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INVESTING IN THE RENEWABLE POWER MARKET

How to Profit from Energy Tranformation

TOM FOGARTY and ROBERT LAMB

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To Yayoi and Atticus

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T.F and R. L.

Introduction

This book was written to help investors, energy practitioners, and students understand the limits of renewable power. It is intended to help the reader learn how to evaluate renewable power investments by reviewing the technical and economic issues for fossil power as well as wind, solar, thermal, and other renewable power technologies.

Together, we bring both an academic and a practitioner perspective to this book. Tom is an energy executive at a major international energy corporation. He was a financial-management and energy consultant and a former executive MBA student of Professor Bob Lamb. Bob has published books and chapters on energy, finance, and strategic management. He has been debt adviser to New York Power Authority, the U.S. government, various states, public authorities, and corporations. Bob has also served as expert witness in litigations and arbitrations. Tom and Bob have jointly collaborated on a number of energy projects. Both of us, in our work and experience, were frustrated that there was not a text available to soberly evaluate renewable power investments in today's complex energy environment.

The global energy markets have never been so complex and fast changing. The United States has recently discovered very large amounts of shale gas embedded in solid rock formations extending from New York to Texas and California. That shale gas is extractable via new technologies. There is a concern that this plentiful and currently cheap natural gas could make the United States complacent about its energy future. The development and use of hydraulic fracturing has made shale gas an energy game changer. This new natural gas supply makes the overall economics difficult for renewable energies and for coal and nuclear power plants.

In fact, the solar company Solyndra filed for bankruptcy at the end of August 2011 despite having received a 2009 cash grant of $535 million from the U.S. Treasury. Beacon Power, a manufacturer of flywheel based energy storage systems also filed for bankruptcy on October 31, 2011. The extensive U.S. natural gas pipeline and storage infrastructure have made shale gas an immediate player in the energy marketplace. Other countries are also discovering shale gas supplies but might not have the infrastructure to distribute it to end users.

Even more important, these national, political, and social conflicts have been taking place simultaneously with the rapid pace of several major new technology changes and broad, intense global ramp-ups of various types of unconventional energy, gas, shale gas, tar sands extraction, innovations at ultra-deep horizontal wells. Oil and gas drilling innovations in semi-submersibles and arctic drilling platforms.

The major Japanese earthquake, tsunami, and the Fukushima Daiichi nuclear power plant "meltdown," along with Germany's decision to close its nuclear reactors, are deeply impacting the worldwide nuclear power industry. In the United States, the Indian Point nuclear power plant operating license extension is being challenged by various New York state agencies. Their concern is that the facility is too close to New York City.

This book is meant to be a current, realistic analysis of the various changes in the development of renewable energy technologies and how these technologies compare to fossil energy production, energy storage technologies, and energy transmission and demand-side management. One of the most important points of this book is to stress the essential need for multiple types of energy plus coordination mechanisms across both nations and continents. Countries continue to take an approach of either all coal or all nuclear and, more recently, all natural gas. We will need all energy sources in the future.

World scientists now appear to be in agreement that global warming is not solely in evidence in the melting of the polar ice caps but is in evidence in the radical changes in global weather conditions. Little progress has been made despite more than a decade of intense international conferences and pledges of global support for concerted efforts to finally cope with the risks and very clear dangers of global climate changes. They are concerned about record winter snowstorms, record spring rains, record flooding, record droughts and famines, and the escalation of record number of global earthquakes.

Another vital energy and health challenge is that there exists no available technology to economically remove and sequester CO_2 at scale. This point never seems to be made during discussions of climate change.

Due to major budget deficits, the United States and Europe have now been or will be forced to drastically cut back major expenditures on their "various green energy initiatives." The U.S. "1603 cash grant for renewable power plants" will finish at the end of 2011 and is unlikely to be extended in the current political environment.

U.S. states continue to be unrealistic on the size of their renewable energy portfolio standards. Some have gone so far as to count on renewable facilities that would be built in other states. China is currently willing to subsidize the production of solar power plant technology. This will force the United States to continue to be an innovator and to look at China as a partner and not a competitor.

Economic downturns in Spain forced the government to cancel direct government subsidies plus energy grants for solar panels and wind farms. Eliminating energy feed-in tariffs would leave many major energy companies with losses. It raises important questions about whether most new green energy programs generally will be a victim of the long-term U.S. and European recession economies.

Let's start with Chapter 1, where we provide the reader with the fundamentals of evaluating renewable power.

CHAPTER 1

An Overview of Renewable Power

The Walrus and the Carpenter were walking close at hand; They wept like anything to see Such quantities of sand: "If this were only cleared away," They said, "it would be grand!"

"If seven maids with seven mops Swept it for half a year. Do you suppose," the Walrus said, "That they could get it clear?" "I doubt it," said the Carpenter, And shed a bitter tear.

—from *Through the Looking Glass*, Lewis Carroll

Wind, solar, and geothermal renewable power technologies face a number of technological challenges. A typical wind power project has yearly availability only in the low 30 percent range and a typical solar photovoltaic project has an availability of approximately 16 percent. For further clarification, a 100–megawatt (mW) wind project could produce only 262,800 megawatt hours (mWh) in one year (e.g., 100 mW $\times$ 365 days/yr $\times$ 24 hours/day $\times$ 30 percent $=$ 262,800 mWh). Solar thermal projects have a higher availability but are more expensive, have regulatory permitting challenges, and are typically not located in liquid power trading markets.

