A national laboratory of the U.S. Department of Energy
Office of Energy Efficiency & Renewable Energy

National Renewable Energy Laboratory

Innovation for Our Energy Future

Innovations in Wind and Solar PV Financing

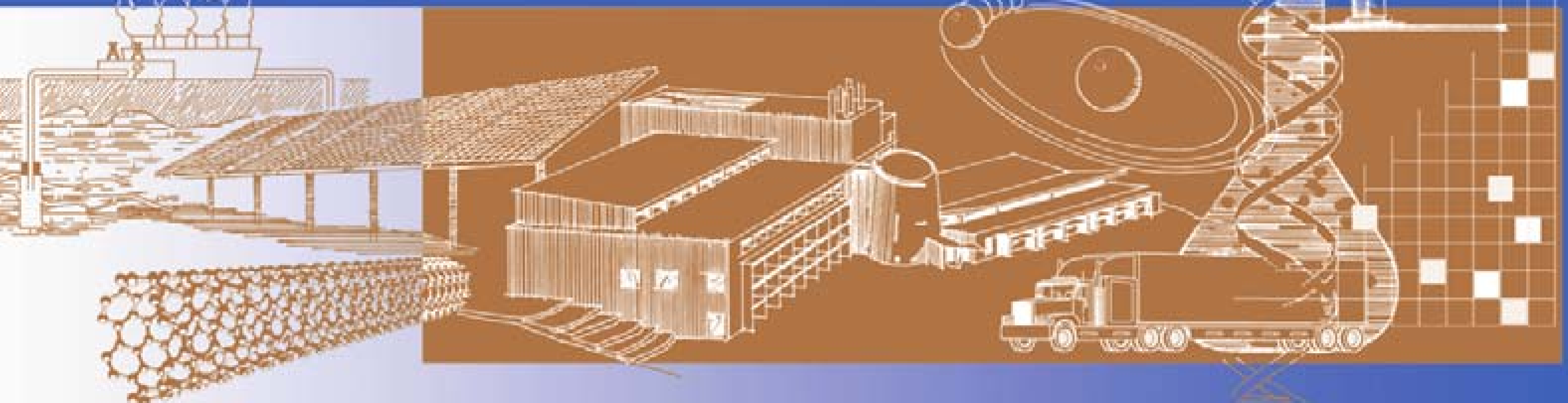
K. Cory, J. Coughlin, and T. Jenkin
National Renewable Energy Laboratory

J. Pater
Summit Blue

B. Swezey
Applied Materials

Technical Report
NREL/TP-670-42919
February 2008

NREL is operated by Midwest Research Institute • Battelle   Contract No. DE-AC36-99-GO10337



Innovations in Wind and Solar PV Financing

Technical Report
NREL/TP-670-42919
February 2008

K. Cory, J. Coughlin, and T. Jenkin
National Renewable Energy Laboratory

J. Pater
Summit Blue

B. Swezey
Applied Materials

Prepared under Task No. ASA6.2004

National Renewable Energy Laboratory
1617 Cole Boulevard, Golden, Colorado 80401-3393
303-275-3000 • www.nrel.gov

Operated for the U.S. Department of Energy
Office of Energy Efficiency and Renewable Energy
by Midwest Research Institute • Battelle

Contract No. DE-AC36-99-GO10337

NOTICE

Available electronically at http://www.osti.gov/bridge

Available for a processing fee to U.S. Department of Energy
and its contractors, in paper, from:

U.S. Department of Energy
Office of Scientific and Technical Information
P.O. Box 62
Oak Ridge, TN 37831-0062
phone: 865.576.8401
fax: 865.576.5728
email: mailto:reports@adonis.osti.gov

Available for sale to the public, in paper, from:

U.S. Department of Commerce
National Technical Information Service
5285 Port Royal Road
Springfield, VA 22161
phone: 800.553.6847
fax: 703.605.6900
email: orders@ntis.fedworld.gov
online ordering: http://www.ntis.gov/ordering.htm

Printed on paper containing at least 50% wastepaper, including 20% postconsumer waste

Acknowledgments

The initial research that served as a foundation for this report was originally funded by the U.S. Department of Energy's (DOE) Office of Planning, Budget, and Analysis (PBA). The authors would like to thank Darrell Beschen, Scott Hassell (now at RAND), and Michal Leifman (now at GE Energy) for their support of the initial research and the preliminary interviews referenced in this report.

To turn the initial research into a publishable, citable report, additional research and interviews were funded directly by the National Renewable Energy Laboratory (NREL). To that end, the authors wish to thank Douglas Arent, Ron Benioff, and Gian Porro of NREL for their guidance, encouragement, and support to see this report to completion.

The authors are especially grateful to all of the individuals who were willing to be interviewed for this research. In addition, the authors wish to thank Douglas Arent, Lori Bird, Margaret Mann, and David Peterson of NREL; Mark Bolinger of the Lawrence Berkeley National Laboratory; and John Harper of Ze-Gen Inc. for their thoughtful review of the draft report. Finally, the authors thank Michelle Kubik and Jennifer Josey of NREL for their editorial support.

Table of Contents

1.0 Executive Summary

There is growing national interest in renewable energy development based on the economic, environmental, and security benefits that these resources provide. Historically, greater development of our domestic renewable energy resources has faced a number of hurdles, primarily related to cost, regulation, and financing. With the recent sustained increase in the costs and associated volatility of fossil fuels, the economics of renewable energy technologies have become increasingly attractive to investors, both large and small. As a result, new entrants are investing in renewable energy and new business models are emerging. This study surveys some of the current issues related to wind and solar photovoltaic (PV) energy project financing in the electric power industry, and identifies both barriers to and opportunities for increased investment.

Traditionally, renewable projects are financed using long-term, fixed-price energy contracts called power purchase agreements (PPAs) signed with utilities. Under the PPA structure, project developers find a way to use federal tax credits, sometimes with a partner. However, significant innovation is occurring in renewable project financing as U.S. electricity markets evolve and new investors enter the market. Interviews were conducted with more than 30 wind and solar PV project developers, brokers, suppliers, and financiers to identify innovations that are moving beyond the traditional utility PPAs.

Information from the interviews was compiled to create a concise synthesis of ideas and information on existing and evolving financial mechanisms relevant to the wind and solar PV energy industries. These include the different roles played by market participants, various ownership structures, available sources of financing, and how these elements may vary by technology and application. Several specific financing innovations for wind and solar PV projects were identified, including:

- Utilities are deciding to own wind, rather than just sign PPAs
- Power from solar PV projects is being sold directly to end users on a retail basis, through the third-party ownership model
- The financial sector is increasingly recognizing wind and solar PV as commercial, reliable technologies
- Merchant wind projects, without contracts covering their full output, are becoming a more attractive alternative
- Derivatives are being used to partially mitigate risk, adding to the potential appeal of merchant wind
- Renewable energy certificate (REC) revenues are increasingly important to the success of many projects
- Solar REC revenues in states with a solar renewable portfolio standard (RPS) set-aside are particularly important for solar PV development
- As developers are acquired or team up with larger, better capitalized companies, the financial options available to finance new renewable projects will increase
- Investors diversify wind and solar PV investment in a number of ways, including the purchase of structured debt instruments, entering into equity investment partnerships, and possibly partnering with hedge funds.

2.0 Introduction and Methodology

The expansion of renewable energy in the United States continues to increase rapidly, and a number of market factors contribute to this growth. Across the United States, public policies encourage new renewable development through economic subsidies and state-mandated renewable energy targets for electricity production. Market changes are also encouraging additional renewable development, including higher and more volatile natural gas (and associated peak power) prices, and an overall increase in the relative economic attractiveness of wind compared to more traditional fossil fuel-based generation. Additionally, renewable generators have experienced significant reductions in capital costs over the long term, although recent shortages have tempered some of the cost reductions for wind and solar PV. Finally, private-sector financing mechanisms have evolved to better take advantage of the combination of these opportunities.

To gain a greater understanding of these developments – and, in particular, the private-sector financing mechanisms – the National Renewable Energy Laboratory (NREL) conducted background research and interviewed 34 market professionals actively engaged in developing and financing new wind and solar PV energy projects.[1] This paper synthesizes NREL's analysis and findings on evolving financing trends and competitive dynamics, as well as insights on recent changes in the sector.

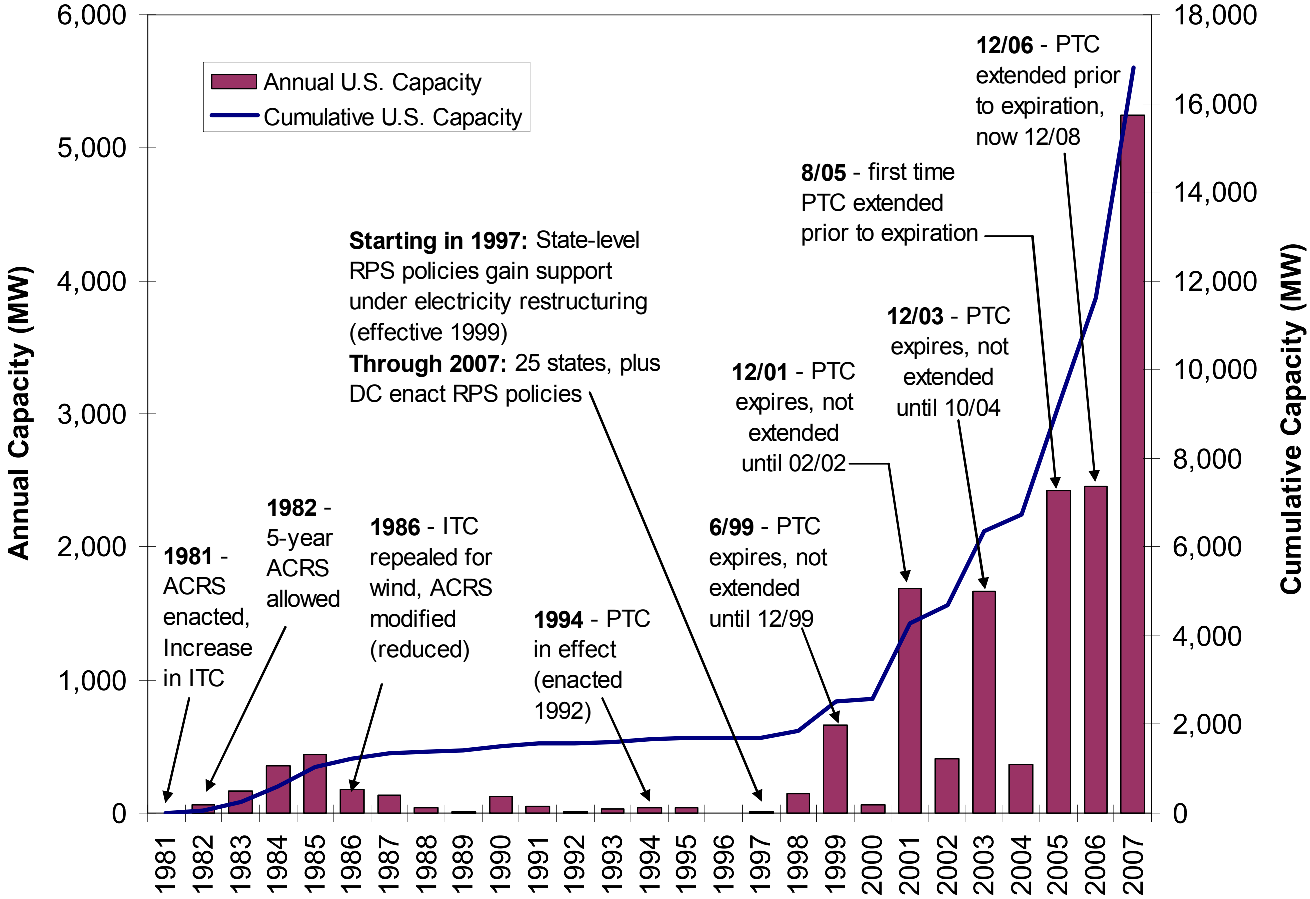
2.1 Wind and Solar PV Market Background

Wind and solar PV energy development in the United States is experiencing explosive growth. According to the American Wind Energy Association (AWEA), 5,244 megawatts (MW) of new wind capacity was added in the United States in 2007, which increased total wind power capacity by 45% in a single year and injected more than $9 billion into the U.S. economy. Total installed capacity at the end of 2007 was 16,818 MW, and projected wind capacity installations in the United States in 2008 are expected to total more than 5,000 MW (AWEA 2008). This is more than twice the 2,400 megawatts (MW) of new wind capacity that was added to the system in 2006 at a cost of $4 billion (2007$) (AWEA, 2007a). Note that more wind power capacity was installed and made operational in 2007 than was developed in the United States between 1981-2002.

