UNIVERSITAT ROVIRA I VIRGILI
DEPARTAMENT D'ECONOMIA

CREIP
CENTRE DE RECERCA EN ECONOMIA INDUSTRIAL I ECONOMIA PÚBLICA

WORKING PAPERS

Col·lecció "DOCUMENTS DE TREBALL DEL DEPARTAMENT D'ECONOMIA - CREIP"

Determinants of energy efficiency and renewable energy in European SMEs

Elisenda Jové-Llopis
Agustí Segarra-Blasco

Document de treball n.1 - 2018

DEPARTAMENT D'ECONOMIA – CREIP
Facultat d'Economia i Empresa

UNIVERSITAT ROVIRA I VIRGILI
DEPARTAMENT D'ECONOMIA

CREIP
CENTRE DE RECERCA EN ECONOMIA INDUSTRIAL I ECONOMIA PÚBLICA

Edita:

Departament d'Economia
www.fcee.urv.es/departaments/economia/public_html/index.html
Universitat Rovira i Virgili
Facultat d'Economia i Empresa
Av. de la Universitat, 1
43204 Reus
Tel.: +34 977 759 811
Fax: +34 977 758 907
Email: sde@urv.cat

CREIP
www.urv.cat/creip
Universitat Rovira i Virgili
Departament d'Economia
Av. de la Universitat, 1
43204 Reus
Tel.: +34 977 758 936
Email: creip@urv.cat

Adreçar comentaris al Departament d'Economia / CREIP

ISSN edició en paper: 1576 - 3382
ISSN edició electrònica: 1988 - 0820

DEPARTAMENT D'ECONOMIA – CREIP
Facultat d'Economia i Empresa

Determinants of energy efficiency and renewable energy in European SMEs

Elisenda Jové-Llopis and Agustí Segarra-Blasco

Abstract

This paper empirically investigates the factors driving the adoption of energy efficiency (EE) and renewable energy (RE) measures in a sample of 8,213 Small and Medium-Sized Enterprises (SMEs) in European countries. Using a bivariate probit model we examine their drivers, complementarities, and potential temporal persistence in three European country clusters (Core countries, Mediterranean countries and New EU members). Our results suggest that sustainable energies actions (EE and RE) are highly persistent both at the firm level and across countries and that there are relevant complementarities between EE and RE practices, as well as other resource efficient practices. In addition, strategies for EE seem to rely more on cost saving and regulations, while those for RE are more linked to public support and environmental awareness. This paper ends with some recommendations for policymakers suggesting that Europe needs to design an energy policy for the SMEs firms that jointly pursues both EE and the diffusion of RE according to the technological gap of each member country.

Keywords: energy efficiency, renewable energy, European Union, SMEs firms

Highlights:

- ✓ Sustainable energies measures (EE and RE) are highly persistent at the firm level and across countries in the European Union.
- ✓ High complementarities between EE and RE practices are found. Also, European SMEs firms undertaking such measures are more likely to continue applying them in the future.
- ✓ EE strategies are influenced by cost saving and regulations, in contrast, RE are more linked to public support and environmental awareness.
- ✓ The drivers of EE and RE, in addition to their persistence and the complementarities between them, highlight the need to deploy an energy policy that jointly pursues EE improvements and the promotion of RE.

Research Group of Industry and Territory
Department of Economics – CREIP, Universitat Rovira i Virgili

This paper is part of a research project carried out with the financial support of the Consolidated Group of Research 2014-SGR-1395, the Xarxa de Referència en Economia Aplicada (XREAP) and the Secretaria d'Universitats i Recerca del Departament d'Economia i Coneixement de la Generalitat de Catalunya. We are also grateful to Anna Rovira for their research support. The usual disclaimers apply.

1. Introduction

Over recent decades, the increase in energy consumption and its impact on the emission of greenhouse effect gases (hereafter GEG) has forced the government to deploy public policies oriented towards accelerating energy intensity improvement, especially in the populations most sensitive to environmental degradation and in activities with high levels of emissions (transport, energy, industry). To limit the impacts of global warming, it is essential to reduce GEG emissions, which will only be possible by moving toward a new energy model where the weight of fossil energy sources is considerately reduced.

Recently the public policies that promoted the transition to a sustainable energy model have focused on two objectives: the promotion and diffusion of energy efficiency (hereafter EE) and the adoption new sources of renewable energy (hereafter RE) from green energy technologies. In the short term, public policies pursuing the reduction of GEG, primarily use regulations and financials tools, but, in the longer term, the most important determinants of success or failure in environmental protection are related to the development and more efficient spread of new technologies (Jaffe and Stavins, 1994). Although, these goals are not independent and present significant synergies, the relationship between EE and RE has received limited attention from policy makers and academics, especially in empirical studies focused on the determinants of the environmental performance of European firms (IRENA, 2015).

One key option for transitioning to a low-carbon energy model is to increase the share of RE sources, especially for electricity generation (Pfeiffer and Mulder, 2013). Nevertheless, RE technologies are even more costly to use than traditional fossil fuels, above all for SMEs. Considering that SMEs are responsible for approximately 64% of industrial pollution in Europe (European Commission, 2010), it is essential to design policies that facilitate the use of these technologies to reduce global GEG emissions (Popp et al., 2011). Following these lines, policymakers have increasingly supported the development of more efficient energy technologies and, especially in the diffusion of RE technologies (Polzin et al., 2015)

Consequently, this empirical paper uses an extensive sample of European SMEs to analyse the drivers of both environmental strategies at firm level. Our starting point is that both EE and RE measures carried out by SMEs tend to increase the share of resource efficiency actions and reduce the total final energy consumption at country level. In this interpretation, EE and RE are the two main pillars of the sustainable energy policy. However, saving energy usage and promoting RE sources will lead to complex interactions that condition results depending on the characteristics of sectors and countries (Del Río González, 2007).

Despite an overall consensus that the most promising solution to global concern about energy sector seems to be using energy more efficiently and increasing the share of RE sources(IEA, 2015); recently some research has displayed that RE measures are often not implemented by SMEs because of the evidence of market failures and market barriers, a limited consumer demand, and lack of organizational flexibility in the firms (Backlund et al., 2012; Brown, 2001; Cagno and Trianni, 2012; Hirst and Brown, 1990; Jaffe et al., 2003; Palm and Thollander, 2010).

Across the EU28, SMEs can make a relevant contribution towards that challenge since they are considered the backbone of Europe’s economy. According to Eurostat's Structural Business Statistics Database, in 2015, European SMEs accounted for 99.8% of the business fabric, generating 66.8% of employment and 57.4% of added value (European Commission, 2016). But at the same time, it is estimated that SMEs account for approximately 64% of the industrial pollution in Europe (European Commission, 2010). Furthermore, the adoption rate of EE and RE measures is surprisingly unfavourable – while only 4% of European SMEs have put a system in place to monitor and control energy consumption, more than 90% of SMEs have not yet or have only recently adopted many measures to control their energy consumption (European Commission, 2007).

The main goal of RE policy is to promote the investment in R&D activities for developing new sustainable energy technologies and to increase the volume of demand for clean energy (Popp et al. 2010). Unfortunately, European SMEs implement hardly any RE measures. This situation is extremely worrying if we consider that RE has been recognized as a primary means of increasing a firm’s competitiveness, especially among SMEs (Trianni et al., 2016). The low implementation rate of such measures among European SMEs represents a clear warning of the existence of an ‘RE gap’. For these reasons, the European Commission through its Green Action Plan for SMEs aims to help them take advantage of the opportunities offered by the transition to a green economy.

Over the last few years, several studies have analysed the role of barriers to the adoption of RE practices (Rohdin et al., 2007; Schleich and Gruber, 2008; Sorrell et al., 2000; Trianni et al., 2016, 2013) while research into the drivers of EE and RE seems to be less explored at both firm level, especially across SME firms (Costa-Campi et al., 2015; Horbach et al., 2012). In addition, mainly due to data restrictions, there are few analyses comparing different countries (Horbach, 2016).

Starting from this evidence, one of the challenges is the need to explore the drivers of EE and RE in greater detail across European SME's. Hence, the present paper empirically analyses the main firm characteristics that drive the adoption of EE and RE practices to help policymakers to implement suitable instruments to promote them. The Flash Eurobarometer 426 "SMEs, resource efficiency and green market" permits an analysis of the determinants of both EE technologies and RE in SME firms across 28 different European countries. To examine the differences among European countries in some depth, we classify the EU28 countries into three clusters: Core country, Mediterranean, and New EU countries.

Applying a biprobit model to take into account the synergies between undertaking a sustainable energy policy now and the probability that a firm continue adopting future actions related to the improvement of EE and RE our results suggest that sustainable energies (EE and RE) are highly persistent at the firm level and that there are high complementarities between both, as well as other resource efficient practices. In addition, EE strategies seem to rely more on cost saving and regulations, in contrast, RE strategies are more linked to public support and environmental awareness.

The paper is organized as follows. Section 2 presents the theoretical framework regarding the main factors fostering EE actions. Section 3 describes the data and variables and presents the empirical methodology. Section 4 shows the econometric results and, finally, section 5 provides the main conclusions.

2. Literature review: drivers of energy efficiency and renewable energies

2.1 Sustainable energy: an overview

The transition towards a more sustainable energy model requires a wide range of technically useful and economically appropriate measures that affect all stages of the energy supply chain. In this regard, public policies aimed at improving EE and the increasing participation of RE technologies in the energy mix are the two main lines of action.

