Solar’s rapid evolution makes energy planners rethink the grid

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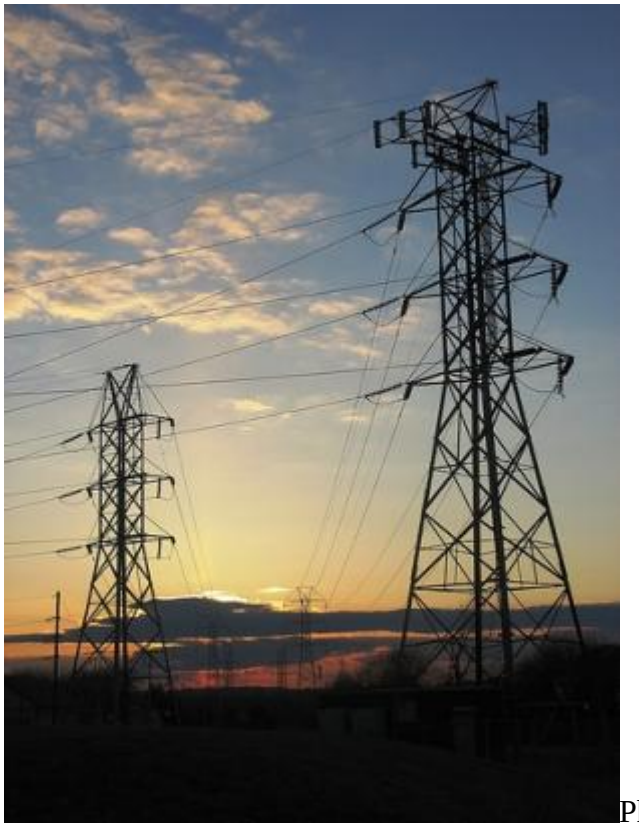
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California’s ambitious goal of obtaining a third of its electricity from renewable sources by 2020 has spawned a green energy boom with thousands of megawatts of solar, wind, and biomass power plants planned for ... the middle of nowhere.

And therein lies the elephant in the green room: transmission. Connecting solar farms and geothermal plants in the Mojave Desert and wind farms in the Tehachapis to coastal metropolises means building a massive new transmission system. The cost for 13 major new power lines would top $15.7 billion, according to a report released in August by the state’s Renewable Energy Transmission Initiative.

The initiative, called RETI, is an attempt to build a statewide green grid in an environmentally sensitive way that will avoid the years-long legal battles that have short-circuited past transmission projects.

But the rapidly evolving solar photovoltaic market may moot the need for some of those expensive and contentious transmission lines, requiring transmission planners to rethink their long-term plans, according to Black & Veatch, the giant consulting and engineering firm that does economic analysis for RETI.

In short, solar panel prices have plummeted so much as to make viable the prospect of generating gigawatts of electricity from rooftops and photovoltaic farms built near cities.

“This has pretty significant implications in terms of transmission planning,” Ryan Pletka, Black & Veatch’s renewable energy project manager, told me last week. “What we thought would happen in a five-year time frame has happened in one year.”

That’s prompted Pletka to radically revise the potential for so-called distributed generation—solar systems that can plug into the existing grid without the construction of new transmission lines—to contribute to California’s need for 60,000 gigawatt hours of renewable electricity by 2020.

When Black & Veatch did its initial analysis last year, it predicted that photovoltaic solar could contribute 2,000 gigawatt hours, given the high cost of conventional solar modules and the fact that a next-generation technology, thin-film solar, had yet to make a big commercial breakthrough.

Pletka’s new number is a bit of a shocker: Distributed generation could potentially provide up to 40,000 gigawatt hours of electricity, or two-thirds of projected demand.

“Certainly some of the new transmission lines will be needed but not as many as before,” he says.

That analysis also calls into question the need for as many large-scale solar power plants. Currently there are about 35 Big Solar projects planned for California that would generate more than 12,000 megawatts of electricity.

A game-changer has been the rapid rise of thin-film solar. Thin-film solar modules are essentially printed on glass or other materials. Although such solar panels are less efficient at converting sunlight into electricity than traditional crystalline modules—which are made from silicon wafers—they can be produced more cheaply.

In the past year, utilities like Southern California Edison have signed deals with First Solar, the thin-film powerhouse, to buy electricity from four massive megawatt thin-film solar farms. And in September, China inked an agreement with the Tempe, Ariz., company to build a 2,000-megawatt power plant, the world’s largest.

The next day, Nanosolar, a Silicon Valley startup, announced it had secured $4.1 billion in orders for its thin-film modules, which it claims will be even more efficient and cost less to produce than those made by First Solar.

Meanwhile, California's two biggest utilities, PG&E and Southern California Edison, this year each unveiled initiatives to collectively install 1,000 megawatts of distributed solar generation. SoCal Edison will put solar arrays on warehouse roofs throughout the Southland—First Solar snagged the first big contracts—while PG&E is focusing on ground-mounted solar systems near its existing substations.

So what's behind this rooftop revolution in solar?

Partly it's due to a glut in the solar panel market. The global economy collapsed last year just as solar module makers ramped up production. But it's also a result of technological innovation and economies of scale that have made thin-film solar, for instance, competitive. Strides have also been made in cutting installation costs, which typically account for half the price of photovoltaic systems.

The solar market, of course, is heavily dependent on government incentives—in the United States and overseas—and thus vulnerable to disruption. But the trajectory remains one of falling prices and thus Black & Veatch's projections pose a conundrum for transmission planners.

Given that transmission projects can take a decade to complete, power bureaucrats make their plans based on 10-year projections of energy costs according to Pletka. That wasn't much of a problem when planning transmission for, say, a grid supplied by natural gas-fired power plants as the technology or the market was not likely to change radically.

Not so for solar, where technological advances and fast-changing market conditions are shaking long-held views that photovoltaic power, or PV, is not ready for prime time.

"I've worked in renewables since the '90s and I myself had written off solar PV for years and years and years," Pletka says. "That's a firmly rooted mindset among everyone who works from a traditional utility planning perspective."

"We present this new information on photovoltaics to people and it's still not sinking in," he adds. "It would cause a major shift in how we plan."

While fewer massive transmission projects would be needed if California generates gigawatts of electricity from rooftops, the distribution network will need to be upgraded and a smart grid created to manage tens of thousands of pint-sized solar power plants.

Cities, Pletka notes, could become generators of electricity rather than consumers of power.

"It brings up questions people haven't had to talk about before," says Pletka.