Thesis Proposal: To what extent does policy support of renewable energy reflect a net benefit to society?

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This thesis proposal is submitted to the Department of Business and Social Sciences, Aarhus University, in partial fulfillment of the requirements of the PhD degree.

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Introduction

Policy support for renewable energy is an intensely debated, but integral part of any current energy policy. Optimal policy design is elusive, as the appropriate energy mix is highly dependent on local characteristics but is necessarily determined at national or even international levels. Increasing policy support for renewable energy reflects the assumption that an increased share of renewables in the energy supply is considered a net benefit to society. Arguments both supporting and opposing this claim abound. The energy market is perhaps the perfect example of an imperfect market, where the magnitude and multitude of immeasurable spillover effects is only rivaled by the social, political and economic necessity of a stable, affordable energy supply.

This Industrial Ph.D. investigates the claim that renewable energy investments are a net benefit to society in an applied case study of a renewable energy technology (RET) with favored status in policy support in Germany, Denmark and the United Kingdom (UK). Characteristics of the considered RET include:

- Onsite generation (energy generation at the point of consumption – minimizing waste)
- Combined heat and power (maximizing energy efficiency – full utilization of the fuel energy content)
- Small-scale (use of local resources – minimizing fuel transport and stimulating the local economy)

Additionally, the technology is a new entry in the market with few suppliers and little direct competition (Carrara, 2010), which is assumed to reduce the level of bias from corporate lobbying on the level of policy support. Specifically, the high rates of policy support for both solar and wind technologies could be partially motivated by strong industrial lobbying factions as well as their perceived net benefit to society. By using a case study of a little-known technology, it is assumed that the level of policy support available primarily reflects the assumed net benefit such an application would bring.

The closest identified alternative for the private investor seeking to purchase the described RET is a natural gas fuelled combined heat and power unit, and the decision to invest in the RET considered is strongly affected by the economic returns to the private investor. National support mechanisms therefore have a direct impact on the decision to invest in the RET over the fossil-fuelled alternative.

Using cost benefit analysis (CBA) and investment modeling, it is possible to compare and contrast the net social benefit of the RET investment relative to the financial gain to the private investor. Using the same RET scenario in three neighboring countries, Denmark, Germany and the UK, it will be possible to determine to what extent a net social benefit is captured and transferred to the private investor via policy support in each country. An analysis at this level of detail allows the capture of not only explicit financial policy incentives but also implicit market support and barriers.

Structure of thesis proposal

An overview of the expected papers resulting from this Ph.D. study is given below. A brief description of each, including a progress overview, is given in the pages following. Particulars of the Industrial Ph.D. program are given along with an estimated timeline for completion of various requirements, including course work, stay abroad, dissemination requirements and conference presentations.

Paper overview

1. A policy analysis paper comparing the policy support for renewable electricity relative to renewable heat in Denmark, Germany and the UK; (work in progress)
2. An investment analysis paper investigating the bias against RETs from incorrect applications of the internal rate of return (IRR) (work in progress)
3. A country comparison of the differences between private investor returns for Denmark, Germany and the UK for the same RET case study (work in progress – submission to the European Biomass Conference 2012)
4. A case study comparison between a CBA and a private investor analysis of the same RET application
5. A country comparison of the differences between CBAs and private investor returns for Denmark, Germany and the UK for the same RET case study
6. Cointegration of biological oils with diesel/gasoline (joint paper with Professor Jan Bentzen)

Paper 1: Why is policy support promoting renewable heat significantly different from policy support promoting renewable electricity? A closer look at Denmark, Germany and the UK

The European Union (EU) Directive 2009/28/EC (2009 Directive) promotes the use of policy support to encourage market demand for renewable energy. The scope and scale of these is primarily left up to the individual member states, with the caveat that certain targets are reached by 2020 and a biannual progress report is submitted for review. A recent report, qualitatively assessing policies promoting renewable energy sources for heating and cooling (RES-HC), concludes that significant changes are required in all member states if the RES-HC targets from the 2009 Directive are to be achieved (Bürger et al., 2011). This corresponds with the findings from Klessmann et al. (2011) that policies promoting renewable heat are less effective overall than those promoting renewable electricity.

Optimal policy design for the promotion of renewable energy is intensely discussed in the literature (for example, see Loock, 2012; Bürer and Wüstenhagen, 2009; Wiser and Pickle, 1998). Particular emphasis is placed on the design and impact of feed-in tariffs[1] (Couture and Gagnon, 2010). A survey completed by Bürer and Wüstenhagen (2009) of 60 European and North American private equity investors highlighted that policies like feed-in tariffs were considered an important way to encourage renewable energy technologies (RETs). Klessmann et al (2011) find feed-in tariffs can be effective policies, but that success depends on policy design and market characteristics. Feed-in tariffs are rarely used to promote RES-HC; this may due to differences in market characteristics, although the

[1] Feed-in tariffs in this paper refer to financial support schemes offering a predetermined renumeration based on energy generated or delivered.

recent launch of the Renewable Heat Incentive (RHI) in the United Kingdom (UK) would suggest that these differences are not insurmountable.

Given the need for rethinking the design of RES-HC policies to ensure that the 2020 targets are met, a comparison of existing characteristics and active policies in the renewable electricity and heating markets is in order. No satisfactory explanation for the differences in design between policies for heat and the policies for electricity has been found in the existing literature.

This paper contributes to the existing literature by explicitly comparing the policies promoting renewable heat and renewable electricity in Denmark, German and the UK. Whether the differences between the policies applicable to the two segments are adequately explained by the inherent characteristics of the markets is assessed. If possible, suggestions on possible improvements to RES-HC policies are given.

