

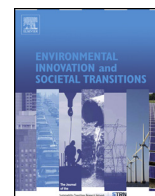


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## Characteristics of investors in onshore wind power in Sweden

Anna Darmani<sup>a</sup>, Eva M.M.I. Niesten<sup>b,\*</sup>, Marko P. Hekkert<sup>c</sup>

<sup>a</sup> Department of Industrial Economics and Management, Royal Institute of Technology, 10044 Stockholm, Sweden

<sup>b</sup> Alliance Manchester Business School, The University of Manchester, M15 6PB, Manchester, UK

<sup>c</sup> Copernicus Institute of Sustainable Development, Utrecht University, 3584 CS Utrecht, The Netherlands

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### ABSTRACT

In order to facilitate the transition to electricity industries with low CO<sub>2</sub> emissions, it is important to understand which firms invest in renewable energy technologies. This study concentrates on the heterogeneous characteristics of investors in wind power that are embedded in the investors' dynamic capabilities. Data on 617 investors in the Swedish onshore wind industry are analyzed. Investors with higher investment and management experience and a mixed generation portfolio whose business is electricity production have more assets in wind. Investors' age in the wind industry has a negative relation with assets in wind, illustrating that latecomers are investing more. Individual incumbents of the electricity industry hold a relatively large amount of assets in the Swedish wind industry, but the group of incumbents as a whole possesses only 15 percent of wind assets. The results suggest that tailor-made policies could stimulate a greater variety of firms to invest in wind power.

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### 1. Introduction

To tackle the negative consequences of climate change, sustainability transitions in the electricity industry are essential. One potential approach to achieve sustainability in the electricity industry is through the adoption of renewable energy technologies and the production of Electricity from Renewable Energy Sources (RES-E). In this context, an especially promising technology is electricity production with wind turbines (GWEC, 2013). In Europe, governmental targets are set and massive investments are directed into the electricity industry to stimulate this sustainability transition (Darmani et al., 2014; Masini and Menichetti, 2013). However, the adoption rate of RES-E is still low and its share in the power generation portfolio is limited. The International Energy Agency even observes a recent slowdown in the deployment rate of solar and wind power, and concludes that this undermines the trajectory needed to decarbonize the energy supply and meet the 2 °C scenario (IEA, 2015).

To explain this slow adoption rate of RES-E, a wide body of literature shows that sustainability transitions in the electricity industry are impeded by path dependence, because we are confronted by an already-established system in the form of a fossil-fuel industry (Smink et al., 2015), profitable nuclear power generation, centralized transmission (van der Vleuten and Raven, 2006) and preexisting technologies and infrastructure (Verbong and Geels, 2010). Firms are confronted by these investment paths of the past, and hence are partially hesitant to invest in new technologies and new markets (i.e., RES-E) (Pinkse and Van den Buuse, 2012).

\* Corresponding author.

E-mail address: [eva.niستن@manchester.ac.uk](mailto:eva.niستن@manchester.ac.uk) (E.M.M.I. Niesten).

In the old regulated European electricity industries, a few oligopolistic and often state-owned firms controlled the majority of these industries. However, the landscape of the electricity industries has changed after the electricity market deregulation, which allowed all types of firms to enter the industries and compete (Högselius and Kaijser, 2010). New firms entered the electricity industry with renewable energy technologies (Bergek et al., 2013; Darmani, 2015; Masini and Menichetti, 2013).

Therefore, in the current electricity industries, RES-E investors are comprised of various groups of firms, who are willing to benefit from electricity market changes. These firms play a pivotal role in the decarbonization of the electricity industry, ergo the pace of sustainability transitions in this industry. However, as yet knowledge on firms who invest in the renewable electricity industry and their heterogeneous characteristics is underdeveloped (Bergek et al., 2013; Masini and Menichetti, 2012; Wüstenhagen and Menichetti, 2012). This is problematic when plans are made about the electricity industry's future or when new policy instruments are designed. For policies aimed at stimulating RES-E investments, it is important to understand what the characteristics are of firms that invest in RES-E (Schmidt et al., 2012; Wüstenhagen and Menichetti, 2012). This understanding is especially important because still far larger investments in RES-E are needed in order to achieve the targets of the EU renewable directive (Jacobsson and Bergek, 2011).

