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Investments in the Dutch onshore wind energy industry: A review of investor profiles and the impact of renewable energy subsidies

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ABSTRACT

The 2020 renewable energy targets have stimulated the debate on the efficacy of policy schemes. Discussion on the efficacy of these schemes has largely been on the growth in the share of renewable energy, and less on the alignment of policies to the needs of investors. However, research in this field has emphasized that ‘who is investing’ is as relevant as ‘how much is invested’. This study aims to identify and better understand ‘who is investing’, by researching more than 1000 investments by 646 firms that produce electricity with Dutch onshore wind energy. These firms received renewable energy subsidies under Dutch policy schemes between 1996 and 2013. The regression results highlight the type of investors that invest more in wind energy. The results show that firms with a higher wind energy capacity are firms that have more investment experience; are latecomers to the wind industry; have an industrial background in the electricity or wind industry; are medium- or large-sized and are limited liability companies. Data on investments, combined with a document analysis, show that changes in policy schemes affect the perceived risks and expected returns of investors, and that these changes influence the amounts invested and the type of investors in wind energy.

1. Introduction

The consumption and production of renewable energy in the Netherlands have steadily grown over the past decade, but the chances of reaching the 2020 renewable energy target are growing dim. Renewable energy in the Netherlands achieved a 5.8% share of total energy consumption in 2015 [1], but this number still falls short of the policy goal of a 14% share by 2020. Traditionally, wind energy has been an important renewable source, comprising 21% of renewable energy consumption in the Netherlands in 2015 [1]. An overwhelming amount (85.1%) of total wind energy consumption is sourced from onshore wind capacity [1]. In a recent study on the Dutch energy sector, onshore wind energy is estimated to play a crucial role in reaching the 2020 renewable energy target [2]. Meanwhile, private sector investments in renewable energy in the Netherlands are trailing behind the levels required to promote innovations and improve performance [2]. This study focuses on explaining who invests in onshore wind energy in the Netherlands and how Dutch energy policies encourage this investment.

The Dutch government's energy policy is aimed at stimulating the production and consumption of renewable energy. This policy mainly includes the use of economic instruments, such as subsidizing exploitation projects or reducing energy taxes. Discussion on the efficacy of these subsidies and tax reductions has largely been on the growth in the share of renewable energy and less on the alignment of the policy to the characteristics of investors [3]. A better understanding of the characteristics of investors would not only be valuable to establish the effectiveness of the policy, given the diversity of investors in the Dutch wind energy industry, but also to appreciate the feasibility of the policy targets, given the lack of transparency on the contributions of investors to investments in wind energy production [4].

The empirical identification of the investors in renewable energy studies is only a recent issue in a long-standing discussion on the necessity and feasibility of renewable and sustainable energy [4]. In most studies [5,6] on investment in electricity produced from renewable energy sources (RES-E), attention has focused on investment rather than the investor. Although some studies have looked at the perceptions of entrepreneurs in realizing wind energy projects under specific social and institutional conditions [7–9], investors have implicitly been assumed to safeguard the economic efficiency of the investment, and as such, to represent a homogenous group of profit-

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maximizing actors. In the last decade, several qualitative studies have started to explore the diversity among investors, adding to the discussions on the effectiveness of energy policies [10–12]. In an early study, Agterbosch et al. [10] identified different entrepreneurial groups involved in wind energy in the Netherlands. Similarly, Wüstenhagen and Menichetti [11] have made different types of investors an integral part of their conceptual framework, stressing that 'not all investors are the same, and similar investment opportunities are valued differently by different investors' [11, p. 6]. Bergek et al. [12] questioned 'Who invests in renewable electricity production?', completely deviating from the homogenous, unidentified investors in wind energy.

This study aims to identify and better understand the types of firms that invest in the production of Dutch onshore wind energy, and receive a renewable energy subsidy. Regression analyses with data on 646 firms with more than 1000 investments in the Dutch onshore wind industry explain what type of investors invest more in wind energy. Furthermore, by combining data on investments with an analysis of energy policy documents, the article explores how changes in the Dutch energy policy have led to alterations in the behaviour of wind energy investors. This study, therefore, contributes to the literature that argues for a greater emphasis on reviewing the diversity of investors and on determining the impact of energy policy on investment decisions.