The marked differences in annual wind capacity additions between the periods 1981-1998 and 1998-2007 show the important role of the production tax credit (PTC) in driving deployment (as illustrated in Figure 1). The figure also shows how early investment tax credits (ITCs), the Modified Accelerated Cost-Recovery System (MACRS), and renewables portfolio standards (RPS) influenced the wind market over time.[2] Complex contract structures and partnerships have been set up to allow the economic value of these subsidies to be extracted from wind projects, even when the original developer cannot use them directly.[3]

[1] This report does not examine the prospects for financing other renewable energy generation projects, such as solar thermal electric, geothermal, landfill or digester methane gas, traditional or advanced biomass, or hydroelectric.
[2] This report focuses on private-sector projects and, therefore, does not deal with Clean Energy Renewable Energy Bonds (CREBS), which are provided to public-sector projects.
[3] A common structure is the "equity flip" approach where an investor that can use the tax credits takes a 90%+ equity position, and the project developer retains the remaining equity. This ownership arrangement "flips" after 10 years when the available production tax credits have expired. Ownership structures are described in Harper 2007.

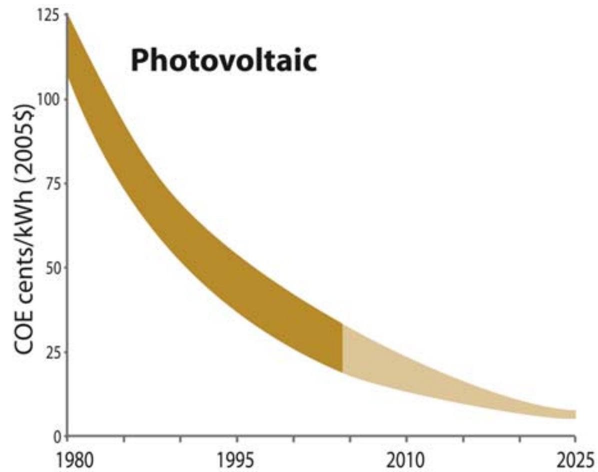
Recent extensions in the PTC have supported the continued expansion of wind energy capacity. Increased competition in the wind sector has driven down the cost of equity, and – to a lesser extent – debt (as a premium over the "risk-free" rate). However, increased costs due to turbine shortages and increased costs in underlying raw materials have somewhat offset the lower cost of financing.



Sources: AWEA, 2007b; Baratoff, 2007; Kern, 2000; and Wiser, 2007

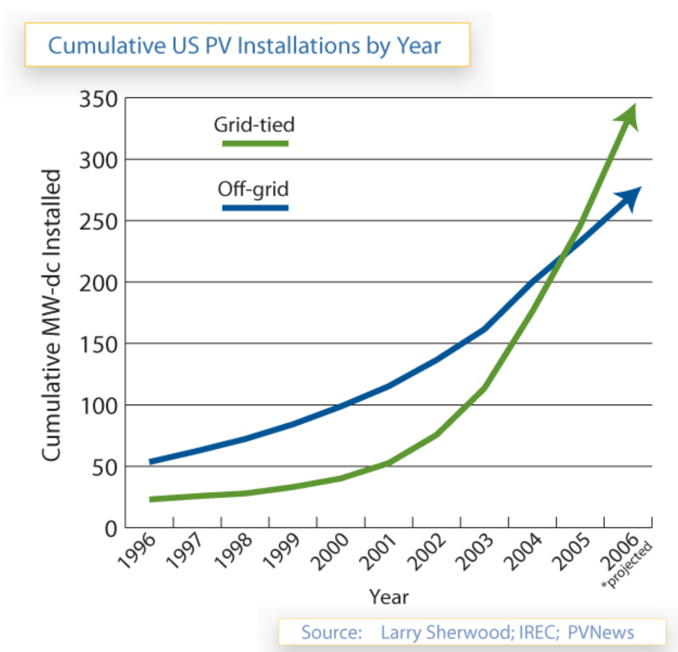
Figure 1. U.S. Wind Power Capacity Additions, 1981-2007

As with wind, solar PV energy deployment is also increasing. Figure 2 displays the long-term, dramatic decrease in costs of solar PV during the past 20 years. Figure 3 shows that grid-based solar has replaced off-the-grid solar as the primary market for PV. The pace of solar PV capacity growth is more consistent than wind, because state and federal subsidies have been more consistent over time, and recent policies are making a big impact. The Energy Policy Act (EPAct) of 2005 increased the federal ITC from 10% to 30% from January 1, 2006-December 31, 2007, and was extended to residential solar PV applications (with a $2,000 cap for residential). In late 2006, the timeframe for expiration was extended to December 31, 2008. Unless there is further legislative action before the end of 2008, the ITC will revert to 10% for commercial entities and expire for residential customers. In addition to the federal tax credits, states such as New Jersey, Colorado, and California also have provided sizable incentives to promote solar PV. Thanks to these drivers, the market is going beyond the traditional customer-financed models to more creative mechanisms for solar PV deployment, such as the third-party ownership model.



Source: NREL-draft 2005

Figure 2. U.S. PV Cost of Energy, 1980-2025



Source: SEIA 2006

Figure 3. U.S. Photovoltaic Installations, 1996-2006

2.2 Methodology

The information in this report is based on market research and on 34 interviews with a cross-section of renewable energy industry participants. Utilities, banks, private investors, renewable energy certificate (REC) brokers, lawyers, project developers, and independent power producers shared their views on financial innovation in the marketplace and opinions on the future direction of the industry. Several participants provided this information with the understanding that they would not be directly quoted – any direct quotes were authorized by the interviewee. The respective institutions that agreed to be identified are listed in **Appendix A**.

Background research and the interviews were analyzed to identify the changing market conditions that are leading to innovations in financing structures for wind and solar PV. Some utilities are expressing increased interest in owning wind assets. In addition, higher and more volatile natural gas and power prices – and perceived pricing disparities among (i) the contracted PPA market, (ii) the spot market, and (iii) forward energy markets – are leading to new trends in the industry. RECs are emerging as a key source of revenues, particularly for solar projects in states with solar RPS set-asides. New market entrants are infusing large amounts of capital into the market and are partnering with developers and end-users to make projects happen. Also, the market is starting to see the beginnings of convergence across wind and PV markets. Wind developers are getting into the PV market, while PV developers are adopting financing techniques used by the wind sector. Therefore, many comments here are likely to be applicable to other RE projects over time. The research and interviews highlighted a number of these trends, which can be broken into five main categories described in this report:

- Rate-Based Development of Wind Projects by Utilities
- Merchant Wind and the use of Derivatives to Mitigate Risk
- RECs as an Additional Potential Source of Revenue
- Changing Players and New Alliances
- Diversification and Other Financial Considerations

This report examines recent innovations in the financing structures of new wind and solar PV project development. Section 3 examines innovations in wind energy project financing, including utility wind project ownership and merchant wind projects. Under merchant structures, the report examines the motivations behind the structure, the energy market characteristics needed for success, and the use of derivatives to financially back merchant wind projects. Section 4 considers renewable energy certificates as a source of revenue, how they are valued by different investors, and the methods for including them in merchant wind projects. The changing market players and new alliances are explored in Section 5, including the infusion of large investors to the market and the third-party ownership structure for solar PV. Finally, Section 6 explores diversification and other financing considerations. This last section investigates the use of debt instruments, equity investment partnerships, and hedge funds to finance projects.

3.0 Financing Trends and Innovations in the Wind Energy Market

Wind capacity has traditionally been developed and deployed under the Independent Power Producer (IPP)-Power Purchase Agreement (PPA) model. Under a typical PPA, the buyer agrees to purchase some (or all) of the output, usually at a fixed price (or a price with a simple escalation term). Historically, the various financial structures for renewable energy technologies were specifically designed to take advantage of the different types of government support, such as the ITC or the PTC. This section explores some important trends in the financing of wind energy projects, including utility ownership, merchant wind projects, and the use of derivatives to manage risk.

3.1 Rate-Based Utility Wind Project Ownership

With few exceptions, traditional investor-owned utilities have preferred to own conventional fossil, nuclear, and hydroelectricity power plants, and have been reticent to invest in and own new renewable projects. Contributing to this lack of interest were the fact that the technology was unfamiliar, the costs appeared too high to justify, and there did not appear to be regulatory support for renewables. However, in the past few years, a number of utilities have decided that incorporating wind assets into their portfolio makes sense. In fact, several utilities have decided to go beyond just signing contracts with wind projects, to owning wind, including Kansas City Power and Light, MidAmerican Energy Company (MidAmerican), Oklahoma Gas and Electric (OGE), and Puget Sound Energy (PSE) (Grimwade 2007, MidAmerican 2007a, OGE 2007, PSE 2007). A number of factors have contributed to this shift from aversion to ownership including recognition that:

- improvements in wind power technology have led to lower costs, increased reliability, increased production, and better overall economics;
- RPS standards require load-serving entities to support new renewable project development;
- ownership offers greater control over the project during construction as well as ongoing operations throughout the life of the project (builds on a utility core competency);
- the project will cost less if the utility owns it, because a utility’s regulated rate of return is usually less than a private investor’s expected return;
- transmission scheduling for wind can be managed more efficiently over a portfolio of projects (rather than incorporating each individual wind project separately);
- the utility can be a good steward to its community by supporting regional economic and environmental benefits;
- in general, a more favorable regulatory climate exists toward wind projects (moving toward “reasonable cost” and away from “least cost”);
- regulators sometimes mandate that utilities construct and own wind;
- federal production tax credits can be used by utilities, and the cost savings can be passed on to their customers;
- adding wind to a traditional portfolio can help mitigate the impact of fossil fuel price volatility and improve the portfolio’s cost and return (improving risk management);
- in some cases, there is a customer willingness to pay more for wind; and

- a utility can prepare for potential federal regulations that might enact a national RPS or some form of climate regulation.

