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[Link Foundation Fellowship Final Report]

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Introduction

My research seeks to understand investment decision making in the electric power sector as it relates to wind energy and, ultimately, other forms of renewable energy, by investigating investor attitudes, preferences, and behavior.

One strand of my research focuses on industry response to political uncertainty. One piece of this research addresses current policy incentives for wind energy. The primary source of current support for renewable energy, the federal production tax credit (PTC), typically gets renewed on a short-term basis (one to two years at a time), creating regular intervals of uncertainty about future policy. My research investigates the relationship between this uncertainty and the boom-bust cycle of wind plant investment.

Another piece of this research focuses on uncertainty over future climate change policy. Ironically, as the debate over climate change has heated up over the past few years and legislation in the U.S. becomes increasingly likely, the fuel of choice in the electric power industry has shifted away from natural gas, a relatively clean fuel, and interest in coal plant development has surged. While logical with respect to current fuel prices (natural gas prices have risen and remained high, making coal attractive), this shift ignores the climate change debate. As a very carbon-intensive fossil fuel, coal would be strongly impacted by future carbon legislation, and yet current enthusiasm for coal plant development appears not to take this risk into consideration. My research investigates industry response to the logic of “carbon risk” (the risk that future carbon policy will have a negative financial impact on fossil fuel plants).

A second strand of my research focuses on behavioral biases in financial decision making. One example is the “wishful expectations” bias, first observed by Ito (1990, *AER* 80(3): 434), who found that among people in the import-export business, views on future yen-dollar exchange rates correlated with whether they were on the import or export side of business, with expectations matching hope/self-interest. My research investigates similar biases in the energy sector between fuel price expectations and economic interests and between fuel development predictions and preferences.

A third strand of my research, focused on valuing strategic opportunities in wind energy investment using a real options framework, is still under way.

Results

The major result of this research to date is an extensive online survey of energy professionals completed in 2006. The first wave of this survey (May) was sent to over four thousand people in the wind industry (attendees of various wind energy conferences, including the American Wind Energy Association (AWEA)’s annual Wind Power conference). The second wave (June-September) was sent to nearly six thousand professionals in the general electric power sector (all fuel sources). The combined survey yielded 847 responses, with ca. 700-800 people responding to most questions.

The survey covers a wide variety of pertinent topics in the electric power industry, including views on various fuel sources and technologies, fuel price predictions, climate change, energy policy, incentives for renewable energy investment, financial modeling methodology, and power project risk factors and investment motives, as well as respondents' demographic and professional background and experience.

Results from this survey have been presented at AWEA's 2006 and 2007 Wind Power conferences, in the wind industry literature, at the American Association for the Advancement of Science (AAAS) 2007 annual meeting, and at the US Association of Energy Economics (USAEE) 2007 annual meeting (upcoming).

In addition to the survey, ca. 20 in-depth interviews with power sector professionals have been conducted.

Some of the overall findings from the survey include:

- Respondents expect coal to dominate new power plant development over the next 10-15 years, followed by natural gas, with nuclear and renewables last.
- Among renewables, wind is expected to dominate new plant development.
- Contrary to expectations, respondents' *preferences* put renewables and nuclear above natural gas and conventional coal.
- The majority of respondents view global warming as a serious or very serious threat.
- Respondents expect natural gas prices to remain high and similarly volatile to recent years.

Data analysis to date has focused on two areas of political uncertainty:

1) Impact of PTC uncertainty on wind plant investment

It is generally understood that the pattern of repeated expiration and short-term renewal of the federal production tax credit (PTC) causes a boom-bust cycle in wind plant investment in the U.S. This on-off pattern is detrimental to the wind industry because ramp-up and ramp-down costs are high and players, particularly equipment manufacturers, are deterred from making long-term investments.