Electricity, unlike other commodities, can't be stored, which leads to a large amount of volatility in electricity prices. It is important to remember that current battery technology is only capable of storing electricity for up to four hours. Switching the world's energy supply to renewable power is not like starting the next Google. It is not a case of placing five or six smart boys and girls in a room and asking them to think up the next clean energy technology. Older facilities are endowed with a scarcity value due to the difficulty of obtaining air permits for new fossil power plants. These are a number of the issues that make it difficult for renewable power plants to be competitive with traditional fossil power plants.

The economic profile of a typical wind and solar power project is a small amount of earnings before interest, taxes, depreciation, and amortization (EBITDA), tax credits, and accelerated depreciation. Only EBITDA can be used to pay down debt, and overestimating kilowatt hours (kWh) produced or underestimating maintenance expense can lead to a debt default. Since there is currently no inexpensive, high-capacity battery technology, it is not possible to run the electric grid with wind and solar power on a 24/7 basis. For the next few years, the economics for these types of projects will work when constructed projects can be purchased on a distressed basis for cents on the dollar. An October 16, 2009, *Forbes* article stated that the U.S. Energy Information Administration estimates that a kilowatt hour of electricity from a photovoltaic (PV) solar plant entering service in 2016 will cost 40 cents/kWh in 2009 dollars. The article further stated that this is three to five times the projected cost of electricity generated from natural gas, coal, or uranium.[1]

Other than battery technology, the only way to firm up the power produced from these facilities is to use gas turbine engines. One study under development will show that a gas turbine engine that provides backup to a wind power plant actually produced more carbon dioxide (CO_2) emissions than a coal-fired power plant. A gas turbine engine would also require a local supply of natural gas and pipeline transportation, which might not be available. Improvements in gas turbine engine design might also be required to meet both quick-start and a low-emission profile. There is also a shortage of electric transmission in locations where there is potential for wind power projects.

IT'S ALL ABOUT NATURAL GAS

A key challenge is that prices for renewable power in the United States are priced off of natural gas, which is currently at historic lows. Recent large unconventional natural gas finds throughout the United States should continue to support natural gas prices below $7 per million British Thermal Units (MMBtu).

The Energy Information Administration estimates that the United States has approximately 1,770 trillion cubic feet (Tcf) of technically recoverable gas, including 238 Tcf of proven reserves. The Potential Gas Committee estimates total U.S. gas resources at 2,074 Tcf. It is estimated that technically recoverable unconventional gas including shale accounts for nearly two-thirds of American onshore gas resources. At the current production rates, "the current

[1] Duncan Greenberg, "Seeing the Light," *Forbes*, October 19, 2009.

recoverable resource estimate provides enough natural gas to supply the United States for the next 90 years."[2] In 1996, it was estimated that the Barnett Shale contained only 3 Tcf of reserves. As a result of an upgrade in technology, it was estimated in 2006 that it now contains 39 Tcf. The natural gas was always there; it was just not possible to get to it with older technology. At the time of this writing, this new supply of natural gas has resulted in natural gas prices in the $4/MMBtu price range. This is a large drop from $13.57/MMBtu in the summer of 2008. The economics for natural gas storage projects still appear to work since there has been weekly and seasonal movement in price.

This unconventional natural gas supply situation has resulted in the return on equity for renewable power plants to be actually lower than the return from purchasing a secured loan in some existing natural gas–fired power producers. That an equity security in the bottom of the capital structure of a yet-to-be-constructed power plant could require a lower return than a first lien secured loan in an operating gas-fired power plant doesn't make sense. This situation is similar to the real estate crisis, whereby real estate market mortgage loans written prior to 2007 were priced at levels that didn't reflect their risk and ultimately defaulted. This situation means that in the short term it makes sense to bet against renewables as opposed to developing or investing in new projects. By comparison, renewable power producers in Europe are currently paid a very high fixed price for power under the national government's feed-in tariff program. This situation is also unsustainable. A May 20, 2010, *Bloomberg* article entitled "Greek Crisis and Euro's Drop Snare Clean-Energy Stocks" stated:

> *. . . The aid to renewable energy, paid by consumers through their power bills, is being slashed by governments aiming to curb their own budget deficits and to cut energy costs for businesses and consumers. . . .*[3]

CONTROL OF CO_2 EMISSIONS IS NOT CURRENTLY POSSIBLE

Another challenge that renewable power faces is that there is currently no proven technology to remove CO_2 emissions from existing power plants. This is a critical fact that makes it difficult to switch from traditional fossil

[2] John D. Podesta and Timothy E. Wirth, *Natural Gas: A Bridge Fuel for the 21st Century* (Washington, DC: Center for American Progress, August 10, 2009).
[3] Ben Sills and Mark Scott, "Greek Crisis and Euro's Drop Snare Clean-Energy Stocks," *Bloomberg*, May 20, 2010.