When energy policy meets free-market capitalists:

The moderating influence of worldviews on risk perception and investment decisions

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Abstract

Several countries have set targets and implemented policies to increase the share of renewable energy sources. Whether or not those targets will eventually be met critically hinges upon the effectiveness of policies to mobilize private investment. An implicit assumption shared by many policy makers is that there is a positive correlation between renewable energy policies and private investment. However, just as energy policy can create opportunities, it can also create risk, and perceptions may differ between policy makers and investors. This paper adds to a growing stream of research in *Energy Policy* that empirically investigates investor perceptions of policies, and their influence on investment decision-making. Based on a survey of 29 venture capital investors conducting 1,064 experimental investment decisions, we show that high levels of regulatory exposure have a significantly negative effect on their likelihood to invest in renewable energy. However, venture capitalists are less risk-averse when it comes to low levels of regulatory exposure. Our findings suggest

that investors' worldviews are an important moderating factor: respondents who expose strong "free-market" worldviews are more risk-averse under high levels of regulatory exposure than other investors.

Keywords: Regulatory exposure, worldview, venture capital.

1 Introduction

An extrapolation of current energy trends into the future is not sustainable. A culmination of increasing concerns about climate change, the nuclear accident in Fukushima, and discussions on energy security in a world with growing energy demand have led to a call for increasing the share of renewable energy. Building up a cleaner energy infrastructure requires significant investment. UNEP (2012) reports that total global investment in renewable energy was $257 billion in 2011, which is an increase of 17% compared to 2010. While this is remarkable, it is not enough to meet the renewable energy targets. The International Energy Agency estimates that $26 trillion need to be invested in energy infrastructure by 2030, and that this number increases to $36 trillion if the goal of stabilizing the atmosphere at below 2 degrees is to be met (IEA, 2012). Thus, despite lively government activity to promote renewable energy, current policies seem not to spur the required levels of investment. Worse still, conventional energy projects still attract at least similar amounts of investment as the cleaner sources of energy that would secure a sustainable future.

At least two factors have been offered to explain the puzzling gap between renewable energy targets and actual levels of investment. First, recent research has pointed to the importance of policy risk (Mitchell et al., 2006; Lüthi and Wüstenhagen, 2012). While policy makers tend to assume that political incentives create opportunities for renewable energy investors, those policies might actually be viewed as a possible source of risk by investors, leading to disappointing levels of capital flowing into the sector. Second, recent work inspired by behavioural economics suggests that a purely rational risk-return perspective may fall short of explaining the observed investment behaviour and how it is influenced by energy policy. Real-world investor decision-making in the energy industry seems to be more characterized by bounded rationality

(Simon, 1955) leading to path dependence and carbon lock-in (Unruh, 2000). Focusing on one particular type of investor, venture capitalists, we investigate a specific "behavioural" effect, namely whether investors' general attitudes toward the role of government, their worldviews, influence their level of risk perception with respect to regulatory exposure, and thus negatively influence investment in renewable energy. Based on an adaptive choice-based conjoint (ACBC) analysis with 29 venture capitalists from the United States and Europe conducting 1,064 experimental investment decisions, we address the following research questions: What impact does regulatory exposure have on the decision to invest in renewable energy, and to what extent is this impact moderated by investors' worldviews? Our results show that high regulatory exposure has a negative influence on investment decisions in renewable energy. We further provide empirical evidence that investors' worldviews on government involvement in markets moderate the relationship between regulatory exposure and the decision to invest in renewable energy. Investors with a "free-market" worldview perceive risks induced by high regulatory exposure more pronounced than other investors.

2 Literature review

2.1 Policy makers versus investors – two perspectives on energy policy

A general assumption behind the introduction of renewable energy policies is that investors are more likely to invest in renewable energies in the presence of such policies than they would be in their absence. For example, in the case of feed-in tariffs or investment incentives, policies are designed to provide attractive returns to

renewable energy investors. Policy makers tend to pay less attention to the other side of the equation, i.e. the implications of policy risk on investments (cf. Figure 1).

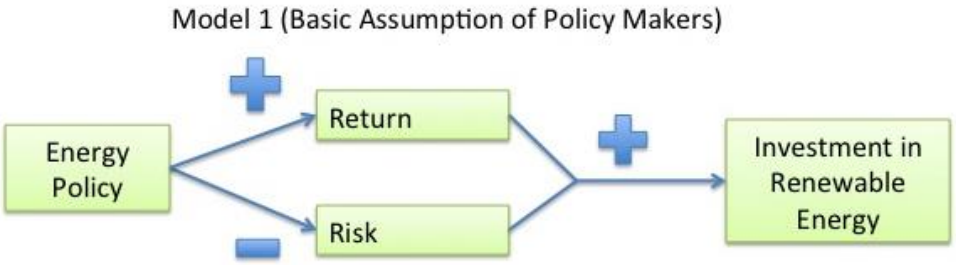

Figure 1. A simple model of how policies influence renewable energy investment (adapted from Wüstenhagen and Menichetti, 2012)

