The disruptive potential of solar power

As costs fall, the importance of solar power to senior executives is rising.

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The economics of solar power are improving. It is a far more cost-competitive power source today than it was in the mid-2000s, when installations and manufacturing were taking off, subsidies were generous, and investors were piling in. Consumption continued rising even as the MAC Global Solar Energy Index fell by 50 percent between 2011 and the end of 2013, a period when dozens of solar companies went bankrupt, shut down, or changed hands at fire-sale prices.

The bottom line: the financial crisis, cheap natural gas, subsidy cuts by cash-strapped governments, and a flood of imports from Chinese solar-panel manufacturers have profoundly challenged the industry's short-term performance. But they haven't undermined its potential; indeed, global installations have continued to rise—by over 50 percent a year, on average, since 2006. The industry is poised to assume a bigger role in global energy markets; as it evolves, its impact on businesses and consumers will be significant and widespread. Utilities will probably be the first, but far from the only, major sector to feel solar's disruptive potential.

Economic fundamentals

Sharply declining costs are the key to this potential. The price US residential consumers pay to install rooftop solar-photovoltaic systems has plummeted from nearly $7 per watt peak of best-in-class system capacity in 2008 to $4 or less in 2013.[1] Most of this decline has been the result of steep

reductions in upstream (or "hard") costs, chiefly equipment. Module costs, for example, fell by nearly 30 percent a year between 2008 and 2013, while cumulative installations soared from 1.7 gigawatts in 2009 to an estimated 11 gigawatts by the end of 2013, according to GTM Research.

While module costs should continue to fall, even bigger opportunities lurk in the downstream (or "soft") costs associated with installation and service. Financing, customer acquisition, regulatory incentives, and approvals collectively represent about half the expense of installing residential systems in the United States. Our research suggests that as they become cheaper, the overall costs to consumers are poised to fall to $2.30 by 2015 and to $1.60 by 2020.

These cost reductions will put solar within striking distance, in economic terms, of new construction for traditional power-generation technologies, such as coal, natural gas, and nuclear energy. That's true not just for residential and commercial segments, where it is already cost competitive in many (though not all) geographies, but also, eventually, for industrial and wholesale markets. Exhibit 1 highlights the progress solar already has made toward "grid parity" in the residential segment and the remaining market opportunities as it comes further down the curve. China is investing serious money in renewables. Japan's government is seeking to replace a significant portion of its nuclear capacity with solar in the wake of the Fukushima nuclear accident. And in Europe and the United States, solar adoption rates have more than quadrupled since 2009.

While these economic powerhouses represent the biggest prizes, they aren't the only stories. Sun-drenched Saudi Arabia, for example, now considers solar sufficiently attractive to install substantial capacity by 2032,[2] with an eye toward creating local jobs. And in Africa and India, where electric grids are patchy and unreliable, distributed generation is increasingly replacing diesel and electrifying areas previously without power. Economic fundamentals (and in some cases, such as Saudi Arabia, the desire to create local jobs) are creating a brighter future for solar.