For example, the shift in the regulatory climate in Iowa shows how utilities can be encouraged to own wind. In the 2001-2003 timeframe, the State of Iowa reexamined the process for utilities to secure and own renewable resources. First, the state changed the timing of the public prudency hearing that determines allowable rate recovery for renewable energy resources. The hearing can now be held before construction begins, rather than after the plant is built; and it requires agreement to a binding set of assumptions to which future PUCs are bound (Iowa 2001). This creates certainty in the economics of renewable energy projects. Second, the state requires utilities to demonstrate that they have considered a variety of power sources in their planning – and that the cost is "reasonable" (Iowa 2001), rather than "least-cost," which allows for diversity and externalities to be valued in a utility's portfolio. Third, utilities were allowed to own renewable energy facilities (Iowa DNR 2004). The combination of these factors helped MidAmerican Energy Company include more wind as part of its portfolio. In 2007, MidAmerican received regulatory approval to include another 540 MW of wind in its portfolio to achieve a total of almost 1,000 MW, or 18% of their energy needs (MidAmerican 2007b). Note that while MidAmerican is not relying on wind to meet their load growth exclusively, from 2003-2008, 50% of their new capacity additions were wind, more than 25% is fueled by natural gas, and less than 25% is fueled by coal (MidAmerican 2007c).

The ability to take advantage of the PTC is one factor that convinced these utilities and their regulators that wind power should be utility-owned. According to the utility executives interviewed, it is a common market myth that investor-owned utilities are unable to take advantage of the PTC.[4] One utility interviewed secured a private-letter, revenue ruling directly from the Internal Revenue Service (IRS) that explains that the power being sold to the ratepayers qualified as the third-party sale, which allows the utility to directly take advantage of the PTC.[5] For example, Puget Sound Energy reduces its tax liability and claims to pass on the savings to its customers (Horizon 2006). This structure may be replicable for other utilities, but it is not widely known and understood. One important note is that, to-date, utilities have tended to use corporate funds to finance new wind power projects. If private investors and lenders were approached for funds to support the project, they may be uncomfortable financing such projects unless the utility secured its own private-letter, revenue ruling from the IRS.

Internal modeling that examines a utility's portfolio also has been used to demonstrate some of the advantages of adding wind. One utility that has pursued wind power both "in-house" and through power purchase agreements has used Monte Carlo simulations combined with scenario analysis to look at a variety of scenarios as part of its integrated resource planning process. Helped by high and volatile natural gas prices, a "virtual ban" on conventional coal power sold into California, and the looming threat of carbon caps or taxes, this utility found that by putting wind in its portfolio (up to 10% and potentially higher), it would lower overall costs while

[4] This may have perpetuated because it appears that utilities cannot use the investment tax credit.
[5] To secure the PTC, the owner of the facility must sell the power to a third party.

improving the overall cost and volatility characteristics of its portfolio.[6] Such analysis has contributed to the utility's decision to pursue ownership and joint ownership of wind projects.

3.2 Merchant Wind Projects and the Use of Derivatives

Another major financing trend on the rise is the emergence of merchant wind projects. Power plants that are built as so-called "merchant" facilities do not have contracts to cover all of their power output and associated renewable energy attributes – the energy and attributes are therefore sold at the market price. The merchant wind energy producer forgoes the revenue certainty associated with a PPA with the hopes that it will receive more cumulative net revenue, on average, due to projected higher prices in the spot market.

3.2.1 Shift to Merchant for Energy Revenues

As with most power plants, energy revenues provide the majority of total cash revenues for merchant wind power projects, as opposed to capacity or REC payments (also ignoring tax credits). This section explores how project owners and investors allocate risk and some other associated issues. In a later section, we discuss potential revenue from RECs, for both merchant-only and non-merchant considerations.

Utilities considering building wind projects and putting them in the rate base are starting to become competitors to Independent Power Producers (IPPs). The utility's regulated rate of return is usually lower than an independent developer's expected rate of return, which makes it hard for an IPP to compete – at least under a fixed-price contract. This "competition" from the utilities is one of the reasons IPPs are considering alternate business models.

Another reason is changing market conditions that can make a merchant model more attractive, due to the promise of significant potential returns. In regions where natural gas-fueled power plants tend to be on the margin,[7] high (and volatile) natural gas prices have driven up the cost of energy in the spot market. An interviewee shared a New York example of this pricing dynamic, noting that while PPA prices for wind were in the $34-$45/MWh range, the spot market had been trading in the $45-85/MWh range. This short-term price disparity can make the merchant model more attractive, particularly if some downside risks can be mitigated at minimal or reasonable cost. It is important to note that developers cannot depend on spot market prices consistently exceeding PPA prices over the 10- to 30-year time period for which PPAs are signed, so there is significant risk with merchant structures. The use of energy derivatives to partially mitigate the downside risk is discussed below.

[6] The basic intuition behind the value of adding wind to a more traditional generation portfolio is the reduction in uncertainty in the overall production cost of the portfolio, because wind's costs are **uncorrelated** to the price of fossil fuels such as coal and natural gas. The incremental value of wind from such effects has been explored in some detail by Awerbuch (see e.g., www.awerbuch.com), though his analysis is largely macro-level and directional from the perspective of optimizing the portfolio.

[7] The last power plant turned on to meet demand is said to be "on the margin," because it generally sets the market price that all generators receive in that region. Throughout the United States, different regions have different mixes of generation technologies that are on the margin at any particular time, and throughout the year. Because natural gas prices have been higher and more volatile in recent years, regions that have natural gas-fired generation on the margin have tended to have more volatile and higher electricity prices. Examples include Texas, Pennsylvania-New Jersey-Maryland Interconnect, and New York.

3.2.2 Energy Market Characteristics for Successful Merchant Projects

There are characteristics of particular markets that create the conditions for merchant wind projects to be successful. Those interviewed cited the following as key criteria driving the economics of merchant power plants.

- The plant is located in energy markets where natural gas is on the margin most of the time, leading to higher and more volatile peak power prices (which are reflected in spot and forward markets for both natural gas and peak power).
- A liquid market for electricity creates both an actively traded spot market and a derivatives market to partially hedge risk.[8]
- An active state or regional renewable energy certificate (REC) market, underpinned by strong demand for renewable power, can create a second cash-flow stream for the energy producer in addition to the electricity itself.

Examples of markets meeting these criteria include Texas, New York, Pennsylvania-New Jersey-Maryland (PJM), and the New England Power Pool.

Banks are wary of lending money to merchant power facilities. Traditionally, banks attempt to minimize their risks by lending against predictable cash flows. For those risks that banks are unwilling to take, developers must depend on equity investors, who are more richly compensated for their higher level of risk. The more risks developers ask their investors to shoulder, the higher the cost of capital. Because lenders do not benefit from risky situations that turn out better than expected, they want to protect against the downside of any potential loss. An unhedged, volatile future revenue stream (derived from the price risk in the spot market) will make them wary. The lender – if willing to lend at all – might compensate by increasing the debt service coverage ratio, reducing the tenor, introducing cash sweeps, or raising the interest rate, effectively seeking to reduce the debt-to-equity ratio to offset these revenue risks. In addition, there is a historical reason why banks are wary of the merchant model. In the late 1990s and early 2000s, many bank-financed, merchant natural gas-generating facilities were not hedged against sharp changes in gas prices. When natural gas prices increased from $2-$3/MMBtu to $5/MMBtu and higher, many of these plants became uneconomic to operate, causing many power plant owners to default on their loans to the banks.

Given these risks and recent history, merchant wind projects rely on higher levels of equity finance. According to a recent wind finance paper by Lawrence Berkeley National Laboratory, only 20% of wind projects developed in 2006 had project-level debt (Harper 2007; original source: Chadbourne 2007). Unlike power plants with fuel costs, many renewable technologies have no fuel cost and very small operating and maintenance costs. These low operating costs allow these technologies to benefit from power price volatility far more than technologies with significant (and often correlated) fuel costs. Therefore, as long as they can make enough money in the electricity market (on an expected basis) to recover their initial capital costs of construction and include a reasonable return on capital, these projects will be financially viable.

---

[8] Energy assets may be only partially hedged under the merchant model, because derivative contracts used in the electricity and natural gas markets (forward contracts and options – typically up to 10 years in duration), can be significantly shorter than the asset life of a renewable energy generator (generally 10-40 years).

Investors that are starting to venture into quasi- or fully-merchant investments include project developers, retail energy suppliers, and large financial-equity investors**.**

3.2.3 Hybrid Traditional-Merchant Structure

Interviewees suggested that hybrid structures – using a combination of traditional PPAs and merchant power – were recently completed. Such arrangements also potentially allow the developer to obtain some project-level debt. Two ways discussed were:

> **i) Divide production between a PPA and merchant.** A wind developer can enter into a PPA for a percentage of its output, creating a certain level of revenue stability. The remaining output is sold on the spot market at (hopefully) higher prices, on average. For example, the 7.5 MW Jersey Atlantic wind project in Atlantic City, New Jersey, is selling 50% of its output under a PPA and 50% in the spot market (Babcock & Brown 2008).[9]
>
> **ii) Start with a PPA and then convert to merchant**
> A wind developer can sign a PPA that is substantially shorter than the life of the project; the length can either match the life of the debt (5-10 years), or be substantially shorter (1-3 years). While many debt lenders prefer to lend 1-3 years less than the PPA to have a "tail" that ensures repayment, some are willing to lend up to the length of the PPA. Payment of the debt may be on an accelerated basis (e.g., less than 10 years). After paying off this debt, the IPP "goes merchant" and sells the electricity into the spot market. By reducing leverage, the IPP reduces its required revenue risk profile, allowing it to take on greater market risk with spot prices.

3.2.4 Derivatives to Manage Price Risk

A key element in the emergence of merchant energy production of wind is the use of derivatives as a risk management tool to partially hedge revenues. Merchant producers can offset some of the market risk associated with their projects by turning to the natural gas or electricity derivatives markets.

One method for a project developer to partially hedge risk is to find a counterparty willing to enter into a contract for differences (CFD). The owner sells its power directly into the spot market. Separately, the project owner and counterparty agree to a contract price, and differences between that price and the spot price are settled through cash payments, rather than through physical delivery of electricity. Therefore, the CFD is purely a financial instrument. To the owner of the wind project, this is effectively a way to assume a fixed price for their power. In turn, the financial institution might hedge part or all of this risk using the forward power markets, or by finding someone to buy the power at a higher price.[10] Our interviews suggest that some project developers are arranging fixed-price CFDs for 5-7 years with financial institutions, though some are as long as 10 years, as described below. In many regions, natural gas is another potential way to partially hedge future power prices, because of the strong correlation (both

---

[9] It is reported that this project originally won a REC contract under NYSERDA's first RPS solicitation, and that after examining the PJM market, the developer decided they could secure higher prices directly in the market.

[10] Interviews with brokers indicate that there is a forward market for power that goes out about seven years, and is most active in the two-year time frame. The hedge is quite crude because it uses a single annual price for peak and off-peak periods, although that value will have been calculated to average anticipated seasonal effects.

historical and projected) between future natural gas prices and peak power prices, and the greater degree of liquidity in the natural gas markets.

An example of a CFD financial arrangement is one closed in August 2007 – between Enel North America and Fortis Merchant and Private Banking – for the Snyder wind farm in Scurry County, Texas. The two parties signed a 10-year "financial fixed-price power purchase agreement" to cover the output of the 63 MW project. Power will be sold directly into the Texas spot market for electricity. At that time, the project was under construction. Twenty-one 3.0 MW Vesta V90s turbines were installed and are expected to output 1.1 million MWh annually. The agreement starts in 2008 and runs through February 2018, and it provides the project developer, Enel, with a hedge against unstable electricity prices; it's also designed to accommodate wind seasonality (Enel 2007a and Enel 2008).

Another structure is to partially hedge merchant price risk during the first few years of generation by using electricity market "put options" to create a floor for electricity prices. A put option sets a strike price where the project owner has the right – but not the obligation – to sell electricity at the put option strike price to the seller of the option. The off-taker receives an option premium for bearing the risk that electricity market prices will be lower than the strike price. This put option provides the owner with a minimum guaranteed revenue stream, provided they can find someone willing to sell a put option at a price that is acceptable to the owner. Establishing such a floor (or minimum price) creates revenue certainty, which can be attractive for debt repayment. By not exercising their put option, but selling into the spot market, developers can take advantage of high energy spot market prices. Figure 4 describes a put option.

