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Renewables at a Crossroads



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EXECUTIVE SUMMARY

The global economic downturn has cast at least a measure of doubt on the business case for renewable energy technologies, leaving some industry observers to point to previous periods of renewables growth in questioning whether the market is resilient enough this time to withstand volatile energy prices and a shifting political climate. Yet, despite this uncertainty, the market has evolved in important ways, setting the stage for it to maintain its economic viability and continue to grow. One of the hallmarks of the renewables sector today is its structural diversity in terms of the technologies, players, and geographic regions involved in its growth.

For that growth to continue, companies and investors participating in the sector will need to explicitly address uncertainty through effective risk management and contingency planning. In many cases, even those investments with promising near-term prospects will need to be evaluated on the basis of their ability to adapt to future fluctuations in demand. The relatively favorable investment climate of the past decade attracted a bevy of companies that lacked the expertise to build and sustain a competitive advantage. With industry consolidation now on the horizon, those that survive will be the ones that develop the strategic and operational capabilities required to capture value and manage regulatory and market risk.

KEY HIGHLIGHTS

- The renewables sector is far more technologically diversified today than in prior periods, stimulating innovation and competition and helping to ensure that product characteristics meet the targeted needs of different customers.
- The geographic reach of renewables is no longer confined to certain regions within the U.S., strengthening the sector's contributions to local economies and extending the base of its political support.
- The renewables sector has attracted a range of new entrants that have joined with industry veterans to form a strong "ecosystem" that is focused on technology advances, improved project economics, and commercialization successes.
- The current state of oversupply has depressed certain renewable asset prices, creating opportunities for acquirers with strong project development and management expertise.
- Targeting technology companies in the higher-margin segments of the renewables value chain and investing in emerging technologies promising dramatic cost reductions are two high-risk, high-reward options.

THE RENEWABLES BOOM

Beginning in 2005, a number of diverse factors came together to accelerate the growth of new renewable energy generation in the United States (*see Exhibit 1*). Power prices jumped as natural gas prices reached a historical high, technology advances led to significant reductions in renewable energy costs, and the investment community began to invest in the sector in earnest.

But by far the biggest driver behind the growth of renewables during this time was meaningful policy support, at both the federal and state levels. 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. These mechanisms included the renewable portfolio standard (RPS), renewable energy credit (REC), feed-in tariff (FIT), investment tax credit (ITC), and production tax credit (PTC), along with various cash grants.

Renewable Portfolio Standard

More than 30 U.S. states have enacted renewable portfolio standards, which mandate the use

of renewable power for a certain percentage of retail electricity sales and are largely seen as the most effective policy approach to supporting the growth of renewable energy. Though each state implements its own timing, targets, and compliance, most states start with moderate targets that, in some cases, reflect existing renewable generation capacities. However, in almost all cases, the targets for 2015 and beyond are well above 2005 levels, and as a result, they have stimulated much investment and planning. Wind power, the least expensive renewable power source, has been the dominant choice of most states to date, but technology-specific set-asides have also helped to stimulate investments in higher-cost solar and geothermal technologies.

Renewable Energy Credit

REC trading programs are now established in most states that have RPS obligations to provide electricity suppliers with flexibility in complying with the mandate. RECs are tied to generating units and can be sold along with or separately from the underlying power generation to third parties that, in turn, can redeem them with regulators to satisfy RPS requirements. These markets are typically state-specific, vary in their setup, and are still in their infancy. However, the arbitrage opportunities in the REC markets have been critical in attracting private-sector investors, as they have incentivized investors to bundle RECs acquired from single providers and sell them at a premium

to companies that need to satisfy RPS obligations. Some states have also set REC prices for specific generation technologies (such as solar RECs, or SRECs) to help provide cash flow certainty to investors and secure financing (see “New Jersey’s SREC Success,” page 6).

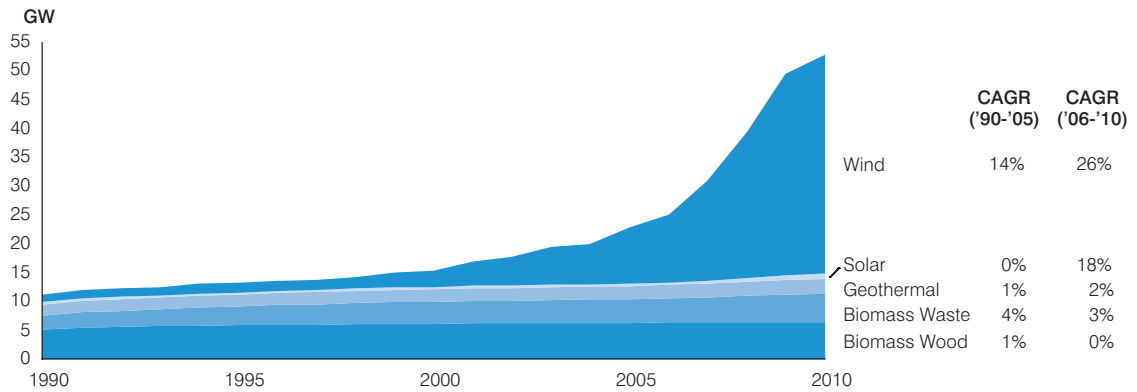
Feed-In Tariff

Feed-in tariffs, which establish a guaranteed price for the generation output over a set period (typically 10 to 15 years), are also selectively employed by state and local governments as a way to encourage utilities and developers to invest in new renewable energy capacity.

