

 fab2farm™

**Distributed Generation Breaks
Transmission Bottleneck**

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Legislatures and regulators in many states have imposed renewable portfolio standards (RPS) on electric utilities. Typically, these standards require that utilities derive some fraction of the electricity they supply from renewable sources, but give the utilities broad discretion in meeting that goal. In California, for example, most utility-scale renewable energy projects now being planned depend on wind or solar thermal generation, concentrated in large sites in remote areas. Utilities believe that these are mature technologies, and offer the most cost effective renewable alternative.

THE TRANSMISSION BOTTLENECK

Unfortunately, the delivered cost of electricity — the number that matters to ratepayers — includes more than just generation. To deliver electricity to customers, the generation site must connect to the grid. In California, a California Public Utility Commission (CPUC) study¹ found that most high-potential centralized wind and solar thermal generation sites will require construction of new transmission lines. Line construction significantly increases the delivered cost of electricity, while imposing delays that can threaten overall renewable energy goals.

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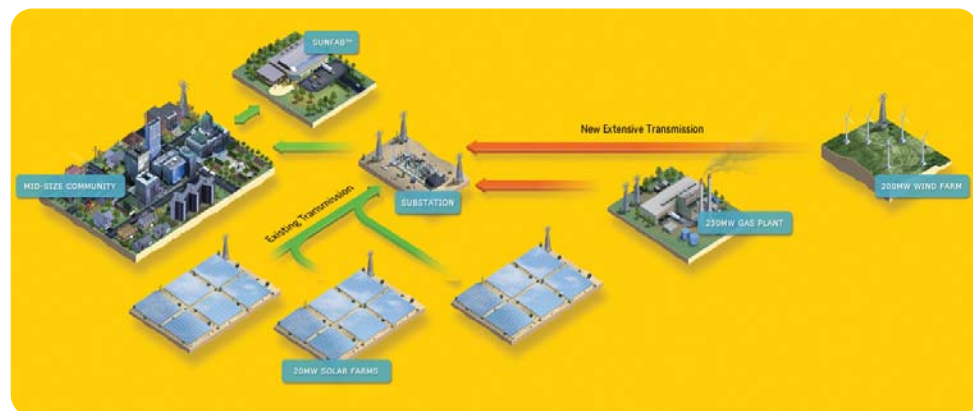
Site developers are reluctant to begin construction, and may not even be able to obtain financing, until they are confident that transmission lines will be available. Yet permitting for transmission lines is a long and arduous process. Each landowner and each regulatory jurisdiction in the line's path must approve the project, often requiring separate environmental impact studies and public hearings for each major segment. Lawsuits can delay any portion of the line at any point in the process, or can force rerouting around a sensitive area — and of course the new route introduces new stakeholders who must also approve the project. For generation projects that depend on new transmission lines, these issues can delay the project construction by as much as four or five years.

Painful and expensive as these delays are for site developers, they also impede a state's ability to meet renewable energy goals. In California, for instance, the CPUC expects that achieving a 20% RPS target by 2020 will require four new major transmission lines at an estimated cost of \$4 billion². The more aggressive 33% RPS target will require construction of seven additional lines at an estimated cost of \$12 billion. While California is taking steps to streamline the

permitting process, for example by identifying and working toward pre-approval of the most likely transmission corridors, circumstances outside the state's control can still impede the process. Failure to develop even one of the required lines could jeopardize achievement of the RPS target.

WHY DISTRIBUTED GENERATION?

As noted above, the transmission bottleneck is a direct result of the current utility emphasis on centralized generation projects in remote areas. The CPUC study's reference scenario emphasizes renewable projects that are already in the utility procurement process, either contracted or short-listed, and as such depends on wind or solar thermal generation for more than half of the renewable energy resource mix. An alternative CPUC scenario assumes limited availability of new transmission infrastructure, and instead makes extensive use of distributed generation model – rooftop installations and 10-20 megawatt (MW) scale ground-mounted solar photovoltaic (PV) systems, placed near existing substations.