Investors, on the other hand, may have very different views on energy policy. Rather than seeing renewable energy policies as a source of opportunity – as assumed and intended by policy makers – they might interpret them as a source of risk. This alternative view of the policy-investment nexus has been presented as a possible explanation for puzzling findings about renewable energy policy effectiveness (Barradale, 2010). For example, it has been shown that countries with seemingly similar policy frameworks had widely differing outcomes in terms of the amount of new capacity installed (Lüthi, 2010), and the "price of policy risk" (Lüthi and Wüstenhagen, 2012) could be a central factor in explaining observed differences. In this perspective, well-designed policies decrease (perceived) risk in investment decisions, which in turn has a positive influence on renewable energy project developers' cost of capital (Baratoff et al., 2007; de Jager and Rathmann, 2008). The variations in the risk level that different renewable energy policy frameworks imply are an important indicator for investments – and as a consequence for future installed capacity and policy effectiveness in the longer term (Wüstenhagen and Menichetti,

2012). Thus, compared to the policy maker's point of view on the relation between renewable energy policies and investment, the investor's perspective actually seems to place a higher emphasis on risk aspects, cancelling out some or all of the intended positive effect of policies (cf. Figure 2).

Figure 1. An alternative model of how policies influence renewable energy investment (adapted from Wüstenhagen and Menichetti, 2012)

2.2 Venture capital investment in renewable energy

A variety of investors is involved in financing renewable energy, ranging from venture capitalists investing in early-stage technology firms to project financiers engaging in the later stages of the innovation cycle, i.e. deployment. While later stage investment typically appears in larger quantities, venture capital has been shown to be a crucial element of the commercialization process of a range of innovative technologies (Florida and Smith, 1990; Baum and Silverman, 2004), and has recently gained prominence in clean energy. Venture capital can be defined as "professional equity capital co-invested with the entrepreneur to fund an early stage (seed, start-up) or expansion venture" (EVCA, 2013). Venture capitalists have developed specific skills and processes that allow them to engage in the early stages of the innovation cycle and manage risks that other investors (e.g. banks) tend to

avoid. Despite critical comments about the adequacy of the venture capital model for the capital-intensive energy industry (Kenney, 2011), "cleantech", including renewable energy and other technologies to increase resource-efficiency, has recently become the third-most important category of venture capital investing.

Like other investors, venture capitalists weigh the risks and return prospects of an investment opportunity when taking a decision to invest. Typical risks involved in venture financing decisions include technology risk (e.g. DeSarbo et al., 1987; MacMillan et al., 1985, 1987; Petty & Gruber, 2011; Tyebjee & Bruno, 1984; Zider, 1998), people risk (e.g. DeSarbo et al., 1987; Franke, et al., 2006, 2008; MacMillan et al., 1985, 1987; Petty & Gruber, 2011; Zider, 1998), market adoption risk and regulatory risk (Wüstenhagen and Teppo, 2006). While the importance of regulatory risk varies across industries, it has been shown to be a relevant factor in clean energy venture capital investing (Bürer and Wüstenhagen, 2009). Research on how venture capitalists perceive the regulatory risk and opportunity implied by renewable energy policies shows mixed results. Some policies, such as feed-in tariff schemes that effectively stimulate renewable energy demand, appear to be viewed positively by venture capitalists (Bürer and Wüstenhagen, 2009). However, some venture investors seem to have a reluctant view on regulatory exposure as they find it "harder to manage or even outside their area of influence" (Wüstenhagen and Teppo, 2006, p. 73). Based on these empirical insights from previous research we state:

Hypothesis 1: Renewable energy policy and investments are *negatively* correlated, in that venture capitalists' likelihood to invest in renewable energy firms *decreases* with the level of regulatory exposure.

2.3 The influence of worldviews on risk perception and investment decisions

Research in different financial and non-financial contexts shows that risk perception is moderated by personal attributes such as feelings (Loewenstein et al., 2001) or worldviews (e.g. Peters and Slovic, 1996). Worldviews are defined as measure of a person's general attitudes toward political, economic, and social relations (Peters and Slovic, 1996) along the dimensions individualism and interventionism. From these two dimensions, Peters and Slovic deduce the four basic worldviews hierarchical, fatalist, individualist and egalitarian. They show that worldviews serve as orienting mechanisms and are "highly predictive of perceptions of risk" and support for specific energy technologies (Peters and Slovic, 1996, p. 1427). Shafer (2006) provides empirical evidence that worldviews in form of social paradigms influence environmental beliefs and attitudes (Shafer, 2006): Specific elements of the dominant social paradigm (Dunlap and van Liere, 1984; Kilbourne et al., 2002) in western countries such as the opposition to government regulation, have a significant negative effect on attitudes toward corporate sustainability standards. In a similar vain, Grubb (2004) speaks about the influence of „schools of thought" on the debate of the effectiveness of market pull and technology push policies in the context of climate change technology innovation: „The argument (…) seems to be mostly between different western schools of thought, and itself reflects the tendency of western economies – and the underlying theories upon which they are based – to draw a sharp line between the role of the State (and of regulation as its tool of implementation) on the one hand, and the role of the Market (and of private industry as the implementor) on the other" (Grubb, 2004, p. 110). In research on venture capital investment decision-making in the clean energy industry, preliminary evidence hints at venture capitalists' pronounced views on government intervention:

"If there is no clear need for the government, make them stay out of the way." (venture capitalist interviewed by Wüstenhagen and Teppo, 2006).