We can consider that EE and RE are integrated into the more general concept of eco-innovation. In fact, the Eco-Innovation Observatory (EIO, 2013) defines eco-innovation as the "*the introduction of any new or significantly improved product (good or service), process, organisational change or marketing solution that reduces the use of natural resources (including materials, energy, water, and land) and decreases the release of* *harmful substances across the whole lifecycle*". Consequently, actions that aim to save energy and change the energy mix in favour of cleaner energy sources is a key way of achieving a more energy sustainable model.

Nevertheless, defining EE is not a simple task. Our definition is that EE is the use of energy in an optimum manner to achieve the same service that might have been achieved less efficiently. In other words, EE is the practice of reducing the energy requirements and can be improved by technological, organizational, institutional, and structural transformations that seek to save energy. In addition, EE refers to using less energy input to deliver the same service, but gains in the EE will result in an effective reduction in the energy price per unit, and as a result the total energy use should increase partially reducing the impact of the efficiency gain (i.e., "rebound" effect).[1] To overcome this situation and following the Flash Eurobarometer Survey 426 we interpret that the European SMEs carry-out EE actions when firms undertake energy-saving actions and reduce the total energy use.

Without a doubt, EE energy is a valuable means of overcoming the environmental challenges of more developed economies. In Europe, the transition to a new and more energy-efficient model will reduce primary energy consumption, improve the security of supply and moderate energy imports. Then, future growth must be driven with less energy and lower costs. However, the new energy model will only be possible thanks to the emergence of new technologies more sustainable and cheaper in traditional fossil technologies and in RE sources. with the appearance of more efficient fossil fuel technologies and cheaper such as the increase of the weight of the RE sources. In European SMEs, improving the EE appears as a key method of ensuring their profitability and competitiveness.

On the other hand, we interpret RE as the actions that firms carry out to increase the use of solar, wind, geothermal, hydro, ocean and biomass energy sources. In the past four decades, solar and wind power systems have experienced rapid sales growth, declining capital costs and costs of electricity generated, and have continued to improve their performance characteristics (Arent et al., 2011). Furthermore, the evolution of fossil fuel prices and RE costs have headed in opposite directions and, consequently, have facilitated the development of new energy technologies. In addition, the growth of research activities

---

[1] Definitions of the "rebound" effect vary in the literature, and the empirical research found the size of the rebound effect is moderate. See a survey of the conceptual and empirical literature in Greening et al. (2000).

in the field of sustainable technologies and the subsequent adoption by private firms have been supported by public energy policies that facilitate the rapid diffusion of RE sources.

According to the Flash Eurobarometer Survey 426 (FL426), European firms have several means at their disposal to improve their level of environmental management (Table 1). The survey considers that European SMEs have eight practices to be more resource efficient. Six of them are related to saving of supplies or materials and waste management — water saving, materials saving, waste management, sell scrap material to another firm, recycling or reusing material and waste, designing new products that are easier to maintain or reuse; while the remaining two practices are related to saving energy usage and increasing the RE sources. Hence the empirical analysis is focused on deepening the drivers that affect EE and RE strategies in European SMEs. In addition, a relevant dimension of the work is to examine the complementarities that may exist between both sustainable energy actions and, also, between EE and RE actions and other resource efficient practices related to related to saving supplies or materials and waste management.

Looking at Table 1 we observe that most of SMEs firms are taking some actions to be more resource efficient. Specifically, the reduction of energy is the most prevalent action among SMEs across the EU-28, followed by other actions aimed at saving materials and minimising waste. In contrast, SMEs are less likely to be taking actions using predominantly RE. Regarding using RE, we see that few SME firms decide to implement this resource efficient practice (14% and 19% in status t and status $t+2$). It is an incipient activity and still rare in European countries. This lack of motivation might be related to high switching costs that renewable technologies incur, which may impair the attractiveness of the sector for firms.

Furthermore, the moderate propensity of Mediterranean and Eastern countries to invest in resource efficient practices and, especially, in EE and RE actions, reflects the weakness of their environmental awareness and eco-policies system at regional and country level in facilitating the implementation of green practices among their local firms. Therefore, these data calls for an active and coordinated European energy policy to reduce internal differences among European countries. Country members are required to set up national objectives and sustainable energy programs; these objectives and the actions of each Member State should be coordinated with other members and evaluated by the European Commission to determine the likelihood of achieving the EU's overall objective of improving 20% improvement in EE levels by 2020 (European Council, 2012).

Table 1. Resource efficiency practices by country groups

	Total		Core		Mediterranean		New members	
	Mean	**S. Dev.**	**Mean**	**S. Dev.**	**Mean**	**S. Dev.**	**Mean**	**S. Dev.**
Energy efficiency practices								
Saving energy	0.6344	0.4816	0.6909	0.4622	0.5917	0.4917	0.6001	0.4900
Renewable energy	0.1386	0.3455	0.2068	0.4051	0.1145	0.3185	0.0881	0.2834
Saving energy future	0.5107	0.4999	0.5423	0.4983	0.5404	0.4986	0.4736	0.4994
Renewable energy future	0.1887	0.3912	0.2376	0.4257	0.1914	0.3935	0.1457	0.3528
Other resource efficiency practices								
Saving water	0.4441	0.4969	0.4596	0.4984	0.4147	0.4929	0.4405	0.4965
Saving materials	0.5866	0.4925	0.6247	0.4843	0.5653	0.4959	0.5611	0.4963
Minimising waste	0.5802	0.4936	0.6925	0.4615	0.5156	0.5000	0.5053	0.5000
Selling scrap	0.3135	0.4640	0.3364	0.4726	0.3010	0.4589	0.2980	0.4575
Recycling	0.3850	0.4866	0.4636	0.4988	0.4532	0.4980	0.2948	0.4560
Designing products	0.2404	0.4273	0.2761	0.4471	0.2826	0.4505	0.1956	0.3967

Source: Flash Eurobarometer 426, own calculations

Despite, the growing effort in harmonizing environmental policies within the EU, countries may establish different priorities taking into account, among a wide range of factors, their level of development, sectoral structures, energy intensities, citizen environmental awareness and their distance from the environmental technological frontier. Significant differences in environmental efficiency among EU countries are observed (Beltrán-Esteve and Picazo-Tadeo, 2017). Looking at Table 2, we observe that the newer member states which joined the EU from 2004 onwards are characterized by pollution-intensive technologies and operate farther from their respective environmental technological frontiers. In addition, New EU Members, especially Hungary and Estonia still seem to use high levels of energy intensity, meaning that there is still room for promoting RE in the future.

Table 2
Country performance in terms of economic, innovation and environmental indicators

Countries	**Volume indices GDP per capita (EU28=100)**	**R&D (% of GDP**	**Carbon dioxide emissions (kg per capita)**	**Share of RE in electricity in %**	**Energy intensity[a]**	**Eco-IS[b]**
	2015	**2015**	**2014**	**2015**	**2015**	**2015**
EU 28	100	2.03	5,731.85	28.8	120.3	100
Belgium	118	2.45	6,470.77	15.4	141.3	90
Bulgaria	47	0.96	5,960.71	19.1	448.5	43
Czech Republic	87	1.95	8,232.50	14.1	249.2	103

Denmark	127	3.03	11,659.19	51.3	65.1	128
Germany	124	2.87	8,336.05	30.7	112.2	135
Estonia	75	1.5	14,103.28	15.1	355.1	73
Ireland	177	1.51	5,292.71	25.2	59.4	98
Greece	68	0.96	5,691,68	22.1	132.5	77
Spain	90	1.22	4,245.77	36.9	113.7	105
France	107	2.23	3,501.10	18.8	120.5	108
Croatia	58	0.85	3,014.60	45.4	192.9	61
Italy	96	1.33	4,201.99	33.5	100.4	101
Cyprus	81	0.46	6,474.91	8.4	128.7	48
Latvia	64	0.63	3,345.73	52.2	206.7	63
Lithuania	75	1.04	5,065.37	15.5	205.4	66
Luxembourg	269	1.31	11,882.21	6.2	89.1	123
Hungary	68	1.38	3,400.45	7.3	233.6	72
Malta	93	0.77	12,232.20	4.2	90.8	54
Netherlands	128	2.01	9,521.27	11.1	117.9	101
Austria	128	3.07	5,720.61	70.3	107.1	101
Poland	69	1	7,417.54	13.4	227.3	59
Portugal	77	1.28	3,950.92	52.6	133.9	90
Romania	57	0.49	3,186.57	43.2	226.7	74
Slovenia	83	2.21	5,555.01	32.7	177.9	98
Slovakia	77	1.18	5,363.48	22.7	215.1	65
Finland	109	2.9	8,542.38	32.5	177.7	136
Sweden	124	3.26	4,346.21	65.8	111.3	111
United Kingdom	108	1.7	5,678.26	22.4	94.3	112

Source: Eurostat

[a] Gross inland consumption of energy divided by GDP (kg of oil equivalent per 1,000 EUR).

[b] Eco-IS: Eco-Innovation Scoreboard.

2.2 Drivers of energy efficiency and renewable energy

The literature contributions on eco-innovation and the impact of environmental policies on innovation business decisions open a wider perspective than that exclusively focused on saving costs. The Porter and Linde (1995) contribution introduced a new approach based on the existence of a positive relationship between environmental policies and innovation that strengthen the product quality, cost savings, and in the end, the enterprise's competitiveness, which allows EE and RE to be examined from a new perspective. To the extent that EE and RE are located at the core of such policy, and even though it has been partially questioned (Lanoie et al., 2011), this approach is helping to make progress in the interpretation of firm decisions and the role of environmental regulation in decision-making on sustainable energies. The progress in EE and RE has internal effects in terms of costs as well as external ones, in terms of the direct effect on emission reduction and climate change mitigation.

