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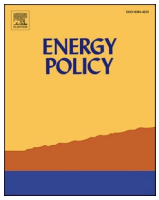

Conceptualizing an interpretative framework for energy transition among Italian innovative small and medium enterprises

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ABSTRACT

Energy transition (ET) is becoming essential for most countries worldwide. Companies can only adapt their behaviours to the objectives set by countries' institutions. A new research stream has thus emerged, which investigates the factors facilitating ET among companies. To date, less attention has been paid to small and medium-sized enterprises (SMEs). One of the greatest difficulties in examining SMEs is their extreme heterogeneity, making results difficult to interpret.

This study analyses the factors supporting ET among a specific population of companies in a defined territorial context: the so-called innovative SMEs belonging to a special Italian database. The high propensity towards eco-environmental innovations characterizing these SMEs and their inclination towards sustainable development suggests that their experience represents a prospective path that policymakers could adopt for other types of SMEs.

Through a partial least squares analysis of data collected from these SMEs, outcomes show that the only factor supporting the ET is the sensitivity of these economic organizations towards energy issues developed over time; that is, the corporate culture with regard to sustainability.

This result is only seemingly surprising under the specific features of these SMEs. Conversely, it presupposes new implications regarding policy measures, questioning the traditional approach based on providing incentives and/or regulations.

1. Introduction

In line with the basic principles stated by the SDGs, energy transition has become one of the most topical issues among the international scientific community, attracting the attention of researchers from different disciplines. Most studies on this issue focus on macroeconomic aspects related to the conditions favouring the transition processes among the various territorial contexts. Less attention has been devoted to understanding how companies address energy transition (hereafter ET) – that is, the factors stimulating or hindering their investments in systems consistent with sustainable industrial development, as expected by the Agenda 2030 and Addis Abeba Action Agenda.

Studies concerning companies and ET also tend to focus on large companies with high environmental impact, while the perception of SMEs' environmental behaviour is generally poor. Nevertheless, although large companies have a high pollution index, these enterprises usually do not represent the primary source of pollution in a territorial context if taken jointly. For instance, a recent report by Marchese and Medus (2023), based on employment weights, estimates that EU SMEs account for 63% of business-driven direct carbon emissions at the EU level. At the same time, the International Energy Agency (IEA, 2015) estimates that SMEs account for 13% of global energy demand and about one-third of energy demand in industry and services. Moreover, large companies often do not represent the most widespread type of locally placed companies or the most significant in terms of territorial competitiveness, and the rationale that drives the ET processes of large and small businesses is different. Large companies with a high carbon footprint not infrequently can affect external environmental decisions in terms of ET (Fouquet, 2010; Dell'Anna, 2021; Dragomir et al., 2023); for instance, a large plant whose activity causes a high level of pollution but that cannot be closed due to its high employment level. Conversely, the behaviour of SMEs is much more likely to be influenced by external

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environment expectations (Triguero et al., 2013; Hojnik and Ruzzier, 2016; Thomas et al., 2022).

However, the research stream regarding companies' behaviour usually focuses on objective elements, such as the availability of incentives and subsidies, considered in terms of barriers and drivers. More rarely, investigations examine how internal stimuli affect the choices made by companies. These stimuli can emerge both from the environmental sensitivity that a company develop within its cultural evolution, and as an answer to the awareness of sustainable development reached by the companies' stakeholders (Chapman and Okushima, 2019; Komendantova and Neumueller, 2020; Janik et al., 2021; Calabrese et al., 2024a).

For these reasons, a comprehensive understanding of companies' approaches toward ET is still lacking, especially when the same companies have small dimensions. Currently, most SMEs – often small and very small organizations – do not have the capacity, interest, or economic advantage to adopt the so-called "eco-innovation" (EC, 2007; Horbach et al., 2012; Segarra-Blasco and Jové-Llopis, 2019; Nowakowski and Wnuk, 2021).

Hence, as underlined by Köhler et al. (2019: 39), "much work remains to be done regarding the connection of micro and macro level analyses" of the processes of ET, going beyond the undifferentiated examination of the drivers and barriers that influence the companies in general, but emphasizing the changing relationship between microeconomic and macroeconomic aspects for each typology of company.

This study sheds light on on the decision-making process leading to green transition investments of a specific category of high-potential SMEs: the innovative SMEs. To this purpose, it investigates, from a microeconomic perspective, the pressures affecting investment decisions regarding the ET of these specific SMEs; namely, the SMEs with a high level of knowledge incorporated in their output and a strong propensity toward the implementation of innovations (e.g. Thomas et al., 2015). Many reasons support this choice.

Firstly, according to the statistics (Di Bella et al., 2023), in 2022 approximately 24.3 million SMEs were active in the EU-27, accounting for 99.8% of all enterprises in the non-financial business sector. Therefore, as underlined by leading authorities (OECD, 2018; EC, 2022; IEA, 2022), no ET process can effectively occur without SMEs' being actively involved.

Secondly, by their intrinsic nature, innovative SMEs exhibit a greater inclination to invest in innovations and knowledge (Trianni et al., 2013; Triguero et al., 2013; Costa-Campi et al., 2015). For this reason, the policies supporting their diffuson could be a forerunner of other SMEs with a lower degree of innovative propensity.

Thirdly, although innovative SMEs already have a low environmental impact from the start-up because of their activity (Carfora et al., 2021), it is worth understanding whether they invest in reducing their impact further or assume a static attitude.