Wholesale distributed generation, with multiple 10-20MW solar farms located at the distribution level, does not require new transmission.

The CPUC estimates that such sites could supply more than 8 gigawatt (GW) of solar generation capacity; the 33% RPS scenario requires about 24 GW of renewable capacity. In this scenario, individual installations would still require local approval, but neither they nor their transmission lines would need the complex approvals — from dozens of jurisdictions spanning hundreds of miles — that long-distance transmission lines do. Even if an individual installation did

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encounter approval difficulties, the delay would not affect other facilities or jeopardize the state's overall goals as a transmission line delay would.

The most serious obstacle to wholesale distributed generation, i.e. 10-20MW, distribution-level installation of solar PV, has always been cost. At current prices, the CPUC analysis estimates that the distributed generation scenario would impose a 7% cost premium compared to the Commission's reference case. The CPUC analysis assumes a current cost of \$5.83 per installed watt for PV generation, and notes that driving the cost down to \$3.08 per installed watt would make distributed generation cost-equivalent to the reference scenario. As discussed in more detail in the "fab2farm™: New Model Creates Job, Delivers Lowest Solar Energy Cost" whitepaper, a fab-to-farm ecosystem based on Applied Materials' SunFab manufacturing line optimizes manufacturing, balance-of-system costs, and financing to put this target within reach.

After the transmission bottleneck, the CPUC study's second important concern is the state's reliance on relatively new technologies to meet its RPS goals and in the 33% RPS scenario, to meet the energy needs of Californians. In the 33% RPS scenario, none of the renewable generation technologies being considered is yet a major contributor to the global electricity supply, and all will need to achieve unprecedented growth to deliver the capacity required. In the face of such rapid expansion, it is likely that some companies will fail, and others will be unable to meet their original timelines. Solar thermal, a central generation renewable source, has a current worldwide installed capacity of less than 1 GW; yet the CPUC's 33% RPS scenario depends on this particular technology for more than 7 GW of renewable capacity. The distributed generation approach on the other hand, spreads the risk across many projects and the collective knowledge of many entrepreneurs, rather than putting a state's energy supply at the mercy of a few centralized installations. With about 16 GW in global installed capacity, including substantial utility-scale installations in Europe, the photovoltaic industry's manufacturing infrastructure is more robust than any of the renewable alternatives other than wind. Moreover, the industry's manufacturing capacity is leaping forward as companies like Applied Materials offer turnkey production lines backed by extensive high-volume manufacturing expertise.

NOT JUST A CALIFORNIA ISSUE

Though this discussion has focused on analysis of California's needs by the CPUC, the same constraints apply wherever renewable energy is deployed on a large scale. Centralized generation sites, by their nature, require large expanses of land that are most likely to be found in remote areas. Wind and solar thermal resources are often concentrated in mountains and deserts, respectively, far from large concentrations of people. Transmission of electricity from these sites to centers of demand has long been recognized as a formidable challenge for renewable energy. In other jurisdictions, as in California, wholesale distributed generation can break the transmission bottleneck. With recent advances in solar technology, it can do so at a cost comparable to that of other technologies.

FOR MORE INFORMATION

The CPUC study referenced in this report provides both an excellent overview of transmission and distribution issues and a detailed analysis of the impact of those issues on California renewable energy deployment. It can be obtained from the Commission's web site:

<http://www.cpuc.ca.gov/PUC/energy/Renewables/hot/33implementation.htm>

The Materials Research Society's MRS Bulletin published a special issue on energy in April 2008. The Bulletin places transmission and distribution issues in the larger context of transformation of the global energy economy, observing that these issues are critical even at that macroeconomic level. It can be obtained from the Society's web site:

http://www.mrs.org/s_mrs/sec.asp?CID=10867&DID=200925

REFERENCE

¹ "33% Renewables Portfolio Standard: Implementation Analysis Preliminary Results", published by the CPUC in June 2009

² all estimates in constant 2008 dollars



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A vertical, abstract graphic element on the right side of the contact box, consisting of overlapping, wavy yellow and orange shapes that resemble a flame or a stylized ribbon.

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