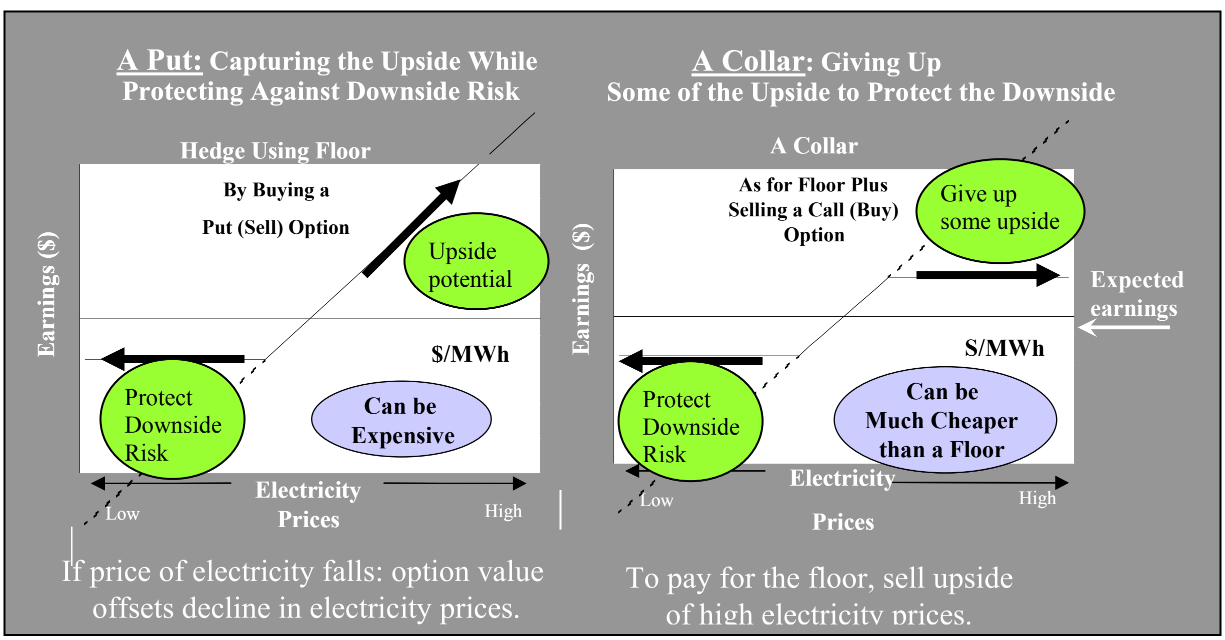


Figure 4. Graphical Representation of a Put Option and a Collar Option

An alternative to purchasing options on electricity prices is for merchant wind power producers to use natural gas options. As mentioned earlier, in regions where natural gas-fired power plants are on the margin most of the time, natural gas prices can be well-correlated to electricity prices. There is greater liquidity in the natural gas options market and, as such, they can be both cheaper than electricity options and available for longer tenors. According to various participants in the market, over-the-counter natural gas options are liquid out to 7-10 years – and possibly longer, depending on the structure of the transaction. In contrast, the electricity options market tends to be less liquid and of more limited duration.

However, put options are not free and a fee must be paid to the counterparty. The cost of put options can be offset if merchant producers also sell "call options" to create a collar. In return for receiving a payment for selling call options, the seller (merchant energy producer) caps the upside that can be reaped by high spot market prices. The structure creates a band ("collar") within which prices will fluctuate. This can still be attractive if the revenue within the band is higher on an expected basis (from the owner's perspective) than the revenue available from a fixed-price PPA. The difference between a "put" and a "collar" option is shown in Figure 4.

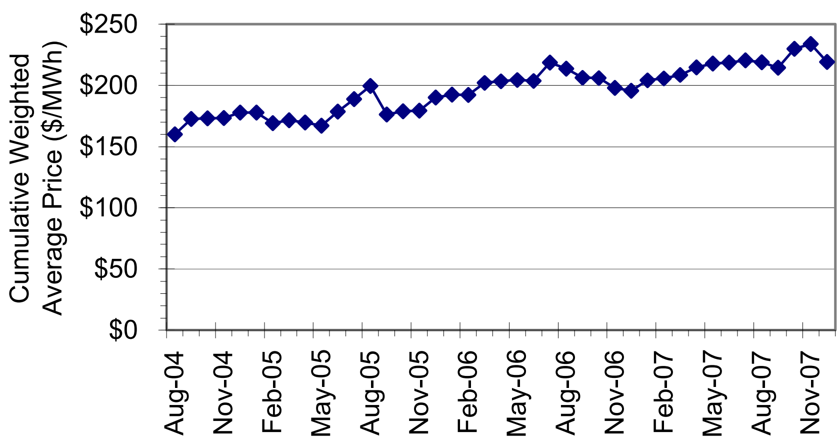
In summation, wind project financing has experienced significant changes in the past few years. Utilities sometimes choose to own wind projects because the technology is reliable and regulators support ownership. In addition, owning wind allows utilities to secure the benefits of increased control over operation and transmission scheduling, to increase the diversity of generation resources, to lower development costs, and to prepare for potential national RPS or climate regulations. Also, in some markets, the conditions are favorable to capture the upside of potentially higher spot market prices through merchant wind project financing. This can be done by either securing contracts for a portion of energy and REC output, or through partially hedging risk using derivative transactions in electricity or natural gas markets.

4.0 RECs as an Additional Potential Source of Revenue

In addition to energy revenues, renewable project developers often anticipate revenues from the sales of renewable energy certificates (RECs), which represent the environmental attributes of renewable energy.[11] One REC typically represents the environmental attributes of 1 MWh of renewable-generated electricity.[12]

4.1 Value of RECs

The value of a REC is established in one of two ways. The first is through a mandatory requirement on load-serving entities to secure renewable energy on behalf of their customers, often called a renewable portfolio standard (RPS). As of January 2007, 25 states and the District of Columbia had mandatory RPS requirements,[13] where a specific amount of renewable power (or sometimes capacity) must be supplied by eligible renewable resources. Effective RPS requirements have clear eligibility rules, tend to use RECs to prove compliance, and have a substantial penalty that encourages compliance. In markets with RECs, utilities may purchase RECs and renewable energy bundled together (making it difficult to determine the actual REC price);[14] they may purchase RECs separately; or, in some cases, they might decide to own renewable facilities (discussed earlier). The most active REC spot markets are those where RPS penalty provisions are priced higher than the actual cost to develop eligible projects.



Source: NJ Clean Energy 2008

Figure 5. New Jersey Solar REC Prices

Compliance-REC prices for new renewable facilities tend to have a wide range, depending on location and technology. RECs for non-solar RPS compliance have lower prices and will be considered first. In regions with adequate supply, RPS-compliance RECs can range from $3-30/MWh; while, in New England, supply

[11] RECs are not used in every U.S. region to represent environmental attributes, but their use continues to expand – and most renewable project development is occurring in areas that use or are contemplating using RECs.

[12] Typically, the environmental attributes captured in a REC include the avoided CO_2 and mercury emissions, although there is some controversy about what environmental attributes are included. As potential carbon regulations are debated, it will be important to coordinate the carbon market with the REC market, so that the environmental attributes captured in each market are clear.

[13] A map of U.S. state-level RPS requirements can be found at: http://www.dsireusa.org/documents/SummaryMaps/RPS_Map.ppt

[14] If a utility purchases RECs bundled with energy, it is difficult to determine the REC price for a few reasons. First, the bilateral transaction is private and the price paid is often not disclosed. Second, if a price is disclosed, it might be a single price that does not distinguish a separate price for the RECs.

shortages of eligible RECs have led to REC prices near or at the penalty price. In Connecticut, Massachusetts, and Rhode Island, spot REC prices are close to the alternative compliance price and have recently ranged from $48-56/MWh (Evolution Markets 2007). Additionally, several RPS markets have a separate tier for solar, often called a solar set-aside. As a result, solar RECs (SRECs) are traded separately and are subject to a distinct penalty price (e.g., until December 2007, this was $300/MWh in New Jersey). This carves out solar to recognize that the technology is not economically competitive with wind, landfill methane, anaerobic digester, or biomass. Figure 5 shows that the historical solar REC prices for New Jersey started at approximately $175/MWh, increased over time to about $220/MWh, and have reached almost $235/MWh on a cumulative weighted average basis. However, New Jersey SREC prices are expected to increase dramatically. In December 2007, New Jersey started a new program that gradually eliminates state-provided solar rebates (NJ BPU 2007a) and increased its SREC penalty price to $711/MWh (NJ Clean Energy 2007). More details of the program's structural changes are discussed in section 5.2.

In markets that are experiencing a REC shortage, there is a potential arbitrage opportunity. Many RPS policies include a price cap, or penalty price for noncompliance, to encourage development of new renewable generation. The cap can be set substantially higher than the incremental cost of development that's above expected energy revenues and state and federal incentives. In markets that experience a REC shortage (e.g., Massachusetts), load-serving entities are willing to pay REC prices on the spot market that are almost as high as the price cap. Because this price can be substantially above the actual incremental cost of development, there is a potential arbitrage opportunity. Some undercapitalized developers might need a long-term REC contract (10+ years) to secure financing and would be willing to provide RECs at prices that are below the current spot market. If the spread between the long-term REC price and the spot REC price is large enough, project investors can make substantial returns by selling long-term contracted RECs into the spot market at higher prices; this also might allow them to feel more confident selling the project's energy on a merchant basis.

REC value also can be determined by what consumers are willing to pay for the incremental cost of renewables in the voluntary market. However, the prices paid in the voluntary market are typically much less – around $1-7/MWh – for non-solar RECs;[15] and $18-21/MWh for voluntary products that are based on solar generation (Bird 2007 and Evolution Markets 2007). Whether from compliance or voluntary markets, RECs can create additional cash flow and improve the economics of a merchant project.

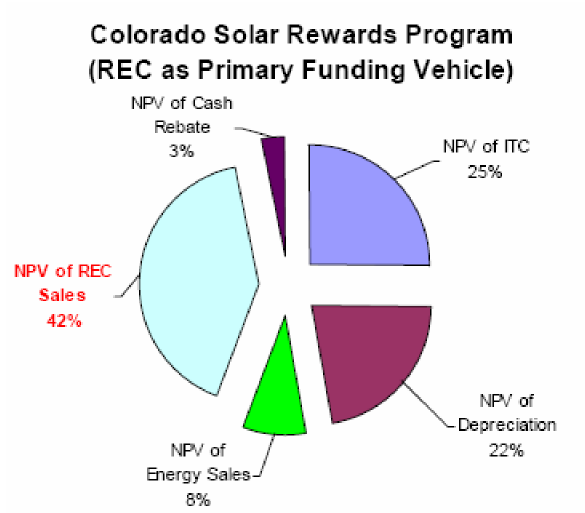
4.2 RECs and Financing

The REC cash-flow stream may determine whether or not a particular project is able to attract financing. As shown in Figure 6, in the case of Colorado, solar REC cash flows can account for roughly 40% of total project cash flows. One interviewee noted that RECs can account for 40%-80% of the total revenue stream of a project.