Fourthly, innovative SMEs constitute a heterogeneous aggregate with regard to the indistinct plethora of all SMEs. Commonly, investigations consider undifferentiated aggregates of SMEs, whereby the presence of organizations whose activity does not necessarily presuppose a constant introduction of innovations can alter the understanding of the outcome (Wüstenhagen and Bilharz, 2006; Cagno and Trianni, 2013; Hoicka et al., 2021).

As the wide diffusion of SMEs makes it urgent to reach a better identification of the dynamics fostering their choices in terms of ET, the contribution of this study to the existent literature is somewhat new, as it deepens the relationship between the factors endorsing the processes of the ET of a specific category of SMEs, and the sustainability and competitiveness ambitions of the area in which they are located. Policymakers should be interested in understanding to what extent the innovative SMEs, crucial to the local economy competitiveness, are supportive of ET investments and consistent with the policies proposed by national and EU institutions (Fleiter et al., 2012; Trianni et al., 2016; Qadir et al., 2021). The purpose is to improve the effectiveness of public policies, reducing the risk of the possible enlargement of territorial inequalities among contexts and countries (Panarello and Gatto, 2023; Gao et al., 2023; Kashour, 2023), slowing down the EU cohesion, and aggravating the existing differences (Maltby, 2013; Hoicka et al., 2021; Singh, 2023).

The study is organized as follows: Section 2 describes the analytical background regarding the factors leading the ET of innovative SMEs by proposing a specific model; Section 3 describes the considered database, while Section 4 explores the method and discusses the quality of the model. The discussion is presented in Section 5, while conclusions and policy implications are in Section 6.

2. Background

2.1. About the concept of energy transition

The term ET is usually applied to indicate "the change in the composition (structure) of primary energy supply, the gradual shift from a specific pattern of energy provision to a new state of an energy system" (Smil, 2010: VII). Specifically, the word *transition* alludes to:

> "the change from a present state to a future one. This undertaking consists of integrating innovative smart technology and control systems in order to help optimize the effective use of energy and minimize primary energy demand, through, for example, better control of energy use in buildings and the integration of city infrastructure and energy planning. (EU, 2022: 1)."

Most definitions (e.g. Solomon and Krishna, 2011; Bridge et al., 2013; Sovacool, 2016) point out that the current ET can be qualified as a regime shift from an energy system based on fossil fuels to one powered by renewable energy sources (RES). The increasing penetration of RES into the energy supply mix and the improvements in energy efficiency and storage are key factors of ET, pursuing the goal of sustainable industrial development and economic growth. Nevertheless, making the necessary devices for a sustainable economy based on renewable power, such as wind turbines, solar panels, electric car batteries, and other "green" technologies, requires vast amounts of resources, and, in addition, the rapidly rising amount of green technology waste at the end of their lifetime can pose further environmental hazards (Chen et al., 2019). This is why recycling output materials must be greatly improved to sustain energy transition (Habib and Wenzel, 2014; Manberger and Stenqvist, 2018; Régis et al., 2023).

Recent unexpected events, such as the energy crisis resulting from the pandemic and the conflict between Russia and Ukraine, have further extended the concept of ET. Thus, nowadays, ET is believed to include even the security of energy supply and the initiatives tackling energy poverty (e.g. Hoicka et al., 2021; Mišík and Nosko, 2023; Carfora et al., 2022; Carfora and Scandurra, 2024). As stated by the UN (2021:3): Carfora et al., (2022)

> "It has been long recognized that the global energy system needs to change. But if there ever was any doubt, the COVID-19 pandemic has cemented that resolve. The Covid crisis has demonstrated the weaknesses of the existing energy system and exposed the consequences of energy poverty experienced by billions of people worldwide. Achieving SDG7 can fundamentally change this reality. The energy transition is a crucial enabler of sustainable development and climate resilience. Forward-looking actions will create jobs, stimulate growth, and harvest social and health benefits. The energy transition is not a uniform, one-size-fits-all process. It reflects diverse priorities and combines abilities, technologies, policies, finance, and resources. While the specific path to the end goal depends on individual circumstances, the destination is common. The process must be just, inclusive, and systemic to ensure no one is left behind. International and regional cooperation is essential to facilitate sharing experiences and good practices."

Despite the comprehensive and optimistic approach theorized by the UN, some positive signals, and the efforts to endorse ET commitments, there is still little talk about ET in many countries, and even less is known about it. At least in the EU, energy policy communication is recurrently characterized by poor information and understanding, and strong or even false assumptions and myths that need to be debunked (Maltby, 2013; Child et al., 2018; Kashour, 2023). Thus, implementing efforts and strategies aimed at learning, disseminating, and discussing crucial questions related to ET and energy policy represents an effective strategy and a step forward (Smil, 2010; Andrews-Speed, 2016; Chang et al., 2019).

It is not surprising, therefore, if in the face of this indeterminacy, policies concerning ET often prove to be ineffective (Rhodes et al., 2021; Drago and Gatto, 2022), even more so when directed to heterogeneous SMEs in forms of external supports such as incentives and regulations provided by public institutions (Fleiter et al., 2012; Triguero et al., 2013; Sáez-Martínez et al., 2016).

In line with the described approach, we contribute to this strand of research by proposing a comprehensive framework that connects the traditional focus on external factors (Schleich and Gruber, 2008; Trianni et al., 2016; Qadir et al., 2021) with other elements linked to SMEs' behaviours. Compared to other investigations that have examined the relevance of single barriers or drivers, as well as just one of the three described aspects of ET (substitution of the sources, reduction of the consumption, and recycling of resources), the proposed model intends to investigate the main factors dealt with in the scientific literature over the years regarding ET as a whole.