Business consumption and investment

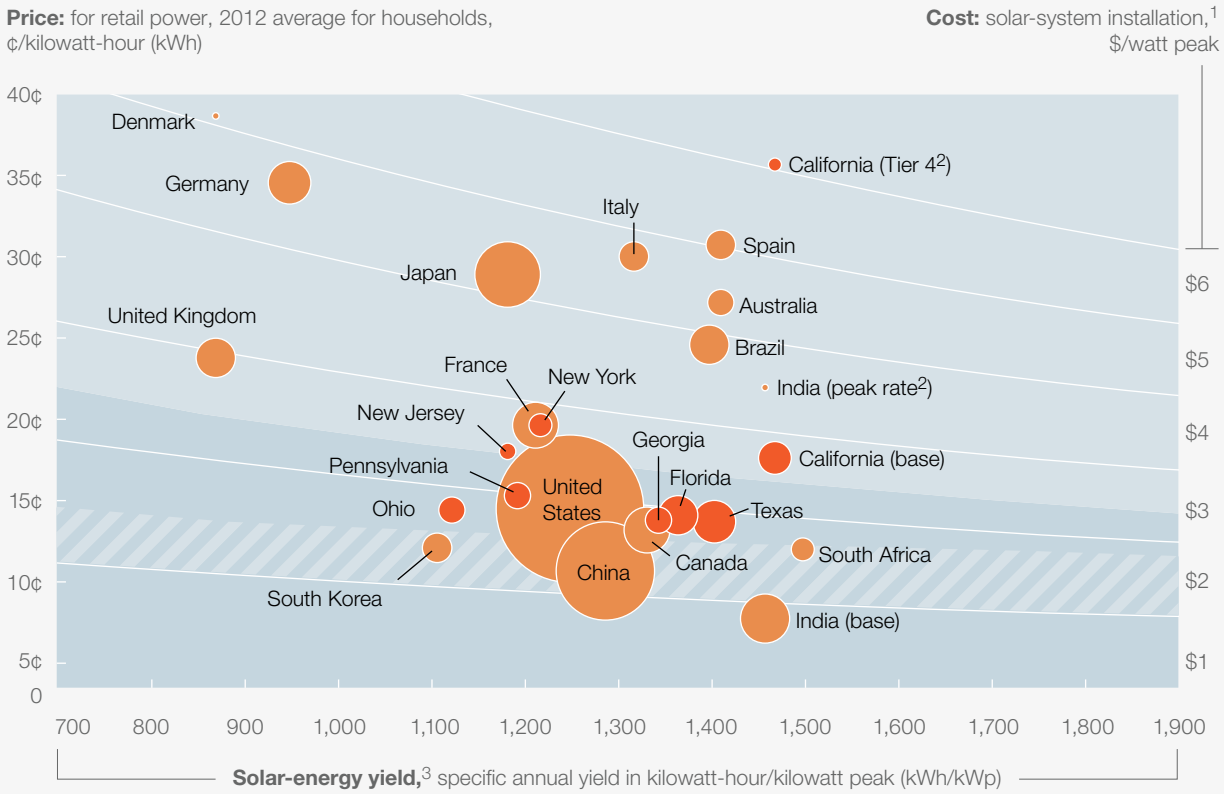
Solar's changing economics are already influencing business consumption and investment. In consumption, a number of companies with large physical footprints and high power costs are installing commercial-scale rooftop solar systems, often at less than the current price of buying power from a utility. For example, Wal-Mart Stores has stated that it will switch to 100 percent renewable power by 2020, up from around 20 percent today. Mining and defense companies are looking to solar in remote and demanding environments. In the hospitality sector, Starwood Hotels and Resorts has partnered with NRG Solar to begin installing solar at its hotels. Verizon is spending $100 million on solar and fuel-cell technology to power its facilities and cell-network infrastructure. Why are companies doing such things? To diversify their energy supply, save money, and appeal to consumers. These steps are preliminary, but if they work, solar initiatives could scale up fast.

As for investment, solar's long-term contracts and relative insulation from fuel-price fluctuations are proving increasingly attractive. The cost of capital also is falling. Institutional investors, insurance companies, and major banks are becoming more comfortable with the risks (such as weather uncertainty and the reliability of components) associated with long-term ownership of solar assets. Accordingly, investors are more and more willing to underwrite long-term debt positions for solar, often at costs of capital lower than those of traditional project finance.

Major players also are creating advanced financial products to meet solar's investment profile. The best example of this to date is NRG Yield, and we

Exhibit 1 **A sharp decline in installation costs for solar-photovoltaic systems has boosted the competitiveness of solar power.**

Grid-parity potential of solar-photovoltaic (PV) power in major markets, residential-segment example



[1]Full cost estimated, based on residential 5-kilowatt c-Si system; levelized cost of energy accounts for solar insulation and assumes 5% weighted average cost of capital, 25-year lifetime, 0.3% annual degradation, and fixed 1% operating and maintenance costs.
[2]California's rate structure charges more for higher consumption; the highest rate ranges from 31–37¢/kWh, depending on the utility. For India, peak rate refers to the rate without an artificial cap, which is imposed to close the peak-power deficit filled by diesel-generated power. Only 2008 data available.
[3]Amount generated by a south-facing 1 kWp module in 1 year (a function of solar intensity).

Source: Enerdata; India Central Electricity Authority; International Energy Agency; Solar Energy Research Center at Lawrence Berkeley National Labs; US Energy Information Administration; US National Renewable Energy Laboratory's PVWatts calculator; McKinsey analysis

expect other companies to unveil similar securities that pool renewable operating assets into packages for investors. Google has been an active tax-equity investor in renewable projects, deploying more than $1 billion since 2010. It also will be interesting to track the emergence of solar projects financed online via crowd-sourcing (the best example is Solar Mosaic, which brings investors and solar-energy projects together). This approach could widen the pool of investors while reducing the cost of capital for smaller installations, in particular.