As with RPS mandates, FIT commitments vary significantly across states and tend to favor certain technologies. Consequently, in combination with regional wholesale power price variation, returns vary widely across technologies and states (see Exhibit 2).

Exhibit 1
Renewables Ramp Up

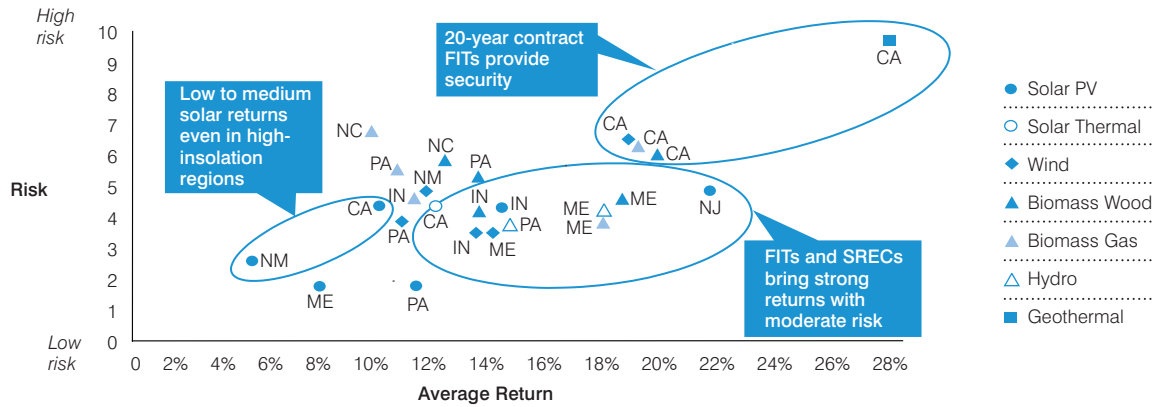
RENEWABLES MIX
(U.S. NAMEPLATE CAPACITY, IN GIGAWATTS)



Note: Includes only plants currently in operation.
Source: SNL Financial

Exhibit 2
Returns Run the Gamut

RISK VS. RETURN
(UNLEVERED INTERNAL RATE OF RETURN, SELECTED STATES AND TECHNOLOGIES)



Notes: Risk is determined by the difference between the p10 and p90 values. Average return is the p50 value.
Source: Booz & Company Generation Technology Returns and LCOE model

Investment Tax Credit and Production Tax Credit

Beyond state-level incentives, federal investment and production tax credits have been on-and-off components of American energy policy since well before 2005, subject to extensions by Congress. Despite uncertainty about their longevity, both programs have played a crucial role in the development of the renewables sector. ITCs have been favored by solar photovoltaic (PV) manufacturers and other industry participants considering investments with high capital costs (relative to recurring costs). PTCs effectively guarantee a

“fee” in the form of a tax credit for every unit of electricity produced (see Exhibit 3). As such, they are a better fit for the wind energy industry, due to the technology’s lower up-front costs and greater potential to generate ongoing cash flows from producing power.

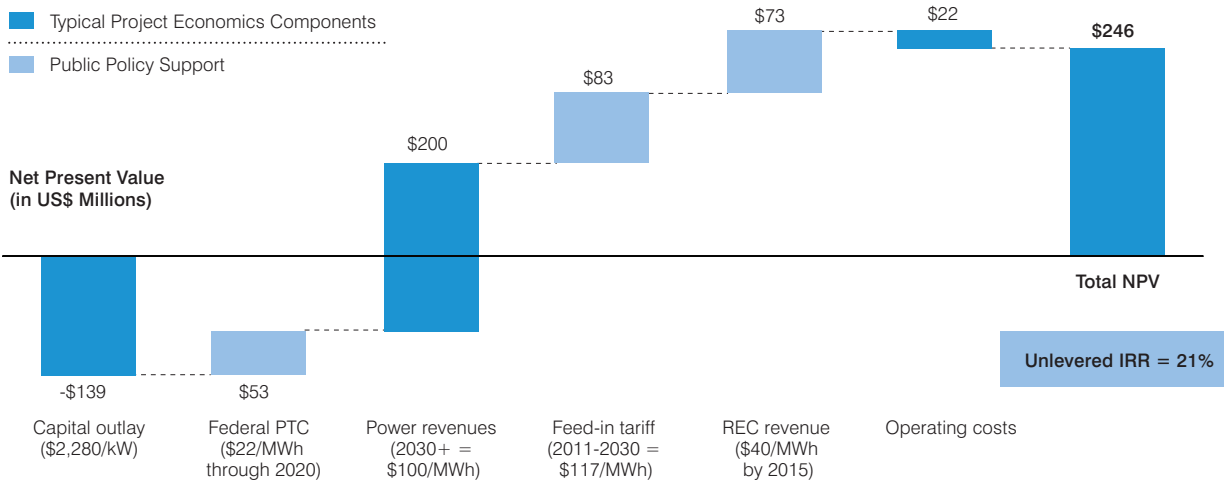
During the global economic downturn, participation in both programs was limited, since the tax credit benefits are not immediate and require reliable positive cash flows for offsetting the credits. However, this limitation (from investors’ perspective) was addressed by the

American Recovery and Reinvestment Act of 2009, which temporarily allowed cash grants in place of the tax credits. This change, which was recently extended for another year, helped stimulate solar PV investment in 2010. The Recovery Act also renewed the PTC program through the end of 2013 (2012 for wind), helping to further strengthen the business case for wind and biomass investments.