In the next section a conceptual framework is introduced based on the literature that portrays the relationships between investors, energy policy, and investments in renewable energy, followed by a description of Dutch renewable energy policies in Section 3. Section 4 presents the methods used for the results in Section 5. Section 6 presents the conclusions and Section 7 lists the limitations of the study and the suggestions for future research.

2. Theory on investments in renewable energy

An emergent stream in the renewable energy policy literature [11,13] recognizes the importance of strategic decisions in energy policy design. A major tenet in this stream of literature is that a policy design that considers the risk for investors will effectively influence the deployment of renewable energy [11]. This article adopts the conceptual framework offered by Wüstenhagen and Menichetti [11], which takes perceived risk and expected return as pivotal concepts and adapts them to the Dutch wind energy investments (see Fig. 1).

Within this framework, the investments in wind energy are explained in terms of perceived risk and expected return. As in any business venture, the risk is an essential feature that lies at the heart of all investment decisions [13]. Drawing on Wüstenhagen and Menichetti [11] and Forlani and Mullins [13], this study argues that perceived risk underlies the firm's investment decisions on wind energy. Similarly, expected returns of energy investments are largely based on the firm's expectations of future developments. Both perceived risk and expected return are estimates at the investor's level, and therefore allow for a bandwidth of different risk-return combinations [11]. In the Wüstenhagen and Menichetti framework, the differentiation in the estimates and decision-making of investors can be attributed to investor profiles[3] [11,14]. An investor profile is largely informed by the prior investments of an investor in renewable energy and by the type of investor (Fig. 1). This study focuses on prior investments and the type of investor to explain an investor's total investment in onshore wind energy in the Netherlands. It is assumed that perceived risk and expected returns are influenced by the investor profile. Fig. 1 also shows that these are also influenced by energy policies.

[3] Wüstenhagen and Menichetti [11] refer to 'cognitive aspects' based on decision-making under bounded rationality.

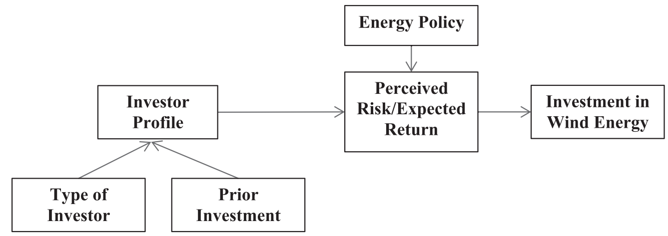

Fig. 1. Conceptual framework (adapted from Wüstenhagen and Menichetti [11]).

2.1. Impact of investor profiles on investments

2.1.1. Prior investments

Previous research [15,16] has shown that firms with investment experience display a higher level of accuracy in predicting the probabilities of outcomes. Experienced investors are also able to make more accurate risk estimates. Kaufmann et al. [17, p. 325] have argued that "knowledge about risk can be acquired through *experience*, through feedback about the outcomes of previous decisions." This experience and knowledge about risk may lead to a lower risk perception, in particular with small probabilities of loss [17], which in turn may lead to larger investments.

2.1.2. Type of investor

Bergek et al. [12] have argued that investors in renewable energy act as those '...who invest in renewable electricity production (e.g. utilities and farmers) 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 ownership of the plant once it is in place. Electricity production then becomes a part of their business' [12, p.573]. Given the different stages of investment in renewable energy, from early-stage technology and early-adopters to mature technology and large-scale deployment, the group of investors in renewable energy can be categorized in a variety of ways, illustrating the heterogeneity of the group [12]. Wüstenhagen and Menichetti [11] argue that future research should review the heterogeneity of these investors, and categorize them into different types to explain their behaviour towards investments in renewable energy. Based on previous research [12,18], this study analyses different types of investors by studying (1) their age, (2) industrial background, (3) size, and (4) legal form. Following conventional wisdom, it is assumed that investors in RES-E are risk averse [19].