Consequentially, this study's research question is: *What are the most significant factors favouring energy transition in SMEs, at least with regard to the specific investigated category?*

2.2. The proposed interpretative framework

In the last 20 years, a great effort has been made to detect a taxonomy of the ET determinants that was not limited to the presence of incentives and regulations (e.g. Rohdin et al., 2007; Horbach et al., 2012; Janik et al., 2021). Many contributions also differentiate measures suitable for energy efficiency (Fleiter et al., 2012; Costa-Campi et al., 2015; Solomon and Krishna, 2011), or for renewable energies (Hrovatin et al., 2016; Chang et al., 2019; Sung, 2019).

As explained in the previous section 2.1, with respect to many other contributions that have, up to now, been proposed, this study focuses on a category of SMEs with a high propensity to invest in cutting-edge technologies. At the same time, their activity does not exhibit, on average, a substantial environmental impact. In this regard, without neglecting external stimulus factors, it is easier to bring out the internal drivers of the SME to invest in ET. In addition to the tangible variables that constitute the prevailing factor that leads to most virtuous behaviour and are investigated in other surveys, this study identifies the solicitations and stimuli that these SMEs experience from external pressures or the evolution of subjective beliefs within the company. Moreover, by following a seminal article by Horbach et al. (2012), the study distinguishes between factors soliciting (*push factors*) or attracting (*pull factors*) investments in ET.

Accordingly, as shown in Fig. 1, we propose a model with two main sections. The first section refers to three push factors that somehow induce or force SMEs to trail this pathway: i) the introduction of legislation by public institutions at different levels (*regulations*); ii) the expectations and/or requests of stakeholders (*awareness*); iii) the *corporate culture* mirroring the sensitivity of the organization developed over the time with regard to energy issues and sustainability in general, emerging from the subjective receptivity of the staff.

i) *Regulations* are unanimously recognized (Horbach et al., 2012; Rubashkina et al., 2015; Rhodes et al., 2021) as a powerful tool to achieve specified aims in terms of pollution, the share of renewable energy, fossil consumption, and so on. Companies cannot avoid ensuring their behaviour and choices conform to parameters defined by other entities; for instance, by adopting a quality standard issued by external organizations. Many studies confirm the positive linkage between regulations and virtuous behaviours (Cagno and Trianni, 2013; Garrone et al., 2017; Segarra-Blasco and Jové-Llopis, 2019). Even so, the effects of regulations do not always lead to the expected results (Guo and Yuan, 2020; Drago and Gatto, 2022; Qiao et al., 2022). Within this factor, we also include the efficiency of the judicial system, as it has been proven to represent a barrier to environmental sustainability, preventing investments in critical technologies that support green strategies (Falavigna and Ippoliti, 2022).

ii) Each territorial context expresses an *awareness* of issues related to ET and a correlated intensity (Trianni et al., 2016). The awareness permeates the expectations of the various stakeholders (e.g. suppliers, customers, mass media, citizens) with whom economic organizations deal (Segarra-Blasco and Jové-Llopis, 2019; Komendantova and Neumueller, 2020; Komendantova, 2021). Companies wishing to improve their image and satisfy stakeholders' expectations are constantly solicited, if not forced, to adapt their orientation towards ET to match the external level of

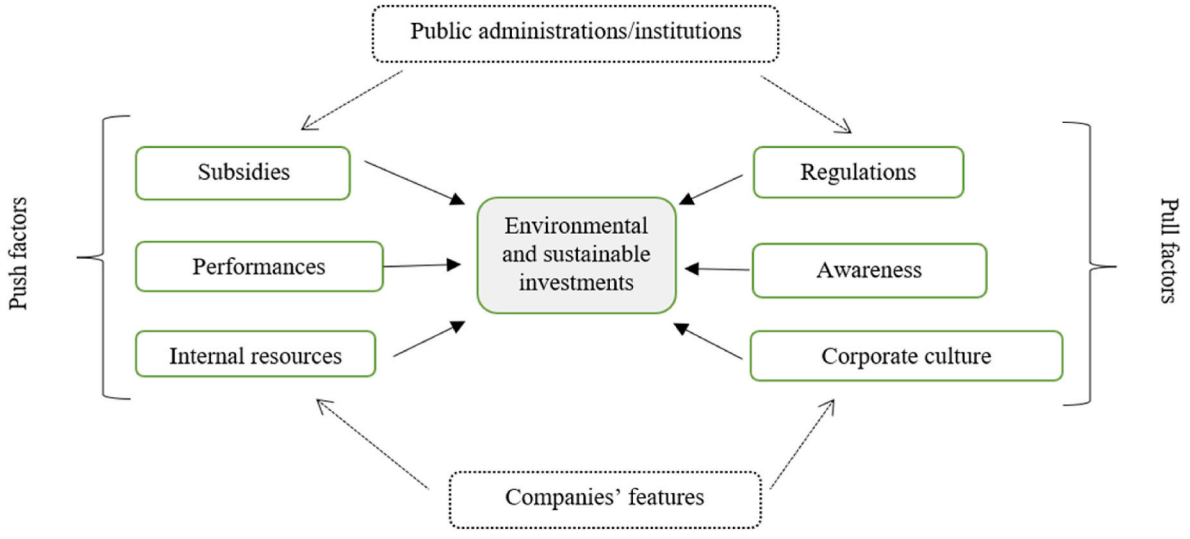

Fig. 1. The proposed interpretative model.

awareness (Janik et al., 2021; Panarello and Gatto, 2023). Due to their lower "visibility" than larger companies, SMEs are usually less exposed to the influence of stakeholders (Triguero et al., 2013; Hojnik and Ruzzier, 2016; Thomas et al., 2022).

iii) Several descriptions of *corporate culture* exist. A leading definition of Hampden-Turner (1990) explains it as:

" a pattern of basic assumptions invented, discovered or developed by a given group as it learns to cope with its problems of external adaptation and internal integration that has worked well enough to be valid and to be taught to new members as the correct way to perceive, think and feel in relation to these problems."