While these policies have worked in tandem to help increase demand for renewables and create a market, the sector has benefited

Exhibit 3
Project Returns Buoyed by Incentives

PROJECT ECONOMICS (EXAMPLE: 100-MEGAWATT WIND PLANT IN CALIFORNIA)



Notes: Capital outlay is net of depreciation tax shield. Feed-in tariff is incremental revenue relative to power revenues; 20-year contract. As proposed, feed-in tariff program in California has not been finalized. RECs are eligible through 2025. Numbers might not add up due to rounding.
Source: Booz & Company Renewables LCOE and IRR model

on the supply side from scale and technology advancements, which have reduced the cost for a wide array of renewables technologies and made them more competitive with established generation options.

Of all renewables, solar PV has arguably benefited the most in the past couple of years from scale and technology advancements. Solar PV costs have decreased for both thin-film and crystalline silicon technology. Through a combination of technology advancements, assembly automation, and other advantages of scale, U.S. company

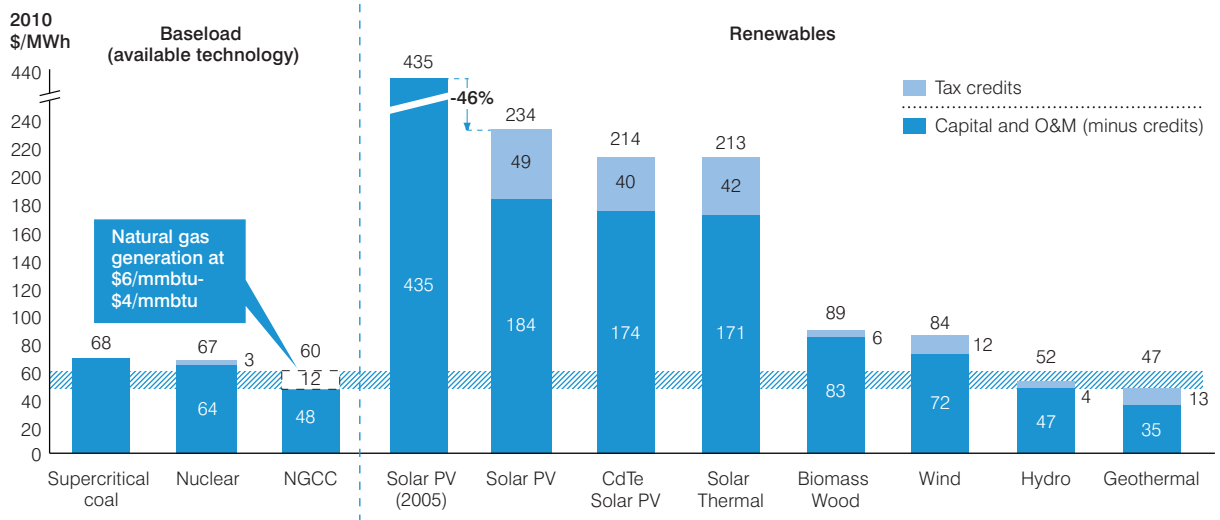
First Solar has driven significant reductions in one thin-film technology in particular—cadmium telluride (CdTe)—which has witnessed a 74 percent reduction (more than US\$2 per watt) in module cost since 2004. This dramatic decline has made the less efficient CdTe technology a viable large-scale solution for commercial and utility customers. At the same time, the more established crystalline silicon technology—preferred by residential customers with limited roof space—has benefited from advances in manufacturing processes and a shift in manufacturing capacity to lower-

cost China. These developments have helped cut crystalline silicon module costs by 45 percent, or more than \$1 per watt, since 2008.

Though cost reductions have been less immediate and dramatic for other renewables technologies, the overall trend has been quite favorable. New wind installations, for instance, today enjoy a levelized cost of electricity (LCOE) net of tax credits that is roughly on par with supercritical coal and nuclear, even in the absence of a price on carbon emissions (*see Exhibit 4*).

Exhibit 4
Closing the Gap with Traditional Generation Technologies

GENERATION COST
(INDICATIVE LEVELIZED COSTS BY TECHNOLOGY)



Notes: \$2/mmBtu coal; \$25/ton CO₂ starting in 2020; \$5,060/kW nuclear capital cost; \$4,200/kW solar PV capital cost. Renewables exclude backup power requirements. Numbers might not add up due to rounding.
Source: MIT; Energy Information Administration; Lawrence Berkeley National Laboratory; Office of Energy Efficiency and Renewable Energy; industry reports and company filings; Booz & Company analysis

Recognizing a favorable investment environment, private equity and venture capital firms committed more and more money to the renewables-heavy cleantech sector between 2006 and 2008, exceeding \$10 billion at the peak in North America alone. These investors were assured that predictable revenue streams from policy mechanisms such as feed-in tariffs and long-term purchase agreements would help outweigh the technology risk. Investments were also influenced to some degree by a fear of missing out on the “next big thing,” creating a herd mentality in the market—at least before the global financial crisis hit.

New Jersey's SREC Success

New Jersey arguably has the nation's most generous SREC mechanism, which helped the state achieve a 13-fold expansion in its solar PV capacity from 2005 to 2009, one of the highest increases in the country. New Jersey's SREC prices have increased from \$250 per megawatt hour in mid-2008 to well above \$600 today. Throughout much of 2010, the SREC price in New Jersey was more than 10 times the regional wholesale power price and roughly double the SREC price in other states. This price is supported by relatively high set-asides for solar power in the state's RPS and alternative compliance payment, along with several unique measures to incentivize project financing. The SREC, in combination with investment tax credits and accelerated depreciation, can enable a utility-scale solar plant to earn a 20 to 25 percent internal rate of return.