(1) In their review on risk taking by firms, Skromme Baird and Thomas [18] show that the firm's age is one of the variables affecting risk perceptions. The sustainability transitions literature [4,20] argues that first movers (the older firms in an industry) experience more uncertainty than latecomers (the younger firms in an industry). First movers provide positive external economies to later firms in that they make visible new business opportunities and reduce uncertainties [21]. Latecomers perceive less risk and are therefore likely to invest more than the older firms.
(2) Bergek et al. [12] distinguish between investors by describing their main area of business activity, which they measure by looking at their industrial background. The industrial background will impact the perceived risk and expected return of investments, and consequently the level of investment. If a firm invests in its main activity, it will have valuable knowledge in that area, which it can use to solve problems and detect opportunities in a more effective way [22]. These firms will have better insights into the potential risks and returns and will invest more, compared to the firms that invest in technologies that are not related to their main activity.
(3) Based on several other studies, Skromme Baird and Thomas [18] argue that firm size is also an important determinant of risk perception by firms. Wüstenhagen and Menichetti [11] mention

firm size as an important dimension in differentiating between investors and one that may have an effect on investments. Larger firms invest less in risky projects than smaller firms [23,24], but they can spread their risks over a larger amount of assets and therefore, can also make greater investments than smaller firms.

(4) Bergek et al. [12] also distinguish between different types of investors by studying the different legal forms of investors. Greenwood et al. [25] show that firms with different legal forms function differently, such as public and private corporations versus partnerships, based on differences in monitoring by owners and the motivation of professional workers. Fama and Jensen [23] showed that firms with different legal forms make different types of investment decisions. In some legal forms owners are more at risk because of the degree of liability, which impacts their perceived risk and expected returns and thus their level of investment.

2.2. Impact of energy policy on investments

Based on Wüstenhagen and Menichetti [11] and an expanding stream in the energy policy literature on the role of investors [20], this study argues that the design of renewable energy policies affects the perceptions of investors on the risk-return combination of investment projects [26], and consequently, the level of investments in RES-E (Fig. 1). Several studies argue that risk reduction makes a support mechanism effective in promoting the deployment of renewable energy technologies [26–28]. In a comparative study on renewable energy policies, Mitchell et al. [26] make a distinction between price risk and volume risk to determine the effectiveness of different policies. Price risk may occur when the compensation for investing in renewable energy depends on energy market prices and thus varies over time, but it is negligible when fixed tariffs are paid to renewable energy generators. Volume risk may occur when renewable energy policies are quota systems determining an overall volume for renewable energy generation or the policies include a maximum budget thereby restricting the total sum of subsidies provided. Volume risk is absent or negligible when there is no quota or budget cap. Mitchell et al. [26] show that German renewable energy policies have been more effective in increasing the share of renewables than those in England and Wales because they have much lower price and volume risks for renewable energy generators.

3. Renewable energy policies in the Netherlands

Since 2003, the Dutch government has implemented three types of renewable energy subsidy schemes, which are called the Environmental Quality of the Electricity Production (Milieukwaliteit van de Elektriciteitsproductie, MEP), Stimulation of Sustainable Energy Production (Stimulering Duurzame Energieproductie, SDE) and SDE+. Firms applying for subsidies for renewable energy production in the Netherlands between 2003 and 2006 turned to the regulations in the MEP, which aimed at providing firms with some long-term security by offering subsidies for up to ten years [29]. As a consequence, several wind energy projects still received an MEP subsidy in 2013, the final year in the study period. Even though the regulations were implemented in July 2003, projects that started between 1 January 1996 and July 2003 could apply for the MEP subsidy, or at least for part of their subsidy duration [30]. The MEP allocated subsidies based on the amount of renewable energy generated (in kW h), allowing for a distinction in the subsidy levels given to different types of renewable energy [31]. One of the goals of the MEP was to deliver on the national potential for wind energy [31]. Regulatory decisions set the tariffs that each type of renewable energy would receive for the entire duration of the subsidy period [32–34]. The MEP had no maximum budget for the total amount of subsidies provided to renewable energy generators.

In 2008 the MEP was succeeded by the SDE scheme, which lasted two years. The SDE subsidy was based on a compensation mechanism that considers that the electricity production with renewables is more expensive compared to the electricity production by fossil fuels. The SDE subsidy compensated the extra costs and was dependent on the market prices of electricity and/or natural gas [1]. The compensation was for a period of twelve or fifteen years [29]. In 2011, the SDE scheme was replaced by the SDE+ scheme [29]. The SDE, characterized by budgets per renewable energy technology, made way for the SDE+ scheme, characterized by a budget for all technologies combined [1]: technologies that required lower subsidies were more likely to obtain funding [30]. The tariffs of the SDE+ scheme are also based on the market price of energy [35].