Even though the design and implementation of diverse EE and RE encouragement policies from different government levels —European, state, regional and local— sustainable energies actions are still scarcely implemented by European SMEs. Because of this, it is crucial to improve such public policies effectiveness through a better understanding of the barriers to be tackled and the drivers to be promoted.

Since the late 1970s, a great effort has been made to identify the main barriers to EE and RE. In particular, many contributions have been focused on formulating a comprehensive taxonomy of the main barriers to EE (Fleiter et al., 2012; Sorrell et al., 2011, 2000). We note, for example, a recent survey of empirical studies on barriers to industrial EE by Trianni et al., (2016) and a taxonomy of barriers adopted for empirical investigation by Cagno and Trianni (2013). However, too little research has dealt with the study of the drivers of sustainable energies actions and the complementarities between saving energy and using RE at the firm level (Costa-Campi et al., 2015; Trianni et al., 2016). Certainly, most of the empirical contributions that we observe, study the determinants of eco-innovation in general and establish a distinction according to the areas of impact, which allows the identification of the determinants of EE (Horbach, 2016; Horbach et al., 2012). In addition, mainly due to data restrictions, there are still few contributions which attempt to conduct a country comparison analysis among European SME (Horbach, 2016).

Here we develop a classification of drivers to sustainable energies bases on the preceding empirical studies and the information available in our primary data source. Following Horbach (2008), we examine the drivers of EE and RE strategies from the perspective of the supply side, demand side, environmental policy, as well as the firms' structural characteristics and country factors in line with resource-based and evolutionary perspective approaches. [2]

Considering that neoclassical approaches provide a better understanding of eco-innovation as characterized by a double externality problem (Rennings, 2000) and consequently there is the need for a regulatory push and pull stimulus and a proper incentivizing system, evolutionary approaches are more suitable for interpreting the relevance of the context in which environmental innovation emerge, and for emphasizing

---

[2] It is worth mentioning that there is no consensus in the literature on a theoretical framework, consequently each approach underlines some drivers and rejects others (Del Río et al., 2016; Hojnik and Ruzzier, 2015). The different approaches are not mutually incompatible and should be combined.

the importance of innovation systems, the dynamic interaction between different actors and the internal and external factors influencing the innovation process (Nelson and Winter, 1982).

Furthermore, a complex set of different factors, including supply, demand, and firm-specific ones, are highlighted in general innovation theory and the literature on determinants of eco-innovation and accentuate the important role of regulations. In many studies, regulation has been identified as an important determinant of eco-innovation. Horbach et al. (2012) for Germany, Horbach et al. (2013) for Germany and France; del Río et al. (2015b) for Spain, or Horbach (2016) for 19 different European countries. Additionality, an important contribution to the discussion was made by Kammerer (2009) and showed the need to distinguish between eco-innovations that target energy from others because regulation effects vary depending on the environmental area. For instance, Horbach et al., (2012) using a German sample examine the determinants of eco-innovations by type of environmental impact and show that regulation seems to be important for many environmental innovations but not specifically for reducing the use of energy. Similar results are found by Horbach (2016) in a European context. In contrast, others authors show that regulations affect innovation behaviour that has the objective of reducing energy consumption (Costa-Campi et al., 2015; Veugelers, 2012).

Along the same lines, the literature considers that public policies in the form of investment incentives (grants or low-interest loans), incentive taxes and tariffs, mainly feed-in-tariffs, voluntary programs and compulsory renewable targets are relevant to explaining the RE development (Gan et al., 2007; Johnstone et al., 2010; Wüstenhagen and Bilharz, 2006). Although public policies are a major driver in the development of renewables, some authors point out that different types of policy instruments are effective for different RE sources (Johnstone et al., 2010; Marques and Fuinhas, 2012).

While regulation and public policies still seems to be necessary to overcome the double externality problem, there is no strong empirical evidence that market pull supports eco-innovation (Del Río et al., 2016). The expectation of a future demand, created by environmentally conscious customers, plays a key role in eco-innovations if the product or service delivered adds value to the customer.

Furthermore, supply factors play a relevant role in eco-innovation. Mostly they are linked to the development of technological capabilities, which can be increased through R&D investments or activities, but also rely on organizational capabilities and organizational innovations. In this regard, internal R&D seems to be particularly important for material and energy savings. This might be expected as material and energy savings often stem from changes of the individual production process. Several empirical studies stress that cost savings are determining factors of eco-innovations, particularly for clean technologies (Horbach, 2016; Horbach et al., 2012).

Finally, empirical evidence also emphasizes that a firm's profile is a key factor when it comes to introducing innovations aimed at improving EE and RE levels. The group of drivers considered to be as firm-specific factors include all those firm characteristics, such as size, location, sector, and age which usually affect together with other more relevant determinants, a firm's firm innovativeness (Barbieri et al., 2016). In particular, the size of a firm and fits focus on foreign markets are important variables for a group of Spanish manufacturing firms in implementing EE practices (Costa-Campi et al., 2015).

3. Data and methodology

3.1 Data

The empirical part of the paper relies on the Flash Eurobarometer Survey 426 (FL426) on *"Small and Medium Enterprises, Resources Efficiency and Green Markets, wave 3"*[3] addressed to more than fifteen thousand managers of firms between the 1st and 18th of September 2015. It follows from past Eurobarometers (FL342 in 2012 and FL381 in 2013),[4] in reviewing the current levels of resource efficiency actions and the state of the green market amongst SMEs.

The database includes the 28 Members States of the European Union, Albania, the Former Yugoslav Republic of Macedonia, Montenegro, Serbia, Turkey, Iceland, Moldova, Norway and the US, and covers large companies and SMEs. The, the survey covers businesses employing at least one person in the manufacturing (NACE category C), retail (G), services (H/I/J/ K/L/M), and industry (B/D/E/F) sectors

One of the main strengths of our dataset from the Flash Eurobarometer Survey 426 (FL426) is that it includes three dimensions, namely country, sector, and firm size. Most

---

[3] SME enterprises are defined as those with a staff headcount below 250. In addition to the staff headcount ceiling, an enterprise qualifies as an SME whether it meets either the turnover ceiling or the balance sheet ceiling, but not necessarily both. The full definition can be found at:
http://ec.europa.eu/growth/smes/business-friendly-environment/sme-definition/index_en.htm

[4] Each Flash Eurobarometer is a cross-sectional survey, consequently, it is conducted with a completely new sample of firms. Therefore, the data are not panel data, and a merging of the data sets is not possible.

environmental empirical datasets offer aggregate information at country level, so having three dimensions in the same database allow researchers many possible views and perspectives on the data. On the other hand, one of the main drawbacks of the Flash Eurobarometer Survey 426 data is that it is a cross-sectional dataset. This makes the simultaneity problem almost unavoidable and is a common problem for all studies using Flash Eurobarometer datasets (Hoogendoorn et al., 2015; Marin et al., 2015).

After a cleaning process, our final sample consists of 8,213 SMEs located in the 28 EU member countries. The final sample includes the questionnaires of SMEs belonging to mining, energy and construction clusters, manufacturing industries, and services activities. Because of the particular characteristics of retail, public administration, health and hospitals, and activities related to arts and entertainment, these sectors are excluded from the final sample.

Considering that the levels of the EE and the weight reached by RE sources differ between the SMEs, and, between European countries our empirical analysis adopts a double perspective. On the one hand, we carry out our econometric analysis at firm level and, at the same time, we group the countries into three clusters to capture the expected country heterogeneity. Accordingly, to examine the differences among European countries in some depth, we classify the EU28 countries into three clusters: Core countries (Austria, Belgium, Denmark, Finland, France, Germany, Ireland, Luxembourg, Sweden, the Netherlands, the United Kingdom), Mediterranean countries (Greece, Italy, Portugal, and Spain), and New EU countries (Bulgaria, Croatia, Cyprus, the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Romania, Slovakia, and Slovenia).

3.2 Descriptive statistics

Our data set offers evidence highlighting that the patterns adopted by SMEs of each country differ significantly, both in the current implementation of EE and RE actions and in the future decisions to adopt them. Tables 3 and 4 give us information about the two sustainable energy practices that SME firms across EU28 are currently undertaking (*status in t*) and the practices that would like to take in the next future (*status in t+2*). First, 43% of firms saving energy in status *t* intent to remain EE in the future, while only 20% shift to become non-EE. On the other hand, 28% of firms that are not saving also intend to remain non-efficient in the future, while only 8% shift to become more EE.

Table 3 shows that there is a general pattern of moderate persistence in energy-saving behaviour of firms and the degrees of persistence in the three clusters are not equal. This medium level of persistence in saving energy may be related to the fact that investments in saving energy are related to tangible assets. Hence, once the investment has been made, for some years, it is less probable that it will be necessary to invest in the same resource-efficient practice. Regarding differences between country groups, new members show the lowest level of persistence. Once they have undertaken EE practices in status *t*, few firms would consider it necessary to continue undertaking saving energy practices in the future.