Private equity and venture capital firms committed more than \$10 billion in North America alone to the renewables-heavy cleantech sector between 2006 and 2008.

FROM BOOM TO BRAKES

In the wake of the crisis, many of the underlying factors that converged to drive demand for renewables have faded, and others remain highly uncertain.

One of the key elements supporting the business case for renewables has been high power prices anchored to high natural gas prices. That dynamic has shifted, now that natural gas prices have retreated due to the economic slowdown and the development of unconventional gas resources; most analysts forecast that natural gas prices will remain below \$6 to \$7 per million British thermal units for the foreseeable future. As such, renewables are likely to face stiff competition from natural

gas generation in markets without revenue-setting FITs.

The worsening economic conditions have also brought a shift in political priorities, favoring budgetary restraint over fresh spending on environmental issues, and some federal subsidies supporting renewables may be sacrificed as a result. The Democrat-controlled lame-duck Congress of December 2010 was able to secure a one-year extension to the ITC cash grant, but a Republican-dominated House of Representatives will likely be far less supportive of such fiscal expansions. While project developers may speed up their plans again this year, fearing a potential lapse of federal

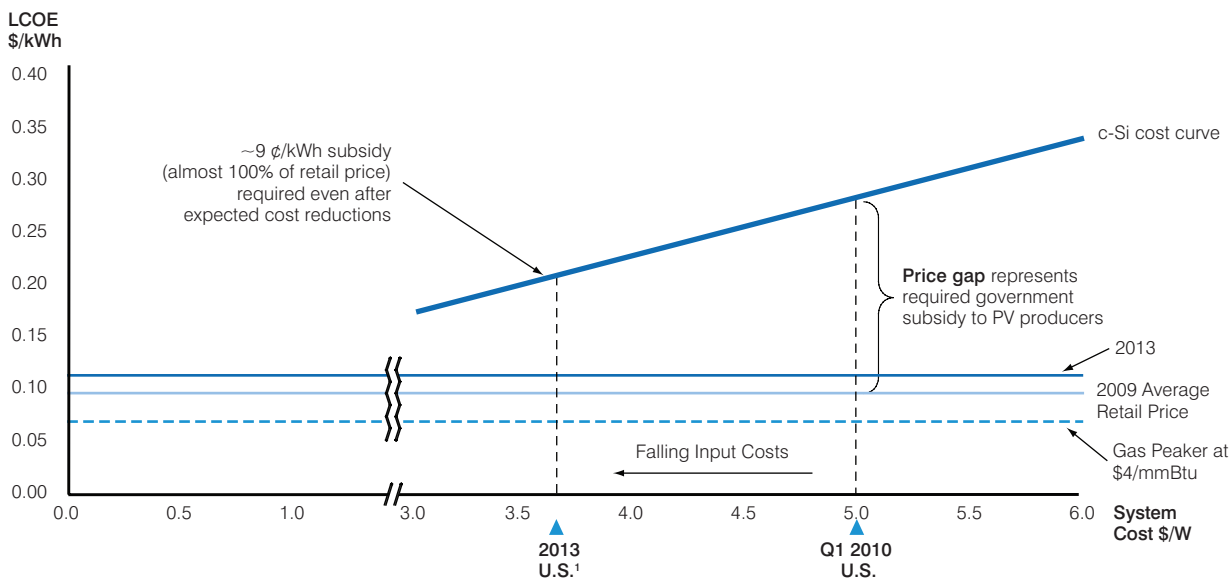
subsidies, renewables investment prospects would certainly dampen if the cash grants or tax credits expire. The same pattern could occur at the

state and local levels, where support for long-term FIT and REC contracts could fall prey to state budget cuts. Even with projected system cost

reductions, solar PV will continue to rely on significant public subsidies—nearly 100 percent of retail rates in 2013 (see Exhibit 5). In this

Exhibit 5
Solar PV Subsidy Requirements

**SOLAR PV ELECTRICITY COST
(LEVELIZED FOR TOTAL SYSTEM)**



Notes: U.S. average retail price from EIA; predicted cost derived from weighted average of global predicted 2013 cost (Lux Research). Projected 2013 system cost based on global PV production cost forecast (Lux Research) adjusted for U.S. market.
Source: Lux Research; Deutsche Bank; SolarBuzz Quarterly update; EU Energy Portal; Energy Information Administration; Booz & Company analysis

environment, a domestic federal cap-and-trade regime, which would have put a price on carbon emissions and improved the competitiveness of renewables, is likely off the table for the foreseeable future.

Another potential headwind is the amount of wiggle room that states built into their RPS laws. State RPSs remain one of the key drivers for renewables, but there is sufficient flexibility in the requirements to dial back the mandates, meaning renewables capacity may fall well short of the stated goals. Most RPSs have clauses allowing the

requirements to be relaxed if the price impact on customers is deemed too severe. Seven states have explicitly capped incremental rate impacts at or below just 2 percent. Other states have limits on customer bill increases, force majeure mechanisms, or rigorous approval requirements for annual procurements. Furthermore, the rate impact caps are often vaguely worded, leaving regulators significant flexibility. For instance, they do not always specify the time period for which the percentage increase threshold applies. There is also the question of how strictly

states will enforce financial penalties for noncompliance.