Building upon these insights from literature and previous empirical research we investigate whether venture capitalists' worldviews on the role of governments in economic markets influence their perception of regulatory exposure as risk or opportunity, and consequently their decision to invest in renewable energy firms (cf. Figure 3).

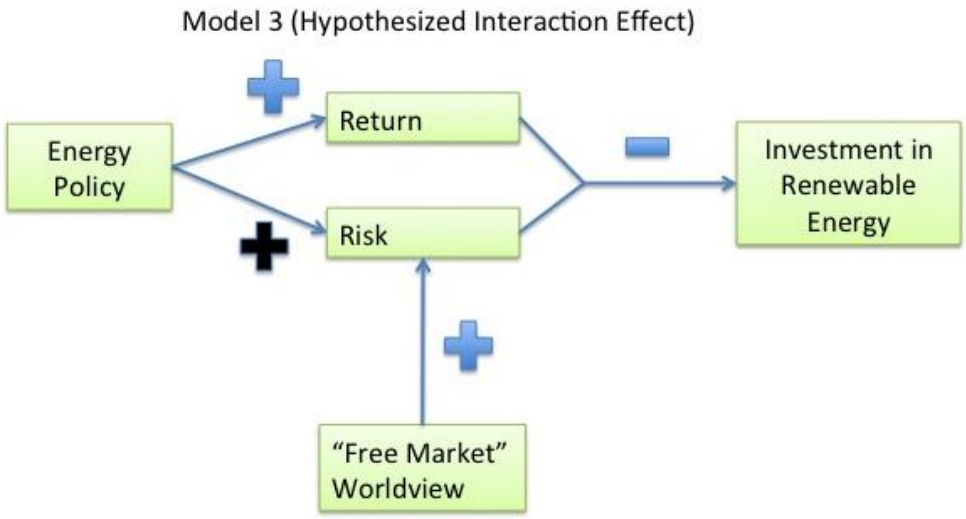

Figure 2. The moderating influence of worldviews on renewable energy policy effectiveness

We test the following hypothesis:

Hypothesis 2: The relationship between renewable energy policy and likelihood to invest is moderated by investors' worldviews, in that venture capitalists with free-market worldviews are more likely to avoid an investment opportunity characterized by a high level of regulatory exposure.

3 Methodological approach

3.1 Choice experiments and adaptive choice-based conjoint analysis

In order to investigate the influence of regulatory exposure on investor decision-making, we conducted a survey of venture capitalists using a particular form of choice experiments, namely adaptive choice-based conjoint analysis (ACBC, Sawtooth Software 2009a). Choice experiments and conjoint analysis are widely used in marketing research to assess the relative importance of different attributes for decision-making, and these methods have become increasingly popular in environmental economics and energy policy research as well (e.g. Alvarez-Farizo and Hanley, 2002; Ladenburg and Dubgaard, 2007; Birol et al., 2008; Lüthi and Prässler, 2011; Lüthi and Wüstenhagen, 2012; Friebe, von Flotow and Täube, 2013; Kaenzig, Heinzle and Wüstenhagen, 2013). Typically, respondents are asked to choose among different alternatives (e.g. products, or in our case, investment opportunities) described along a limited number of attributes. Levels of the attributes vary across the presented alternatives. Choice models assume that the decision maker maximizes utility, and that the utility of any given alternative is the sum of the part-worth utilities of the different attribute levels (Backhaus et al., 2010).

We used a specific conjoint method called Adaptive Choice-Based Conjoint (ACBC) by Sawtooth Software to design the choice experiment in a web-based format. ACBC collects preference data in an interactive mode and through three different sections, which increases the information gathered per respondent. In the first section of the interviewing process (the "build your own" or BYO section) the respondents can compose their most preferred investment opportunity by choosing out of a list of previously defined levels for each of the attributes included in the conjoint design. In

the second section (the "screening section") the software generates 24 hypothetical investment opportunities by randomly combining the predefined attribute levels. Respondents have to indicate for each of the presented investment opportunities whether they would invest or not. All selected investment opportunities then enter the third section of the interviewing process (the "choice tournament"). In this last step, the investment options compete against each other in a series of choice tasks until the most preferred alternative is identified. In each choice task, the respondent needs to choose one out of a group of three investment options (Johnson and Orme, 2007; Sawtooth Software, 2009).

3.2 Experimental design

We applied a symmetric conjoint design with six attributes and four levels per attribute. In order to make the conjoint experiment as realistic as possible, we included the most important factors influencing venture capital investment decisions (e.g. Petty and Gruber, 2011). As we were particularly interested in the influence of energy policy on investment decision-making, we added a firm's degree of regulatory exposure to the list of attributes, with four levels ranging from "very low" to "very high". A pre-test with six students and twenty professional venture capitalists confirmed the relevance of the attributes and levels. For a complete list of the attributes and levels included in the conjoint design, see Table 3 below.