Table 3. Save energy present decisions vs. future decisions

		Status in t+2			
		Not saving energy		**Saving energy**	
	Status in t	**Firms**	**(%)**	**Firms**	**(%)**
Total	Not saving	2,365	28.80	638	7.77
	Saving	1,654	20.14	3,556	43.30
Core Countries	Not saving	742	23.07	252	7.84
	Saving	730	22.70	1,492	46.39
Mediterranean Countries	Not saving	399	31.95	111	8.89
	Saving	175	14.01	564	45.16
New Countries	Not saving	1,224	32.66	275	7.34
	Saving	749	19.98	1,500	40.02

Source: Flash Eurobarometer 426, own calculations

Table 4 also indicates that there is a general pattern of weak persistence in using RE across European countries and the degrees between the various clusters are not similar. Only, 8% of firms implementing RE practices say they intend to remain EE in the future, while only 6% shift to become non-EE. On the other hand, 75% of firms agree not using RE and continue to be non-green firm in the subsequent period, while 11% shift to using predominantly RE.

Table 4. Use of renewable energy present decisions vs. future decisions

		Status in t+2			
		Not using RE		**Using RE**	
	Status in t	**Firms**	**(%)**	**Firms**	**(%)**
Total	Not using	6,185	75.31	890	10.84
	Using	479	5.83	659	8.02
Core Countries	Not using	2,165	67.32	386	12.00
	Using	287	8.92	378	11.75
Mediterranean Countries	Not using	969	77.58	137	10.97
	Using	41	3.28	102	8.17
New Countries	Not using	3,051	81.40	367	9.79
	Using	151	4.03	179	4.78

Source: Flash Eurobarometer 426, own calculations

Table 5 shows the main features of SME firms in EU28 distinguishing the three country clusters that we consider in this study:

- ✓ On average, the most important reason for SME firms to take actions to become more resource efficient is cost saving (60%). A less important reason is to catch up with the main competitors who have already taken green actions.
- ✓ Firms belonging to Core countries tend to anticipate future changes in legislation and sell more of their products to public administration than do Mediterranean and New member countries.
- ✓ In New EU members, firms are younger and smaller than in Core and Mediterranean countries.
- ✓ Core countries have the highest level of CO^2 emissions per capita and their inhabitants have a greater environmental awareness being more likely to buy ecological goods, even if they have a higher price.

Table 5. Descriptive statistics of EE drivers by country groups

	Total		Core		Mediterranean		New members	
	Mean	**S. Dev.**	**Mean**	**S. Dev.**	**Mean**	**S. Dev.**	**Mean**	**S. Dev.**
Policy influences								
Anticipation legislation	0.1243	0.3300	0.1570	0.3639	0.0849	0.2788	0.1094	0.3122
Public support	0.1520	0.3590	0.1975	0.3981	0.1385	0.3456	0.1174	0.3219
Market pull drivers								
Customers and suppliers	0.2094	0.4069	0.2540	0.4354	0.2074	0.4056	0.1718	0.3773
Public demand	0.3225	0.4675	0.3666	0.4820	0.2906	0.4542	0.2954	0.4563
Technology push drivers								
Cost saving	0.6093	0.4879	0.6362	0.4812	0.6245	0.4845	0.5811	0.4934
Competitors	0.0886	0.2842	0.0637	0.2443	0.1153	0.3195	0.1011	0.3015
Environment priority	0.3579	0.4794	0.3760	0.4844	0.3739	0.4840	0.3370	0.4727
Future changes								
Satisfied	0.4894	0.4999	0.5420	0.4983	0.5028	0.5002	0.4397	0.4964
Intensity	0.0996	0.2995	0.1008	0.3010	0.0945	0.2926	0.1003	0.3005
Competitive advantage	0.2109	0.4080	0.2397	0.4270	0.2082	0.4062	0.1870	0.3900
Firm characteristics								
Size (workers)	47.006	459.35	49.908	398.42	41.518	88.040	46.336	570.04
Age (years)	23.736	20.041	30.039	25.733	24.812	17.285	17.970	12.033
Manufacturing (% firms)	0.3278	0.4694	0.2671	0.4425	0.3851	0.4868	0.3607	0.4803
Services (% firms)	0.4740	0.4994	0.5457	0.4980	0.4404	0.4966	0.4237	0.4942
Industry (% firms)	0.1982	0.3987	0.1872	0.3901	0.1745	0.3797	0.2156	0.4113
Aggregate determinants								
CO^2	7.3993	2.8019	8.4564	2.9122	6.2887	1.1839	6.8623	2.7934

Willingness pay	76.208	7.9214	82.708	5.2447	68.355	4.3649	73.249	6.4806
Observations	8,213		3,216		1,249		3,748	

Source: Flash Eurobarometer 426, EUROSTAT own calculations

3.3 Methodology and variables

To consider the possible complementarity between current EE and RE actions be more resource efficient and those planned them over the next two years, we apply a bivariate probit procedure. Hence, we consider a simultaneous model where the present actions to be more EE and the future plans are interrelated.

The general specification is the following:

$$EEnow_{i,t} = x_{i,t}\beta_{11} + \varepsilon_{1i,t} \quad (1)$$

$$EEfuture_{i,t+2} = z_{i,t}\beta_{21} + \varepsilon_{2i,t} \quad (2)$$

where

$$\binom{\varepsilon_1}{\varepsilon_2} \sim N\left\{\binom{0}{0}, \begin{bmatrix} 1 & \rho_{12} \\ \rho_{22} & 1 \end{bmatrix}\right\}$$

Equation (1) estimates the probability that a firm undertakes an EE practice.[5] *EEnow* is a dummy variable equal to 1 if the firm reports having introduced an EE action. Our dependent variable is decomposed into two EE and RE strategies. As explanatory variables to examine the drivers of EE and RE practices we include four factors. Factor 1 relates to policy influences: the effects of regulation and incentives are measured by two dummy variables. The first one is a variable which reflects the concern of the firm about anticipating of future changes in legislation (*public_regulation*) and the second one refers to the public support in form of financial and fiscal incentives (*public_incentives*). In factor 2, market pull is proxied by two dummy variables: the demand of customers or providers (*demand_pull*) and the demand from the public sector (*public_demand*). In factor 3, technology push includes a dummy variable that takes the value 1 if the firm recognizes that cost saving is the main reason to be more resource efficient (*cost_saving*), if the firm considers catching-up with main competitors to be relevant (*competitor*s), and the personal attitude of the firm towards environment (*environment_priority*). In factor 4, firm specific characteristics are related to the age (*firm_age*) and the size (*firm_size*) of

[5] See Table A.2 for the variables definitions.

the firm, the sector of activity *(Industry, Manufacturing, and Services*) and the country. We additionality include some control variables related to the other resource efficient actions.

Equation (2) estimates the probability that a firm is planning to implement some sustainable energy practices over the next two years. *EEfuture* is decomposed into two dummy variables that are equal to 1 if the firm reports planning to implement additional resource efficiency actions, such as saving energy and predominantly using RE, respectively. As an explanatory variable we include the lag of the dependent variable to capture any possible persistence in the decision to undertake resource-efficient actions. Then, given that engagement in a specific type of resource-efficient practice may result from decisions that are not taken independently of each other, we analyze whether there is any complementarity between the EE and RE actions. We also include a set of variables related to economic and environmental awareness proxied by four variables: the self-perceived profitability (*satisfied*), the intensity to be green (*intensity*) the relevance for the firm of the creation of a competitive advantage or business opportunity when it comes to undertaking eco-efficiency actions (*competitive_advantatge*) and finally, the personal attitude of the firm towards the environment (*environment_priority)*. In Equation 2, we also introduce firm-specific characteristics related to the age and the size of the firm, the sector of activity and the country.

Finally, since macroeconomics factors may help to explain the adoption of EE and EE measure, we control the level of CO^2 emissions per capita in EU countries and the importance of willingness to buy environmental products in both equations. This is predicated on higher amounts of CO2 and greater environmental concerns being incentives for a widespread use sustainable energy practices.

We assume that ε_i are independently and identically normally distributed residuals. The parameter ρ identifies the correlation between the disturbances, and accounts for omitted or unobservable factors that simultaneously affect the decision to undertake EE and RE practices and the likelihood of planning them over next two years.[6] Our results show that

[6] If ρ is equal to 0, the probability of planning EE actions in the future will not be correlated with the error term in Equation (1) and the probability of undertaking EE will not be affected by the error term in Equation (2). Whereas, if ρ is different from 0, a joint estimation is required to obtain consistent estimates. Rho is just the correlation between the residuals of the two equations, so, apparently, their negative coefficient means that there is a variable that is not in our model that leads a firm to undertake a sustainable energy practices and, at the same time, negatively affects on the probability of implementing future EE and RE actions.

the coefficient ρ is significantly different to 0 in both practices and in all clusters (except for the case of RE in the Mediterranean cluster). This suggests that the bivariate probit methodology is more efficient than the estimation of two separate probits.

4. Results

We are interested in analyzing, from a temporal and geographic perspective, the factors that affect a firm's ability to undertake measures related to saving energy or promoting RE sources. From the temporal perspective, we distinguish between implementing sustainable energy measures now and the capacity to plan additional energy actions in the proximate future, and consider their possible complementarities. From the geographic perspective, we are interested in examining the differences that might exist between the three clusters of EU country members considered in this paper, Core countries, Mediterranean countries, and the New EU members.

Table 6 shows the results of our first measure of sustainable energy, that is EE, for the whole database and the three country groups. [7] In relation to EE that firms are planning to implement in the next two years, our results reveal that engaging in EE actions during the previous years has a positive relationship with the probability of engaging in EE practices in the future. Indeed, the estimation results show that this persistence is present in all country clusters. The results also point to the possible existence of complementarities between EE and RE practices across European SMEs, an increased use of RE leading to an increased use of EE. [8] Moreover, firms that report high self-perceived resource investment profitability are more likely to implement new sustainable energy practices in the future, especially across Core and New EU members.

