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INVESTOR-SPECIFIC COST OF CAPITAL AS EXPLANATORY FACTOR FOR HETEROGENEITY IN ENERGY INVESTMENT DECISIONS – A CONCEPTUAL MODEL

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Overview

The diffusion of renewable energies in Germany and other European countries has led to the participation of new and heterogeneous investor groups in the energy market, including project developers, industrial companies, small and medium-sized enterprises, regional utilities, and institutional investors, but also farmers and private homeowners (Bergek et al., 2013; Trendresearch, 2013). While for several decades, investments in power generation infrastructure were largely dominated by large utility firms (Schleicher-Tappeser, 2012; Richter 2013), they have lost a significant portion of their market share to new entrants in the emerging renewables segment. Why has this shift occurred? This paper proposes investor-specific cost of capital as an important explanatory factor. We argue that fuel-cost free renewable energy projects with guaranteed feed-in tariffs, such as wind and solar power generation, offer a lower-risk and lower-return opportunity that is systematically undervalued by investors with high cost of capital, such as incumbent utilities.

The behavior and preferences of renewable energy investors has been researched through different lenses, including *path dependency* (Unruh, 2002; Wüstenhagen and Teppo, 2006), *dynamic capabilities* (e.g. Stenzel and Frenzel, 2008) *behavioral economics* and *microeconomics* (e.g. Kaenzig and Wüstenhagen, 2010), and through a *cognitive* lens (Chassot et al., 2013). Nonetheless, the drivers and motives of investors remain largely open (Masini and Menichetti, 2012; Wüstenhagen and Menichetti, 2012; Bergek et. al., 2013). A considerable stream of literature indicates differences among investors in terms of motives, resources, or previous experience influencing investment behavior and decisions, but little empirical evidence exists (Bergek et al., 2013). This is particularly true for differing financial characteristics and motives (Langniss, 1996; Dinica, 2006; Bergek et al., 2013), which will be the scope of this study. A *standard economic perspective* is reasonable to analyze renewable energy investments and investors, as the energy sector can be regarded as a business context “dominated by highly rational and well informed investors” (Masini and Menichetti, 2012). Available studies in this field are mostly focusing on comparisons of renewable energies with conventional power generation (Awerbuch, 2003; Söderholm et al., 2007; Bergek et al., 2013) or between different types of renewable energies (Munoz et al., 2009; Delmas and Montes-Sancho, 2011; Bergek et al., 2013), but may also contribute to understand investment decision processes by different investor groups. The most common instrument for investment analysis is the *net present value (NPV)* calculation, and the *cost of capital* a crucial variable for the valuation outcome (Ryan and Ryan, 2002; Titman and Martin, 2008). Considering differences among investors in terms of their cost of capital, and the different financial attributes of renewable energies and conventional power generation, we derive our research question: *how does the cost of capital of different investor groups influence their renewable energy investment decisions?*

We derive a theoretical model, illustrating how previous investment activities shape capital costs of investors in the energy sector, and how these capital costs influence choice on renewable energies and other investment opportunities. We demonstrate the role of cost based valuation methods, often applied in the energy industry. Thereby, we challenge existing views, which primarily consider higher technological and regulatory risks as a major barrier for investors to support a large-scale diffusion of renewable energies.

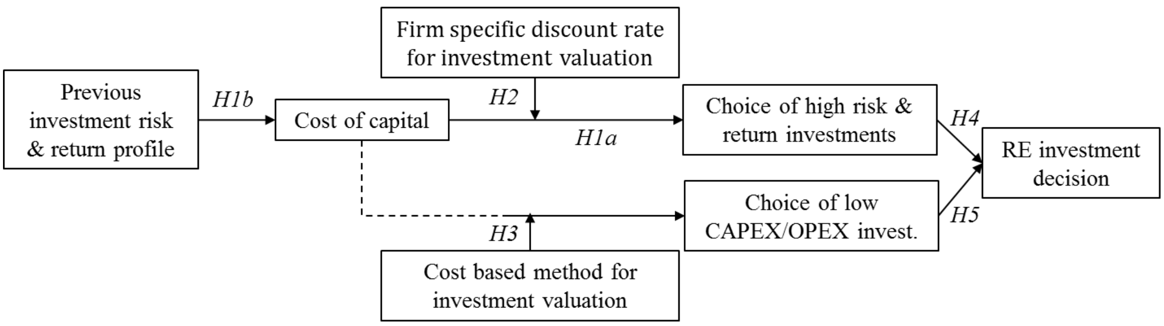

Figure 1: Conceptual model for the role of the cost of capital (own illustration)

Method

This paper follows a conceptual approach, resulting in the development of a conceptual model, illustrated in Figure 1. The model will be validated against the activities of different investor groups in the field of renewable energies, their respective capital costs, other relevant financial characteristics, and the development of return rates of renewable energy investments.