All investment options that were presented to the respondents were deals in the clean energy domain. Table 1 shows a sample choice task from the ACBC experiment (choice tournament section).

Table 1. Sample choice task from web-based survey

Out of these three investment opportunities in the Clean Energy industry, which one is the best option that you would investigate further?			
Technological Maturity	Works in laboratory	Working prototype	Finished product
Founder Experience	Previous startup founder	Previous executive experience	Graduate student
Regulatory Exposure	Low	High	Very high
Return Potential	10x in 5 years	5x in 5 years	20x in 5 years
	○	○	○

3.3 Worldview measures

In order to measure the venture capitalists' worldviews toward government intervention and regulatory exposure, we used a set of three statements (cf. Table 2). Statement 1 is taken from the European Social Survey (ESS). Similarly to Peters and Slovic (1996), ESS distinguishes two dimensions of left-right orientations, which are egalitarianism and interventionism (the preference for the government to intervene in the market) and uses the statement, which we included in our survey, to measure interventionism. Statements 2 and 3 are formulated based on quotes from in-depth interviews with 23 venture capitalists by Wüstenhagen and Teppo (2006). Whereas statement 2 assesses the general view on the role of government, statement 3 specifically measures the investors' attitude toward government subsidies. We used a 5-point Likert scale with values ranging from 1 (totally agree) to 5 (totally disagree) in order to capture the respondents' agreement/disagreement with the statements. Respondents who agree with the statements in Table 2 are perceived to have a more "free-market"-oriented worldview than respondents who disagree with the statements.

Table 2. Worldview statements, 5-point Likert scale (1 = totally agree, 5 = totally disagree)

No.	Statement
1	Private enterprise is the best way to solve our country's economic problems.
2	If there is no clear need for government, let them stay out of the way.
3	We would never invest in a firm that relies on government subsidies.

3.4 Data collection and sample

Invitations to participate in the survey were sent out in a mass e-mailing to venture capitalists included in the Thomson SDC VentureXpert database in March 2010. In total, 176 venture capitalists took part in our survey. The sample was cleaned in several steps for incomplete responses and double entries (44 respondents), respondents from outside of the United States and Europe (16 respondents), and corporate venture capitalists (30 respondents), leading to an extended sample of 86 respondents.[i] For the analysis in this paper, we had to reduce the sample further to eliminate respondents who did not select regulatory exposure as an attribute in the conjoint experiment (57 respondents)[ii], bringing final sample size to 29 respondents. About 55% of the respondents in our final sample are based in Europe, 45% in the United States. The average respondent works in a venture capital firm that has about 22 employees, has been in business for 11 years, manages 3.5 funds and invests on average 7.15 million USD per deal. For detailed characteristics of the respondents in our sample please refer to the Appendix.

4 Results

4.1 Part-worth utilities of regulatory exposure

Each respondent in our sample (N = 29) had to accomplish on average 36.7 choice tasks (includes BYO, screening and choice tournament)[iii], which results in a data set of 1,064 experimental investment decisions. Most of the 29 venture capitalists who chose regulatory exposure as one out of six attributes in the conjoint experiment, also chose the attributes founder experience (28 respondents), technological maturity (18 respondents) and return potential (28 respondents). The attributes deal source and lead investor were chosen by 4, respectively 9 venture capitalists only. Table 3 displays the average part-worth utilities and standard deviations per attribute level as a result from the hierarchical Bayes estimation procedure (Johnson, 2000; Sawtooth Software, 2009b). Using the hierarchical Bayes estimation procedure ensures robust coefficient estimates even in case of scarce information such as in the case of the attributes deal source and lead investor.

The average part-worth utilities indicate the effect of a particular attribute level on the overall utility of the average respondent, i.e. the impact on the hypothetical investment decision. This effect can be positive or negative. One needs to bear in mind that part-worth utilities are usually interval data and scaled to an arbitrary constant, thus it is not possible to directly compare utility values of attribute levels across attributes. The utilities in the table are effects-coded zero-centered differentials (diffs) utilities and sum up to zero within attributes (Orme, 2010).

The results of the conjoint analysis in Table 3 indicate a linear relationship between the attribute levels and part-worth utilities for all attributes, i.e. with increasing risk (e.g. technological risk measured by technological maturity) or return potential the

part-worth utilities decrease or increase, respectively. In general, this also holds true for the attribute regulatory exposure, which supports our first hypothesis that the likelihood to invest in renewable energy deals decreases with an increase in regulatory exposure. However, this effect is stronger for high levels of regulatory exposure, whereas the average respondent appears to be almost indifferent between low and very low levels of regulatory exposure.

Table 3. Average part-worth utilities and standard deviations per attribute level.