4. Methods

4.1. Description of the data

Two datasets from different sources were combined in order to study the attributes of firms that invest in wind energy. The data on the investments in wind energy were supplied by the Netherlands Enterprise Agency (NEA) and the data on firm attributes were obtained from Statistics Netherlands (CBS). The NEA is an executive agency of the Ministry of Economic Affairs that implements regulations on the stimulation of sustainable energy production (including the MEP, SDE, and SDE+). The data on wind energy investments consist only of the investments made by firms that received subsidies in the MEP, SDE, or SDE+ subsidy schemes. It is assumed that most, if not all, investors apply for these subsidies. This assumption is supported by a recent interview with an investor in wind turbines [36] and by Statistics the Netherlands [1]. Both sources claim that financial support of the government is necessary for the profitable exploitation of wind turbines [1]. The data on firm attributes were supplied by the General Business Register (GBR) of Statistics Netherlands, which contains information on the size, industry, and the legal form of firms. Both datasets report the Chamber of Commerce codes of firms, which enable a link between the data on firms' investments in wind energy and the data on the attributes of these firms. This combined dataset contains information on 1053 investments in onshore wind energy made by 646 firms over the period of 1996–2013.[4] The year 1996 was used as a starting point because wind energy projects that started after 1 January 1996 could apply for an MEP subsidy. The year 2013 is the final year in the dataset because of data availability at the time of data collection.

The effect of renewable energy policies on wind energy investments was examined by an extensive document analysis of the MEP, SDE, and SDE+ policy documents that identify and evaluate the consequences of the different renewable energy policies for the perceived risk and expected return of onshore wind energy projects. All policy documents are publicly available online (www.overheid.nl).

4.2. Operationalization of variables

The dependent variable is the *total investment in wind energy* (in MW) of a firm at the end of 2013. The total investment in wind energy per firm was obtained by summing the investments in wind energy over the period 1996–2013.

A first independent variable is *prior investments,* which is a count variable that reflects the total number of times a firm invested in wind energy over the period 1996–2013.

Four other independent variables that reflect all aspects of the investor types were included in the analysis. These variables are the *age in the wind industry*, *industrial background*, *size* and *legal form* of the investors. The *age in the wind industry* is calculated by

[4] In the original database there were 1207 investments, but 154 investments did not contain information on the Chamber of Commerce code. As a result, these 154 investments could not be linked to attributes of firms. The dataset therefore contained information on 1053 investments.

subtracting the first year that a firm made an investment in wind energy, from the year 2014. When the General Business Register reports a year of discontinuation of a firm, this year replaces 2014 to calculate the age in the wind industry. *Industrial background* is a categorical variable that classifies firms according to their main industrial activity. It consists of three categories. The first category includes firms whose main industrial activity is the production of wind energy. The second category includes firms registered in the electricity industry whose main industrial activity is not the production of wind energy, but the production, distribution or transportation of electricity, the production of other types of renewable energy, or the production of electricity generators or transformers. The third category of firms is 'other industries', so called because they are not registered as firms in the electricity industry. The industry of these firms includes among others agriculture, finance, construction, real estate, retail and wholesale. The Standaard Bedrijfsindeling (SBI) codes, the Dutch equivalent of Standard Industrial Classification (SIC) Codes, were used to determine the industry of each firm. *Firm size* is an ordinal variable with four categories of firm size, in line with the Eurostat classifications. A first category are firms that report having no employees; micro firms have between 1 and 9 employees; small firms between 10 and 49; and medium and large firms have more than 50 employees. *Legal form* is a categorical variable that reflects the legal structure of the firms in the dataset and contains five categories: cooperatives, associations and foundations; sole proprietorships; public partnerships; commercial and limited partnerships; and private and public limited liability firms.