For internal factors, firm size has a positive and significant coefficient only for Core countries, while firm age has not been found to be significant in any cluster specification. Finally, we observe that the results for aggregate factors are not conclusive some differences are found in the clusters. In core countries as we expected, greater environmental concerns and higher CO^2 emissions increase the propensity to implement EE practices in the future. In contrast, in line with Marques et al. (2010) greater amounts

---

[7] We must stress that the cross-sectional nature of the dataset we are exploiting constitutes a limitation in the scope of the current analysis and only allows us to comment on correlations among variables rather than proper causations.

[8] See Appendix 3 for an extensive analysis of the complementarities between EE and RE.

of CO^2 in Mediterranean countries and more environmental concerns in New EU members do not imply a greater incentive to EE commitment.

Regarding the drivers of currently implementing EE practices, public policies in terms of firm sensitivity towards legislation and public incentives are strongly related to promoting EE actions among SMEs, a result that coincides with the results obtained in other studies (Costa-Campi et al., 2015; Horbach et al., 2012). Splitting the sample into three clusters, we observe that Core countries benefit from both factors, Mediterranean countries seems to rely more on anticipating future changes in legislation than in public incentives, while New EU members depend on public support to promote their EE actions.

Furthermore, market push by customers and providers is a significant driver to incentivize firms to undertake EE practices, although this need to be nuanced when we divide the sample since only Mediterranean and New EU members show a positive and significant relationship. In addition, having public institutions as clients seem to be influential for Core firms. In relation to technology push factors, and in line with the literature, cost saving is a significant driver for undertaking EE practices while, in all country clusters considered, valuing the environment as a top priority for the firm increases the likelihood of being more EE.

Related to internal drivers, as pointed out by Costa-Campi et al., (2015), we found that EE is closely related to firm characteristics such as size and age. Firm size has positive and significant coefficients except for Mediterranean countries, while firm age has only positive relationship for the whole sample and for Core countries. This indicates that small and young firms are finding more barriers than their counterparts carrying out EE actions.

Furthermore, EE is closely related to other eco-efficiency actions. Practices like saving water, RE, saving materials, minimizing waste and designing products that are easier to maintain, repair and reuse show some complementarities with EE activities undertaken. Finally, we observe that aggregate environmental concerns are incentives for a widespread use of EE, mainly in New EU countries.

Table 6
Bivariate probit: saving energy

	Total	**Core**	**Mediterranean**	**New EU**
		FUTURE		
Saving energy (present)	1.777***	1.616***	2.032***	1.792***
	(0.0490)	(0.0834)	(0.1200)	(0.0699)
Renewable energy (future)	0.663***	0.845***	0.529***	0.549***
	(0.0441)	(0.0671)	(0.1050)	(0.0713)
Satisfied	0.148***	0.179***	0.120	0.130**
	(0.0326)	(0.0523)	(0.0845)	(0.0489)
Intensity	-0.073	-0.062	-0.096	-0.045
	(0.0509)	(0.0818)	(0.1320)	(0.0760)
Environment priority	0.059	-0.035	-0.038	0.187***
	(0.0354)	(0.0550)	(0.0870)	(0.0550)
Competitive advantage	0.088*	0.036	-0.087	0.204***
	(0.0378)	(0.0578)	(0.1000)	(0.0586)
Firm characteristics				
Size	0.0174	0.0523**	0.0136	-0.005
	(0.0109)	(0.0177)	(0.0278)	(0.0164)
Age	-0.012	-0.016	-0.024	-0.010
	(0.0193)	(0.0266)	(0.0547)	(0.0326)
Sector (ref. Industry)				
Manufacturing	0.038	-0.002	0.069	0.062
	(0.0446)	(0.0776)	(0.1150)	(0.0626)
Services	0.041	-0.014	0.036	0.080
	(0.0417)	(0.0676)	(0.1130)	(0.0612)
Aggregate determinants				
CO^2	-0.127	0.083*	-0.157**	-0.183
	(0.1290)	(0.0338)	(0.0478)	(0.1340)
Willingness pay	-0.040*	0.092***	0.063***	-0.050*
	(0.0190)	(0.0148)	(0.0135)	(0.0197)
Constant	2.337	-10.360***	-4.482***	3.258
	(1.9990)	(1.5060)	(0.8220)	(2.0670)
		PRESENT		
Other resource efficient practices				
Saving water	0.952***	0.822***	0.897***	1.087***
	(0.0395)	(0.0615)	(0.1030)	(0.0597)
Renewable energy	0.292***	0.385***	0.208	0.174
	(0.0583)	(0.0815)	(0.1410)	(0.1050)
Saving materials	0.426***	0.266***	0.432***	0.552***
	(0.0371)	(0.0594)	(0.0951)	(0.0564)
Minimizing waste	0.372***	0.451***	0.356***	0.326***
	(0.0385)	(0.0620)	(0.0929)	(0.0590)
Selling scrap	0.040	0.075	0.160	-0.029
	(0.0408)	(0.0645)	(0.1010)	(0.0630)
Recycling	-0.011	0.062	0.042	-0.103
	(0.0374)	(0.0584)	(0.0882)	(0.0592)
Designing products	0.195***	0.260***	0.113	0.172*
	(0.0429)	(0.0645)	(0.1010)	(0.0700)
Policy influences				
Anticipation legislation	0.216***	0.242**	0.341*	0.149
	(0.0538)	(0.0771)	(0.1560)	(0.0867)
Public support	0.298***	0.329***	0.225	0.294***
	(0.0503)	(0.0722)	(0.1230)	(0.0865)
Market pull drivers				
Customers suppliers	0.187***	0.090	0.277*	0.258***
	(0.0427)	(0.0623)	(0.1080)	(0.0706)
Public demand	0.041	0.134*	-0.151	0.010

	(0.0368)	(0.0564)	(0.0933)	(0.0579)
Technology push drivers				
Cost saving	0.603***	0.586***	0.613***	0.623***
	(0.0338)	(0.0541)	(0.0838)	(0.0518)
Competitors	0.246***	0.107	0.0877	0.410***
	(0.0613)	(0.1150)	(0.1250)	(0.0889)
Environment priority	0.412***	0.447***	0.453***	0.349***
	(0.0391)	(0.0617)	(0.0920)	(0.0612)
Firm characteristics				
Size	0.062***	0.078***	0.029	0.064***
	(0.0118)	(0.0187)	(0.0293)	(0.0182)
Age	0.0701***	0.0704*	0.0447	0.0707
	(0.0211)	(0.0289)	(0.0578)	(0.0364)
Sector (ref. Industry)				
Manufacturing	0.171***	0.266**	0.119	0.118
	(0.0495)	(0.0852)	(0.128)	(0.0719)
Services	0.295***	0.274***	0.377**	0.290***
	(0.0461)	(0.0738)	(0.1250)	(0.0686)
Aggregate determinants				
CO^2	0.316*	0.001	-0.062	0.403**
	(0.1360)	(0.0377)	(0.0519)	(0.1430)
Willingness pay	0.041*	0.0002	0.007	0.055*
	(0.0206)	(0.0172)	(0.0141)	(0.0217)
Constant	-6.376**	-1.738	-1.640	-7.841***
	(2.1390)	(1.7400)	(0.8840)	(2.2400)
Rho (ρ)	-0.627***	-0.646***	-0.658***	-0.588***
	(0.0486)	(0.0796)	(0.1340)	(0.0668)
Log-likelihood	-7615.5	-2973.1	-1183.4	-3394.9
Wald test of $\chi 2$	6360.7	2340.9	1133.4	3062.2
	0.000	0.000	0.000	0.000
Observations	8,213	3,216	1,249	3,748

Core countries: Austria, Belgium, Denmark, Finland, France, Germany, Ireland, Luxembourg, Sweden, the Netherlands, the United Kingdom. Mediterranean countries: Greece, Italy, Portugal and Spain). New EU countries: Bulgaria, Croatia, Cyprus, the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Romania, Slovakia, and Slovenia.

Estimations control for country, *; **; *** indicate levels of significance equal to 10, 5 and 1 %. Robust standard errors in parentheses.

The results of the bivariate probit model for the drivers of RE considering the whole database and three country groups are displayed in Tables 7. Starting from the drivers of designing future RE actions, and, in line with the results mention above, our results highlight that the coefficients of the lagged dependent variables are positive and significant for Core and New EU members, revealing that engaging in RE strategies during the previous year have a positive link on the probability of being a green innovator in terms of RE actions in the future. The results of the estimations also reveal a tighten complementarity with EE practices in any of the clusters examined.

Regarding other variables explaining the probability of implementing future actions, our results show that firms that are satisfied with the return on the investments made on resource efficiency practices, that invest a high amount of money in them, or that have a better environmental management and awareness are more likely to implement RE actions. These results are particularly consistent for New EU members. In general, firms' characteristics seems to be not important in explaining the probability of planning future RE strategies. In contrast, aggregate determinants seem not be relevant in explaining incentives towards RE commitment in the proximate future.

Looking at the drivers of undertaking RE actions now, policy influences have an important role in stimulating the predominant use of RE. Unlike what we observe for EE, for RE public incentives in the form of financial and fiscal support are strongly related to its promoting -this might be explained by the high capital costs of implementation. By country clusters, Core and New EU countries present a positive and direct link between RE and public support, whereas Mediterranean countries have a negative relationship. The latter seem influenced by firms with a high sensitivity to legislation, that is, who actively anticipate future changes in legislation.