Paper 2: Investigating possible bias issues arising from improper use of the internal rate of return

The internal rate of return (IRR) is, together with net present value (NPV), the most commonly used investment decision tool for management (Ryan and Ryan, 2002). Presented as a simple percentage, it is an easily grasped concept which readily lends itself to investment comparisons.

The IRR is often used in conjunction with net present value (NPV) calculations to estimate the benefit of a given investment decision. Simply put, the IRR is the rate at which the benefits from an investment are equal to the investment itself. Key issues with the IRR calculation arise from the implicit reinvestment assumption, ranking of mutually exclusive projects and the potential for multiple IRRs.

These issues can lead to bias in the investment decision, particularly when applied to energy investment decisions where mutually exclusive projects with different investment costs and different lifetimes are compared. Almost all renewable energy technologies share the characteristics of initial high capital costs followed by a stream of relatively low variable costs over the lifetime of the investment, contrary to fossil fuel technologies (FFTs), which are generally characterized by initial low capital costs with relatively higher lifetime variable costs (partially due to the use of high-cost fuels).

This paper will explore the potential for bias in the investment decision of a high-capital cost RET against a low-capital cost FFT. Particularly, the overstatement of benefits suggested by high IRRs is shown relative to the NPV.

This paper contributes to the existing literature by arguing the existence of an implicit barrier to investments in RETs caused by the way investment decisions are generally made. Investors in particular should be made aware of the dangers in using IRR when facing RET investment decisions.

Paper 3: Comparison of investment cases for Denmark, Germany and the UK: A case study

There is significant debate about the optimal design of financial support schemes to promote the use of biomass in energy generation. Rather than contributing to the extensive theoretical literature on the subject, this paper provides a case study of the impact of current schemes in Denmark, Germany and the UK on the economic viability of an onsite biomass energy technology.

Whether the financial support for the same technology in each of the three countries effectively overcomes the hurdle rate for the decision to invest is discussed. Although the technology application is the same in all three cases, the structural differences between the three countries results in differences in the amount and type of support offered.

This work highlights the importance of designing policies which are closely aligned with national characteristics and criteria.

Approach

Investment cases are prepared for a wood chip combined heat and power plant with an electrical capacity of 140 kW and a thermal capacity of 560 kW, for a general case in Denmark, Germany and the UK. Existing financial support schemes are included for each of the three countries. The impact of the support schemes on the net present value in each case is assessed.

Differences between the three countries are discussed, especially in regard to differences in national energy prices, renewable energy ambitions and existing energy structures.

Scientific innovation and relevance

While significant literature exists on barriers to renewable energy uptake, policy design and the promotion of technological innovation, few papers deal with the investor perspective on renewable energy policy design (Dinica 2006; Bührer and Wüstenhagen 2009, Loock 2010).The literature review revealed no papers on whether a given financial support scheme was successful in promoting the decision to invest for the individual investor.

The contribution of this paper is therefore: to illustrate exactly how financial support schemes affect the decision of the investor to invest or not invest; to compare the impact on the investment decision across Denmark, Germany and the UK; and to discuss the significance of the financial support schemes relative to the existing market conditions.

Results

Only investment cases for Germany and the UK have been prepared at this point. Despite higher natural gas prices and lower biomass prices, returns to investment in Germany are lower than in the UK. The use of biomass for modern energy generation is not widespread in the UK, which corresponds with a necessity for policy to support a higher rate of return on investment scenarios; Germany has a long history with bioenergy projects, which suggests familiarity with biomass projects and therefore a lower risk evaluation.

Conclusions

Without significant policy support, market development in distributed combined heat and power generation from renewable sources would be severely hampered.

Particulars of the Industrial PhD Program

General Information

The Industrial PhD program is a business oriented research project conducted with a private company. The research project spans three years and the student involved must follow the general requirements of the associated university. The project is funded jointly by the private company and the Danish Agency for Science, Technology and Innovation (Agency).

Unlike a regular PhD project, the student is only enrolled at the university and not employed by the university, which means the regular teaching requirement does not have to be fulfilled. Instead, the student is required to spend her time equally between the company and the university.

The student is still required to take 30 ECTS of courses, of which 7.5 ECTS must come from the obligatory Industrial PhD Business Course offered by the Agency. In addition, the student is required gain experience in disseminating knowledge which, to the extent possible, is directly related to their PhD project, in accordance with the Executive Order on PhD Programmes, Part 3, § 7.

Current Status

At the request of my host company, Stirling.DK ApS, I took a leave of absence for a period of six months from 01 May 2011 to 01 November 2011, eight months into my PhD project. Up to this point, I had focused on gaining company- and industry-specific knowledge by spending 80% of my time at the company.

In order to fully capitalize on my value to the company, I was awarded the mid-level management position “Head of Marketing” three months after beginning the project. My position is well suited for the requirements of the Industrial PhD, focusing on expert understanding of the markets for RETs in the company’s core markets and disseminating to both internal and external audiences.

Over the course of the next year, I plan on fulfilling 15-20 ECTS of course work and completing a minimum of three articles. Paper 3, outlined above, is being submitted to the 20th European Biomass Conference, due to be held in June 2012, and will hopefully result in an invitation to present at the conference. In order to fulfill these academic objectives I currently only spend 40% of my time at the company and will continue to do so for the forseeable future.

My stay abroad will preferably be at one of the key energy research centres in Europe. I will begin applying for these by summer, as I wish to complete my first paper beforehand.

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