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Investment decisions in the renewable energy sector: An analysis of non-financial drivers

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ABSTRACT

Notwithstanding their many environmental, economic and social advantages, renewable energy technologies (RE) account for a small fraction of the world's primary energy supply. One possible cause for this limited diffusion is that private investments in the RE sector, although potentially appealing, remain insufficient. The lack of adequate financing is also a clear indication that our understanding of the process by which investors fund RE ventures is still incomplete. This paper aims to fill in this gap and to shed new light on RE investment decisions. Building upon behavioral finance and institutional theory, we posit that, in addition to a rational evaluation of the economics of the investment opportunities, various non-financial factors affect the decision to invest in renewables. We analyze the investment decisions of a large sample of investors, with the objective to identify the main determinants of their choices. Our results shed new light on the role of institutional and behavioral factors in determining the share of renewable energy technologies in energy portfolios, and have important implications for both investors and policy makers: they suggest that RE technologies still suffer from a series of biased perceptions and preconceptions that favor status quo energy production models over innovative alternatives.

1. Introduction

The debate on Renewable Energies (RE) continues to attract a significant amount of attention within the academic, managerial and policy making communities. While some scholars and industry experts remain skeptical about the technical and economic viability of these technologies [1,2], a different view, championed by the IPCC and especially popular in some European countries, considers RE as one of the most effective solutions to curb greenhouse gas emissions [3]. Despite mixed empirical evidence [4,5], RE have been also indicated as a powerful instrument to tackle unemployment and stimulate economic growth [6–8]. The advocates of this view argue that — if the objective of halving CO_2 emissions by 2050 is to be achieved through the diffusion of RE — the contribution of these technologies to primary energy supply must exceed 50% [9,10].

Yet, notwithstanding the public support received in various countries under the form of incentive schemes, taxation or other governmental expenditures, RE technologies only account for a small fraction of the world's primary energy supply. One reason for this limited diffusion is that, while the transition towards a low-carbon economy requires important investments [11,12], private finance has so far played a relatively marginal role in this industry [13]. Mobilizing private capital to support RE projects is challenging, particularly in the current economic context, as investors are reluctant to allocate resources to new technologies that guarantee uncertain returns in the short term. The majority of high-tech VCs prefer to invest in technologies with low-risk low-return profiles and "seem to be steering clear of risky green investments, suggesting that clean-tech companies for a variety of reasons don't work" [14; p. 23].

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Furthermore, most of the resources so far attracted by the RE industry have been channeled towards mature RE technologies that are closer to grid parity, such as on-shore wind or hydro,[1] on the ground that "accelerated deployment of existing technologies will get you down the cost curve much more rapidly than a breakthrough" [14; p. 23]. Compared to these technologies, radically innovative systems that may display higher long-term potentials have somehow failed to attract the amount of capital necessary to pay for the greater upfront investments they usually require. In the long run, this strategy of privileging relatively mature technologies could stifle the development of technological breakthroughs and, ultimately, cause the premature extinction of technological alternatives with potentially superior performance [16]. Investment strategies that focus on a few mature technologies may be myopic in the short term too, because they reduce valuable opportunities for diversifying energy portfolios and hedging against price fluctuations [17,18].

Some scholars have argued that investments in RE technologies can be stimulated only through dedicated policies [19]. Indeed, with the exception of stand-alone systems for remote off-grid applications where RE is sometimes the only available option [20], most RE markets are heavily reliant on direct subsidies, energy taxes, or feed-in tariffs. Yet, most of the mechanisms so far implemented to stimulate RE investments have produced mixed results [21,22], partly because the proposed instruments have been unable to leverage all the drivers of the investment decision process and to fit the broader socio-economic context in which they are deployed [23]. The limited effectiveness of these policies, and the variety of stances that investors take on renewables, suggest that our understanding of the process by which these agents allocate capital to RE technology ventures remains limited.

With a few exceptions [24,25], and despite some recent calls to further investigate the role that private finance can play to accelerate RE market deployment [13], the renewable energy policy literature has seldom incorporated the investors' perspective. Moreover, it has generally focused on the economics of energy systems, adopting market efficiency and full rationality as underlying assumptions to study the behaviors of agents [26]. Yet, there is increasing evidence that a purely rational economic evaluation of the investment alternatives does not suffice to explain how investors deploy capital or how agents choose among competing energy technologies. An emerging stream of literature suggests that broader social and psychological considerations must be included in the analysis of energy systems [27,28]. Behavioral finance and the bounded rationality perspective have long challenged the validity of the rational-actor models of classical economics in many decision making contexts [29,30]. Recently, these perspectives have started to draw the attention of energy economists too, mostly for policy evaluation purposes [31]. However, to our knowledge, they have not been applied to study the investors' behaviors in the RE industry and to examine why these agents have very different and often antithetical attitudes towards RE technologies.

This paper intends to fill this gap in the literature by shedding new light on the process by which investors allocate capital to renewable energy technologies. We posit that, in addition to a rational evaluation of the investment opportunities, a number of non-financial factors affect the investors' decisions, which may lead to very different resource allocation outcomes. We refer specifically to non-financial variables linked to the investors' personal histories, backgrounds or professional experiences that may also affect decisions. These factors include: i) the opinions that investors have formed over time on RE and on the regulatory context in which they operate (i.e. their a priori beliefs vis-à-vis renewable energy technologies); ii) the extent to which investors are influenced by the socio, economic and political environment in which they operate (i.e. their response to institutional pressure); iii) the extent to which investors are willing to invest into radically new technologies with a high degree of technical uncertainty and, iv) their knowledge of the operational context in which RE are deployed.

To fill in this gap, we develop and empirically test a model that examines the impact of non financial factors on RE investments. Following the recent emphasis on energy portfolio diversification [17,18] we examine the impact of these factors not only on the overall share of RE technologies in the investment portfolio, but also on its degree of diversification and the adoption rate of each specific RE technology. The model is empirically tested using primary data collected from a sample of European investors. Europe was chosen as an appropriate context for our empirical analysis, both for its leading role on climate change and energy policies and because it is the world region that, perhaps as a direct consequence of these policies, has attracted the largest share of new RE investments in the past few years [32]. It is worth stressing that, as a consequence of this choice, our results may not necessarily hold for investors operating in other regions.

The paper aims to make several contributions. First, by providing a better understanding of the investors' decision making process, it will help the RE industry attract badly needed capital. Second, it will help policy makers design more effective policy instruments to support the market deployment of RE technologies. Finally, the paper makes a methodological contribution too, as it analyzes a broader set of agents than what usually considered in studies of this nature.

The reminder of the paper is structured as follows: the next section provides an overview of RE investments and it positions our work against extant literature. Section 3 lays out theoretical foundations and it proposes testable hypotheses. Section 4 describes the research design and the empirical methods. Section 5 illustrates the main findings. Finally, Section 6 highlights the main conclusions and discusses implications for theory and practice as well as the limitations of the paper.

[1] Ironically, even mature RE technologies are not totally risk-free, as demonstrated by the failure of T. Boone Pickens' 500 MW wind farm or by the wind turbines accidents reported in the press [15].