The value attributed to RECs by investors depends on the type of investor, the financial strength of the REC purchaser, as well as other associated risks. For load-serving entities purchasing RECs to meet RPS requirements, they can choose to purchase them in the short term at spot

[15] Not counting biomass.

prices, over the longer term at a fixed price (which is usually less than spot prices), or possibly pay a penalty for noncompliance. Therefore, the REC value will range from the long-term market price, up to the spot market price, which is capped at the price level of the penalty (often called the alternative compliance payment). On the voluntary side, utilities and competitive suppliers with green power programs will pay for the RECs based on the green power product offered to their customers, and what their customers are willing to pay.[16]



Source: 3 Phases 2007

Figure 6. Colorado Solar Rewards Program

For both the mandatory and voluntary markets, debt lenders do not usually attribute much, if any, value to the RECs, unless they are under contract. Because utilities tend to be creditworthy, lenders usually fully value RECs under contract with regulated, investor-owned utilities (IOUs). However, because of the California energy crisis, even some IOUs were not deemed to have the financial strength needed to secure debt investment in new projects (Cory 2007).[17] Similarly, private, load-serving entities that purchase RECs may have limited financial strength if they do not have a creditworthy parent company, are new to the market, or are relatively small. Another potential risk that concerns lenders is that most RPS policies were created by state legislatures, which means that the policies might be changed or eliminated by policy makers. This uncertainty makes lenders wary, particularly if they are asked to lend for 10 or more years.

Equity investors are usually willing to take more risks than lenders and are increasingly willing to consider the REC revenues as probable in exchange for a significant return on their investment. They recognize that even if one RPS is changed, a neighboring state with a comparable RPS could provide a potential buyer for the project's RECs. In addition, in some REC markets, there is a disparity between current short-term REC prices and the actual incremental price needed to develop a project. While it is not guaranteed, equity investors hope that this disparity will continue for several years so that they earn a substantial return on an expected basis. It is also important to point out that the tax appetite among various equity investors – including project developers, strategic investors, hedge fund investors, and tax investors – does vary; these types of investors are described in more detail in a report, "Wind Project Financing Structures" by the Lawrence Berkeley National Laboratory (Harper 2007).

[16] While some utilities and competitive suppliers offer green power products from only one technology (e.g., wind), many blend several technologies and provide their customers with a mix. For example, solar PV RECs might be included because customers prefer solar; but they will be blended with other, lower-cost RECs to lower the overall product price.

[17] For example, Nevada had to institute the temporary renewable energy development (TRED) fund to guarantee payments for renewable energy development by utilities, until their credit ratings improve.

Overall, the difference between how banks value RECs versus how equity investors value them and the emergence of a variety of equity investors is another reason why merchant wind projects tend to be predominantly equity financed.

4.3 REC Value and Merchant Wind Projects

There are two methods of incorporating REC value into a merchant structure:

i) Enter into a contract for the RECs and sell the power on the spot market

Most REC contracts that developers secure are in place with load-serving entities (e.g., investor-owned utilities, competitive retail suppliers) that must meet RPS requirements. If a developer can secure enough REC revenues, it might be able to move forward with a merchant wind project without signing a PPA for its electricity production.

There are two exceptions where the state is doing a substantial portion (or all) of the REC contracting. In New York, the New York State Energy Research and Development Authority (NYSERDA) is the central state agency that signs contracts to meet the state's RPS requirement. In most other states, the load-serving entity is assigned the task of meeting the RPS. As specified in law, the utilities collect funds from ratepayers, on a cents/kWh basis, and provide the money to NYSERDA. Based on the amount of money available, NYSERDA holds a competitive auction process, chooses the winners, and signs long-term contracts for RECs. In 2006, NYSERDA purchased RECs at a weighted average price just below $23/MWh per REC; and for the 2007 auction, the price was $15/MWh per REC (weighted average). The weighted average price for both auctions was $17/MWh (Saintcross 2007). Developers who placed winning bids create revenue certainty with their RECs and were able to pursue spot market power sales.

The Massachusetts Technology Collaborative (MTC) developed the Massachusetts Green Power Program (MGPP), to provide either a REC purchase contract, or a REC option contract with a minimum-price floor at which the project can sell its RECs to the MTC (energy is not included). The program was implemented due to the relative scarcity of long-term REC contracts, 10+ years in length (Cory 2004). RECs can be sold to the MTC for up to 10 years within the first 15 years of the project's operation, allowing projects to take advantage of shorter-term REC contracts available in the market and reduce their reliance on MTC funds. If the project is not built, or if it can secure a better REC price on the spot market, the money that MTC has set aside is released from an escrow account and returned to the MTC. If the MTC purchases the RECs, they will sell them through a market auction, and the proceeds will return to the MTC. So far, two rounds of MGPP funds were made available: $34.4 million in Round 1 (2003) and $34.6 million in Round 2 (2005) (MTC 2008). If the funds returned are used to support additional MGPP rounds, then the MTC has essentially created a revolving loan fund. The option contracts provide a financial backstop that helps these projects secure financing, and the program's structure also encourages the development of a short-term REC market.

However, both the New York and Massachusetts programs are limited by their funding allocations. In both states, the money for their REC support programs is collected through a charge on ratepayer bills, and neither charge is adequate to support the new renewable development needed to fulfill their respective RPS programs. In fact, the MTC's funds are designated to be used for a wide variety of programs, including industry support, consumer education, community-level programs, etc. Therefore, neither state has created a self-sustaining market for long-term RECs.

ii) Merchant sales of both RECs and power

A new trend is emerging for some wind projects where a substantial portion of both REC and power sales are considered merchant and not under contract per se. One example is the 54 MW Crescent Ridge wind farm in Illinois. Crescent Ridge was initially constructed when it was selling both energy and RECs into the PJM wholesale power pool "at attractive prices and higher than available PPA terms" (Babcock & Brown, 2006). One interviewee pointed out that the original financing was difficult and protracted, and that ownership now rests with Babcock & Brown, who is more comfortable with the merchant risk. Now that Illinois has a mandatory RPS policy, the owner will sell into a market with higher prices and the project now has a 3-year REC deal. If energy and REC prices continue to remain high – relative to the cost of developing wind or other renewable projects – and as market experience is gained with structuring these deals, a greater number of investors may have the confidence to invest in projects without contracts for either energy or power. Those that want certainty can turn to the derivatives market to hedge themselves on their energy purchases.

As described in this section, RECs are presenting another potential source of revenue for renewable energy projects. The value of RECs is derived either from a mandatory RPS policy with penalty requirements or from the voluntary market, based on a customer's willingness to pay for green power. During project financing, the value attributed to RECs depends on the investor – debt lenders usually only attribute value to RECs under contract with a creditworthy off-taker. Equity investors are increasingly willing to attribute value to RECs if the right market conditions exist. Some projects are even able to structure financing with some portion of energy and/or RECs being sold as merchant, rather than being under contract. In general, if a state does not have large incentives like in California, or a separate solar tier in its RPS, solar PV does not have a chance to compete against more economic technologies such as wind and landfill gas.

5.0 Changing Players and New Alliances

The shift to merchant wind power projects described in the previous section is often enabled by creativity in project ownership and financing. This section briefly explores how ownership roles are changing as new entrants participate in wind and solar PV projects, and how new alliances are strengthening the opportunities in the market.

5.1 Large-Scale Acquisitions of Wind Developers

In the past few years, large investors have taken an interest in the renewables market – particularly wind and solar PV projects – illustrating a degree of market maturity. Instead of creating their own portfolio, they have often chosen to purchase wind developers that have a pipeline of projects already under development. The number of acquisitions and mergers continues to grow as shown in Table 1.

Benefits of this consolidation activity include:

- Broader access to financing channels,
- The ability to move beyond project financing to corporate balance sheet financing, which has lower transaction costs,[18]
- Potentially higher returns by investing in projects at earlier stages,
- Partnering experienced developers with wind and solar PV developers, and
- Greater leverage for wind turbine procurement, given current supply constraints.
- Greater financial strength of acquiring entities, enabling flexibility to optimize timing of financing (independent of project cash needs) and simultaneous bundling of financing for multiple projects
- Lower risks to investors and lenders to diversified project portfolios

Goldman Sachs' Foray into Wind

In March 2005, the investment bank, Goldman Sachs, purchased the Texas wind developer, Zilkha Energy, for an undisclosed sum and renamed it Horizon Wind Energy. (Montara Energy Ventures, 2007). [The article suggests that the purchase price was "widely speculated to be in the $500 million range."] Two years later, in March 2007, Portugal's largest electric utility, EDP, agreed to purchase Horizon Wind from Goldman Sachs for a reported $2.15 billion (Horizon 2007).

[18] Project financing – also called limited recourse, non-recourse, or off-balance sheet financing – is structured such that financiers rely only on the revenues of the project itself for repayment. They cannot look to cash or assets outside of the project. Therefore, the assets of the project sponsors are protected from recourse for repayment should the project not perform as expected. On the other hand, corporate balance sheet financing is supported by the assets and cash flows of the project's owner. As a result, the financiers have a claim against the overall assets of the company in the event of default. The advantages of project financing are that it enables developers to finance projects even if they don't have the financial strength/creditworthiness, it protects the project sponsor's other assets in case the project defaults, it allows for a greater amount of debt (which is cheaper than equity), and it increases the debt term lenders are willing to provide (lowering annual revenue required). However, it is more complicated to arrange; and, thus, the transaction costs will be higher than corporate balance sheet financing. For example, debt lenders will thoroughly scrutinize every project detail, particularly given that there is no recourse outside of the project's revenues. Therefore, they will require more assurances, through legal documentation and contracts, to minimize as many aspects of risk as possible to protect their investment. Additionally, potential project returns might be high enough that the parent company will prefer to have the project on its balance sheet, to secure the potential returns. For more information, see Brealey 1991 and GREENTIE 2008.

For example, a wind developer backed by a large and creditworthy strategic equity investor may have the financial strength to finance development costs and/or turbine down payments more easily and efficiently, compared with developers lacking such support.

Table 1. Investment Activity in the U.S. Wind Industry

Investor	Transaction Type	Developer	Announced
EDF (SIIF Energies)	Acquisition	enXco	May-02
Gamesa	Investment	Navitas	Oct-02
AES	Investment	US Wind Force	Sep-04
PPM Energy	Acquisition	Atlantic Renewable Energy Corp.	Dec-04
AES	Acquisition	SeaWest	Jan-05
Goldman Sachs	Acquisition	Zilkha (Horizon)	Mar-05
JP Morgan Partners	Investment	Noble Power	Mar-05
Arclight Capital	Investment	CPV Wind	Jul-05
Diamond Castle	Acquisition	Catamount	Oct-05
Pacific Hydro	Investment	Western Wind Energy	Oct-05
Greenlight	Acquisition	Coastal Wind Energy LLC	Nov-05
EIF U.S. Power Fund II	Investment	Tierra Energy, LLC	Dec-05
Airtricity	Acquisition	Renewable Generation Inc.	Dec-05
Babcock & Brown	Acquisition	G3 Energy LLC	Jan-06
Iberdrola	Acquisition	Community Energy Inc.	Apr-06
Shaw/Madison Dearborn	Investment	UPC Wind	May-06
NRG	Acquisition	Padoma	Jun-06
CPV Wind	Acquisition	Disgen	Jul-06
BP	Investment	Clipper	Jul-06
BP	Acquisition	Greenlight	Aug-06
Babcock & Brown	Acquisition	Superior	Aug-06
Enel	Investment	TradeWind	Sep-06
Iberdrola	Acquisition	Midwest Renewable Energy Corp.	Oct-06
Iberdrola	Acquisition	Gamesa's U.S. project pipeline	Oct-06
Iberdrola	Acquisition	PPM (Scottish Power)	Dec-06
BP	Acquisition	Orion Energy	Dec-06

* Select list of announced transactions; excludes joint development activity.

Source: Berkeley Lab and Black & Veatch.

