Capital solar energy policy

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In 2011, the U.S. Department of Energy''s Solar Energy Technologies Office (SETO) launched the SunShot Initiative to make solar-generated electricity competitive with conventional sources across most of the country by 2020. That goal was met for utility-scale photovoltaic installations three years early. In 2020, large utility-scale systems produced electricity at a levelized (life-cycle) cost below 5?/kWh in locations with average sunlight, and as low as 3.5?/kWh in the sunniest parts of the country, making it one of the least expensive forms of new electricity generation.1

This reduction in cost in combination with solar policy incentives has led to rapid growth in solar photovoltaic (PV) generation capacity, from providing less than 0.1% of the U.S. electricity supply in 2011 to over 3% in 2020. This upward trajectory is expected to continue. To fully decarbonize power generation by 2035, solar power may need to supply more than 40% of the nation''s electricity.2

To accelerate the deployment of solar power, SETO has announced a goal to reduce the benchmark levelized cost of electricity (LCOE) generated by utility-scale photovoltaics (UPV) to 2?/kWh by 2030.3 In parallel, SETO is targeting a 2030 benchmark LCOE of 4?/kWh for commercial PV,4 5?/kWh for residential PV,5 and 5?/kWh for concentrating solar-thermal power (CSP).6 Figure 1 compares the 2030 LCOE targets to their corresponding historical values.

Figure 1. Solar-power benchmark LCOE targets for 2030 compared to historical values.

The benchmark LCOE targets for PV shown in Figure 1 are for a location with medium solar resource. Areas with more sun have lower LCOE, while those with less sun have higher LCOE. Figure 2 illustratesthe geographic variation in the annual solar resource and the resulting range in LCOE for a large UPV system. Note that there is less than ?30% variation in LCOE across the contiguous 48 states. This geographic variability is less than for any competing renewable-power technology.

Figure 2. Annual solar resource map for a latitude-tilt south-facing surface, showing LCOE values for large UPV systems located near three cities that represent low, medium, and high solar resource.

The different LCOE targets for residential, commercial, and utility-scale PV systems is due primarily to the differences in size. This scale dependence arises because there are some project costs that are nearly independent of the size of the system, including office functions like engineering, sales and marketing, accounting, supply-chain management, and obtaining permits. Larger systems spread these fixed costs across more energy delivered. Utility-scale PV systems are the largest, typically between 5 and 500 MW, with some exceeding 1000 MW. Residential PV systems are the smallest, typically between 2 and 10 kW, though some homes have systems as large as 20 kW.7 Commercial PV systems span the gap between residential and utility-scale systems.

Residential and commercial systems are called distributed PV (DPV) systems. In 2020, DPV systems accounted for 30% of the solar electricity generated in the U.S.8 Although DPV systems have higher LCOE than UPV systems, they have the advantage of delivering power directly at the point of consumption, which makes it possible for DPV to be cost-competitive across most of the country.

The benchmark LCOE for CSP shown in Figure 1 is for a sunny location in the Southwest such as Daggett, CA shown in Figure 2. CSP installations are primarily focused on this region of the country because atmospheric haze and clouds impact CSP performance more than for PV.

Solar power has become inexpensive, but the solar resource is variable - it peaks around noon and goes to zero at night. When solar power grows to supply a substantial fraction of regional energy demand, there will often be more solar power available at midday than can be immediately consumed. This is already happening in some parts of the country.