By generating the company's value, mission, and vision, the corporate culture determines the level of sensitivity toward the evolving issue of ET, and the propensity to invest in this direction (Cagno and Trianni, 2013; Goggins et al., 2022; Chaikumbung, 2023). Corporate culture also affects the innovation orientation toward ET (Sovacool and Enevoldsen, 2015). Of course, the level of corporate culture regarding ET can differ among companies, depending on multiple aspects linked to elements such as personal traits, environmental sensitivity, or experiences lived by the whole staff.

The second section of the model remarks the three basic pull factors that attract SMEs to energy transition. They concern: i) the possibility of obtaining some monetary, fiscal, or immaterial benefit (*subsidies*); ii) the expected *performances* resulting from the investments in ET; iii) the availability of tangible or intangible *internal resources*.

i) *Subsidies* represent one of the variables most investigated in terms of affecting investment decisions in ET. Researchers believe there exists a strong positive correlation between the investments in ET and the provision of monetary and fiscal incentives, as well as the availability of knowledge released by local research centres (e.g. Wüstenhagen and Bilharz, 2006; Liu et al., 2019a; Sung, 2019). Subsidies can also focused to favour the R&D expenditures of companies to accelerate their propensity toward innovations (Plank and Doblinger, 2018; Liu et al., 2019b; Qi et al., 2022). The presence of subsidies and incentives for SMEs is usually more important than for large companies as the former typically have financial and credit constraints. Hence, they represent a source of access to external financial resources (Calabrese et al., 2024a), especially if we refer to the investments considered within the landscape of Industry 4.0 (Calabrese et al., 2024b). Not by chance, ET is a crucial aspect of the European Green Deal's Industry 4.0 strategy (e.g. Baležentis et al., 2023). As is known, the provision of subsidies is dependent on the policies adopted by public institutions. A successful ET typically requests government intervention because of consumers' tendency to free-ride (Fouquet, 2010; Singh, 2023), and because ET "is costly and driven by the need to address the long-term public external cost of energy use rather than deliver a short-term private benefit" (Andrews-Speed, 2016: 223).

ii) Many investigations (Horbach et al., 2012; Huang et al., 2016; Restrepo and Uribe, 2023) proved that a strong reason for companies to follow the ET path is represented by the expected economic and financial *performances* associated with the adoption of green investments. Performance is evaluated in terms of higher profits or revenues, higher levels of cash flow and competitiveness, lower productive costs, or more stable jobs. However, in line with the well-known Porter's assumptions (e.g. Rubashkina et al., 2015), the positive effect of investments in ET over performances has not been proved beyond all doubt. Additionally, there is difficulty forecasting these expected benefits. This uncertainty is a barrier primarily for SMEs rather than larger enterprises (Schleich and Gruber, 2008; Trianni et al., 2013), discouraging the implementation of ET measures (Sáez-Martínez et al., 2016; Trianni et al., 2016).

iii) There is an extensive body of managerial literature on the so-called critical *internal resources* favouring (or hindering) business investment. Although the outcomes of this taxonomy are ambiguous, it is reasonable to suppose that some elements usually favour investments in ET. Among them, researchers include capital availability, export volume, personnel competencies, and internal R&S generating knowledge (e.g. Rohdin et al., 2007; Fleiter et al., 2012; Segarra-Blasco and Jové-Llopis, 2019). As mentioned, SMEs often have limited internal resources of a knowledge and financial nature (Hrovatin et al., 2016; Calabrese et al., 2024a). For SMEs, size and localization in developed areas can also be considered critical resources, as skilled personnel and external consultants are often considered too costly compared to the expected benefits linked to ET (Schleich and Gruber, 2008; Costa-Campi et al., 2015), thus penalizing investments and R&D in ET (Costa-Campi et al., 2017).

The model also highlights the role played by public administrations and other institutions/entities such as research centres, banks, serial investors, and business angels. If public administrations at different levels chiefly affect the policies by issuing laws, compulsory standards, and/or various kinds of *subsidies*, the other entities assure knowledge transfer and financing (Chang et al., 2019; Qadir et al., 2021; Falavigna and Ippoliti, 2022). From the opposite side, the model underlines the influence played by subjective *features* of each SME over its willingness to invest in ET, as well as the amount of resources to devote in this direction.

In a nutshell, we want to assess how the six proposed factors (*awareness*, *corporate culture*, *internal resources*, *performance*, *regulations*, and *subsidies*) influence investing in ET for these highly innovative SMEs. Having distinguished these six factors into push and pull and highlighting the role of public institutions and corporate characteristics themselves, the results of the present study could pave the way for new types of policy measures that, perhaps, could prove more effective in boosting the ET path that countries and the production system must take to meet the SDG targets, combat climate change, and ultimately reduce dependence on fossil fuels.

3. Data

To investigate how push and pull factors affect investment decisions in ET, a sample survey was conducted on a probability sample of innovative SMEs, randomly drawn from an official public database. Subsequently to the survey, the items collected with the questionnaires were analysed using a partial least squares–structural equation modelling (PLS-SEM) method to explain how the identified factors favour ET (Fig. 1). The PLS is crafted following a prediction-oriented framework via SEM. It enables the concurrent estimation and testing of intricate theories using empirical data, as Hair et al. (2011) demonstrated. Importantly, this is achieved with only a few observations and without imposing distributive assumptions on the data. In simpler terms, the statistical properties of PLS-SEM make it especially valuable for exploratory research characterized by rich data and nascent theory, as highlighted by Wold (1985:589).