Concerning market pull and technology push factors to promote RE among the European SMEs, the results are ambiguous, the drivers related to the demand pull and the technology push playing a moderate role. Public demand it seems is a significant driver to incentivize firms to implement RE, on the other hand, this factor did not seem to be relevant in determining EE strategies.

Valuing the environment as a top priority for the firm increases the likelihood of implementing RE practices, mainly for long-establish EU countries. In contrast, cost saving does not seem to have the significant influence on RE than it had on EE actions. In addition, in contrast to EE strategies, internal characteristics such as the size and age of the firms are limited decisive in implementing RE actions.

Table 7
Bivariate probit: renewable energies

	Total	**Core**	**Mediterranean**	**New**
	FUTURE			
Renewable energy (present)	1.880***	1.907***	0.327	1.917***
	(0.1370)	(0.2120)	(0.8770)	(0.1830)
Save energy (future)	0.789***	0.954***	0.719***	0.654***
	(0.0432)	(0.0723)	(0.1260)	(0.0642)
Satisfied	0.165***	0.180**	0.204*	0.144*
	(0.0386)	(0.0582)	(0.0899)	(0.0602)
Intensity	0.197***	0.166	0.151	0.218*
	(0.0566)	(0.0858)	(0.1430)	(0.0856)
Environment priority	0.139***	0.071	0.255*	0.227***
	(0.0396)	(0.0656)	(0.1130)	(0.0605)
Competitive advantage	0.119**	0.062	0.177	0.190**
	(0.0434)	(0.0637)	(0.1010)	(0.0683)
Firm characteristics				
Size	-0.018	-0.049**	0.038	-0.002

	(0.0126)	(0.0185)	(0.0340)	(0.0204)
Age	-0.007	-0.015	0.039	0.025
	(0.0226)	(0.0297)	(0.0719)	(0.0402)
Sector (ref. Industry)				
Manufacturing	0.001	-0.026	-0.111	0.031
	(0.0521)	(0.0850)	(0.1320)	(0.0755)
Services	-0.088	-0.006	-0.314*	-0.139
	(0.0498)	(0.0754)	(0.1420)	(0.0770)
Aggregate determinants				
CO^2	-0.168	-0.127**	0.226***	-0.198
	(0.1480)	(0.0441)	(0.0614)	(0.1490)
Willingness pay	-0.014	-0.027	-0.076***	-0.019
	(0.0222)	(0.0189)	(0.0173)	(0.0224)
Constant	0.125	1.495	2.052*	0.593
	(2.320)	(1.946)	(0.8930)	(2.3280)
		PRESENT		
Other resource efficient practices				
Saving water	0.277***	0.356***	0.109	0.211**
	(0.0428)	(0.0594)	(0.1190)	(0.0751)
Saving energy	0.334***	0.445***	0.415***	0.230**
	(0.0529)	(0.0787)	(0.1240)	(0.0891)
Saving materials	-0.023	-0.010	-0.059	0.044
	(0.0467)	(0.0643)	(0.1220)	(0.0822)
Minimizing waste	0.195***	0.116	0.350**	0.199*
	(0.0495)	(0.0731)	(0.1310)	(0.0833)
Selling scrap	-0.007	-0.018	-0.109	0.003
	(0.0422)	(0.0600)	(0.1320)	(0.0701)
Recycling	0.164***	0.109	0.095	0.237***
	(0.0403)	(0.0576)	(0.1650)	(0.0660)
Designing products	0.263***	0.263***	-0.230	0.410***
	(0.0426)	(0.0580)	(0.1180)	(0.0699)
Policy influences				
Anticipation legislation	0.132*	0.118	0.337*	0.140
	(0.0552)	(0.0744)	(0.1640)	(0.0945)
Public support	0.235***	0.288***	-0.281*	0.308***
	(0.0495)	(0.0654)	(0.1420)	(0.0857)
Market pull drivers				
Customers suppliers	0.006	0.034	-0.185	0.048
	(0.0472)	(0.0648)	(0.1260)	(0.0818)
Public demand	0.086*	0.081	0.074	0.113
	(0.0400)	(0.0552)	(0.1050)	(0.0695)
Technology push drivers				
Cost saving	0.037	-0.062	0.190	0.094
	(0.0434)	(0.0619)	(0.1220)	(0.0719)
Competitors	0.097	0.132	-0.297	0.115
	(0.0651)	(0.1020)	(0.1840)	(0.0969)
Environment priority	0.273***	0.400***	0.267*	0.069
	(0.0406)	(0.0580)	(0.1050)	(0.0691)
Firm characteristics				
Size	0.018	-0.027	0.074*	0.057*
	(0.0134)	(0.0194)	(0.0372)	(0.0228)
Age	0.024	0.023	0.116	-0.003
	(0.0228)	(0.0299)	(0.0672)	(0.0427)
Sector (ref. Industry)				
Manufacturing	-0.186***	-0.117	-0.204	-0.262**
	(0.0546)	(0.0834)	(0.1360)	(0.0831)
Services	-0.175***	-0.038	-0.517***	-0.258**
	(0.0519)	(0.0744)	(0.1420)	(0.0870)
Aggregate determinants				

CO^2	-0.074	-0.148***	0.072	0.021
	(0.2290)	(0.0371)	(0.0662)	(0.2340)
Willingness pay	-0.030	-0.051***	-0.027	-0.014
	(0.0333)	(0.0155)	(0.0195)	(0.0341)
Constant	0.073	4.076**	-0.861	-1.524
	(3.5240)	(1.5800)	(1.3050)	(3.5840)
Rho (ρ)	-0.387***	-0.546**	0.834	-0.391***
	(0.0958)	(0.1920)	(0.6420)	(0.1140)
Log-likelihood	-5782.5	-2692.1	-832.1	-2172.0
Wald test of $\chi 2$	2377.1	1334.7	197.7	852.0
	0.000	0.000	0.000	0.000
Observations	8,213	3,216	1,249	3,748

Core countries: Austria, Belgium, Denmark, Finland, France, Germany, Ireland, Luxembourg, Sweden, the Netherlands, the United Kingdom. Mediterranean countries: Greece, Italy, Portugal and Spain). New EU countries: Bulgaria, Croatia, Cyprus, the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Romania, Slovakia, and Slovenia. Estimations control for country *; **; *** indicate levels of significance equal to 10, 5 and 1 %. Robust standard errors in parentheses.

5. Conclusions

In this study, we provide an overview of European SMEs attitudes to reducing energy costs and increasing the weight of sustainable energy sources. Despite the importance of implementing sustainable energy measures for climate change mitigation, the determinants of EE and RE across European SMEs level have barely been examined. Using a sample of more than 8.000 European SMEs taken from data of the Flash Eurobarometer 426, we explore from a temporal and geographic perspective, the influencing factors in the adoption of EE and RE actions and their potential complementarities.

The empirical evidence in this paper shows slight differences between the drivers of RE and EE measures and across country clusters. On the one hand, implementing EE practices in the present are associated mainly with regulatory and technology push factors. For EE strategies future regulations, public support, cost saving and environmental awareness are the main motivations. Across countries, we observe that Core and Mediterranean countries benefit from firms anticipating future changes in legislation. In contrast, because of public support, New EU members are more likely to implement EE. Firms' characteristics such size and age are also key factors when it comes to introducing EE measures. On the other hand, RE is more linked to public support and environmental awareness of the firms. In particular, public incentives play a crucial role among core and New EU countries.

The econometric estimations also show that EE and RE may complement each other. However, this positive link between energy savings and the incorporation of RE technologies only takes place among the firms in the Core countries. Furthermore, sustainable energy practices are closely related to the ability of firms to undertake other measures for managing resources more efficiently such as saving water, minimizing waste or designing new products that are easier to maintain, repair or reuse.

Regarding the ability of European SMEs to implement future strategies related to EE and RE, it is worth mentioning the strong temporal persistence between the realization of sustainable energy measures and the likelihood that the firms are planning to continue carrying out these actions. In addition, saving energy and RE exhibit strong synergies in the sense that firms performing actions related to RE are more likely to develop energy saving strategies in the future, while firms carrying out saving energy actions also are more likely to promote RE in the future.

Finally, these results highlight the need indicate that European SMEs are likely to jointly undertake EE and RE actions by generating synergies to increase both the share of RE and the improvement of energy use. This implies a need to deploy an energy policy that jointly pursues EE improvements and the promotion of RE, and, especially to reduce the barriers encountered by European SMEs. The design of an energy policy based on a set of instruments that encourages European SMEs to carry out EE and RE is, above all, necessary in environments with high externalities and low initial efficiency of energy technologies.

6. References

ACEEE, 2007. The Twin Pillars of Sustainable Energy: Synergies between Energy Efficiency and Renewable Energy Technology and Policy. Washington.