Our study's point of departure is therefore the observation that the landscape of the electricity industry is changing, though there has been insufficient dialogue on the nature of investors who are changing this industry. This paper intends to contribute to this lack of knowledge by shedding light on the characteristics of firms that invest in wind power assets. To do so, we focus on investors' characteristics that are embedded in their dynamic capabilities, which correspond to the capability of a firm to discover, realize and exploit new opportunities in an existing or a new market (Teece, 2007; Teece et al., 1997). On the basis of this definition, the amount of dynamic capabilities determines the ability and willingness of a firm to implement changes into their processes and to respond to market changes (Lieberherr and Truffer, 2015; Penrose, 1958; Teece et al., 1997; Zahra et al., 2006).

This paper makes several important contributions to the literature. First, it combines dynamic capabilities theory and sustainability transitions literature to propose a set of characteristics of investors that invest more in wind. The identification of these characteristics allows us to highlight which investors contribute to overcoming the path dependence of the system, and are therefore more likely to contribute to transitions toward a more sustainable industry. Indeed, in both the energy and sustainability transitions literature there are arguments for benefits of applying a dynamic capabilities perspective to the energy industry (Dominguez et al., 2009; Gebauer et al., 2012; Markard et al., 2012; Worch et al., 2013), but this has seldom been done. As Markard and Truffer (2012: p. 962) highlight “the incorporation of new theoretical frameworks [e.g., capabilities-based studies and approaches] enhance the understanding of historical and ongoing sustainability transitions”.

Second, this paper explains differences between the amount of wind assets of firms by empirically analyzing the relation between firms' dynamic capabilities and their assets. The majority of empirical studies that employ the dynamic capabilities perspective analyze the relation between dynamic capabilities and firm performance (Niesten and Jolink, 2015). However, several recent studies argue that dynamic capabilities are higher-order resources or routines that influence lower-order resources (e.g. wind assets) of firms, before they impact on performance (Ambrosini and Bowman, 2009; Niesten and Jolink, 2015). Research should therefore focus on studying the link between dynamic capabilities and assets of firms.

Third, this paper studies the heterogeneity of investor groups by bearing in mind that investors have different industrial backgrounds and levels of experience. Differences exist between firms' incumbency in the electricity industry and in the wind industry. The findings of this study are highly relevant for policy makers as they enable them to better understand the differences between RES-E investors and their responses to market changes. Knowing which investors are capable of and willing to contribute to sustainability changes allows for readjusting the policy mix in an effective manner.

To achieve these objectives, the case of wind power in Sweden is chosen for the empirical foundation of this paper. The results are based on data on investments in wind power by 617 firms from 1996 to 2013. In 2003, Sweden has implemented a Tradable Green Certificate (TGC) system to stimulate the integration of RES-E. Using the Swedish TGC database and by applying linear regression modeling, the paper shows which type of investors have more dynamic capabilities and build up more assets in wind power.

## 2. Theoretical foundation and hypotheses

### 2.1. RES-E investors in the electricity industry

Several drivers have been introduced into the electricity industry to increase the share of renewable energy, among which energy policy is considered the most influential (Darmani et al., 2014). Policy supports can be defined as “government policies that affect the structure and functioning of markets and the competitive advantages of its participants” (Baron, 2001, p. 47). The advantages and disadvantages of renewable energy policy for accelerating RES-E adoption have been assessed in several studies (Darmani et al., 2016; Fagiani et al., 2014; Haas et al., 2011b; Richstein et al., 2015). The results show that RES-E investors are to a large extent dependent upon favorable energy policies, and more favorable policies will in general lead to greater investments in RES-E (Haas et al., 2011a; Pettersson and Söderholm, 2009).

An emerging body of literature has started arguing that what is missing in this debate is a particular focus on the investors (Masini and Menichetti, 2013; Smink et al., 2015; Wüstenhagen and Menichetti, 2012). In this paper, investors of RES-E are identified as a heterogeneous group of actors, “. . . who invest in renewable electricity production rather than as actors who finance such investments, e.g. banks, funds. [. . .]. The former initiate the idea for a new plant, mobilize resources to realize it and take

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