3.1. Sample and data collection

To accomplish the goals of our research study, we surveyed a population of young, innovative SMEs that are included in a dedicated section of the Register of the Italian Ministry of Economic Development known as "innovative SMEs". This registry was established in 2015 in alignment with legislation supporting innovative start-ups, which was introduced in 2012.

Policymakers have recognized the potential of innovative SMEs with regard to employment generation and the transformation of the production system towards economic activities with predictable future

development. From this perspective, innovative SMEs represent a vital group of companies contributing to enhancing the competitive capacity of a country.

To be eligible for inclusion in this registry, SMEs must meet specific criteria related to technological innovation. These criteria include factors such as the proportion of investment devoted to knowledge improvement and R&D, ownership of patents, and the educational background of the entrepreneurial team. The Ministry provides various incentives, including credit loans, monetary and fiscal benefits, and the opportunity to raise capital through equity crowdfunding. As a result of these anticipated advantages, the number of SMEs enrolling in this registry is quickly growing.

The choice of sample units based on probability sampling requires an exhaustive population list. In 2023, on 1st March, 2514 companies were included in the Italian Register of Innovative SMEs. To avoid the limitations of administrative data (e.g. Zhang, 2012), which can introduce bias because of incorrect selection (and consequently coverage errors), and to have an exhaustive and updated list that contains all the active companies enrolled in the register, all the SMEs included in the register were initially contacted. Companies for whom it was not possible to trace a website, email, or telephone number (no. = 569) were removed from the list. The final size of the population was 1945 SMEs. Owing to the spatial heterogeneity of the distribution of firms, stratified sampling was used. In particular, firms were stratified according to the region where the same SME is registered. A stratified sampling approach was employed to select a representative subset of firms from various strata, taking into account the proportional representation of each subgroup within the overall population. With a sample size of 400 units, roughly constituting 20% of the reference population, firms across the service, manufacturing, and trade sectors were included. To achieve an adequate regional representation of the population in the survey, differential regional oversampling is used to mitigate biases and minimize the impact of total nonresponse (e.g. Jones, 1996; Pickery and Carton, 2008). Therefore, the minimum sample size was elevated to 420 units. Subsequently, SMEs were randomly selected from the compiled list to partake in an online survey featuring closed questions on a 5-point Likert scale (ranging from 1 for "strongly disagree" to 5 for "strongly agree"), as delineated in Appendix A.

Invitations to participate in the survey were dispatched via email, elucidating the objectives of the survey, and the notion of ET. Each email contained a direct link to the questionnaire and emphasized the importance of having the most knowledgeable individual within the organization respond, if not the recipient. Despite repeated invitations, 52 SMEs refrained from providing feedback, culminating in a final sample size of 348 units.

The questionnaire, which aimed to investigate the factors stimulating ET, was discussed by experienced researchers and company managers who provided suggestions for improving clarity and validity (soundness). In addition, it was pre-tested on five innovative SMEs not enrolled in the register. The questionnaire commenced with a filter question, prompting companies to indicate whether they had invested in environmental and sustainable innovations or technologies facilitating energy transition within the preceding three years (Yes) or not (No). The distinctive attributes discerned from the response to this initial query are expounded in Table 1.

The foremost consideration pertains to the proportion of companies that have invested in environmental and sustainable innovations over the past three years. Examination of the data presented in Table 1 reveals that this subset constitutes approximately 37% (ratio between the SMEs responding Yes – 128 and the total SMEs surveyed – 348) of the sample. Notably, 71.5% of the SMEs operate within the service sector. Within this category, 34.3% (ratio between SMEs operating in the Service sector responding Yes – 85, and the totality of SMEs in the same sector – 248) have reported investments in ET, whereas 43.4% (ratio between SMEs operating in these sectors responding Yes – 43, and the totality of SMEs in the same sectors – 99) of enterprises in the trade and manufacturing sectors have made similar declarations.

Table 1
Sample characteristics (Yes summarizes innovative SMEs that have invested in energy transition in the last three yers; No individuate characteristics of SMEs that have not invested in ET).

	Frequency (n_i)			Percentage by column (%)		
	Yes	No	Total	Yes	No	Total
Activity sector						
Trade and manufacturing	43	56	99	33.6	25.6	28.5
Service	85	163	248	66.4	74.4	71.5
*Total**	*128*	*219*	*347*	*100.0*	*100.0*	*100.0*
Employees						
0–4	31	78	109	25.0	37.3	32.7
5–9	28	43	71	22.6	20.6	21.3
10–19	34	33	67	27.4	15.8	20.1
20–49	22	38	60	17.7	18.2	18.0
≥ 50	9	17	26	7.3	8.1	7.8
*Total**	*124*	*209*	*333*	*100.0*	*100.0*	*100.0*
Capital						
[1–10,000]	14	37	51	11.0	17.1	14.8
]10,000–50,000]	35	71	106	27.6	32.7	30.8
]50,000–100,000]	22	33	55	17.3	15.2	16.0
]100,000–250,000]	20	34	54	15.7	15.7	15.7
]250,000–500,000]	12	15	27	9.4	6.9	7.8
>500,000	24	27	51	18.9	12.4	14.8
*Total**	*127*	*217*	*344*	*100.0*	*100.0*	*100.0*
Production (*thousands of euros*)						
[0–100]	*10*	*28*	*38*	7.9	12.8	11.0
]100–500]	*29*	*61*	*90*	22.8	28.0	26.1
]500–1000]	*16*	*38*	*54*	12.6	17.4	15.7
]1000–2000]	*21*	*26*	*47*	16.5	11.9	13.6
]2000–10,000]	*42*	*55*	*97*	33.1	25.2	28.1
>10.000	*9*	*10*	*19*	7.1	4.6	5.5
*Total**	*127*	*218*	*345*	*100.0*	*100.0*	*100.0*
Localisation						
Northwest	51	82	133	39.8	37.3	38.2
Northeast	25	37	62	19.5	16.8	17.8
Central	27	52	79	21.1	23.6	22.7
South	19	41	60	14.8	18.6	17.2
Islands	6	8	14	4.7	3.6	4.0
*Total**	*128*	*220*	*348*	*100.0*	*100.0*	*100.0*