Arent, D.J., Wise, A., Gelman, R., 2011. The status and prospects of renewable energy for combating global warming. Energy Economics 33, 584–593. doi:10.1016/j.eneco.2010.11.003

Backlund, S., Thollander, P., Palm, J., Ottosson, M., 2012. Extending the energy efficiency gap. Energy Policy 51, 392–396. doi:10.1016/j.enpol.2012.08.042

Barbieri, N., Ghisetti, C., Gilli, M., Marin, G., Nicolli, F., 2016. A Survey of the Literature on Environmental Innovation Based on Main Path Analysis. Journal of Economic Surveys 30, 596–623. doi:10.1111/joes.12149

Beltrán-Esteve, M., Picazo-Tadeo, A.J., 2017. Assessing environmental performance in the European Union: Eco-innovation versus catching-up. Energy Policy 104, 240–252. doi:10.1016/j.enpol.2017.01.054

Brown, M.A., 2001. Market failures and barriers as a basis for clean energy policies. Energy Policy 29, 1197–1207. doi:10.1016/S0301-4215(01)00067-2

Cagno, E., Trianni, A., 2013. Exploring drivers for energy efficiency within small- and medium-sized enterprises: First evidences from Italian manufacturing enterprises. Applied Energy 104, 276–285. doi:10.1016/j.apenergy.2012.10.053

Cagno, E., Trianni, A., 2012. Analysis of the Most Effective Energy Efficiency Opportunities in Manufacturing Primary Metals, Plastics, and Textiles Small- and Medium-Sized Enterprises. Journal of Energy Resources Technology 134, 021005. doi:10.1115/1.4006043

Cassiman, B., Veugelers, R., 2006. In Search of Complementarity in Innovation Strategy: Internal R&D and External Knowledge Acquisition. Management Science 52, 68–82. doi:10.1287/mnsc.1050.0470

Costa-Campi, M.T., García-Quevedo, J., Segarra, A., Segarra-Blasco, A., 2015. Energy efficiency determinants: An empirical analysis of Spanish innovative firms. Energy Policy 83, 229–239. doi:10.1016/j.enpol.2015.01.037

Del Río González, P., 2007. The interaction between emissions trading and renewable electricity support schemes. An overview of the literature. Mitigation and Adaptation Strategies for Global Change 12, 1363–1390. doi:10.1007/s11027-006-9069-y

Del Río, P., Peñasco, C., Romero-Jordán, D., 2016. What drives eco-innovators? A critical review of the empirical literature based on econometric methods. Journal of Cleaner Production 112, 2158–2170. doi:10.1016/j.jclepro.2015.09.009

Del Río, P., Romero-Jordán, D., Peñasco, C., 2017. Analysing firm-specific and type-specific determinants of eco-innovation. Technological and Economic Development of Economy 23, 270–295. doi:10.3846/20294913.2015.1072749

EIO, 2013. Europe in transition: Paving the way to a green economy through eco-innovation. Eco-Innovation Observatory. Funded by the European Commission, DG Environment, Brussels.

European Commission, 2016. Annual report on European SMEs 2015/2016– Final Report, Internal Market, Industry, Entrepreneurship and SMEs. Brussels.

European Commission, 2010. SMEs and the Environment in the European Union. Luxembourg: Publications Office of the European Union.

European Commission, 2007. Survey of the observatory of European SMEs. Brussels.

European Council, 2012. Directive 2012/27/EU of the European Parliament and of the Council of 25 October 2012 on energy efficiency, amending Directives 2009/125/EC and 2010/30/EU and repealing Directives 2004/8/EC and 2006/32/EC Text with EEA relevance.

Fleiter, T., Schleich, J., Ravivanpong, P., 2012. Adoption of energy-efficiency measures in SMEs—An empirical analysis based on energy audit data from Germany. Energy Policy 51, 863–875. doi:10.1016/j.enpol.2012.09.041

Gan, L., Eskeland, G.S., Kolshus, H.H., 2007. Green electricity market development: Lessons from Europe and the US. Energy Policy 35, 144–155. doi:10.1016/j.enpol.2005.10.008

Greening, L., Green, D., Difiglio., C., 2000. Energy efficiency and consumption - the rebound effec - a survey. Energy Policy 28, 389–401.

Hirst, E., Brown, M., 1990. Closing the efficiency gap: barriers to the efficient use of energy. Resources, Conservation and Recycling 3, 267–281. doi:10.1016/0921-3449(90)90023-W

Hojnik, J., Ruzzier, M., 2015. What drives eco-innovation? A review of an emerging literature. Environmental Innovation and Societal Transitions 19, 31–41. doi:10.1016/j.eist.2015.09.006

Hoogendoorn, B., Guerra, D., van der Zwan, P., 2015. What drives environmental practices of SMEs? Small Business Economics 44, 759–781. doi:10.1007/s11187-014-9618-9

Horbach, J., 2016. Empirical determinants of eco-innovation in European countries using the community innovation survey. Environmental Innovation and Societal Transitions 19, 1–14. doi:10.1016/j.eist.2015.09.005

Horbach, J., 2008. Determinants of environmental innovation—New evidence from German panel data sources. Research Policy 37, 163–173. doi:10.1016/j.respol.2007.08.006

Horbach, J., Oltra, V., Belin, J., 2013. Determinants and Specificities of Eco-Innovations Compared to Other Innovations—An Econometric Analysis for the French and German Industry Based on the Community Innovation Survey. Industry & Innovation 20, 523–543. doi:10.1080/13662716.2013.833375

Horbach, J., Rammer, C., Rennings, K., 2012. Determinants of eco-innovations by type of environmental impact — The role of regulatory push/pull, technology push and market pull. Ecological Economics 78, 112–122. doi:10.1016/j.ecolecon.2012.04.005

IEA, 2015. Energy and Climate Change: World Energy Outlook Special Report. Paris, France.

IRENA, 2015. Renewable energy capacity statistics 2015. Bonn, Germany.

Jaffe, A.B., Newell, R.G., Stavins, R.N., 2003. Technology Policy for Energy and the Environment Technology Policy for Energy and the Environment ISBN, 0–262.

Jaffe, A.B., Stavins, R.N., 1994. The energy paradox and the diffusion of conservation technology. Resource and Energy Economics 16, 91–122. doi:10.1016/0928-7655(94)90001-9

Johnstone, N., Haščič, I., Popp, D., 2010. Renewable energy policies and technological innovation: Evidence based on patent counts. Environmental and Resource Economics 45, 133–155. doi:10.1007/s10640-009-9309-1

Kammerer, D., 2009. The effects of customer benefit and regulation on environmental product innovation. Ecological Economics 68, 2285–2295. doi:10.1016/j.ecolecon.2009.02.016

Lanoie, P., Laurent-Lucchetti, J., Johnstone, N., Ambec, S., 2011. Environmental Policy, Innovation and Performance: New Insights on the Porter Hypothesis. Journal of Economics & Management Strategy 20, 803–842. doi:10.1111/j.1530-9134.2011.00301.x

Li, J., Bibas, R., 2013. Enhancing efficiency and renewable energy technology policy complementarity in mitigating climate change, Energy Transition and Policy Challenges, 36th IAEE International Conference, June 16-20, 2013. International Association for Energy Economics.

Marin, G., Marzucchi, A., Zoboli, R., 2015. SMEs and barriers to Eco-innovation in the EU: exploring different firm profiles. Journal of Evolutionary Economics 25, 671–705. doi:10.1007/s00191-015-0407-7

Marques, A.C., Fuinhas, J.A., 2012. Are public policies towards renewables successful? Evidence from European countries. Renewable Energy 44, 109–118. doi:10.1016/j.renene.2012.01.007

Marques, A.C., Fuinhas, J.A., Pires Manso, J.R., 2010. Motivations driving renewable energy in European countries: A panel data approach. Energy Policy 38, 6877–6885. doi:10.1016/j.enpol.2010.07.003

Mohnen, P., Röller, L.H., 2005. Complementarities in innovation policy. European Economic Review 49, 1431–1450. doi:10.1016/j.euroecorev.2003.12.003

Nelson, R.R., Winter, S.G., 1982. An Evolutionary Theory of Economic Change. Harvard University Press, Cambridge, MA.

Palm, J., Thollander, P., 2010. An interdisciplinary perspective on industrial energy efficiency. Applied Energy 87, 3255–3261. doi:10.1016/j.apenergy.2010.04.019

Pfeiffer, B., Mulder, P., 2013. Explaining the diffusion of renewable energy technology in developing countries. Energy Economics 40, 285–296. doi:10.1016/j.eneco.2013.07.005

Polzin, F., Migendt, M., Täube, F.A., von Flotow, P., 2015. Public policy influence on renewable energy investments-A panel data study across OECD countries. Energy Policy 80, 98–111. doi:10.1016/j.enpol.2015.01.026

Popp, D., Hascic, I., Medhi, N., 2011. Technology and the diffusion of renewable energy. Energy Economics 33, 648–662. doi:10.1016/j.eneco.2010.08.007

Porter, M.E., Linde, C. van der, 1995. Toward a New Conception of the Environment-Competitiveness Relationship. Journal of Economic Perspectives 9, 97–118. doi:10.1257/jep.9.4.97

Rennings, K., 2000. Redefining innovation — eco-innovation research and the contribution from ecological economics. Ecological Economics 32, 319–332. doi:10.1016/S0921-8009(99)00112-3

Rohdin, P., Thollander, P., Solding, P., 2007. Barriers to and drivers for energy efficiency in the Swedish foundry industry. Energy Policy 35, 672–677. doi:10.1016/j.enpol.2006.01.010

Schleich, J., Gruber, E., 2008. Beyond case studies: Barriers to energy efficiency in commerce and the services sector. Energy Economics 30, 449–464. doi:10.1016/j.eneco.2006.08.004

Sorrell, S., Mallett, A., Nye, S., 2011. Barriers to industrial energy efficiency: a literature review, United Nations Industrial Development Organisation. doi:10.1016/j.rser.2015.03.002

Sorrell, S., Schleich, J., Scott, S., Eoin, O., Fergal, T., Ulla, B., Katrin, O., Peter, R., 2000. Reducing barriers to energy efficiency in public and private organisations. Mechanical Engineering 232.