Beyond its impact on the specific drivers listed above, the economic slowdown has also caused overall electricity demand to decline, resulting in overcapacity in most U.S. power markets. This “demand destruction” has slowed renewables development in the absence of FITs. Less generation translates into lower power prices, which weaken the business case for renewables, and there is little reason to add new capacity when the market is oversupplied.

“Demand destruction” resulting from the economic downturn has slowed renewables development in the absence of FITs.

TOO BROAD TO FAIL

Some industry observers point to previous periods of renewables growth—such as the mid-1980s—in questioning whether anything has really changed to ensure the market’s resilience in the face of volatile energy prices and changing politics.

Yet, despite this uncertainty, we believe the market has evolved in important ways, setting the stage for it to maintain its economic viability and continue to grow. One of the hallmarks of the renewables sector today is its structural diversity along several dimensions.

Technological Diversity

The renewables sector is far more diversified today than it was in the early part of the 1980s, when non-hydro renewable generation was primarily reliant on biomass (*see Exhibit 1*). Biomass—both wood and waste—accounted for more than 70 percent of renewable installations through 2000. Though a convenient and economical source of power in areas like California and the

Northeast, biomass demonstrated limited potential for either rapid technological improvements or large-scale capacity development. Meanwhile, wind and solar technologies were in their embryonic stage. Consequently, the political commitment to renewables as a viable alternative to fossil fuels was weak, particularly as the supply of oil and natural gas increased and prices fell.

Today, the renewable generation portfolio in the U.S. is much more balanced, in large part thanks to wind and solar, which have grown substantially over the last decade. Diversity extends beyond the 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 PV—and the even further subsets of thin-film and crystalline silicon—helps to ensure that product characteristics meet the targeted needs of different customers (for example, utility versus residential). This technological diversity carries a number of key benefits:

- Regions often have expanded flexibility to meet renewable generation goals by leveraging

technology alternatives that were previously unavailable.

- Intermittent renewables technologies can complement one another to help smooth output variations and better match supply with demand.
- Proliferation of different technologies enhances intra-renewable competition, thereby stimulating innovation and encouraging continuous cost improvements.

To this last point, other opportunities may still exist to bring down the cost of renewables technologies and help them compete with traditional generation sources.

Wind: Wind power, the most widespread renewables technology, has already benefited from \$3 billion in R&D spending over the past decade, and the technology may have reached the point of diminishing returns. Still, the slowdown has led to an estimated 30 percent overcapacity, which should lead to lower equipment cost and thus help sustain steady growth in wind installations.

Solar—CSP: Concentrating solar power (CSP) is a mature but reemerging renewables technology

The renewables market has evolved in important ways, setting the stage for it to maintain its economic viability and continue to grow.

that exhibits strong growth potential for the next five years. CSP plants have been operating in California's Mojave Desert for nearly 30 years, and despite the introduction of some new technologies (such as the power tower), most plants are expected to feature the mature parabolic trough technology. As such, most technological breakthroughs to bring down the cost have already occurred. Despite this, the technology may build enough momentum to scale up component manufacturing and reduce costs if CSP projects continue to perform well in places such as California and Spain and installations increase.

Solar—Crystalline Silicon: Despite significant progress on the cost front in recent years, solar PV remains the highest-cost renewables technology and holds the greatest potential for further cost reductions. In crystalline silicon, there remain several levers for further reductions across the value chain, including consolidation, scale, and increased competition. Here, the impact of the rise of Chinese PV module manufacturers cannot be overstated. These manufacturers have increased their share of the market in the last four years to more than 50 percent. Today, the top 10 Chinese PV module manufacturers combined have six times the manufacturing capacity of the top 10 U.S. module manufacturers combined. Building on their strong position in the

module segment, these companies will continue to integrate forward and backward, setting themselves up to deliver further cost reductions through both innovation and investments.

Solar—Thin Film: Beyond pursuing scale economies, an array of thin-film competitors are testing alternative designs and materials that promise to reduce the technology's cost per watt or increase cell efficiencies. Though unlikely in the immediate future, a breakthrough development related to manufacturing costs, material costs, or cell efficiency could reduce costs on the order of First Solar's experience with CdTe or that of the Chinese crystalline silicon module manufacturers.

Biomass: Wood combustion, the predominant biomass generation technology, is well established and thus unlikely to experience a breakthrough that would reduce costs. The availability of moderately priced feedstock for a proven renewables technology option has attracted significant investment in potential new biomass wood projects. However, prospects for completion and sustained growth hinge on public support and regulatory treatment. Specifically, uncertainty over the carbon neutrality of burning wood, along with concerns about forest sustainability and health

implications, has triggered national- and state-level debates about the technology's eligibility for RPS compliance. The Environmental Protection Agency's recent ruling to include biomass combustion in greenhouse gas permit requirements is at least a temporary setback for biomass wood's prospects. As regulatory and political developments continue to hang over biomass wood's future, attention may shift to less controversial technologies that convert waste to energy.

Geographic Diversity

Renewable generation is no longer confined to certain regions of the U.S., and its new geographic reach has positive implications for political support and implementation.

Six years ago, just two markets—the Western Electricity Coordinating Council (WECC) and the SERC Reliability Corporation—accounted for more than 55 percent of the nation's renewable generation capacity. The establishment of RPS mandates in more than 30 states has dropped their share to about 40 percent as other regions have grown at a faster clip. The markets of the Electric Reliability Council of Texas (ERCOT), the ReliabilityFirst Corporation (RFC), and the Midwest Reliability Organization (MRO) were among the biggest gainers, adding a combined 23 gigawatts of wind and lifting their share of

renewables capacity from less than 10 percent apiece in 2004 to 18, 12, and 16 percent, respectively, in 2010 (see Exhibit 6).