4.3. Data analysis

In order to explain firm level investments, ordinary least squares regression was used to estimate various models, because the dependent variable is a continuous variable. Table 1c shows five different estimation models. The first model contains only the prior investments as an independent variable. Model five is the full model and also contains data on the type of investor, reflected in the variables of *age in the wind industry*, *industrial background*, *firm size*, and *legal form*. In Section 5, an interpretation of the results of this full model will be presented. Table 1c also includes models 2, 3, and 4 as a robustness check. These models display a successive introduction of the *age in the wind industry*, *industrial background* and *legal form of the investors*. They show that the results are largely consistent across the different models, both in terms of the size and significance of the effect.

For the second part of the analysis the investments in onshore wind energy (in MW) were aggregated per year. This resulted in a time series of investments in onshore wind energy (in MW). Observed developments in investments over time are explained by the information obtained on the renewable energy policies. The documents on renewable energy policies were analysed separately by two of the authors, based on the original purpose of the document and the target audience in mind. The interpretations were sampled based on the concepts shown in Fig. 1. The interpretations were then provided to the third author and a common interpretation was established. Finally, this common interpretation was triangulated with other policy interpretations [37].

5. Results

5.1. Impact of investor profiles on investments in Dutch onshore wind energy

Table 1a shows that firms invest in wind turbines with a combined capacity of 4 MW on average, and they invest more than once in the production of wind power. The average age of firms in the wind industry is slightly above ten years. Table 1b shows that the majority of firms in the dataset are based in industries other than the electricity or wind, such as agriculture, finance, construction, real estate, retail and wholesale. In terms of firm size, the majority of firms are micro firms with less than 10 employees. With respect to the legal form, the category with the highest number of firms is the private and public limited liability form.

All regression models are statistically significant and explain a relatively large part of the variance. The full model explains almost 50% of the variance in the total investments in onshore wind energy. Zooming in on the effect of the independent variables, the results of the regression analysis show that firms with higher levels of investment experience have a higher capacity in wind energy. This is in line with previous research that argues that experience enables more accurate risk predictions and can thus be favourable to investments [16]. With respect to firm age, the analysis shows that firms that started to invest in wind energy more recently have higher amounts of MW in wind. This supports the idea that latecomers profit from the positive externalities of first movers and thus perceive a lower risk when investing in wind energy [20]. In addition, technological developments have increased the scale and efficiency of wind turbines over time, which may have contributed to the higher capacity of latecomers [36]. The variable industrial background categorizes the firms into those registered in the wind industry, electricity industry, or another industry. The results show that firms registered as electricity firms have a 3.7 times higher capacity in wind energy, and firms that are registered as wind energy production firms have a 2.3 times higher capacity in wind energy compared to the firms from other industries. Although the largest group of firms in the dataset was from outside the wind or electricity industry, these firms are not the major investors in wind energy. In terms of firm size, the results demonstrate that the medium- and large-sized firms invested more MW in wind energy compared to the smaller firms. These two results are as expected since larger firms and firms in the wind and electricity industries can spread their risks over a larger amount of assets in their core business. With respect to the legal form of the investors, the analysis shows that firms in the category private or public limited liability firms have higher installed capacities compared to the firms with other legal forms. This relation is only significant when the limited liability firms are compared

Table 1a
Descriptive statistics of continuous and count variables.

	Observations	Mean	Std. dev.
Total investment in wind energy (in MW)	646	4.268	13.850
Prior investments	646	1.630	3.036
Age in wind industry	646	10.690	4.024

Table 1b
Descriptive statistics of categorical variables.

Variable[a]	Category	Frequency (No. of firms)
Industrial background (n = 633)	Wind energy production	248
	Electricity industry	66
	Other industries	319
Firm size (n = 631)	Zero	187
	Micro	380
	Small	45
	Medium and Large	19
Legal form (n = 635)	Private/public limited liability firms	244
	Cooperative, association & foundation	18
	Sole proprietorship	108
	Public partnership	113
	Commercial / limited partnership	152

[a] The number of observations is lower than 646 due to missing values for some variables.

Table 1c
Regression output, predicting total investments in wind energy (in MW).