It is widely assumed that the severe downturn in investment during "off" years is evidence that wind power is unviable without the PTC. However, as my research demonstrates, the volatility of investment associated with the PTC is unrelated to the underlying economics of wind; instead it is due to the dynamic of power purchase agreement (PPA) negotiations in the face of uncertainty. These findings are derived using a strategic negotiations model, supplemented with survey evidence. The research goes on to consider alternatives to the PTC, presenting survey respondents' views on the relative stability and efficacy of various types of policy incentives.

2) Industry response to the logic of "carbon risk"

Preliminary results from the energy survey suggest that respondents expect existing plants—and “permitted but not yet constructed” may be sufficient to be considered “existing”—to qualify for some form of grandfathering (exemption) under carbon legislation. Additionally, most respondents expect that the costs of carbon regulation compliance will be passed onto the consumer. These results suggest a logic for why coal plant investment could be experiencing significant momentum, even with carbon legislation looming on the horizon.

Significance and Impact

In the field of public policy, my research addresses the important area of policy uncertainty in understanding the impact of government policy on industry. By highlighting the critical distinction between responses to the process of making policy (which is fraught with uncertainty) and responses to the policy itself, this research can help policymakers avoid unintended consequences of policymaking by focusing first and foremost on creating an environment of certainty.

In the field of behavioral economics, my research will contribute to a better understanding of behavioral biases in decision making through evidence in the energy sector.

Where might this lead?

The survey of energy professionals has generated an extensive data set which will serve as the basis for ongoing research over the next several years.

Ongoing elements of this research include:

1) Additional behavioral elements of investment-decision making

- Analyzing respondents’ perspectives and motives associated with project development in order to understand the drivers behind investment in new technologies;
- Analyzing respondents’ choice of risk factors for inclusion in their financial modeling methodology in order to understand how qualitative attitudes translate into quantitative assessment

2) Case study on strategic intangibles

A company’s choice of technology for new power plant investment is influenced by the company’s portfolio of assets and broader corporate strategy. My research includes a case study using real options analysis to quantify the value of strategic “intangibles,” including:

- plant modularity/flexibility
- public image/positioning to meet green demand
- ability to respond to uncertain policy scenarios
- first-mover access to best wind sites/key relationships

Publications

Barradale, MJ (2007). *The Logic of Carbon Risk*, Presentation at Symposium on Decision Making Under Climate Uncertainty, Society for Judgment and Decision Making Annual Meeting, November (submitted).

Barradale, MJ (2007). *Impact of Policy Uncertainty on Renewable Energy Investment: Wind Power and PTC*, Presentation at 27th USAEE/IAEE North American Conference, “Developing & Delivering Affordable Energy in the 21st Century,” September 16-19, Houston, TX (upcoming).

Barradale, MJ (2007). *The Myth of Wind Industry Dependence on the PTC*, Poster presented at WINDPOWER 2007, June 3-6, Los Angeles, CA.

Barradale, MJ (2007). *Results from 2006 Survey of Energy Professionals*, Poster presented at AAAS Annual Meeting, February 15-19, San Francisco, CA.

Jones, M (2006). “Survey Respondents Still Confident in a Post-PTC World,” *North American Windpower*, Vol. 3, No. 8, September, pp. 30-32, 46.

Jones, M (2006). *Results from 2006 Survey of Wind Conference Attendees*, Poster presented at WINDPOWER 2006, June 4-7, Pittsburgh, PA.

Statement of Discretionary Funds

Funds were used primarily to attend energy industry conferences, both as a way to meet interviewees and survey respondents, and in order to present research results. Funds were also used to buy some computer software and digital recording equipment for conducting interviews and to pay monthly subscription fees for online survey services.

Making a difference

The fellowship enabled me to conduct an extensive survey of energy professionals at a rigorous level. Crucially, I was able to tell my interviewees and survey respondents that I was funded through an independent academic fellowship and that I was *not* industry-sponsored. This made a significant difference in gaining people’s willingness to participate in my research.