Attributes and Levels	Average Part-Worth Utility	Standard Deviation
Regulatory Exposure		
Low	65.54	36.11
Very Low	64.22	47.33
High	-35.26	40.97
Very high	-94.49	46.62
Return Potential		
20x in 5 years	53.87	34.83
15x in 5 years	25.09	14.33
10x in 5 years	-10.08	19.44
5x in 5 years	-68.88	34.19
Technological Maturity		
In production with customers	54.15	64.11
Finished product	12.45	28.12
Working prototype	-19.76	33.89
Works in laboratory	-46.84	49.14
Founder Experience		
Previous startup founder	50.73	46.35
Previous startup experience	35.35	29.12
Previous executive experience	11.28	40.51
Graduate student	-97.36	43.88
Lead Investor		
Draper Fisher Jurvetson	4.03	15.04
Kleiner Perkins	3.19	14.87
Insight Capital Partners	-2.66	9.25
Khosla Ventures	-4.56	12.81
Deal Source		
Syndicate partner	3.32	10.15
Personal network	2.82	8.59
Met at venture fair	-2.59	6.90
E-Mail business plan	-3.56	9.33

4.2 The moderating effect of worldviews

In order to test whether the investors' worldviews on the government's role in the market moderate the relationship of regulatory exposure and the willingness to invest in renewable energy firms we first calculated the average rating of the three worldview statements in Table 2 per respondent. In a next step we built two distinct groups of respondents, where the first group ("High Free-Market Worldview") on average strongly agreed with all of the three statements (average ratings up to 2.0 from a 5-point Likert scale ranging from 1 = totally agree to 5 = totally disagree) and respondents in the second group were indifferent or disagreed with the statements on average indicating a low free-market worldview.

Figure 4 below shows the average part-worth utilities per level of regulatory exposure for each of the groups. The difference in part-worth utilities per attribute level shows that the group with a high free-market worldview are significantly sensitive to regulatory exposure than respondents with a low free-market worldview. The detailed results further reveal that the group with a pro-governmental worldview differentiates less between low levels of regulatory exposure (reversal in the part-worth utilities), which also indicates their willingness to accept some level of regulatory risk. Thus, our results provide evidence that worldviews influence venture capitalists' risk perception related to the exposure of a renewable energy firm to energy policy and support our second hypothesis: investors with a more positive general attitude toward government intervention in markets perceive higher levels of regulatory exposure as less risky and are more likely to invest in such renewable energy deals than investors with a "free-market" attitude.

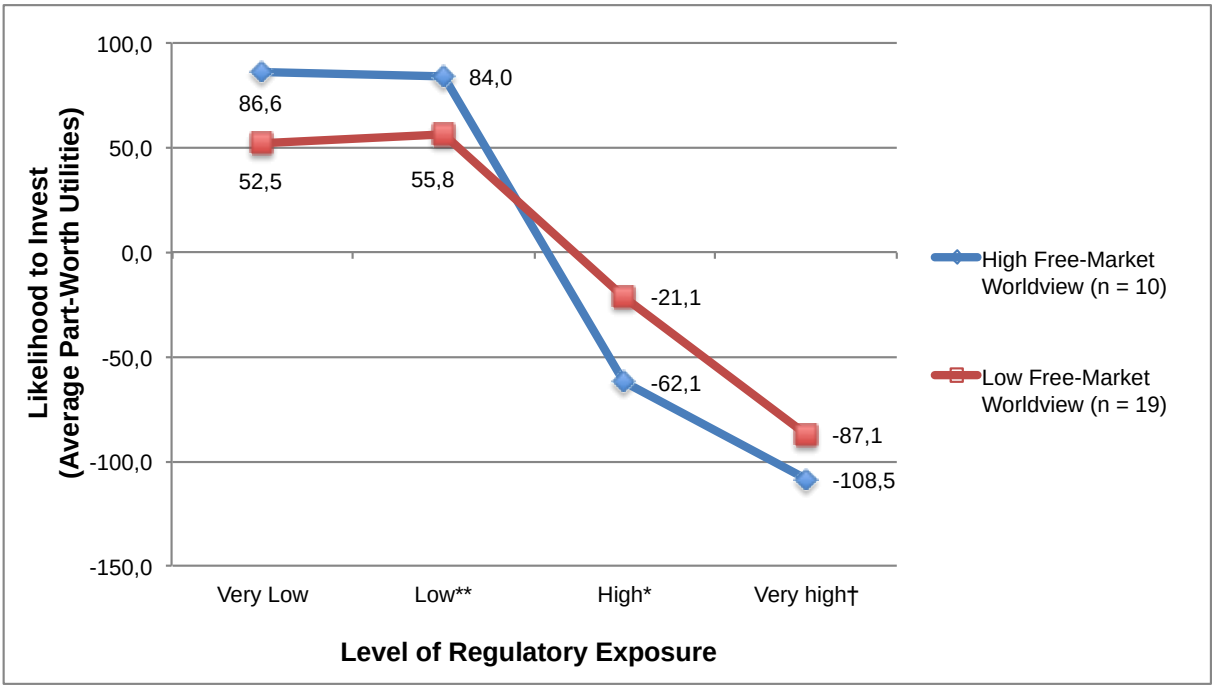

Figure 4. Average part-worth utilities per level of regulatory exposure and worldview groups.