Source: Wiser 2007

5.2 Third-Party PV Project Financing

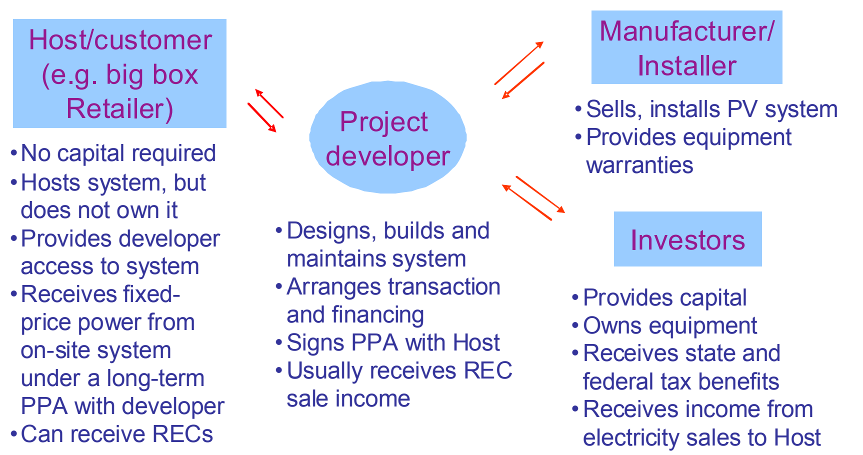
In contrast to the traditional solar PV model where a customer purchases a PV panel system for rooftop installation, the third-party ownership model is rapidly developing as way for a customer to deploy solar energy without providing up-front capital. Under the third-party ownership model, a big box retailer or some other large institution agrees to host solar panels on its rooftop and sign a PPA to purchase the generated power, often at a fixed price that is at, or slightly lower than, their utility's retail rate. A solar PV developer installs, operates, and maintains the system on behalf of the project owner and the host. An equity investor buys the project rights from the developer, provides the upfront capital needed to the project's limited liability company (LLC) specifically created for the project, and receives the benefits from the investment tax credits. The project LLC buys the equipment from the manufacturer and perhaps construction services from the developer. Sometimes, the developer might retain ownership of the project until after construction is completed and sell the project on a turn-key basis. This depends on the cash flow and financial strategic goals of the developer. This third-party model is driving significant amounts of capital to the market, a few examples of which include:

- $39 million worth of new solar PV projects financed by MMA Renewable Ventures in the fourth quarter of 2006 (MMA-RV 2007); as of the beginning of 2008, their solar portfolio totals 24.8 MW (MMA-RV 2008)
- The $60 million SunE Solar Fund I launched by SunEdison in 2005 to develop 25 projects in the United States, with Goldman Sachs providing the equity and Hudson United Capital (now, a unit of TD Bank North) providing construction and term debt financing (BP Solar 2005).
- SunEdison's $26.1 million equity partnership with Goldman Sachs, MissionPoint Capital Partners, and Allco Finance (SunEdison 2006).
- UPC Solar expecting to do big deals by working with owners of large facilities that are willing to host solar PV projects, using at least $50 million worth of solar equipment across multiple properties (McCabe 2007).

Examples of equity investments in the third-party ownership concept in the past few years include:

- Developing Energy Efficient Rooftop Systems (DEERS) installing approximately 1 MW of rooftop PV on a General Motors facility in California and expecting to be involved with 50 MW worth of solar roofing projects each year (McCabe 2007).
- Chevron and Bank of America partnering with the San Jose Unified School District to install 5 MW of solar PV on the grounds of K-12 schools in California (Chevron 2007).
- Wal-Mart purchasing power from solar PV projects from SunPower, BP, and SunEdison located on 22 sites including Wal-Mart stores, Sam's Clubs, and two distribution centers. Total annual production is estimated to be as much as 20 million kWh (Wal-Mart 2007), which translates into approximately 14.2 MW of total capacity, assuming an average capacity factor of 16%.
- Macy's installing 8.9 MW of solar PV on 28 stores across California. In combination with energy efficiency measures executed in these stores, Macy's expects to offset more than 24 million kWh of annual energy consumption. At 11 stores, Macy's owns the solar PV systems outright; while, at the remaining 17 stores, they purchase the electricity generated at the stores from SunPower (SunPower 2007).
- Kohl's signing an agreement with SunEdison, under which SunEdison will manage the 25 MW of solar PV installed on Kohl's stores in exchange for the retailer's commitment to purchase energy from the projects. The installations are expected to be completed in 2008, and the 138,000+ solar panels are expected to generate more than 35 million kWh annually (SunEdison 2007).

As shown in Figure 7, benefits of the structure are shared among the participants. The host buys solar electricity at or below the retail market price for electricity, without an outlay of upfront capital. Ten years is usually the required minimum tenor of the PPA, but some hosts (usually public entities) are willing to sign 20- to 25-year PPAs. The equity investor gets the federal investment tax credit, federal 5-year accelerated depreciation, and the revenue from the electricity sales. The solar equipment company generates equipment sales. The solar developer arranges the transaction (for a fee) and is paid for designing, building, and maintaining the system. Sale of the RECs depends on the desires/pricing offered by the rooftop owner. Some may want the RECs themselves to claim they use solar power, so the project would sell both the power and the RECs to the rooftop owner. Other times, the developer retains ownership of the RECs, which can be sold to third parties. The host may decide to replace the solar RECs with non-solar RECs purchased on the market, so they can claim green power for their facility.



Adopted from WRI 2004, Ashley 2008, and EI Solutions 2007

Figure 7. Solar PV Third-Party Ownership Model

In effect, the innovations here are twofold. First, the PPA model applies to end users, rather than selling the power to a utility. Second, this model is an adaptation of the partnership flip model developed for wind deals to the PV sector.

To make the third-party, solar PV ownership model work, specific solar provisions such as federal tax credits, solar investment subsidies, and solar-specific tiers in RPS requirements have proven to be important. Currently, federal tax credits and state-level solar equipment subsides are critical for the economics to work – and they are driving the solar PV deals in California. Without both federal tax credits and state incentives, solar PV developers claim they cannot offer power at or below the retail rate and, thus, the customer will not consider the deal. This also becomes more challenging over time, as the solar PV rebates in California are lowered as state-wide capacity targets are reached. However, the value of fixed-price power over a period of up to 20 years might be valued by some customers more than savings over today’s retail rates.

As described earlier, it is helpful if the RPS has a separate carve-out for solar, where each load-serving entity (LSE) must acquire a specific amount of solar resources, or face a significant penalty for noncompliance. In states with such provisions, the utilities are therefore willing to pay a high price to a project to secure the solar attributes and prove compliance with the solar

RPS carve-out. This high price can help reduce the overall price offered from the developer to the end-use customer, bringing it closer to retail rates.

New Jersey is one example of a state that has seen explosive growth in solar PV installations, thanks to the combination of solar rebates and a solar RPS set-aside. However, the state has decided to change the program's structure. The up-front solar PV rebates were more expensive than anticipated, and its customer on-site renewable energy (CORE) budget was quickly oversubscribed. Therefore, at the end of 2007, New Jersey decided to eliminate the rebates. As of early 2008, developers have to depend solely on the value created by the solar carve-out in the state's RPS, where the solar REC sales to utilities are expected to cover the incremental cost above electricity sales and incentives (NJ BPU 2007b). To compensate for the loss of the up-front solar PV rebate, the New Jersey Board of Public Utilities increased the price cap on solar RECs from the current $300/MWh to $711/MWh in 2009, which decreases by approximately 2.5% per year through 2016 (NJ Clean Energy 2007). This new structure is feasible, as long as the cost of solar panels continues to decrease, REC prices increase in response to the increase in price caps, and the penalty for noncompliance of the solar RPS is at a level that encourages development[19] rather than payment of the penalty. Note that this new structure could significantly slow down residential solar PV development, because households will bear more of the up-front costs with the loss of the rebate. This increase in cash outlay at installation could discourage residential participation.

In summation, wind and solar PV ownership roles are changing as new participants enter the market. Wind developers are being bought by large, capitalized companies that want to participate in the U.S. wind market, and that include foreign utilities. For solar, the increase in the third-party ownership model helps new projects secure financing by efficiently capturing the tax credits without a capital outlay by the customer that hosts the project. These new alliances are strengthening the opportunities available in the market.

[19] If the incremental cost of developing solar – above energy revenues, federal tax credits, and state rebates – is lower than the solar RPS penalty, then it is presumed that the market will respond, developers will offer solar RECs at a price that is lower than the penalty price, and new solar will be built.

6.0 Diversification and other Financial Considerations

The fourth trend discussed in the interviews considered various types of investment diversification. Traditional diversification works when the correlation between the returns on different assets is low (or, even better, when negative). Diversification can be addressed at a number of levels: technology, geography, contract/financial, (etc.) to address the breadth of risks for renewable projects. For example, owning wind assets in several different regions creates diversification in a number of ways. First, wind projects situated in different geographic locations usually have distinct wind resource profiles as a result of differences in weather and topography over time, i.e., wind blowing – or not blowing – in Region A may not be strongly correlated with wind blowing in Region B. Wind investments in different regions produce further diversification benefits because power prices will not be perfectly correlated – and neither will REC revenues. Also, diversification can reduce exposure to the credit of any single off-taker. In addition to regionality, there are potential benefits to adding wind to a more traditional generation portfolio (these were discussed earlier).

An investor also may use financial instruments to diversify investments across a portfolio of wind projects. Some examples of ways to reduce risk through various financial instruments are discussed below.

6.1 Diversified Debt/Bond Instruments

A few of those interviewed commented on FPL Energy's bond issue to recapitalize a set of operational wind projects. FPL is an unregulated subsidiary of the FPL Group Inc. and is the largest wind developer in the country with more than 4,000 MW in operation (FPL 2007). FPL is notable not only for its significant wind assets, but also for how it finances them.

In 2003, FPL issued a $380 million bond to raise money to repay a portion of its investment in a variety of wind assets. The 20-year bond instrument represents 697 MW of capacity from seven wind projects in six different states, the revenues of which support the interest payments on the bonds (FPL 2003). The bond was a success as it provided investors with a new asset class and diversification. The fact that the wind projects were either operational or under construction eliminated many of the risks associated with investing in new wind projects still in the development stage.

Based on this successful issuance, FPL was able to issue two additional bonds in 2005 for a total of $465 million under similar structures. These two bonds bundled nine separate wind projects in five different states (FPL 2005). In each instance, FPL used the proceeds from the bond issuances to refinance a portion of the original investments in the various wind projects.

While creative, this bundled approach to financing may be limited to large market participants. The FPL bonds also benefited from the corporate parent's willingness to extend certain contingent guarantees as needed to secure "investment-grade" ratings from Moody's Investors Service, and Standard & Poor's. It appears that there are at least a few developers that potentially meet these criteria (and also have more than 1,000 MW of wind). While not an exhaustive list, some examples include the Spanish utility, IBERDROLA (IBERDROLA 2008); and Horizon Wind Energy – owned by Portugal's largest electric utility (Horizon 2008). Additionally, Enel/TradeWind Energy, owned by Italy's largest power company, has a pipeline of 1,000 MW of wind in the Midwest. If all of the projects are built, they could be potentially packaged into a bond (Enel 2007b).

6.2 Equity Investment Partnerships

One way for an equity investor to reduce risk is to partner with one or more additional investors and co-invest in a project (or set of projects). This allows an investor to leverage its funds with those from other investors. The goal is a diversified investment portfolio with risk spread among a number of projects and where investment in each individual project is limited.

