

ISSUE 64 AUTUMN 2011

Renewable Energy at a Crossroads

The wind, solar, biomass, and geothermal sector has grown in fits and starts — and now may have the momentum to become a self-sustaining industry.

BY CHRISTOPHER DANN, SARTAZ AHMED,
AND OWEN WARD



Renewable Energy at a Crossroads

The wind, solar, biomass, and geothermal sector has grown in fits and starts — and now may have the momentum to become a self-sustaining industry.

by Christopher Dann, Sartaz Ahmed, and Owen Ward

In 2007, renewable energy sources were poised for accelerated growth. Then the global economic downturn intervened, depressing energy demand in general and casting particular doubt on the business case for wind, solar, biomass, and geothermal energy. Now that the sector is beginning to grow again, some industry observers are still questioning whether the market is resilient enough to continue that growth, considering the volatility of energy prices and a shifting political climate. The answer is more optimistic than one might expect, because the market has evolved in several important ways during the last

few years; it is unlikely to experience the periods of decline or stagnation we have seen in the past. One of the hallmarks of the renewables sector today is its structural diversity in terms of technologies, players, and geographic regions — and that will make all the difference.

The story of the new wave of renewables begins in 2005, when a number of diverse factors came together. The first was an incentive for change: Power prices jumped as natural gas prices reached a historical high. The second was an opportunity: Technology advances led to significant reductions in renewable energy costs. Finally, the investment community, flush with capital, began to invest in the sector in earnest.

But by far the biggest driver be-

hind the growth of renewables during this time was meaningful policy support, at both federal and state levels in the United States, and also around the world. With a focus on fighting climate change and jump-starting new industries, legislators adopted a wide range of incentive mechanisms to support the development and adoption of renewable energy technologies.

Recognizing a favorable investment environment, private equity and venture capital firms committed more and more money to the cleantech sector, which is heavy in renewables, between 2006 and 2008. At the peak, these investments exceeded US\$10 billion per year in North America alone. Then the global financial crisis hit.

Boom to Bust to Balance

During the first year of the crisis, pessimism about the sector returned. Many of the underlying factors that had converged to drive demand for renewables faded, and others became highly uncertain. For example, one of the key elements supporting the business case for renewables was the high price of electric power, which in turn was anchored to high natural gas prices. That dynamic shifted with the development of unconventional gas resources; most analysts forecast that natural gas prices will remain below \$7 per million BTUs for the foreseeable future.

The worsening economic conditions have also brought a shift in political priorities, one that favors budgetary restraint over fresh spending on environmental issues. Some federal subsidies supporting renewables may be sacrificed in forthcoming cutbacks. State and local support could likewise fall prey to state budget reductions.

The economic slowdown also caused overall electricity demand to decline, resulting in overcapacity in most U.S. power markets. Less generation translated into lower power prices, which weaken the business case for renewables.

Yet despite this uncertainty, the market continued to evolve in important ways, setting the stage for

high-level technology categories such as wind, biomass, and geothermal to the subsectors underpinning them. For instance, the proliferation of different solar technologies such as thermal and photovoltaic (PV) — and the further subsets of thin-film and crystalline silicon — helps to ensure that product characteristics meet the targeted needs of different

nies will continue to vertically integrate, setting themselves up to deliver further cost reductions through both innovation and investments.

- **Geographic diversity.** Renewable energy generation is no longer confined to certain regions around the world, and its new geographic reach has positive implications for political support and implementation. For example, in the U.S. six years ago, just two markets — the western and southeastern regions — accounted for more than 55 percent of the nation's renewable energy generation capacity. Their share is now down to about 40 percent; other regions have grown at a faster clip. Several states with comparatively little sunlight — Massachusetts, New Jersey, and Oregon — have seen significant growth in PV installations thanks to generous state subsidies.

Renewable energy generation and supporting industries have become an integral part of local economies. In the industrialized world, with few other industries in growth mode, local governments are beginning to see renewables as a source of opportunity. In the U.S., local politicians and economic development officials in such locations as Florida and Arizona have extended a range of tax breaks and other incentives to attract renewable energy companies.

The sector's geographic diversity has also helped it address specific technical challenges, including the intermittent nature of renewable energy sources. Distributing renewables capacity more broadly across the country helps to mitigate such variability (that is, the wind blows in different places at different times).

Too Broad to Fail

Several decades ago, the renewables landscape was relatively bare and un-

Chinese PV module manufacturers have increased their share of the global market in the last four years to more than 50 percent.

a return to economic viability and growth. This evolution took place along two broad dimensions.

- **Technological diversity.** The renewables sector is far more diversified today than it was in the early part of the 1980s, when renewable energy generation (other than from long-established hydro sources) was primarily reliant on biomass. Biomass — both wood and waste — accounted for more than 70 percent of renewable power generation installations through 2000. Although it was a convenient and economical source of power in areas like California and the northeastern United States, biomass demonstrated limited potential for either rapid technological improvements or large-scale capacity development. Wind and solar technologies, meanwhile, were in their embryonic stage.