Note: Level of significance indicated for each of the attribute levels relates to the difference in average part-worth utilities between the two groups (t-Test, two-sided).

† $p < 0.10$; * $p < 0.05$; ** $p < 0.01$.

5 Limitations and further research

Our study is an innovative contribution to the emerging research stream on energy policy and renewable energy investment, as it is based on a unique dataset with real investors in a sophisticated experimental setting. Our innovative approach combines regulatory risk perception, worldviews and investment decision, and provides new and important insights on the impact of energy policies. However, as any early exploration into an emerging field, our research is characterized by a number of limitations that can provide promising starting points for further research.

First, our results are based on 1,064 experimental investment decisions conducted by a final sample of 29 venture capitalists out of a larger group of 86 venture capitalists participating in our overall survey. The reduction in sample size was necessary

because this paper has focused on one particular factor in the decision-making process, regulatory exposure, which several of the surveyed venture capitalists deemed not to be among the top four factors they consider when making an investment. We carefully checked for differences between the final sample and the extended sample, and we are therefore confident about the direction of the observed effects, but there are limits to how far we can generalize our findings to the entire venture capital population. Future research using larger samples would be helpful in confirming our findings.

Second, venture capitalists are only a specific subset of the energy investment community. While they have been shown to be important agents in the financing of innovation, the magnitude of capital flows in other parts of the industry is more significant. Future research should therefore shed light on other investor types, notably corporate investors, pension funds, banks and insurance companies.

Third, we investigated venture capitalists' worldviews by surveying their preference for private enterprise over government intervention, using a simplified scale. Further research could apply established or novel scales to confirm the effects we observed, for example comparing investors' support for either the Dominant Social Paradigm (DSP) or the New Ecological Paradigm (NEP), developed by Dunlap and van Liere (1984) and Dunlap et al. (2000). We would caution, however, that applying more comprehensive psychological scales developed with time-constrained professional investors may pose significant challenges in terms of data collection, resulting in either small samples and/or concerns about self-selection bias. Further research that would develop robust but shorter scales would be particularly valuable.

Fourth and final, our analysis provides broad support for the idea that "behavioural" factors play a role in investor decision-making, but we would encourage further

research to elucidate exactly how and where this plays out in the decision process. This would ultimately contribute to the recent debate in the decision sciences about "thinking fast and slow" (Kahneman, 2011), painting a nuanced picture of how analytical and intuitive components are combined by real-world decision makers.

6 Conclusions

Achieving policy targets for the transition to renewable energy will require substantial private investment. In the analysis presented in this paper, we confirm previous research that suggests policy makers should pay particular attention to risk, rather than just think about providing attractive returns to investors. We empirically demonstrate that venture capital investors exhibit policy risk aversion, in that they tend to avoid renewable energy investment opportunities if regulatory exposure is perceived to be high. We also show that investors are comfortable with taking some policy risk, in that there is little difference between their preference between low and very low levels of regulatory exposure. Finally, we highlight that not all investors are equal, and that worldviews play an important moderating role beyond purely "rational" considerations of risk and return. The aversion to policy risk is more pronounced among investors who hold strong preferences for "free markets" over government intervention.

Our findings have important implications for energy policy. When choosing between various policy instruments to achieve renewable energy targets, policy makers should aim at lowering perceived risk for investors. Furthermore, our findings about the influence of behavioural factors such as worldviews suggest that reducing "objective" levels of risk may be a necessary but not sufficient condition for investor acceptance of policies. Perhaps equally important is that these policies are framed in

a way that is consistent with the basic worldviews of key target segments in the investment community. For example, policy-averse venture capital investors might be more likely to accept renewable energy policies that are framed as "mobilizing private capital" rather than as "government intervention", and they may prefer "incentives" over "subsidies".

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7 References

Álvarez-Farizo, B. and N. Hanley (2002). „Using conjoint analysis to quantify public preferences over the environmental impacts of wind farms. An example from Spain", Energy Policy, 30 (2), 107-116.

Backhaus, K., Erichson, B., Plinke, W. and Weiber, R. (2010). Multivariate Analysemethoden: Eine anwendungsorientierte Einführung. Berlin, Springer-Verlag.

Baratoff, M. C., Black, I., Burgess, B., Felt, J. E., Garratt, M. and Guenther C. (2007). Renewable power, policy, and the cost of capital: Improving capital market efficiency to support renewable power generation projects. Prepared for UNEP/BASE Sustainable Energy Finance Initiative. Ann Arbor, MI, University of Michigan, Erb Institue for Global Sustainable Enterprise.

Barradale, M. J. (2010). "Impact of public policy uncertainty on renewable energy investment: Wind power and the production tax credit." Energy Policy **38**: 7698-7709.

Baum, J. A. C. and B. S. Silverman (2004). "Picking winners or building them? Alliance, intellectual, and human capital as selection criteria in venture financing and performance of biotechnology startups." Journal of Business Venturing **19**(3): 411-436.