Of particular interest is the distribution of enterprises based on their employee count, where roughly 54% employ fewer than ten individuals. Among these smaller establishments, less than half have engaged in initiatives related to ET. Interestingly, a departure from this trend is observed among enterprises with 10–19 employees, exhibiting a heightened propensity for such investments, which aligns with larger enterprises in terms of workforce.

Approximately three-quarters of the total number of enterprises fall within the capital class of up to 250,000 euros. However, businesses demonstrating a greater commitment to ET tend to belong to the capital class exceeding that figure. Notably, enterprises exhibiting a higher propensity for innovation predominantly fall within the production class exceeding one million euros, accounting for approximately one-half of the total.

With regard to geographical distribution, one-fifth of the investigated companies are situated in southern Italy and the two big islands. Interestingly, no significant disparities were observed across the national territory concerning their inclination to invest in ET.

4. Method

Consistent with the interpretative framework proposed, we estimate a model using the structural model approach based on PLS-SEM using the data collected with the sample survey.

PLS-SEM represents a second-generation method of data analysis within the structural equation modelling framework. Unlike the covariance-based SEM approaches, PLS-SEM prioritizes prediction and

is commonly employed in exploratory research, although it is also suitable for confirmatory studies. According to Vinzi et al. (2005), PLS-SEM is particularly advantageous for predictive causal analysis in situations characterized by high complexity and limited theoretical information. Additionally, researchers favour PLS-SEM due to its superiority over covariance-based methods. Its benefits encompass its ability to accommodate theoretical and measurement conditions, distributional considerations, and practical constraints. Furthermore, it is deemed suitable for prediction-focused objectives, handling non-normal data distributions, and managing small sample sizes (Qureshi and Compeau, 2009; Hair et al., 2012).

These characteristics, including minimal requirements concerning measurement scales, sample size, and residual distributions, render it applicable whether relationships are present or not, and it can guide propositions for future testing (Chin and Newsted, 1999; Hair et al., 2017). The PLS-SEM process involves a two-step approach: estimating the measurement model and then analysing the structural model. It operates as an iterative algorithm, solving blocks of the measurement model separately before estimating path coefficients in the structural model.

A measurement model is an integral part of a broader model where latent (i.e. unobserved) constructs (or variables) (LVs) are defined by one or more observed (or manifest) variables (MVs). LVs typically denote multidimensional concepts not directly measurable but inferred through a combination of MVs that act as indicators of the underlying constructs (Khine, 2013). The structural model illustrates the theoretical framework with LVs, symbolized as ovals, that are not directly observable but are explained within the model.

ET and its determinants encompass multidimensional concepts defined by a broad set of indicators (MVs) gathered during the survey. Utilizing the PLS-SEM method, these indicators were grouped into latent constructs, assuming that changes in MVs reflect changes in the LVs. Specifically, a reflective PLS-SEM model was estimated, aligning with the rationale outlined by Coltman et al. (2008). This choice was grounded in several factors, including the nature of the construct, the direction of causality (changes in the construct drive changes in indicators), and the characteristics of the indicators (changes in LVs precede variations in MVs).

The analysis of this model class entails evaluating two primary stages of the equation system: the measurement (outer) model and the structural (inner) model, as delineated by Henseler et al. (2009) and Hair et al. (2017), respectively. However, we checked for common method bias before assessing the estimated model's quality. It is known that systematic error can arise in research when the method used to collect data affects respondents' answers, leading to inflated correlations among variables. This can distort the relationships between variables, potentially resulting in inaccurate conclusions. Various techniques to identify and mitigate common method bias are proposed, such as statistical tests like Harman's single-factor test, which examines whether a single factor explains a substantial portion of the variance in measured variables. If a single factor accounts for a large portion of variance, it suggests the presence of common method bias. Other approaches include procedural remedies during data collection and analytical techniques like controlling for method variance in statistical analyses. Addressing common method bias is crucial for ensuring the validity and reliability of research findings. Following the procedure suggested by Tehseen et al. (2017) to mitigate common variance bias, we still opted to verify its absence. In particular, we employed Harman's single-factor test, summarized by Jakobsen and Jensen (2015). Based on the total variance explained by survey items via exploratory unrotated factor analysis, this test assumes that if common method bias exists, one component will account for over 50% of the covariance between items and the criterion construct. In our case, this factor explains approximately 39.67% of total variability, thus excluding the presence of common method bias.

To analyse the relationships between the LVs and ET, we initially evaluated the reliability and validity of the associations between MVs and their associated LVs, known as the measurement model. Additionally, a bootstrap procedure was employed to ascertain the significance of estimated coefficients. Data analysis was conducted using SmartPLS (Ringle et al., 2015) ver. 4.0.