Equity investment partnerships are starting to take hold in the United States. The most common structure is when an investor joins with a developer to finance a pool of disparate projects. All the projects are developed by the same developer and are on approximately the same development schedule. The investor gets to take advantage of the diversity of a portfolio of projects, which often includes different electricity prices, different REC markets, uncorrelated power output from each project (seasonally and annually), as well as different siting and permitting processes. Thus, the chances of successful investment in the portfolio are improved by the diversity of these individual projects. The downside risk of one project failing or underperforming is also mitigated by this portfolio approach. This strategy is being executed by Noble Environmental Power, and Invenergy.

A slightly different structure is used by Babcock & Brown's Wind Partners (BBWP) investment fund. BBWP's portfolio consists of stakes in 76 wind farms in six countries, with a total installed capacity of approximately 2,431 MW (Babcock & Brown, 2007a). These wind farms are diversified in terms of geography, currency, equipment, supplier, customer, and regulatory regime. As such, investors get diversity with a single investment in BBWP.

In the United States, BBWP has structured nine deals where they partner with other equity investors to invest in wind projects. BBWP also owns 100% equity in another six projects. All of their investments made with partners have been as a Class B "active" investor, where a combination of Class B and Class A "passive" investors have provided equity. According to its June 2007 annual results presentation, Babcock & Brown's total equity ownership per project ranged from 50%-80% (Babcock & Brown 2007b), whereas their initial equity ownership per project ranged from 8.43%-37% (Babcock & Brown 2006). While Class A investors do not appear to be identified on the BBWP Web site, a number of the partnering Class B investment firms were identified and include Horizon Wind Energy (Zilkha), EHN US America, Babcock & Brown Wind Energy, Eurus Energy America Corp., and Catamount Energy (Babcock & Brown 2008). Of the nine projects with equity partners in this portfolio, seven-and-a-half had contracts for their electrical output,[20] most of which extended for 20 years (Babcock & Brown 2007b). By investing alongside other investors, BBWP has limited its exposure if any one of its projects has financial difficulties.

6.3 Potential Hedge Fund Interest

The renewable energy industry has introduced RECs to the marketplace – a commodity whose true value can be elusive. At times, REC revenue can be the difference between getting a project

[20] One project had a contract for 50% of its output.

financed or not. They may be considered worthless in the eyes of lenders or tax-oriented equity investors unless they are under contract for purchase by a creditworthy institution. The potential to take advantage of this disparity in valuations has piqued the interest of hedge funds, according to several of those interviewed.

Hedge funds were reportedly seeking REC streams out to 10+ years from new projects with the belief that the market was undervaluing RECs. Given the secretive nature of hedge funds, their actions are difficult to independently verify. Nonetheless, if accurate, hedge funds may create an additional source of liquidity in the REC markets, enhancing the ability of developers to monetize their REC streams and attract additional capital.

7.0 Summary and Conclusions

The expansion of renewable energy in the United States continues to increase rapidly, and a number of market factors contribute to this growth. Across the United States, public policies encourage new renewable development through economic subsidies and state-mandated renewable energy targets for electricity production. Market changes are also encouraging additional renewable development, including higher and more volatile natural gas (and associated peak power) prices, and an overall increase in the relative economic attractiveness of wind compared to more traditional fossil fuel-based generation. Additionally, renewable generators have experienced significant, long-term reductions in capital costs over time, although recent shortages have tempered some of the cost reductions for wind and solar PV. Finally, private-sector financing mechanisms have evolved to optimize the combination of these opportunities.

The combination of these conditions encourages greater deployment of renewable energy. Today, project developers are working with investors to create innovative financial structures to make the necessary capital available. Information from more than 30 interviews was compiled to identify existing and evolving financial mechanisms relevant to wind and solar PV power. Results of the interviews highlighted some general themes:

- Adequate capital is available for commercial wind and solar PV projects
  - Investors seek certainty, particularly with government policies,
  - Diversification of renewable investments (manufacturer, geography, anticipated temporal resource output, etc.) is important, and
  - The balance between debt and equity is project-specific.
- The market for financing renewables is rapidly evolving to include:
  - New market entrants (e.g., large investors, utilities as owners), and
  - New business models (e.g., consolidation, merchant models with the use of energy derivatives for partial hedging).
- Significant innovation is occurring in project financing of commercially available renewable energy technologies.
- While financing costs are coming down, material shortages have driven wind and solar PV capital costs higher. Although solar PV module supply has increased significantly since the summer of 2007, some predict at this supply-demand imbalance may persist for the next few years.

Evolving market trends are shaping the future capitalization of the industry. The industry interviews conducted also illuminated several specific financing innovations for wind and solar PV projects, including:

- Utilities are deciding to own wind, rather than just sign PPAs,
- Power from solar PV projects is being sold directly to end users on a retail basis, through the third-party ownership model.
- The financial sector is increasingly recognizing wind and solar PV as commercial, reliable technologies
- Merchant wind projects, without contracts covering their full output, are becoming a more attractive alternative,

- Derivatives are being used to partially mitigate risk, adding to the potential appeal of merchant wind,
- REC revenues are increasingly important to the success of many projects
- Solar REC revenues in states with a solar RPS set-aside are particularly important for solar PV development
- As developers are acquired or team up with larger, better capitalized companies, the financial options available to finance new renewable projects will increase.
- Investors seek diversification in a number of ways, including a variety of debt instruments, entering into equity investment partnerships and possibly partnering with hedge funds.

In general, the combination of new market entrants, new strategic investors, new tax investors, new equipment suppliers, new developers, and new buyers are changing the competitive landscape of how new wind and solar PV projects are financed in the United States. As capital continues to flow into the renewable energy sector, financial innovation is expected to continue and to substantially increase renewable technology capacity and generation.

Appendix A

Selected Interviewees

Utilities

- MidAmerican
- Oklahoma Gas and Electric
- Puget Sound Energy

Developers

- Ameresco
- Ausra
- BP Alternative Energy/Greenlight Energy
- Commonwealth Resource Management
- Endless Energy
- Great Point Energy
- IBERDROLA/Community Energy
- Noble Environmental Power
- Palmer Management Capital
- Powerlight
- SunEdison

Financial Community

- Babcock & Brown
- Birch Tree Capital
- Deutsche Bank
- Dexia
- GE Capital
- Redmont Advisors

End-use purchasers

- Bonneville Environmental Foundation
- Constellation New Energy
- Los Angeles County Public Works Department

Brokers

- Clean Power Markets
- Element Markets
- Evolution Markets
- GFI Group

Legal

- Bernstein, Cushner, and Kimmell
- Stoel Rives
- Wilmer, Hale, and Dorr

Appendix B

Citations

3 Phases 2007. "Selling Solar with RECS," Presentation by 3 Phases Energy Services, January 31, California Solar Forum, http://www.californiasolarcenter.org/pdfs/forum/2007.1.31_SolarForum_TDerrick-3PhasesEnergy_SellingSolarRECs.pdf

Ashley 2008. Greg, "SunEdison – Simplifying Solar," SunEdison VP of Sales Presentation, February. file://nrel.gov/Shared/6200/cory/resources/finance/SunEdison%20(Feb%2008)%20SC_GregAshley-SunEdison.ppt#256,1,SunEdison - Simplifying Solar

AWEA 2007a. "AWEA Quarterly Market Report: Wind Delivers Vital New Power Supply with Over 2,300 Megawatts Installed This Year to Date," American Wind Energy Association (AWEA) news release, November 7, http://www.awea.org/newsroom/releases/AWEA_Quarterly_Market_Report_110707.html

AWEA 2007b. "Wind Energy Projects Throughout the United States: Annual and Cumulative Capacity Growth Chart," Web site of the American Wind Energy Association (AWEA) http://www.awea.org/Projects/growth.xls

AWEA 2008. "Installed U.S. Wind Power Capacity Surged 45% in 2007: American Wind Energy Association Market Report," American Wind Energy Association news release, January 17, http://www.awea.org/newsroom/releases/AWEA_Market_Release_Q4_011708.html

Babcock & Brown 2006. "Annual Results Presentation," Babcock & Brown Wind Partners, September 7. http://www.bbwindpartners.com/media/167575/070906%20presentation%20pages.pdf

Babcock & Brown 2007a. "BBW Portfolio and Funding Update," Babcock & Brown Wind Partners ASX news release, December 21. http://www.bbwindpartners.com/media/322283/bbw%20211207%20portfolio%20and%20funding%20update.pdf

Babcock & Brown 2007b. "Full Year Result for the Period to 30 June 2007," Babcock & Brown Wind Partners, August 27. http://www.bbwindpartners.com/media/289598/bbw%20full%20year%20result%20for%20the%20period%20to%2030%20jun%2007%20final.pdf

Babcock & Brown 2008. "Babcock & Brown Wind Partners' USA Assets," Web site accessed January 31. http://www.bbwindpartners.com/bbw-assets/usa.aspx

Baratoff 2007. Michael C., Ian Black, Bodhi Burgess, Justin E. Felt, Matthew Garratt, Christian Guenther, "Renewable Power, Policy and the Cost of Capital: Improving Capital Market Efficiency to Support Renewable Power Generation Projects," prepared for UNEP/BASE Sustainable Finance Initiative, April. http://sefi.unep.org/fileadmin/media/sefi/docs/publications/Renewable_Power__Policy_and_the_Cost_of_Capital.pdf

Bird 2007. Lori, Leila Dagher, and Blair Swezey, "Green Power Marketing in the United States (Tenth Edition)," National Renewable Energy Laboratory technical report NREL/TP-670-42502, December, http://www.nrel.gov/docs/fy08osti/42502.pdf

BP Solar 2005. "BP Solar and Sun Edison create a new solar offer with launch of $60 million Fund. Initial projects slated for Staples, Inc. Hudson United Capital provides financing," BP Solar news release, November 28. http://www.bp.com/genericarticle.do?categoryId=3050551&contentId=7021960

Brealey 1991. Richard A. and Stewart C. Myers, *Principles of Corporate Finance* (Fourth Edition), San Francisco: Published by McGraw-Hill, Inc.