Today, the renewable energy portfolio in most countries is much more balanced, in large part thanks to wind and solar, which have grown substantially over the last decade. The diversity extends beyond the

customers (for example, utility versus residential).

This technological diversity allows local governments and businesses to mix and match sources of renewable energy. Consider the case of wind power, the most widespread renewables technology. Having already benefited from \$3 billion spent on R&D globally over the past decade, it may have reached the point of diminishing investment returns. Still, the slowdown has led to an estimated 30 percent overcapacity, which will result in lower equipment costs and thus help sustain steady growth in wind installations.

Meanwhile, the impact of Chinese PV module manufacturers cannot be overstated. These manufacturers have increased their share of the global market in the last four years to more than 50 percent. Today, the top 10 Chinese PV module manufacturers have six times the manufacturing capacity of the top 10 U.S. module manufacturers. Building on their strong position in the module segment, these compa-

complicated; today, a diverse range of new constituents have joined with industry veterans to form a strong ecosystem of developers, suppliers, customers, financiers, and others. The emergence of this ecosystem, which accelerated during the recent boom, has brought needed innovation and capabilities to the industry, and helped to reduce its reliance on government subsidies.

We segment the new players into three categories: those that primarily improve technology, those that improve project economics, and those that improve commercialization and marketing.

- **Entrants improving technology.** In recent years, market entrants from other, established industries have brought new technologies into the renewables industry, which has helped lower installed costs and improve efficiency. Nowhere is this more evident than in the solar market. General Electric Company is reentering the solar playing field, directly taking on market leader First Solar Inc. Boeing Company is applying technology first developed in its

Christopher Dann

christopher.dann@booz.com

is a partner with Booz & Company based in San Francisco. He specializes in developing strategy, assessing risk, and facilitating decision making for clients in the U.S. power, gas, and renewable energy industries.

Sartaz Ahmed

sartaz.ahmed@booz.com

is a principal with Booz & Company based in Washington, D.C. She specializes in developing strategy for clients in the energy and infrastructure sectors.

Owen Ward

owen.ward@booz.com

is a senior associate with Booz & Company based in New York. He specializes in assessing markets, investment decisions, and risks for clients in the power generation, renewable energy, and nuclear energy industries.

satellite business to achieve potentially record-breaking efficiencies for solar panels.

Technology firms are increasingly integrating downstream on the renewables value chain. For example, leading Chinese solar PV wafer and cell manufacturers, such as ReneSola and JA Solar, have expanded their businesses to include module assembly, a critical link in the value chain with low barriers to entry. Further downstream, Sharp and First Solar, manufacturers of solar panels and modules, have acquired large solar project developers over the last two years.

- **Entrants improving project economics.** The renewables sector has experienced dramatic growth in the number of project developers, financial players, and other intermediaries in recent years, and this trend has been one of the most critical factors behind the recent boom.

Large international merchants looking for geographic diversification and small startups with hopes of landing their first customers are among the bevy of project developers that have flooded the renewables sector over the past several years. Their participation has helped to identify the most attractive sites and to secure financing, creating a steady pipeline of renewables installations with great potential. Significant competition among developers has helped maintain pricing discipline in power purchase agreements. Companies such as SolarCity have also helped stoke latent residential demand by leasing solar PV systems for home installations, thereby addressing potential customers' concerns about financing the expensive systems and managing their maintenance. Although consolidation is likely to occur in the coming years,

the robust developer market has already provided a strong foundation on which the industry can continue to grow.

Meanwhile, in recent years a number of firms have begun specializing in renewables financing, while tax equity partners have become increasingly involved; these solutions have offered innovative approaches to overcoming the limitations of existing financial incentives. Infrastructure funds joined them by adding renewables positions for long-term steady cash flows, a strategy they will likely continue.

Intermediaries such as renewable energy credit (REC) brokers and green power marketers have provided additional channels to improve project economics. The creation of companies such as Sterling Planet and Green Mountain Energy, which certify and market low-carbon-footprint electricity to residential and business customers, has enabled project developers to secure incremental sources of revenue to achieve positive net present value (NPV).

Going forward, the continued growth of smart grid companies and energy storage providers will play a critical role in enabling the next wave of renewables development. Successful development of economical energy storage technologies would solve many of the intermittence challenges faced by wind and solar, improving project economics. Meanwhile, the widespread adoption of smart meters and variable pricing will make solar power more attractive, given that its greatest output is during the day, when demand is at its peak.

In addition, investor-owned utilities will likely begin to diversify upstream into new parts of the re-

renewables value chain. Companies such as Duke Energy and Exelon have already acquired large asset-ownership and development positions. Utilities that build and own the renewable energy generation and transmission infrastructure, as opposed to simply acquiring energy through power purchase agreements, will have more balance sheet flexibility than smaller renewables financial players to build the new transmission lines required to bring renewable power from remote areas to load centers.