4.1. The measurement model assessment

Reflective measurement posits that an underlying, unobservable concept influences variation in a group of observable indicators, allowing for an indirect assessment of the concept. To evaluate reflective measurement models, four key parameters are typically scrutinized (e.g. Henseler et al., 2009; Hair et al., 2017):

1. Internal consistency reliability: assesses the consistency of responses across different items measuring the same construct. Commonly used measures include Cronbach's alpha and composite reliability.
2. Indicator reliability: examines the reliability of individual indicators in measuring the latent construct. It ensures that each indicator provides consistent and accurate information about the underlying concept.
3. Convergent validity: evaluates the degree to which different indicators measuring the same construct converge or agree with each other. High convergent validity indicates that the indicators are effectively capturing the intended construct.
4. Discriminant validity: assesses whether the construct of interest is distinct from other constructs in the model. It ensures that the indicators measure unique aspects of the intended construct and are not influenced by unrelated factors.

These parameters are essential for establishing the reliability and validity of reflective measurement models, providing researchers with confidence in the accuracy of their findings. Table 2 reports the reliability and validity statistics. The overall results provide clear evidence that the measurement model satisfied both the internal consistency reliability and convergent validity criteria, while Table 3 reports the discriminant validity.

4.1.1. Internal consistency reliability

Internal consistency is investigated using Cronbach's alpha and composite reliability. The former has faced criticism for assuming equal reliability and loadings among all indicators, thus overlooking individual item reliability, while composite reliability has emerged as a more appropriate measure for assessing internal consistency reliability, as it considers item loadings (Hair et al., 2017). Therefore, our analysis evaluated both Cronbach's alpha and composite reliability.

Our findings indicate that both measures fall within acceptable ranges, with all LVs demonstrating reliability above the threshold of 0.60. Although Cronbach's alpha for the external context was slightly below the acceptability threshold, it still fell within the range deemed acceptable by some scholars (e.g. Bonett and Wright, 2015; Punzo et al., 2019). Hence, the internal consistency of the items was confirmed, providing confidence in the reliability of the measurement scale.

4.1.2. Individual item reliability

To evaluate the reliability of individual items, we first examined the factor loadings, which represent the strength of the relationship between each item and its corresponding LV. Typically, factor loadings exceeding a certain threshold are considered acceptable. Hulland (1999) suggests a minimum threshold of 0.4 for explanatory studies, or 0.7 as preferred (e.g. Bagozzi and Yi, 1988). In this study, we adopted a threshold of 0.5, consistent with previous research in eco-innovation (e.g. Mazzanti and Zoboli, 2009). We iteratively estimated the model, initially including all items grouped into LVs. However, some indicators exhibited loadings below the threshold, prompting us to remove these items and re-estimate the model. This process was repeated until all item loadings

Table 2
Factor loadings, reliability and validity statistics.

Latent and Manifest Indicators	Factor Loadings	Cronbach's Alpha	Composite Reliability	Average Variance Explained (AVE)
PUSH FACTORS				
Subsidies		0.726	0.866	0.780
3j	0.926			
3k	0.838			
Performances		0.703	0.810	0.524
3h	0.896			
3i	0.715			
3m	0.697			
3n	0.543			
Internal Resources		0.605	0.702	0.512
5a	0.874			
3q	0.678			
PULL FACTORS				
Regulations		0.658	0.756	0.521
3c	0.428			
3g	0.571			
8a	0.796			
8b	0.606			
Awareness		0.882	0.903	0.652
3a	0.876			
3b	0.743			
3d	0.764			
3e	0.708			
3f	0.924			
Corporate Culture		0.815	0.877	0.643
3l	0.694			
3o	0.886			
3p	0.890			
3q	0.715			
OUTCOME				
Energy Transition		0.783	0.823	0.503
2a	0.508			
Q4	0.924			

exceeded 0.5. After completing the iterative procedure, all items in the measurement model demonstrated satisfactory loadings, indicating a relationship with their respective LVs.

4.1.3. Convergent validity

This measurement criterion evaluates the degree to which a group of items can effectively measure the same LV in harmony (Henseler et al., 2009). Conforming to Valerie (2012) and Hair et al. (2014). We applied the average variance extracted (AVE) with a threshold of 0.50 (Bagozzi and Yi, 1988; Coltman et al., 2008) to assess convergent validity. This threshold implies that a latent variable should account for at least half or more of the variability in its indicators. In our study, AVE values for all constructs ranged from 0.523 to 0.780, signifying strong convergent validity across all constructs.

4.1.4. Disciminant validity

Discriminant validity was evaluated at construct and item levels using the criteria proposed by Fornell and Larcker (1981) and Chin (1998). This dual approach is endorsed by several researchers who advocate that the variance extracted estimates should surpass those of the squared correlation. More recently, the heterotrait–monotrait (HTMT) ratio of correlations has been proposed as a comprehensive method for assessing discriminant validity in PLS-SEM. The HTMT offers enhanced specificity and sensitivity compared to cross-loadings and the Fornell–Larcker criterion.

In assessing discriminant validity using the HTMT (Table 3), values below 0.85 suggest no issues with discriminant validity and indicate that collinearity problems among latent constructs are not detected. This multi-pronged approach ensures a thorough examination of discriminant validity, providing researchers with a comprehensive understanding of the relationships between constructs and items in their models.

4.2. Structural model

To assess the quality of the structural model, we consider i) the full collinearity of the model, ii) the determination coefficients (R^2 and *Adjusted* R^2) of the endogenous latent construct, and iii) path coefficients.