Chadbourne 2007. "The Tax Equity Market," *Project Finance NewsWire*, Chadbourne & Parke LLP, April. http://www.chadbourne.com/files/Publication/572b04b4-905e-48e1-8f6b-0f520c4f2615/Presentation/PublicationAttachment/573bdc6c-ff85-4f99-b4d0-25a845907bcc/pfn0407.pdf

Chevron 2007. "San Jose United School District, Chevron and Bank of America Establish Largest K-12 Solar Power and Energy Efficiency Program in the United States," Chevron news release, July 25, http://www.chevron.com/news/press/2007/2007-07-25a.asp

Cory 2004. Karlynn, Nils Bolgen, and Barry Sheingold, "Long-Term Revenue Support to Help Developers Secure Project Financing," paper for the American Wind Energy Association's WINDPOWER 2004 conference, March 28-31, http://www.masstech.org/renewableenergy/green_power/MGPPpaperAWEA.pdf

Cory 2007. K.S. and B. G. Swezey, "Renewable Portfolio Standards in the States: Balancing Goals and Implementation Strategies," National Renewable Energy Laboratory technical report TP-670-41409, December, http://www/nrel.gov/docs/fy08osti/41409.pdf

EI Solutions 2007. "Solar System Assessment Criteria and Case Studies," GREENTECHMEDIA webinar presentation by Paul Breslow, Director of Project Analysis at EI Solutions, November 19. http://w.on24.com/r.htm?e=97460&s=1&k=F99E77655115A3066F52C8C4DB118F85

Enel 2007a. "Fortis and Enel Sign 10 Year Power Purchase Agreement for Synder Wind Farm," Enel news release, August 13, http://www.enel.it/northamerica/boxhp.asp?IdDoc=1513658

Enel 2007b. "Enel: Wind Farm Agreements Signed in United States and Canada," Enel news release, January 5, www.enel.it/azienda_en/sala_stampa/comunicati/ss_comunicatiarticolo.asp?IdDoc=1492853

Enel 2008. "Enel, GE Soar to New Heights at Texas Wind Farm with Tallest [Turbines],"Enel news release, January 10, http://www.enel.it/northamerica/boxhp.asp?IdDoc=1525305

Evolution Markets 2007. "REC Markets – Monthly Market Update," Evolution Markets monthly publication on compliance and voluntary REC markets, December, http://www.evolutionmarkets.com/assets/mmu/mmu_rec_dec_07.pdf

FPL 2003. "FPL announces completion of subsidiary bond offering," FPL Energy news release, July 8, http://www.fplenergy.com/news/2003/contents/03076.shtml

FPL 2005. "FPL Energy announces completion of subsidiary bond offerings," FPL energy news release, February 23, http://www.fplenergy.com/news/contents/05020.shtml

FPL 2007. "FPL Energy: About Us" from the FPL Energy Web site accessed on July 6, http://www.fplenergy.com/about/contents/about_us.shtml

GREENTIE 2008. "Introduction to Project Financing," GREENTIE Web site, funded by the International energy Agency (IEA), accessed January 21, http://www.greentie.org/finance/pfintroduction.php

Grimwade 2007. John R., "Wind Project Ownership: An Investor Owned Utility Perspective," Kansas City Power & Light, presentation to ABA/ACORE teleconference, November 14, http://www.acore.org/renewableenergyinfo/includes/resource-files/john%20grimwade%20presentation.pdf

Harper 2007. John, Matthew D. Karcher and Mark Bolinger, "Wind Project Financing Structures: A Review & Comparative Analysis," Lawrence Berkeley National Laboratory technical report LBNL-63434, September. http://eetd.lbl.gov/ea/EMS/reports/63434.pdf

Horizon 2006. "Wild Horse Wind Farm on Track: First Tower Goes Up Around June 20," HORIZON NEWS, March. http://www.horizonwind.com/news/articles/2006march07.aspx

Horizon 2007. "EDP Consolidates its Position as a Leading Global Player in Renewables Through the Acquisition of Horizon Wind Energy," Horizon Wind Energy news release, March 27, http://www.horizonwind.com/news/articles/2007march27.aspx

Horizon 2008. "Horizon Wind Energy Signs Wind Turbine Supply, Service Agreements with GE Energy," Horizon Wind Energy news release, January 29, http://www.horizonwind.com/news/documents/GE-HORIZONRelease012908.pdf

IBERDROLA 2008. "IBERDROLA RENOVABLES Closed 2007 with an Operational Capacity of 7,704 MW, a 74% Increase for the Year," IBERDROLA news release, January 29 http://www.iberdrola.es/wcorp/gc/comunicacion/notasprensa/080129_OC_Potencia_en.pdf

Iowa 2001. "A bill for an act relating to electric power generation and transmission," House File 577, http://www.legis.state.ia.us/GA/79GA/Legislation/HF/00500/HF00577/Current.html

Iowa DNR 2004. "2004 Iowa Energy Plan Update: A Progress Report" by the Iowa Division of Natural Resources, http://www.iowadnr.com/energy/info/data/04plan.pdf

Kern 2000. Beth B, "The Role of Depreciation and the Investment Tax Credit in Tax Policy and Their Influence on Financial Reporting During the 20th Century," The Accounting Historians Journal, December, http://findarticles.com/p/articles/mi_qa3657/is_200012/ai_n8924641/print

McCabe 2007. Jess, "Raising the Roof," Environmental Finance, April, http://www.environmental-finance.com/2007/0704apr/roof.htm

MidAmerican 2007a. "Form 10-K: Annual Report to the Securities Exchange Commission," by MidAmerican Energy Holdings Company for the calendar year 2006, filed on March 1, http://www.secinfo.com/d1zVvb.u8.htm

MidAmerican 2007b. "Iowa Utilities Board Approves MidAmerican Energy's Plan to Build Additional Wind Energy Generation in Iowa," MidAmerican Energy Holding Company news release, July 30, http://www.midamericanenergy.com/newsroom/aspx/newsdetails.aspx?id=390&type=archive

MidAmerican 2007c. "Celebration Today of First of Its Kind Advanced Supercritical Coal-Fueled Power Plant in the United States," MidAmerican Energy Holding Company news release, August 7, http://www.midamericanenergy.com/newsroom/aspx/newsdetails.aspx?id=391&type=archive

MMA-RV 2007. "MMA Renewable Ventures Closes $39 Million in Solar Project Financing for 2006; Six Solar Projects Cap Milestone Year for Renewable Energy Finance Powerhouse," MMA Renewable Ventures news release, February 7, http://www.mmarenewableventures.com/news/docs/MMARV%20$39M%20Project%20Financing%2006%20final.pdf

MMA-RV 2008. "Portfolio: Current Projects," MMA Renewable Ventures website accessed February 15, http://www.mmarenewableventures.com/portfolio/portfolio.html.

MTC 2008. "Massachusetts Green Power Partnership," Massachusetts Technology Collaborative: Renewable Energy Trust Web site, accessed February 15, http://www.masstech.org/renewableenergy/mgpp.htm

Montara Energy Ventures, 2007. "Goldman Gets 400+% Return on Horizon Wind," Montara Energy Ventures Web site, posted March 28. http://montaraventures.com/energy/2007/03/28/goldman-gets-400-return-on-horizon-wind-investment/

NJ BPU 2007a. "New Jersey Board of Public Utilities Approves Transformation of New Jersey's Solar Market," New Jersey Board of Public Utilities statement, September 12, http://www.njcleanenergy.com/files/file/STATEMENT%20On%209%2012%2007%20BPU%20Statement%20Solar%20Transition%20FINAL.pdf

NJ BPU 2007b. "Suspension of Acceptance and Processing of New Solar Applications in CORE Rebate Program," New Jersey Board of Public Utilities Clean Energy Order, December 20, http://www.njcleanenergy.com/files/file/Core-Suspension-12-20-07-8E.pdf

NJ Clean Energy 2007. "New Jersey's Solar Financing Program Frequently Asked Questions, as Approved by the Board September 12, 2007," New Jersey's Clean Energy Program Web site, accessed January 11, http://www.cleanenergyfunds.org/library/nj/NJ_SOLAR-Transition_FAQs_091207.pdf

NJ Clean Energy 2008. "SREC Pricing: SREC Trading Statistics," New Jersey's Clean Energy Program Web site, accessed February 4, http://www.njcleanenergy.com/renewable-energy/programs/solar-renewable-energy-certificates-srec/pricing/pricing

NREL-draft 2005. "DRAFT Renewable Energy Cost Trends: Levelized Cost of Energy in Constant 2005$," created by the National Renewable Energy Laboratory (NREL) Energy Analysis Office (now the Strategic Energy Analysis and Applications Center), http://www.nrel.gov/analysis/

OGE 2007. "Form 10-K: Annual Report to the Securities Exchange Commission," by Oklahoma Gas & Electric for the calendar year 2006, filed on February 16, http://www.secinfo.com/d28De.u7.htm

PSE 2007. "Form 10-K: Annual Report to the Securities Exchange Commission," by Puget Energy Inc. and Puget Sound Energy Inc. for the calendar year 2006, filed on March 31, http://www.secinfo.com/d113uv.un.htm

Saintcross 2007. Personal communication with John Saintcross, New York RPS administrator at the New York State Energy Research and Development Authority in July 2007.

SEIA 2006. "2006 U.S. Solar Industry Year in Review: U.S. Solar Energy Industry Charging Ahead," http://www.seia.org/Year_in_Solar_2006.pdf

SunEdison 2006. "SunEdison Announces Capital Raise: Goldman Sachs as Lead Investor," SunEdison news release, June 15. http://www.sunedison.com/pdf/061506-gs.pdf

SunEdison 2007. "Kohl's Activates Largest Rooftop Solar Rollout in U.S. History," SunEdison news release, September 26, http://www.sunedison.com/images/press/092607-kohls.pdf

SunPower 2007. "Macy's Launches 28-Store SunPower Solar Power Program in Westminster," SunPower news release, September 28, http://investors.sunpowercorp.com/releasedetail.cfm?ReleaseID=266457

Wal-Mart 2007. "Wal-Mart Announces Solar Power Pilot Project," Wal-Mart news release, May 7, http://www.walmartfacts.com/articles/5008.aspx

Wiser 2007. Ryan and Mark Bolinger, "Annual Report on U.S. Wind Power Installation, Cost and Performance Trends: 2006," U.S. Department of Energy's Office of Energy Efficiency and Renewable Energy, May. http://www1.eere.energy.gov/windandhydro/pdfs/41435.pdf

WRI 2004. "The Solar Services Model: An Innovative Financing Approach to On-Site Photovoltaics," Green Power Market Development Group – Corporate Case Studies, http://www.thegreenpowergroup.org/pdf/case_studies_Staples_2.pdf

REPORT DOCUMENTATION PAGE			*Form Approved* *OMB No. 0704-0188*

1. REPORT DATE *(DD-MM-YYYY)*
February 2008

2. REPORT TYPE
Technical Report

3. DATES COVERED *(From - To)*

4. TITLE AND SUBTITLE
Innovations in Wind and Solar PV Financing

5a. CONTRACT NUMBER
DE-AC36-99-GO10337

5b. GRANT NUMBER

5c. PROGRAM ELEMENT NUMBER

6. AUTHOR(S)
K. Cory, J. Coughlin, T. Jenkin, J. Pater, and B. Swezey

5d. PROJECT NUMBER
NREL/TP-670-42919

5e. TASK NUMBER
ASA6.2004

5f. WORK UNIT NUMBER

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)
National Renewable Energy Laboratory
1617 Cole Blvd.
Golden, CO 80401-3393

8. PERFORMING ORGANIZATION REPORT NUMBER
NREL/TP-670-42919

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)

10. SPONSOR/MONITOR'S ACRONYM(S)
NREL

11. SPONSORING/MONITORING AGENCY REPORT NUMBER

12. DISTRIBUTION AVAILABILITY STATEMENT
National Technical Information Service
U.S. Department of Commerce
5285 Port Royal Road
Springfield, VA 22161

13. SUPPLEMENTARY NOTES

14. ABSTRACT *(Maximum 200 Words)*
There is growing national interest in renewable energy development based on the economic, environmental, and security benefits that these resources provide. Historically, greater development of our domestic renewable energy resources has faced a number of hurdles, primarily related to cost, regulation, and financing. With the recent sustained increase in the costs and associated volatility of fossil fuels, the economics of renewable energy technologies have become increasingly attractive to investors, both large and small. As a result, new entrants are investing in renewable energy and new business models are emerging. This study surveys some of the current issues related to wind and solar photovoltaic (PV) energy project financing in the electric power industry, and identifies both barriers to and opportunities for increased investment.

15. SUBJECT TERMS
NREL; innovative financing; renewable energy certificates; RECs; renewable portfolio standard; RPS; power purchase agreements; PPAs; investory-owned utilities; solar PV; photovoltaics; wind; analysis; Karlynn Cory, Jason Coughlin, Thomas Jenkin, Jane Pater, Blair Swezey

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT	b. ABSTRACT	c. THIS PAGE			
Unclassified	Unclassified	Unclassified	UL		19b. TELEPHONE NUMBER (*Include area code*)

Standard Form 298 (Rev. 8/98)
Prescribed by ANSI Std. Z39.18

F1146-E(12/2004)