Renewables technologies other than wind have also helped new regions of the country gain footholds. For instance, several states with relatively scant solar resources—Massachusetts, New Jersey, and Oregon—have seen significant growth in PV installations, in large part due to solar set-asides in their RPS mandates.

The development of renewable generation and supporting industries has made them an integral part of local economies in regions throughout the country. With few other industries in growth mode, local politicians and economic development officials 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

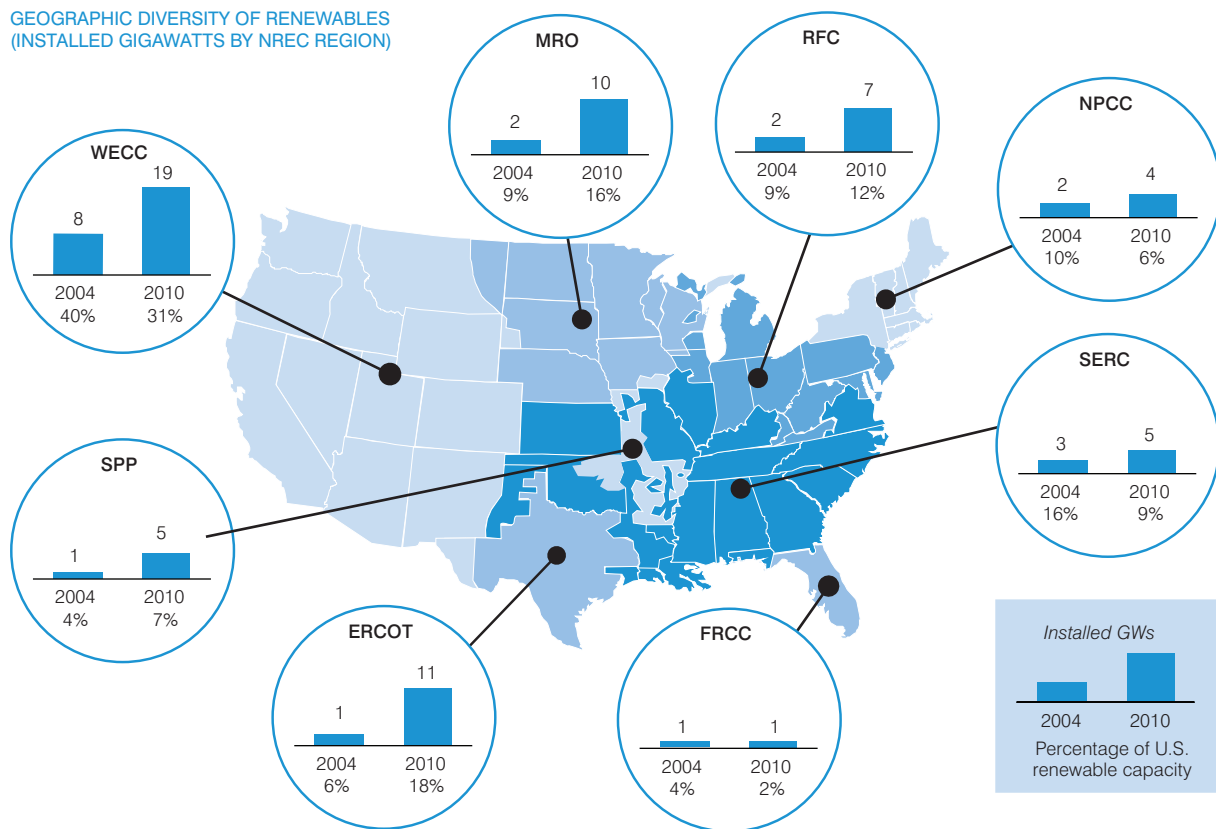
intermittent nature of renewable energy sources. Distributing renewables capacity more broadly across the country helps to mitigate such variability (that is, the wind blows in different places at different times).

Player Diversity

Compared to several decades ago, when the renewables landscape was relatively bare and uncomplicated, the sector has attracted a range of players from different industries and geographies. These new constituents

Exhibit 6
Renewables' New Geographic Spread

GEOGRAPHIC DIVERSITY OF RENEWABLES
(INSTALLED GIGAWATTS BY NREC REGION)



Notes: Excludes hydro. NREC = North American Electric Reliability Corporation. Percentages might not add up due to rounding.
Source: SNL Financial

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 subsidies alone.

For the purposes of this discussion, we segment the new players into three categories: those that 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 to lower installed costs and improve efficiency. Nowhere is this more evident than in the solar market, where several big players have joined the fray to take their own shot at capitalizing on the market’s growth. General Electric is reentering the solar battle with a new CdTe design, directly taking on market leader First Solar. Boeing is getting into the mix by applying technology first developed in its satellite business to achieve potentially record-breaking efficiencies for solar panels.

Technology firms are increasingly integrating downstream across 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 step in the value chain with low barriers to entry. Further downstream, Sharp and First Solar, manufacturers of solar panels and modules, acquired large solar project developers over the last two years to gain a dedicated sales channel in a competitive development environment and to have an integrated, end-to-end play within the solar market.