DV: Total Investment in Wind Energy	Model 1	Model 2	Model 3	Model 4	Model 5
Prior investments	2.918 (0.138)****	2.995 (0.136)****	2.957 (0.137)****	2.857 (0.135)****	2.870 (0.135)****
Age in wind industry		−0.537 (0.103)****	−0.513 (0.104)****	−0.435 (0.103)****	−0.425 (0.103)****
Industrial background:					
– Wind energy production			2.571 (0.891)***	2.396 (0.888)***	2.349 (0.927)**
– Electricity industry(Base: Other industries)			4.943 (1.411)****	3.705 (1.380)***	3.700 (1.400)***
Firm size:					
– Zero employees				−14.986 (2.380)****	−14.350 (2.494)****
– Micro firms				−11.498 (2.768)****	−11.403 (2.769)****
– Small firms(Base: Medium and large firms)				−14.181 (2.437)****	−13.545 (2.451)****
Legal form:					
– Cooperative, association & foundation					−6.566 (2.466)***
– Sole proprietorship					−0.710 (1.347)
– Public partnership					−0.998 (1.378)
– Commercial/limited partnership(Base: Private/public limited liability firms)					−0.445 (1.141)
Constant	−0.488 (0.476)	5.124 (1.172)****	3.441 (1.273)***	16.956 (2.568)****	16.855 (2.564)****
N=R^2	646	646	633	631	631
	40.91%	43.32%	44.72%	48.61%	49.21%

*Significant at 0.1.
** Significant at 0.05.
*** Significant at 0.01.
**** Significant at 0.001.

to cooperatives, associations, and foundations, possibly because the decision makers in limited liability companies perceive lower risks than decision makers in other legal forms do.

5.2. Impact of renewable energy policies on the investments in Dutch onshore wind energy

Fig. 2 shows the change in the investments in onshore wind energy (in MW) in the Netherlands between 1996 and 2013. The numbers reflect the realized capacity. This section analyses the impact of the Dutch renewable energy policies on the changes in investments over time, assuming that there is a time lag of two years between the subsidy and the realized capacity [4]. Table 2 summarizes the main attributes of the policies and the associated perceived risks of investing in renewable energy.

For projects between 1996 and 2006, investors could apply for an MEP subsidy. There was no budgetary limit for the MEP, making it a so-called ‘open-end regulation’. This meant that there was no volume risk for investors. Since the government set fixed subsidy tariffs for a period of up to ten years, investors under the MEP scheme experienced no real price risk, either. Fig. 2 illustrates that after the introduction of the policy in 2003, several firms applied for the MEP subsidy for projects that started between 1 January 1996 and July 2003. Between 2003 and 2007, the investor-friendly characteristics of the policy led to a rapid increase in the investments made per year, indicating that investors expected to earn a return on their investment. This resulted in a substantial and actual increase in renewable electricity production

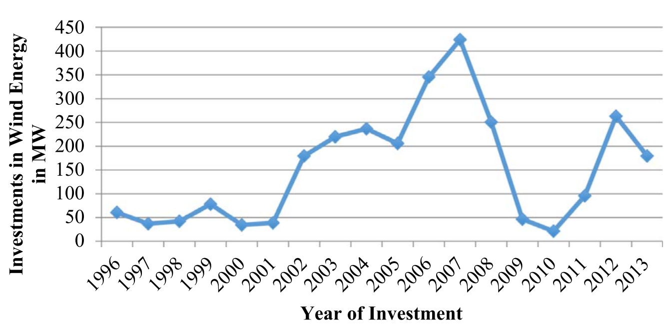

Fig. 2. Number of investments in wind energy over time (in MW). Source: Statistics Netherlands (authors' visualization).

in the Netherlands. Although the investments in wind turbines finally paid off, the popularity of the MEP subsidy scheme resulted in excessive costs for the Dutch government. With a policy aim of 9% renewable electricity production in 2010 in sight, even without further subsidies [1], the aim would have been achieved. The MEP subsidy was abruptly terminated in August 2006 [37]. The tapering off in the level of investments in wind energy after 2007, with very low investment levels in 2009 and 2010, can be explained by this change in energy policies. Even though the MEP was discontinued in 2006, existing projects and the projects for which firms had already applied for funds were still funded. Since wind turbine projects have a long turnaround time, it may take several years for firms to get the turbines installed and running. Therefore, the actual termination of this first energy policy can only be observed from 2008 onwards.