Disruptive potential

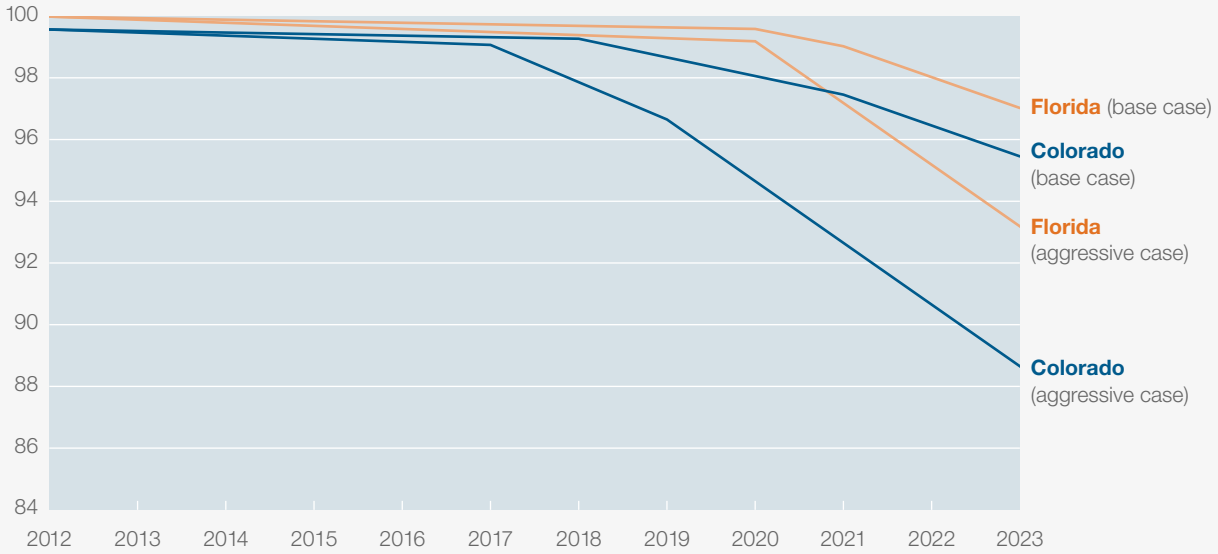
The utility sector represents a fascinating example of the potential for significant disruption as costs fall, even as solar's scale remains relatively small. Although solar accounts for only less than half a percent of US electricity generation, the business model for utilities depends not so much on the current generation base as on installations of new capacity. Solar could seriously threaten the latter because its growth undermines the utilities' ability to count on capturing all new demand, which historically has fueled a large share of annual revenue growth. (Price increases have accounted for the rest.)

Depending on the market, new solar installations could now account for up to half of new consumption (in the first ten months of 2013, more than 20 percent of new US installed capacity was solar). By altering the demand side of the equation,

Exhibit 2

Although solar power will continue to account for a small share of the overall US energy supply, it could well have an outsize effect on the economics of utilities.

Remaining electricity consumption from utilities after solar-photovoltaic (PV) adoption, both residential and commercial,[1] % of megawatt-hours



[1]Assumes 8% discount rate, $0.02/watt year in operations and manufacturing costs, 25-year system life; US solar investment tax credit expires post-2016 (10% thereafter), Colorado incentive of $0.04/kilowatt-hour (kWh) for residential, $0.07/kWh for commercial customers through 2018. Base case assumes 0.05% annual solar PV adoption when levelized cost of electricity is above retail grid electricity prices, and 1% when below. Aggressive case assumes 0.1% and 2%, respectively.

Source: US Energy Information Administration; McKinsey analysis

solar directly affects the amount of new capital that utilities can deploy at their predetermined return on equity. In effect, though solar will continue to generate a small share of the overall US energy supply, it could well have an outsize effect on the economics of utilities—and therefore on the industry's structure and future (Exhibit 2).

That's already happening in Europe. Over the last several years, the demand for power has fallen while the supply of renewables (including solar) has risen, driven down power prices, and depressed the penetration of conventional power sources. US utilities can learn many lessons from their European counterparts, which for the most part stood by while smaller, more nimble players led the way. Each US utility will have to manage the risks of solar differently. All of them, however, will have to do something.

Broader management implications

As solar becomes more economic, it will create new battlegrounds for business and new opportunities for consumers. When a solar panel goes up on a homeowner's roof, the installer instantly develops a potentially sticky relationship with that customer. Since the solar installation often puts money in the homeowner's pocket from day one, it is a relationship that can generate goodwill. But, most important, since solar panels are long-lived assets, often with power-purchase agreements lasting 15 or 20 years, the relationship also should be enduring.

That combination may make solar installers natural focal points for the provision of many products and services, from security systems to mortgages to data storage, thermostats, smoke detectors, energy-information services, and other in-home products. As a result, companies in a wide range of industries may benefit from innovative partnerships built on the deep customer relationships that solar players are likely to own. Tesla Motors already has a relationship with SolarCity, for example, to develop battery storage coupled with solar. It is easy to imagine future relationships between many other complementary players. These possibilities suggest a broader point: the solar story is no longer just about technology and regulation. Rather, business-model innovation and strong management practices will play an increasingly important role in the sector's evolution and in the way it engages with a range of players from other industries. Segmenting customers, refining pricing strategies, driving down costs, and optimizing channel relationships all will figure prominently in the solar-energy ecosystem, as they do elsewhere.

As solar becomes integrated with energy-efficiency solutions, data analytics, and other technologies (such as storage), it will become an increasingly important element in the next generation of resource-related services and of the world's coming resource revolution. In the not too distant future, a growing number of industries will have to take note of the promise, and sometimes the threat, of solar to business models based on traditional energy economics. But, in the meantime, the battle for the customer is taking place today, with long-term ramifications for existing industry structures. ■

[1] Based on the 90th percentile of 2012–13 installed costs in California, as reported to the California Solar Initiative.
[2] Both solar photovoltaic and concentrated solar power are included in the Saudi government's request for proposals.

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