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 were among the bevy of *project developers* that flooded the U.S. market over the past several years. Their participation has helped to identify the most attractive sites and to secure financing, creating a steady pipeline of renewable installations with great potential. Significant competition among developers has helped to maintain pricing discipline in power purchase agreements. Companies such as

SolarCity have also helped to 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. Though 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.

The entry of a diverse group of *financial players* provided the funding the industry needed to establish its footing and identify avenues to cut capital and installed project costs. In recent years, a number of firms began specializing in renewables financing, while tax equity partners became 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 trend that will likely continue.

Intermediaries such as *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 has enabled project developers to secure incremental sources of revenue to achieve positive net present value.

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. Similarly, 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, we expect that *investor-owned utilities* will begin to diversify upstream into new parts of the 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 generation and transmission infrastructure, as opposed to simply purchasing energy through power purchase agreements (PPAs), 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. One of the most important drivers of growth in commercial solar installations was the introduction of long-term, fixed-price contracts for electricity. SunPower 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 in the residential and small commercial market. Different segments of the market will have different wants and needs, but the features are likely to include quick and economical installations, predictable power prices with no up-front investment necessary, and more elegant designs. A number of companies are already offering more sophisticated commercialization and marketing, but more business model innovation will no doubt occur as the renewables market matures.

Application Diversity

Gone are the days when solar PV panels were considered only for small rooftop systems. Increasingly, renewables technologies are broadening in scope when it comes to their potential application.

For instance, many solar PV manufacturers remain singularly focused on megawatt-sized projects,

but some thin-film rivals are pursuing breakthroughs in off-grid applications in a range of markets.

New consumer goods—such as briefcases with solar 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: For every gallon of fuel that reaches Afghanistan, six gallons are expended getting it there. Solar PV has the potential to substantially alter the military’s dependence on fossil fuels.

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

Much work remains to make these markets commercially viable for photovoltaic applications, but all have the potential to drive disruptive change in the growth of demand for and the manufacturing supply of PV modules. One day, these new markets could dwarf the traditional rooftop market.

A NEW LEVEL OF SCRUTINY

Renewables have been a hotbed of activity in the past decade, attracting a wide variety of companies—asset developers, domestic and international utilities, technology companies, and financial companies among them. The evolving environment continues to present opportunities for investment.

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

uncertainty through effective risk management and contingency planning. For example, utilities that are looking to add renewable assets will need to take into consideration RPS mandate requirements, resource availability, regulatory treatment, subsidies, technology alternatives, technology costs, and rate impacts. In some cases, even those investments with promising near-term value will need to be evaluated on the basis of their ability to maintain downstream flexibility and adapt to future fluctuations in demand.

Furthermore, it will be critical for companies to develop the capabilities

Companies must develop the capabilities needed to evaluate and add value to the assets and technologies that are likely to reenter the market.

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 lacking the expertise to endure and win in this 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.

Renewable Asset Companies

Successful renewable asset owners share a number of qualities. They typically have location and portfolio advantages, with assets in resource-abundant geographies and the ability to combine them with other existing assets in their portfolio. In addition, they have distinct capabilities, including technology knowledge, project financing expertise, project development skills, operations and maintenance ability, and trading and marketing savvy.

These capabilities vary by type of player. For example, trading and marketing savvy is more important for unregulated players that do not have access to captive customers, particularly if they are pursuing merchant positions. Capabilities can also be complementary. Utilities and merchants with financial flexibility and operating experience, for instance, are natural partners for financially constrained developers with technology expertise.

Companies vying for ownership of renewable assets can accomplish this through one of two means: development or acquisition. Utilities,

Successful renewable asset owners typically have location and portfolio advantages, along with distinct capabilities.

merchants, and international companies typically go down the development path, either on their own or through joint ventures with pure-play developers, though in some cases, they acquire skilled “developers” to add or expand asset development capabilities. The other option is acquiring assets with PPAs from pure-play developers to mitigate development risks.

As a result, the asset development space is crowded; a wide range of companies have project pipelines in various stages of development. In solar, for instance, many technology players are forward-integrating into asset development; an example is First Solar’s recent acquisition of project development companies NextLight and OptiSolar. In addition to bringing asset development capabilities in-house, such moves help create a market for the company’s products and enable

them to capture margins in the highest-margin vertical of the value chain.

One criterion for success in asset development is the ability to secure offtake agreements such as PPAs to guarantee a future income stream. Relatively few developers currently have projects with PPAs, and there is evidence that developers have been underbidding for PPAs due to the crowded nature of the pure-play competitive space. Merchants and utilities with ambitious plans for renewables, along with forward-integrating technology companies and OEMs with deep pockets, are increasingly on the prowl for developers with established PPAs and capacity at scale.

As the industry matures, there is likely to be consolidation among companies dominating the asset development segment, including

mega-merchants, utility affiliates, and technology firms. While the best of the pure-play developers will survive, the competitive bidding environment will continue to present challenges, limiting returns to the high single digits for even the most adept developers. The capabilities that will help developers differentiate themselves from the pack will likely come from strong project development experience, including siting, and construction management. Developing and maintaining a reputable management team that is able to secure financing and offtake agreements at the right prices will also prove critical.