In contrast to the MEP its successor in 2008, the SDE subsidy, used a budgetary limit for each renewable energy technology [1], exposing the investors to a volume risk. In addition to this budgetary limit, every year the Dutch government would set a compensation tariff based on the market prices of energy, leading to a price risk for investors. These risks substantially reduced the beneficial effect of the policies on investments, as illustrated by the lower levels of investments from 2010 to 2013 compared to the peak in 2007. The timing of the introduction of the SDE subsidies coincided with the global economic crises that affected all investments severely, including investments in renewable energy in the Netherlands [38].

A large part of the SDE money was dedicated to onshore wind energy [30] as it was one of the cheapest alternatives within the SDE scheme and therefore required lower compensations compared to more expensive renewable energy alternatives. Considering the turnaround time for most of the funded projects, the positive effect of the SDE scheme on onshore wind energy in terms of expected returns is visible after 2010 (Fig. 2).

With the implementation of the SDE+ scheme in 2011, the perceived risks increased further, if only for the risks of obtaining funding. While the SDE subsidy scheme had at least a budget per technology, the new SDE+ scheme has one budget for all technologies combined, increasing the competition among renewable energy alternatives. In other words, the volume risk increased compared to the SDE scheme. The SDE+ scheme also imposes a price risk, as the tariffs depend on the market prices for energy. In the first year of the SDE+ (2011), two thirds of the budget was absorbed by green gas projects,

Table 2
Impact of Dutch renewable energy policies on perceived risks and investments.

RE subsidy scheme	Policies impacting risks and investments	Perceived risks	Investments
MEP (1996–2006)	Tariffs set by government for 10-year period No budgetary limit	No price risk No volume risk	High investments in wind until 2007
SDE (2008–2010)	Tariffs depend on market price Budgetary limit per type of RE	Price risk Volume risk	Lower investments compared to peak in 2007
SDE+ (2011 -)	Tariffs depend on market price Budgetary limit for all types of RE combined; competition between types of RE	Price risk More volume risk (compared to SDE)	Drop in investments in 2013

which proved to be an attractive option for farmers [39]. With the first-time introduction of the production of renewable heat into the SDE+ scheme in 2012, almost the entire available budget for 2012 was awarded to heat projects [39]. The final year of the analysis, 2013, showed a drop in investments in wind energy. These results show that perceived price and volume risks result in lower investments (Table 2).

6. Conclusion

This study contributes to emerging research on the diversity of investors in the renewable energy sector, by reviewing the type of investors that invests more in wind energy and determining the impact of energy policies on investment decisions. The article analyses the attributes of 646 firms that invest in the Dutch onshore wind industry and the impact of three different subsidy schemes on the changes in investments over time.

The analysis shows that firms with a higher capacity in wind energy are firms with more investment experience; firms that are latecomers in the wind industry; firms whose main industrial background is in the electricity or wind industry; medium and large firms; and limited liability companies. The analysis also shows that changes in subsidy schemes substantially influence the levels of investment in wind energy. These changes mainly affect the risks of the investment, favouring investors who are better or more experienced at estimating their risks. In the later years of the subsidy schemes, changes in the renewable energy policy also affected the expected returns of specific technologies, leading to smaller investments in wind energy or larger investments in alternative renewable energies.

7. Limitations and future research

This study focused on the investors that invest in onshore wind energy resources in the Netherlands. This focus is novel for the Netherlands. The focus on onshore wind energy implies that insights in the portfolio aspects of investors were disregarded. According to the elaborate framework suggested by Wüstenhagen and Menichetti [11], the renewable energy portfolio would offer an additional explanation for the level of investments in onshore wind energy for the investors in this study. This addition could also explain the consequences of the extension of the SDE+ scheme with other renewable energy options; for instance, data show that in the later years, the number of investors from the agricultural sector decreased possibly because of a shift to other renewable energy technologies that became attractive alternatives. Future research could look at the portfolio effects of the investments to understand policy-induced shifts in renewable energy investments.

The focus on investors has confined the explanation for the investments in wind energy to the investor profiles, and therefore, to the dimensions of the prior investments and the firm type. A variable that may also be considered in the context of wind energy [4] is the geographical location of the wind turbine. Future research may combine the geographical location with the investors' profiles for a complete understanding. Finally, with the emergence of national studies on investors in renewable energy, a comparative study with other renewable technologies and other countries would be useful to explore more generally the efficacy of renewable energy policies [40].

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