Results

The calculation of the NPV of future cash flows is a standard tool to determine the value of investments. The *weighted average cost of capital (WACC)* with its single components, the cost of debt and the cost of equity, has gained major practical relevance as applied discount factor (Gitman and Forrester, 1977; Graham and Harvey, 2001; Brounen et al., 2004). Hence, investors explicitly (through comparison of investment return rate and WACC) or implicitly (through determination of the NPV) compare their cost of capital with the return of an investment. If we furthermore assume the commonly accepted positive relationship of risk and expected return (Markowitz, 1952), we have to conclude that investors with higher cost of capital rather invest in assets with higher risk and expected returns (*Hypothesis H1a*). The *capital asset pricing model (CAPM)* tells us that the expected rate of return of every company's asset is a linear combination of the risk-free interest rate plus a market risk premium (Sharpe, 1964; Lintner, 1965; Bruner et al., 1998; Graham and Harvey, 2001; Copeland et al., 2005). This implies that the cost of capital of the company is also subject to risk valuations of a firm's shareholders, based on previous, current, and expected future activities and investments of the firm. Hence, risk and return characteristics of previous and existing investments shape the cost of capital of the firm *(H1b).*

Corporate practice shows that many companies apply *firm* specific, but no *project* specific discount factors for the valuation of investments, as proposed by *Finance Theory* (Bierman, 1993; Graham and Harvey, 2001; Brounen et al., 2004; Titman and Martin, 2008). This may lead to the systematic undervaluation and rejection of *safer* projects and acceptance of risky projects to cope with their cost of capital, and explains why investors with higher capital costs choose to invest in riskier projects with higher expected returns *(H2)* (Titman and Martin 2008). We also know that investment valuations in the energy industry are often based on cost comparisons (Bergek et al., 2013). The *levelized lifetime cost (LC)* analysis aims to identify the least cost investment opportunity by discounting the cumulated capital and operational costs and dividing them by the economic output of the power plant (Awerbuch, 2000; Awerbuch, 2003; Söderholm et al., 2007; Söderholm and Pettersson, 2011; Bhattacharya and Kojima, 2012; Bergek et al., 2013). We demonstrate that investors with high capital costs will calculate more favorable LCs for investments with lower *capital expenditures (CAPEX)*, whereas investors with low capital costs obtain more favorable LCs for investments with lower *operational expenditures (OPEX)* (*H3*).

In many countries, renewable energy support schemes such as feed-in tariffs reduce investment risks. In contrast, conventional power plants have to compete on the energy-only market and involve additional fuel price related risks, but may promise higher future returns, particularly in times of rising electricity prices (Menanteau et al., 2003; Wüstenhagen and Bilharz, 2006; Lüthi and Wüstenhagen, 2008; Couture and Gagnon, 2009; Bürer and Wüstenhagen, 2009; Blanco, 2009). Considering the limited risk characteristics and moderate returns, and *Hypothesis 1*a and *2*, investors with higher capital costs will more likely reject renewable energy opportunities compared to investors with low capital costs *(H4).* Moreover, renewable energies are very *capital intensive*. They require high upfront payments and capital expenditures, but entail very low operational expenditures resulting in a low CAPEX/OPEX ratio (Blanco, 2009; Kaenzig and Wüstenhagen, 2010). Whereas the upfront investment of a wind farm makes up 80% of the total lifecycle costs and even a higher share in the case of solar photovoltaics, this number is in the range of 40% for a gas power plant, with the remainder being related to fuel cost, operation, and maintenance (Blanco, 2009). Considering *Hypothesis 3,* investors with low capital costs will rather invest in renewable energies than investors with high capital costs *(H5).*

Conclusion

We develop a conceptual model, illustrating the cost of capital as an explanatory factor for heterogeneity in observed energy investor behavior, especially the difference in renewable energy investment activities of utility incumbents compared to new investor groups with lower cost of capital. We propose that traditional energy investors with high cost of capital systematically undervalue low-risk and low-return projects such as investment in fuel-cost free renewable energy projects with guaranteed feed-in tariffs. On the other hand, these characteristics attract new investors with lower capital costs. Thereby, the case of renewable energies presents a formidable example for Christensen's "Innovator's Dilemma" (1997), who argues that incumbents would place their capital resources systematically on the opportunities with the highest expected return, and thereby missing emerging opportunities with margins ranging initially below established technologies. This study contributes to the discussion about financing the energy transition by shedding light on investor heterogeneity, and suggests investor-specific cost of capital and its influence on the valuation of fuel-cost free renewable energy projects as a previously under-researched explanatory factor for observed investment behavior.

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