Birol, E.; Koundouri, P. and Kountoyris, Y. (2008). „Applications of the Choice Experiment Method in Europe: A Review.“ in: Birol, E. and Koundouri, P. (eds.): Choice Experiments Informing Environmental Policy: A European Perspective. Edward Elgar Publishing, Cheltenham UK and Lyme US.

Bürer, M.-J. and R. Wüstenhagen (2009). "Which renewable energy policy is a venture capitalist's best friend? Empirical evidence from a survey of international clean energy investors." Energy Policy **37**(12): 4997-5006.

de Jager, D. and M. Rathmann (2008). Policy Instrument Design to Reduce Financing Costs in Renewable Energy Technology Projects. By Order of IEA RETD Implement Agreement. Utrecht, Ecofys.

DeSarbo, W., MacMillan, I. C. and Dayet D. L. (1987). "Criteria for corporate venturing: Importance assigned by managers." Journal of Business Venturing **2**(4): 329-350.

Dunlap, R. E. and K. D. Van Liere (1984). "Commitment to the dominant social paradigm and concern for environmental quality." Social Science Quarterly **65**: 1013-1028.

Dunlap, R. E., Van Liere, K. D., Mertig, A. G. and Jones, R. E. (2000). "Measuring endorsement of the New Ecological Paradigm: a revised NEP scale." Journal of Social Issues **56**: 425-442.

EVCA (2011a). Yearbook 2011. European Private Equity and Venture Capital Association.

EVCA (2011b). Email conversation with EVCA. 6th and 10th of October 2011.

EVCA (2013). "Research and Data - Glossary." Retrieved 7 January 2013, from http://www.evca.eu/knowledgecenter/glossary.aspx?id=982.

Florida, R. and D. F. Smith (1990). "Venture Capital, Innovation, and Economic Development." Economic Development Quarterly **4**(4): 345-360.

Franke, N., Gruber, M., Harhoff, D. and Henkel, J. (2006). "What you are is what you like - similarity biases in venture capitalists' evaluations of start-up teams." Journal of Business Venturing **21**: 802-826.

Franke, N., Gruber, M., Harhoff, D. and Henkel, J. (2008). "Venture Capitalists' Evaluations of Start-Up Teams: Trade-Offs, Knock-Out Criteria, and the Impact of VC Experience." Entrepreneurship Theory and Practice **32**(3): 459-483.

Friebe, C. A., von Flotow, P. and Täube, F. A. (2013). "Exploring the link between products and service in low-income markets - evidence from solar home systems." Energy Policy **52**: 760-769.

Grubb, M. (2004). "Technology Innovation And Climate Change Policy: An Overview Of Issues And Options." KEIO Economic Studies **41**(2): 103-132.

Hampl, N., Wuebker, R. and Wüstenhagen, R. (2013): The Strength of Strong Ties In An Emerging Industry: Experimental Evidence of the Effects of Status Hierarchies and Personal Ties In Venture Capitalist Decision-Making (Working Paper), University of St. Gallen.

IEA (2012). World Energy Outlook 2012. OECD/IEA. Paris.

Johnson, R. M. (2000). Understainding HB: an intuitive approach. Sawtooth Software Research Paper Series.

Johnson, R. M. and B. K. Orme (2007). A New Approach to Adaptive CBC Sawtooth Software Research Paper Series.

Kaenzig, J., Heinzle, S. L. and Wüstenhagen, R. (2013). Whatever the customer wants, the customer gets? Exploring the gap between consumer preferences and default electricity products in Germany. Energy Policy, 53, 311-322.

Kahneman, D. (2011). Thinking, fast and slow. London, Allen Lane.

Kenney, M. (2011): Venture capital investment in the greentech industries: A provocative essay, in: Wüstenhagen, R., Wuebker, R. (eds.): Handbook of Research on Energy Entrepreneurship. Edward Elgar Publishing, Cheltenham UK and Lyme US.

Kilbourne, W. E., Beckmannb, S. C. and Thelenc, E. (2002). "The role of the dominant social paradigm in environmental attitudes: a multinational examination." Journal of Business Research **55**: 193-204.

Ladenburg, J. and Dubgaard, A. (2007). Willingness to pay for reduced visual disamenities from offshore wind farms in Denmark. Energy Policy, 35 (8), 4059-4071.

Loewenstein, G. F., Weber, E. U., Hsee, C. K. and Welch, N. (2001). "Risk as feelings." Psychological Bulletin **127**(2): 267-286.

Lüthi, S. (2010). "Effective deployment of photovoltaics in the Mediterranean countries: balancing policy risk and return." Solar Energy **84**: 1059-1071.

Lüthi, S. and T. Prässler (2011). "Analyzing policy support instruments and regulatory risk factors for wind energy deployment —A developer's perspective." Energy Policy **39**: 4876-4892.

Lüthi, S. and R. Wüstenhagen (2012). "The price of policy risk - empirical insights from choice experiments with European photovoltaic project developers." Energy Economics **34**(4): 1001-1011.

MacMillan, I. C., Siegel, R., and Narasimha, P.N.S. (1985). "Criteria used by venture capitalists to evaluate new venture proposals." Journal of Business Venturing **1**: 119-128.