- **Entrants improving commercialization and marketing.** The introduction of new and innovative business models — particularly those that address the technology's sometimes steep up-front costs — will likely decide the pace at which renewables are deployed in the marketplace. In the U.S., one of the most important drivers of growth in commercial solar installations was the introduction of long-term, fixed-price contracts for electricity. The SunPower Corporation, a solar

segments will have different wants and needs, but the most successful offerings are likely to include quick and economical installations, predictable power prices with no up-front investment, and more elegant designs. A number of companies are already engaged in sophisticated commercialization and marketing; additional business model innovation will no doubt occur as the renewables market matures.

Application Diversity

Any one of these forces would have led to some change in the industry. Together, they are pushing it past the tipping point to large-scale viability. Gone are the days when solar PV panels were considered only for small rooftop systems. Renewables technologies have broadened in scope to the point at which they can be accepted as contributors to any regional energy mix.

At the same time, renewables are finding a home at a micro scale — with some macro effect. Consumer goods, such as briefcases with solar

to substantially alter the military's dependence on fossil fuels.

PV modules could also bring electricity to many in emerging economies, where the grid is underdeveloped and consumer electronics such as mobile phones have leapfrogged the infrastructure built for them.

Much work remains to make these markets commercially viable for PV applications, but all have the potential to drive disruptive change. One day, these new markets could dwarf the traditional rooftop solar-panel market.

A New Level of Scrutiny

Renewables have been a hotbed of activity in the past decade, and the evolving entrepreneurial environment continues to present opportunities for investment.

However, given the uncertainty and complexity in the renewables marketplace, investment decisions are now much more difficult, requiring decision-making skills and tools that were not essential before the economic downturn. Going forward, investment decisions will need to explicitly address uncertainty through effective risk management and contingency planning.

For utilities, renewables are not viable baseload technologies. Even as a complementary energy source, they carry costs that make them uncompetitive without subsidies. Power source decisions will therefore depend largely on local conditions, including the presence of renewable energy mandates, government incentives, and site availability. Here too, the array of incentives and technologies will make comprehensive business case planning and risk analysis imperative. Many utilities are more accustomed to man-

Gone are the days when solar PV panels were considered only for small rooftop systems.

technology manufacturer, and other companies have introduced new pricing structures whereby they install solar panels on customer rooftops and charge monthly fees, similar to a lease arrangement, rather than requiring the customer to incur large, up-front capital expenditures.

Similar approaches will be needed if the sector is to fully tap the potential of the residential and small commercial market. Different

power chargers for mobile phones, are expected to spur a compound annual growth rate of 30 percent in the \$300 million market for flexible thin-film PV modules.

The military is another likely channel for future growth. The energy demands of the military are considerable: Every gallon of fuel that reaches Afghanistan from the U.S. requires six more gallons to get it there. Solar PVs have the potential

aging older generation assets and will need to consider new operating models and program management capabilities.

Meanwhile, for large energy users, rooftop solar PV remains the only alternative to the grid. Although historically it has been the most expensive renewables option, PV costs are falling, in part because a growing number of installers are willing to take on the investment risk. In locales with sufficient tax and other incentives (for example, those offered by the California Solar Initiative), investments are NPV positive. Still, users need to be cognizant of ongoing technological, regulatory, and political risks that may shift the economics against them.

Furthermore, it will be critical for companies to develop the capabilities needed to both evaluate and add value to the assets and technologies that are likely to reenter the market in the months and years ahead. The relatively favorable investment climate of the past decade attracted a number of companies that ultimately lacked the expertise to endure and win in today's more difficult investment environment. For example, a number of small utilities and other companies made subscale investments in renewables where they could add little value, and they may soon be forced to divest those assets. The companies that can pick up the assets and position them to create a sustained competitive advantage will be the ones that establish the right to win in this market. Clear industry leaders are already starting to emerge, but plenty of opportunity remains for those with the vision and the capabilities to power the next move forward in global energy markets. +

strategy+business magazine
is published by PwC Strategy& Inc.
To subscribe, visit strategy-business.com
or call 1-855-869-4862.

For more information about Strategy&,
visit www.strategyand.pwc.com

- strategy-business.com
 - facebook.com/strategybusiness
 - <http://twitter.com/stratandbiz>
- 101 Park Ave., 18th Floor, New York, NY 10178



strategy&
Formerly Booz & Company

Articles published in *strategy+business* do not necessarily represent the views of PwC Strategy& Inc. or any other member firm of the PwC network. Reviews and mentions of publications, products, or services do not constitute endorsement or recommendation for purchase.

© 2011 PwC. All rights reserved. PwC refers to the PwC network and/or one or more of its member firms, each of which is a separate legal entity. Please see www.pwc.com/structure for further details.