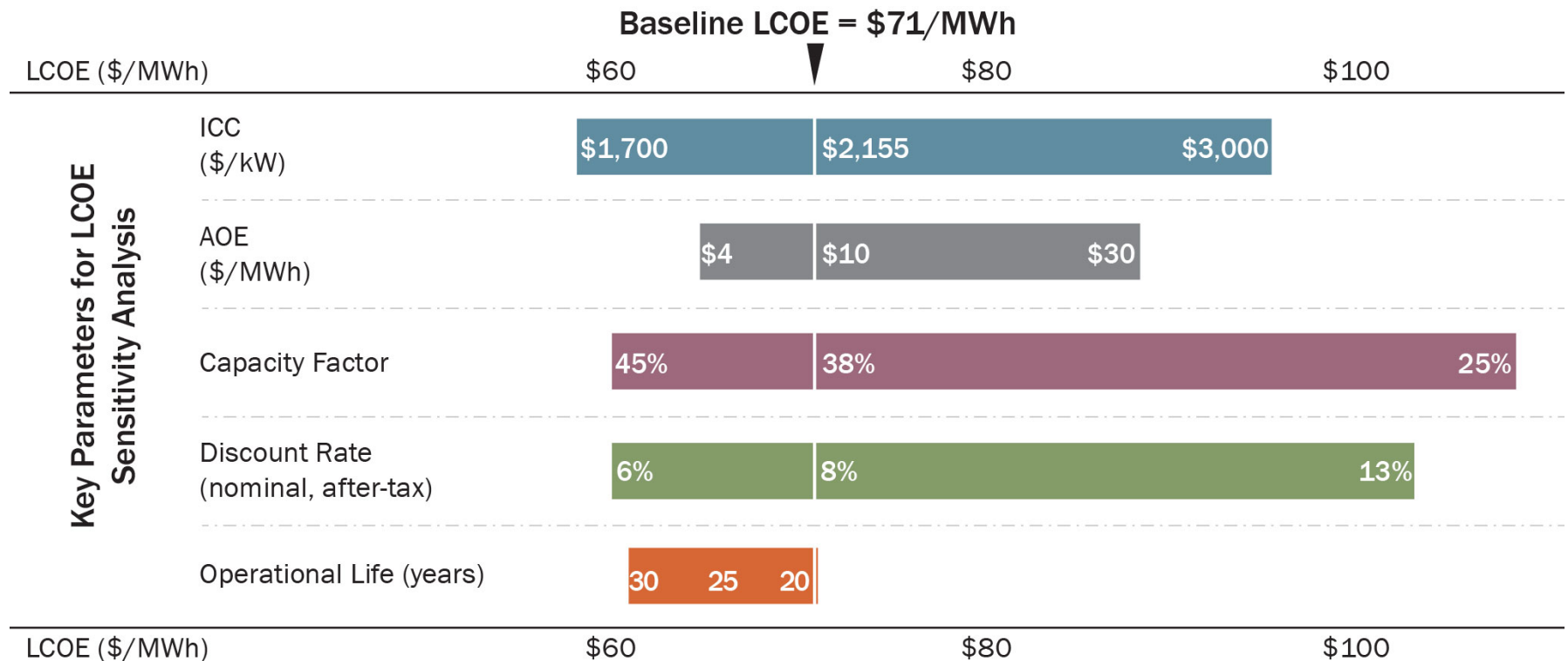
n = Life of the system



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:



Source: Tegen et al. 2012

LCOE Models

CREST

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

The CREST spreadsheet interface is divided into several sections for inputting project data:

- Performance, Cost, Operating, Tax & Financing Inputs:** The main header for the spreadsheet.
- Selected Technology:** A dropdown menu currently set to "Photovoltaic".
- Project Size and Performance:**
 - Generator Nameplate Capacity: 2,000 kW
 - Net Capacity Factor: 25.0%
 - Production: 5,000 MWh
 - Annual Production Depreciation: 8.0%
 - Project Useful Life: 25 years
- Capital Costs:**
 - Select Cost Level of Detail: Simple
 - Total Installed Cost: \$2,000,000
 - Total Installed Cost before rebates/grants: \$2,000,000
 - Total Installed Cost before rebates/grants if any: \$2,000,000
- Operations & Maintenance:**
 - Select Cost Level of Detail: Simple
 - Fixed O&M Expense: \$0.00/kWh
 - Variable O&M Expense: \$0.00/kWh
 - O&M Cost Inflation: 1.0%
 - Initial Period ends last day of: 12/31/2025
 - O&M Cost Inflation thereafter: 1.0%
- Cost-Based Tariff Rate Structure:**
 - Payment Duration for Cost-Based Tariff: 25 years
 - % of Year-One Tariff Rate Escalated: 0.0%
 - Cost-Based Tariff Escalation Rate: 0.0%
- Federal Incentives:**
 - Select Form of Federal Incentive: Cash Grant
 - Investment Tax Credit (ITC) or Cash Grant? 30%
 - ITC or Cash Grant Amount: 100%
 - ITC utilization factor, if applicable: 100%
 - ITC or Cash Grant: \$0
- Additional Federal Grants:**
 - Additional Federal Grants (Other than Section 403): \$0
 - Federal Grants Treated as Taxable Income? Yes
- State Rebates, Tax Credits and/or REC Revenue:**
 - Select Form of State Incentive: Rebate

LCOE Calculator

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

The NREL LCOE Calculator web interface allows users to input various cost parameters for a renewable energy system:

- Renewable Energy System Cost and Performance:**
 - Capital Cost (\$/kW): 1050
 - Capacity Factor (%): 25.0
 - Fixed O&M Cost (\$/kW-yr): 25
 - Variable O&M Cost (\$/kWh): 0.002
 - Heat Rate (\$/Btu/kWh): 10000
 - Fuel Cost (\$/MMBtu): 5
- Today's Utility Electricity Cost:**
 - Electricity Price (cents/kWh): 12
 - Cost Escalation Rate (%): 3.0
- Results:**
 - Levelized Cost of Utility Electricity (cents/kWh): ?
 - Simple Levelized Cost of Renewable Energy (cents/kWh): ?

How are these numbers calculated? See [documentation](#).

Did you find what you needed?

NREL is a national laboratory of the U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy, operated by the Alliance for Sustainable Energy, LLC.

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)