Given the various challenges of asset development, many industry players prefer to acquire assets as a way to build a position in renewables without taking on development risk. The current state of oversupply in many renewable energy technologies

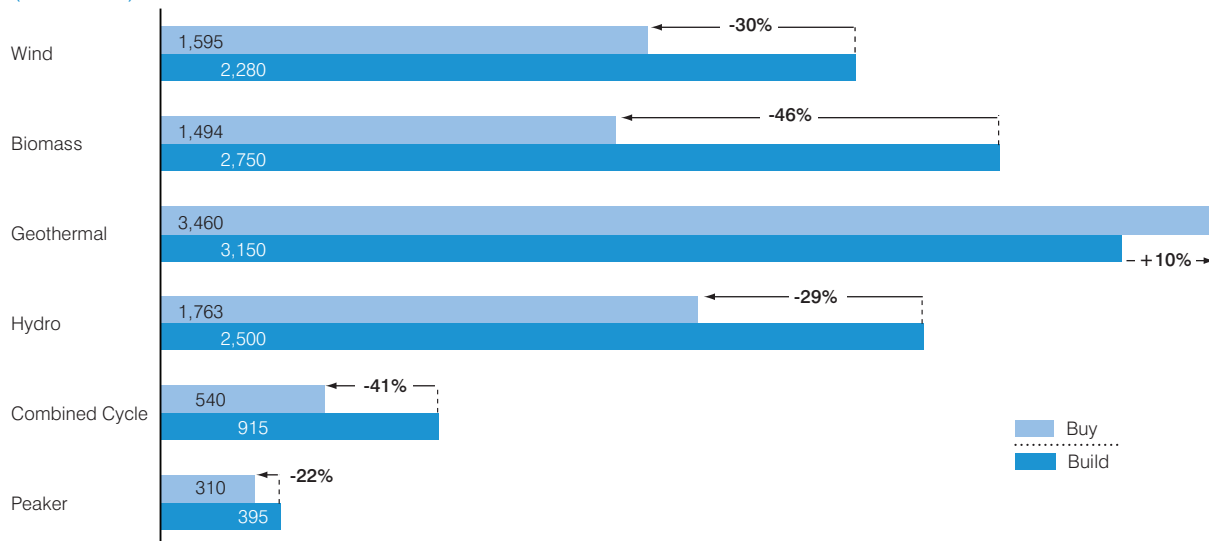
has supported this strategy, as it has pushed prices below replacement cost for many existing generation assets (see Exhibit 7). As a result, renewables transaction values have reached as low as \$1,200 per

kilowatt for certain wind generation assets—a significant discount to the levelized cost to build them. Therefore, there is a clear advantage for asset acquirers that can find undervalued assets.

However, asset prices do vary, depending on their quality and other considerations. For example, assets with secure PPAs trade at a premium, reflecting the safeguard they offer against price fluctuations.

Exhibit 7
How Development Compares with Acquisition

BUILD VS. BUY
(IN \$ PER KW)



Notes: "Build" figures based on levelized investment costs. "Buy" based on average values of transactions in 2008-2010. Biomass includes waste-to-energy only. Only one geothermal transaction in 2008. Solar data not available.
Source: SNL Financial; Barclays; Booz & Company analysis

While transaction values for wind, biomass, and solar assets have generally fallen during the recession, hydro and geothermal have continued to trade at a premium, reflecting their higher capacity factors and reduced variability.

Renewables Technology Companies

The growth of the renewables sector has also attracted an assortment of technology plays in the U.S. and across the globe. The solar PV market, for example, has recently drawn in large diversified companies such as General Electric, Hyundai, and Toshiba. At the same time, new and little-known Chinese companies have established themselves as competitors to established leaders.

Similar to renewable asset companies, technology companies face a host of regulatory and market uncertainties in deciding which technology to invest in and where to invest along the value chain. Though the long-term growth prospects are indeed promising, shifting regulatory

conditions and continuously evolving technologies will force investors to make significant bets on certain technologies, companies, or markets. For instance, they must consider which technology solutions will dominate in five years and what downstream companies will stand to benefit.

One way to help mitigate these uncertainties is by targeting companies in the manufacturing and chemical industries that are focused on the higher-margin segments of the renewables value chain. Specialized Technology Resources (STR) is one such company in the solar PV space. PV modules rely on a thin, transparent laminate—an “encapsulant” that is derived from advanced chemical processing—to protect cells from moisture, ultraviolet rays, and heat. A leading specialist in the encapsulant market, STR has maintained gross margins above 30 percent for several years.

Another potential high-risk, high-reward investment choice relates to emerging renewables technologies: A dramatic reduction in cost or a significant improvement in efficiency could displace incumbent technologies and companies. Several companies in the solar industry, including Nanosolar and MiaSolé, are aggressively investing in R&D to serve two very different markets: utility-scale power, and consumer electronics specialty products. Outside investment in a startup renewable energy company offers enormous upside potential in the best case, but the challenge is to pick the right technology and company.

Ultimately, a successful technology play will require a combination of specialty product and innovation capabilities, established positions in adjacent value chain verticals, an ability to develop a new customer base, an understanding of the renewables marketplace, and the flexibility to adapt to a dynamic market.

CONCLUSION

Given the more challenging renewables market and political environment, now is the time for companies and investors to take a hard look at their capabilities to ensure that they are sufficient to create a sustained competitive advantage. Truth be told, many companies currently participating in the market do not meet this test and will likely exit the market in the coming years. Those that survive will need to isolate and strengthen their capabilities, hone their strategies, take advantage of industry consolidation to build scale, and partner with an increasingly diverse array of specialized players to reach and influence

the market for their products and services.

To be sure, some of the key policy mechanisms and other supports that triggered the boom in renewables have weakened in the face of one of the most severe economic downturns in modern history. In some ways, though, the renewables sector is richer and more dynamic today than when the boom began. 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 era for global energy markets.

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