Trianni, A., Cagno, E., Farné, S., 2016. Barriers, drivers and decision-making process for industrial energy efficiency: A broad study among manufacturing small and medium-sized enterprises. Applied Energy 162, 1537–1551. doi:10.1016/j.apenergy.2015.02.078

Trianni, A., Cagno, E., Worrell, E., 2013. Innovation and adoption of energy efficient technologies: An exploratory analysis of Italian primary metal manufacturing SMEs. Energy Policy 61, 430–440. doi:10.1016/j.enpol.2013.06.034

Veugelers, R., 2012. Which policy instruments to induce clean innovating? Research Policy 41, 1770–1778. doi:10.1016/j.respol.2012.06.012

Wüstenhagen, R., Bilharz, M., 2006. Green energy market development in Germany: effective public policy and emerging customer demand. Energy Policy 34, 1681–1696. doi:10.1016/j.enpol.2004.07.013

Appendix

Appendix 1. Sample distribution

Table A.1.1 Sample distribution

	Countries	Frequency	%
Core country			
	Austria	303	3.69
	Belgium	283	3.45
	Denmark	269	3.28
	Finland	323	3.93
	France	333	4.05
	Germany	314	3.82
	Ireland	300	3.65
	Luxembourg	119	1.45
	Sweden	321	3.91
	The Netherlands	322	3.92
	United Kingdom	329	4.01
Mediterranean countries			
	Greece	271	3.30
	Italy	346	4.21
	Portugal	314	3.82
	Spain	318	3.87
New EU members			
	Bulgaria	299	3.64
	Croatia	275	3.35
	Cyprus	97	1.18
	Czech Republic	330	4.02
	Estonia	352	4.29
	Hungary	308	3.75
	Latvia	358	4.36
	Lithuania	333	4.05
	Malta	123	1.50
	Poland	330	4.02
	Romania	299	3.64
	Slovakia	311	3.79
	Slovenia	333	4.05
	TOTAL	8,213	100.00

Source: Flash Eurobarometer 426, own calculations

Table A.1.2 Sample distribution by sectors

	Total		Core		Mediterranean		New	
	Firms	**(%)**	**Firms**	**(%)**	**Firms**	**(%)**	**Firms**	**(%)**
Manufacturing	2,692	32.78	859	26.71	481	38.51	1,352	36.07
Services	3,893	47.40	1,755	54.57	550	44.04	1,588	42.37
Industry	1,628	19.82	602	18.72	218	17.45	808	21.56
Total	8,213	100.00	3,216	100.00	1,249	100.00	3,748	100.00

Manufacturing (NACE category C); Services (NACE categories H/I/J/K/L/M/N); Industry (NACE categories B/D/E/F)

Source: Flash Eurobarometer 426, own calculations

Table A.1.3 Distribution of the sample by size

	Total		Core		Mediterranean		New	
	Firms	**(%)**	**Firms**	**(%)**	**Firms**	**(%)**	**Firms**	**(%)**
1 to 9	3,260	39.69	1,284	39.93	470	37.63	1,506	40.18
10 to 49	3,182	38.74	1,247	38.77	505	40.43	1,430	8.15
50 to 249	1,771	21.56	685	21.30	274	21.94	812	21.66
Total	8,213	100.00	3,216	100.00	1,249	100.00	3,748	100.00

Source: Flash Eurobarometer 426, own calculations

Appendix 2. Variables definitions

Table A.2.1

Variables and definitions

	Dependent variables
Saving energy	Dummy variable that takes the value 1 if the firm undertakes energy saving actions, and 0 otherwise.
Renewable energies	Dummy variable that takes the value 1 if the firm undertakes renewable energy actions, and 0 otherwise.
	Drivers
Policy influences	
Public regulations	Dummy variable that takes the value 1 if the firm considers the anticipation of future changes in legislation as the main reason of taking eco-efficiency actions, and 0 otherwise.
Public incentives	Dummy variable that takes the value 1 if the firm considers financial and fiscal incentives or other forms of public support as the main reason of taking eco-efficiency actions, and 0 otherwise.
Market pull drivers	
Demand pull	Dummy variable that takes 1 if the firm considers demand from customers and providers as the main reason of taking eco-efficiency actions, and 0 otherwise.
Public demand	Dummy variable that takes 1 if the firm sells its products or services to public institutions, and 0 otherwise.
Technology push drivers	
Cost saving	Dummy variable that takes 1 if the firm considers cost savings as the main reason of taking eco-efficiency actions, and 0 otherwise.
Competitors	Dummy variable that takes 1 if the firm considers catching-up with main competitors as the main reason of taking eco-efficiency actions, and 0 otherwise
Environment priority	Dummy variable that takes 1 if the firm considers the environment is one of the firm's top priority, and 0 otherwise.
Firm characteristics	
Firm size	Number of employees in the firm (in log).
Firm age	Age of the firm in years (in log).
Sector	Industry activities Manufacturing Services
Country dummies	EU28 countries. Core countries: Austria, Belgium, Denmark, Finland, France, Germany, Ireland, Luxembourg, Sweden, the Netherlands, the United Kingdom. Mediterranean countries: Greece, Italy, Portugal and Spain). New EU countries: Bulgaria, Croatia, Cyprus, the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Romania, Slovakia and Slovenia.
Aggregate determinants	
CO^2	CO2 emissions per capita in EU countries during 2012 (tonnes).

Willingness pay	Importance of willingness to buy environmentally friendly products even if they cost a little bit more, share of "total agree" in% during 2014.
Other resource efficient practices	
Water saving	Dummy variable that takes the value 1 if the firm undertakes water saving actions, and 0 otherwise.
Material saving	Dummy variable that takes the value 1 if the firm undertakes material saving actions, and 0 otherwise.
Waste management	Dummy variable that takes the value 1 if the firm undertakes waste management practices, and 0 otherwise.
Selling scrap	Dummy variable that takes the value 1 if the firm sells its scrap material to another firm, and 0 otherwise.
Recycling	Dummy variable that takes the value 1 if the firm recycles by reusing material or waste within the firm, and 0 otherwise.
Designing products	Dummy variable that takes the value 1 if the firm designs products that are easier to maintain or reuse and 0 otherwise.
Future change	
Satisfied	Dummy variable that takes the value 1 if the firm considers fairly or very satisfied with the return on the investments in measures to improve resource efficiency and 0 otherwise.
Intensity	Dummy variable that takes the value 1 if the firm investment share on turnover is greater than 5% and 0 otherwise.
Competitive advantage	Dummy variable that takes the value 1 if the firm considers the creation of a competitive advantage or business opportunities as the main reason of taking eco-efficiency actions, and 0 otherwise.
Environment priority	Dummy variable that takes 1 if the firm considers the environment is one of the firm's top priority, and 0 otherwise.

Note: dependent variables are expressed in present (period t) and planning actions (period t+2)

Appendix 3. Complementary test

To achieve the global energy transition to a low carbon economy, it is important to understand the interactions between EE and RE policies. There are compelling synergies in pursuing them jointly rather than separately (ACEEE, 2007). Li and Bibas (2013) found that an integrative energy policy, combining EE and RE adaptation, significantly reduced the transition costs of climate mitigation policies at both global and regional levels.

To determine whether there is a significant difference in planning future EE and RE strategies by adopting in the present only EE, only RE, or a joint EE and RE strategy, we analyse the complementarities between the two sustainable energy practices using the theory of supermodularity. We assume that a firm can perform two strategies: EE, A_1 and RE, A_2. A firm can adopt two binary decision in relation to each strategy; these being $A_i = 1$ when a firm performs the strategy and $A_i = 0$ otherwise. The function $\Pi(A_1, A_2)$ is supermodular and A_1 and A_2 are complementary only if,

$$\Pi(1,1) - \Pi(0,1) \geq \Pi(1,0) - \Pi(0,0)$$

The complementary test measures how future EE and RE strategies are affected when a firm adds an activity to one that it is already carrying out, and compares this to a situation where a firm adopts an activity in isolation. To test for complementarities we use the framework proposed by Mohnen and Röller (2005) and Cassiman and Veugelers (2006). First, we regress future EE and RE strategies on dummies that identify combinations of present sustainable energy practice, these being: firms that are only implementing EE actions (*only EE*); firms that are only implementing RE actions (*only RE*); and firms that combine both (*EE and RE*). Then, we run the same estimation depending on the three-country cluster and, finally, we apply a one-sided complementarity test to test the incremental effect of adding a sustainable energy strategy.

Table A.3.1

Test for complementarity between sustainable energy strategies.

	EE strategy		**RE strategy**	
	$\chi 2$ value	**Probability**	**$\chi 2$ value**	**Probability**
Whole database	26.72	0.000	17.96	0.000
Core countries	11.08	0.0009	7.26	0.0070
Mediterranean countries	0.08	0.7772	4.05	0.0442
New EU countries	20.23	0.0000	3.65	0.0562

Note: We test the following equation: *-only EE -only RE+EE and RE = 0*

Table A.3.1 reports the complementary test classified by type of future strategy and country clusters. Our results show that implementing EE and RE in the present have a significant positive effect on the probability of planning future EE and RE strategies for all cases considered (except for Mediterranean countries where this positive relationship is not significant in EE strategy).