MacMillan, I. C., Zemann, L. and Subbanarasimha, P. N. (1987). "Criteria distinguishing successful from unsuccessful ventures in the venture screening process." Journal of Business Venturing **2**: 123-137.

Mitchell, C., Bauknecht, D. and Connor P. M. (2006). "Effectiveness through risk reduction: a comparison of the renewable obligation in England and Wales and the feed-in system in Germany." Energy Policy **34**(3): 297-305.

NVCA (2011). Yearbook 2011. National Venture Capital Association.

Orme, B. K. (2010). Getting started with conjoint analysis: strategies for product design and pricing research. Madison, WI, Research Publishers.

Peters, E. and P. Slovic (1996). "The role of affect and worldviews as orienting dispositions in the perception and acceptance of nuclear power." Journal of Applied Social Psychology **26**(16): 1427-1453.

Petty, J. S. and M. Gruber (2011). ""In pursuit of the real deal": A longitudinal study of VC decision making." Journal of Business Venturing **26**(2): 172-188.

Sawtooth Software (2009a). The Adaptive Choice-Based Conjoint (ACBC) Technical Paper Sawtooth Software Technical Paper Series.

Sawtooth Software (2009b). The CBC/HB system for hierarchical Bayes: version 5.0 technical paper. Sawtooth Software Technical Paper Series.

Shafer, W. E. (2006). "Social paradigms and attitudes toward environmental accountability." Journal of Business Ethics **65**: 121-147.

Simon, H. A. (1955). "A behavioral model of rational choice." Quarterly Journal of Economics **69**(1): 99-118.

Tyebjee, T. T. and A. V. Bruno (1984). "A Model of Venture Capitalist Investment Activity." Management Science **30**(9): 1051-1066.

UNEP (2012). Global Trends in Renewable Energy Investment in 2012, Frankfurt School UNEP (United Nations Environment Programme) Collaborating Centre for Climate & Sustainable Energy Finance.

Unruh, G. C. (2000). "Understanding carbon lock-in." Energy Policy **28**: 817-830.

Wüstenhagen, R. and E. Menichetti (2012). "Strategic choices for renewable energy investment: conceptual framework and opportunities for further research." Energy Policy **40**: 1-10.

Wüstenhagen, R. and T. Teppo (2006). "Do venture capitalists really invest in good industries? Risk-return perceptions and path dependence in the emerging European energy VC market." International Journal of Technology Management **34**(1/2): 63-87.

Zider, B. (1998). "How venture capital works." Harvard Business Review **76**(6): 131-140.

Appendix

Table A1. Descriptive statistics

	Final Sample (N=29)				Extended Sample (N = 86)	
Sample Characteristics	**N**		**Mean**	**SD**	**Mean/%**	**Population**
Firm and Fund Information						
Firm location (N = 29)						
Europe	16	(55%)			48%	47% (714) [a]
United States	13	(45%)			52%	53% (791) [a]
Firm size (number of employees)	29		21.86	32.63	18.01	9.91/8.00 [b]
Firm age (years)	29		11.03	7.83	12.76	
Number of funds [c]	28		3.50	3.44	2.89	
Deal size (in thousands USD)	29		7,152	12,803	7,632	
Investor Information						
Investor age (years)	29		42.48	12.56	43.37	
VC industry affiliation (years)	29		8.76	7.52	9.00	
VC investment experience (years)	29		7.00	6.93	7.43	
Number of boards	29		7.28	7.29	7.86	
Position in firm (N = 29)						
Managing director	12	(41%)			33%	
General partner	5	(17%)			14%	
Partner	2	(7%)			20%	
Analyst	8	(28%)			21%	
Other	2	(7%)			13%	
Industry domain experience (years) [d]						
Clean Energy	17		6.12	7.47	5.09	
Biotechnology	13		6.77	6.57	7.50	
ICT	14		7.21	7.51	8.74	
Consumer Related	15		8.73	7.26	7.34	
Conventional Energy	8		10.63	8.12	8.47	
Medical/Health	18		5.61	5.77	6.80	

[a] Active venture capital firms only (EVCA, 2011a, b; NVCA, 2011).

[b] Average number of employees per venture capital firm, Europe (714 firms, 7,077 employees) and U.S. (791 firms, 6,328 employees), respectively (EVCA, 2011a, b; NVCA, 2011).

[c] One respondent did not indicate the number of funds.

[d] Multiple answers possible.

Footnotes

[i] More details on extended sample can be found in Hampl et al. (2013).

[ii] The Adaptive Choice Based Conjoint (ACBC) survey allowed respondents to select four out of six attributes for the conjoint interviewing procedure that they felt are of most importance for the decision to invest in a deal. This feature was applied in order to decrease the complexity of the choice tasks. A test for differences in sample characteristics and answers to the worldview statements between the final sample of N = 29 and the 57 respondents who did not select regulatory exposure as a conjoint attribute did not reveal any significant results.

[iii] The exact number of choice tasks per respondent differs due to the adaptive nature of the ACBC interviewing procedure; for more information, please refer to the "Choice experiments and adaptive choice-based conjoint analysis" section of this paper.