Utility Solar Project Development & EPC — Innovative Outcomes

Direction and Rate of Technological Change

The innovative outcomes in this value chain encompass the decreasing soft costs associated with solar PV system project development and EPC, as well as streamlining and decreasing the development timeline. Other relevant innovations include the increasing efficiency of solar panels that produce more power using less space or increasing capacity factor, and the expansion of durability or life of solar PV panels; these factors all contribute to decreased needs for land and facilities for utility-scale PV projects. The last three attributes are primarily relevant to the technological innovation embedded in the PV modules—they are discussed in detail in the "Module Manufacturing" step of the value chain.

Soft Costs

Soft costs refer to the PV system costs excluding hardware (i.e., excluding modules, inverters, structures, and electrical BOS). Typically, this cost category includes labor costs, equipment rental, EPC overhead, developer overhead, contingency, EPC/developer net profit, land acquisition, permitting fee, interconnection fee, and if any, sale tax and fees related to transmission lines. Soft costs and the costs of hardware interact; as module efficiency improvements have decreased the number of modules needed to reach a given generation capacity, soft costs for labor and installation overhead. The importance of utility-scale solar soft costs has become increasingly evident, in part due to the substantial decline of hardware costs, in particular PV module prices. Between 2010 and 2017, the share of utility-scale PV soft cost has increased from 32% to 41% (see Figure IO.1). The implication is not that the soft costs increased on an absolute basis, but that soft costs declined more slowly than did hardware costs. There is a general trend of lower module and inverter price, higher module efficiency, higher labor wages, and higher net profit to EPC/developers. There is also an evident trend of cost reduction from economies of scale.

Figure IO.1. Modeled Trend of Soft Cost (as percent of total cost by sector), 2010–2017

Source: Figure 36 from U.S. Solar photovoltaic System Cost Benchmark: Q1 2017.

Between 2010 and 2017, total utility-scale PV system costs decreased by approximately 80%, broken down by cost types as follows: about 70% of the cost reduction is attributable to falling hardware costs, especially modules; about 10% of the total cost decrease is attributable to reduced labor requirements; about 20% of the total cost reduction is attributable to decreases in other soft costs, including permitting, inspection, and interconnection, sales tax, overhead, and net profit. The U.S. Department of Energy Solar Energy Technologies Office maintains a Solar Business Innovation website for the purpose of disseminating financing and other soft cost information to support innovative business solutions.

Along with fees and the labor costs associated with acquiring all necessary contracts, permits, and financing, these stages of the utility solar development process require a substantial amount of time, which a developer or EPC could otherwise spend engaged in other projects. As demonstrated in Figure IO.2, major permit, contract, and finance negotiations can be expected to be three or more years.

Figure IO.2. Utility-Scale PV Development Timeline (250MW)

Source: SEIA https://www.seia.org/research-resources/development-timeline-utility-scale-solar-power-plant

Permitting

One of the “soft cost” barriers to the growth of the utility solar PV market is the length of time associated with the permitting and grid interconnection process. Typically, a utility-scale solar PV project can take up to 4-5 years from beginning to end, of which up to 3 years may be spent negotiating permitting and interconnection (REF: SEIA). Once an installer makes the sale on a system, the cost of carrying inventory must be covered until the project is operational, despite the delay. Several states have taken action to address permitting associated soft costs (see Strategic Conditions for project development and EPC). Unfortunately, in many cases, streamlined permitting or an expedited track for improved interconnection processing is only available for small scale residential or commercial PV systems. While there is little research available on cost differences attributable to differences in utility-scale permitting and interconnection processes, Burkhardt et al. (2015) find that local permitting and broader variations in local regulations can impact residential PV system prices by $0.18/W and $0.64-0.93/W, respectively; these values provide context for the potential soft cost reductions available from streamlining the utility-scale PV permitting process. Much of the growth in utility-scale solar generation capacity has been quite recent; as of December 2016, there were 21.5 GW of utility-scale solar capacity, 7.6 GW of which came online in 2016. As these projects become more common, experience over time may help reduce the permitting timescale and associated costs.

On federal lands, the Western Solar Plan of the Bureau of Land Management pre-identifies Solar Energy Zones (SEZs) in Nevada, Utah, Colorado, New Mexico, Arizona, and California; in these areas, solar projects and their supporting transmission infrastructure will be prioritized. The Western Solar Plan also streamlines permitting to allow projects to be processed in less than 10 months, which is at the shorter end of the expected 9-36 month permitting and interconnection process. In 2015, the first three sites gained approval for construction on federal land in Nevada, expected to provide 440 MW of generation capacity.

Data on Quantity, Cost, and Quality

It is less obvious how one would construct a learning curve for project development and EPC as compared to a technological commodity like a PV module. However, we propose several data types that can shed light on advancements in this sector. For a PV module, “quality” includes things such as efficiency and expected lifetime; for process- and procedure-driven sectors like project development and EPC, one important “quality” is the efficient use of time. Data that will be valuable for future research into the value of innovations in project development and EPC include:

- Time series of the quantity of PV projects completed (ideally number of installations, but installed capacity could be useful as well)
- Time series of various project development and EPC costs, particularly types of soft cost (see, e.g., Figure IO.3)
- Time series of average time-to-completion for a benchmark-sized utility PV project
- Time series of average time to obtain permits, PPAs, and project financing (see, e.g., Figure IO.4)

Figure IO.3 PV System Cost Benchmark Summary (inflation adjusted), 2010–2017

Source: Figure 29 from NREL U.S. Solar PV System Cost Benchmark Q1 2017.

Figure IO.4 Days for Each Interconnection Stage, (full U.S. residential PV sample, up to 50 kw)

Source: Figure 11 of NREL A State-Level Comparison of Processes and Timelines for Distributed Photovoltaic Interconnection in the United States (2015) 2015

Note: This figure refers to the residential and commercial PV permitting, construction, and interconnection processes, but it provides an example of the type of data needed for utility-scale PV.