4.2.1. Full collinearity

We employed the full collinearity approach, as outlined by Kock and Lynn (2012), to examine collinearity, assessing both vertical and lateral collinearity (Table 4). Hair et al. (1995) propose a maximum acceptable variance inflation factor (VIF) value of 10, while Kock (2015) suggests that VIF values should be close to 3 or lower. All latent variables (LVs) in our proposed model had VIFs below 3. Overall, collinearity concerns were effectively addressed within the model.

4.2.2. The determination coefficients and the effect sizes

We considered the determination coefficients (R^2 and Adjusted R^2) of the endogenous LVs to assess the structural model's quality. In PLS-SEM, R^2 is akin to multiple regression analysis, indicating the proportion of variance in the endogenous LV explained by its independent variables (Table 5). Following the literature on PLS (e.g. Chin, 1998), R^2 values are typically categorized as low if $R^2 \leq 0.20$, moderate if $0.20 < R^2 < 0.50$, and high if $R^2 \geq 0.50$.

In our proposed model, the adjusted R^2 of the endogenous LV indicates a low explanatory power of the model in capturing the variance in the endogenous LV.

Table 4
Collinearity statistics.

Latent Constructs	*VIF*
Internal Resources	1.053
Regulation	1.373
Corporate Culture	1.237
Awareness	1.589
Performaces	1.595
Subsidies	1.700

Table 3
Heterotrait-Monotrait ratio of correlations.

	ET	Internal Resources	Regulation	Corporate Culture	Awareness	Performaces	Subsidies
ET							
Internal Resources	0.404						
Regulation	0.876	0.147					
Corporate Culture	0.829	0.085	0.258				
Awareness	0.541	0.093	0.851	0.223			
Performaces	0.878	0.103	0.612	0.532	0.388		
Subsidies	0.834	0.118	0.674	0.400	0.565	0.745	

Table 5
Determination coefficients and effect sizes.

	R^2	Adjusted R^2
ET	0.151	0.109

4.2.3. Significance of the estimates

Based on the analysis of the reliability and validity of the measurement model and the explained variance (R^2) of the structural model, we can reasonably conclude that the model is correctly specified. It effectively captures the hypothesized relationship between push and pull factors and ET in innovative SMEs.

5. Results and discussion

The proposed model complies with the quality requirements of the method used, as set out in Section 4.

Given that partial least squares (PLS) does not rely on distributional assumptions, traditional significance levels for parameter estimates are not applicable. Instead, resampling techniques such as bootstrapping were utilized to assess the variability of parameter estimates. To ascertain the significance of estimated coefficients (i.e. path coefficients) pertaining to the research hypotheses, a bootstrapping technique employing 6000 sample replications was employed. This rigorous approach ensures robustness in evaluating the relationships within the model and provides confidence in the validity of the research findings. Table 6 reports the estimated path coefficients, standard errors, and *p*-values.

Focusing on the LVs, almost all of them are non-significant. Only *corporate culture* significantly affects the investments in energy transition in our sample.

This study aimed to test a relatively structured model of the many factors that scientific literature believes support energy transition choices by companies and SMEs, organizing them according to six main categories (*awareness*, *corporate culture*, *internal resources*, *performances*, *subsidies*, *regulations*). A seminal contribution by Horbach et al. (2012) argues that these factors should be preliminarily distinguished between those that solicit (push factors) and those that attract (pull factors) SMEs towards ET, as they have many different practical and theoretical implications. Even so, most investigations have focused on the *sources* of factors without distinguishing between the two mentioned categories.

The action of public administrations is emblematic (as well as the effect of *companies' features*). Several European, national, or local institutions are constantly faced with the dilemma of adopting regulations that force companies to make ET choices, rather than offering incentives and subsidies of various kinds or a mix of the two. Regulations tend to be cheaper for public budgets, but their effectiveness is not always guaranteed (Singh, 2023). It is no coincidence that many incentives and subsidies are aimed at stimulating virtuous behaviour. The choice between push or pull factors usually varies depending on the type of SME (in terms of size, legal form, sector of activity, or other parameters), as policies often intends to make up for any shortfall in the company's internal capacity to meet the economic policy objectives set by the institutions (Qadir et al., 2021; Qi et al., 2022). For example, institutions often provide monetary or fiscal incentives to encourage the replacement of devices and plants with greater environmental impact.

Specifically, the business and managerial literature (Thomas et al., 2015; Yang, 2017; Sung, 2019) argues that the likelihood of adopting innovations in the Schumpeterian sense, or respecting regulations, is directly related to the availability of internal resources. The most important resources are usually the monetary ones and staff skills. Such resources represent a fundamental prerequisite to respect the rules and laws issued by public institutions. Still, they are also a stimulus to change or to accommodate any requests the company has received from the external environment.

Therefore, in general, the presence of public subsidies or tax benefits is unanimously regarded as a key element in promoting SMEs' investment in ET. As argued by Yang et al. (2019) and Qi et al. (2022), there is a positive threshold effect of government subsidies on renewable energy investments and the ET processes. This effect is higher for SMEs than for large companies; furthermore, subsidies and low-cost financing are more effective for SMEs than fiscal or tax benefits. Even so, public subsidies can reveal an ambiguous effect, as some SMEs engage in free-riding behaviour, and after receiving government subsidies they reduce the proportion of their investments in ET. This aspect is very relevant as, at least in Europe, the main financial resources used by SMEs to support the ET are internal ones, while ET investments are not considered a priority (Caporale et al., 2023). The quoted researchers also pointed out that, although the external support is fundamental, the decisions to invest in ET are widely affected by the sensitivity level with regard to the sustainability of the external context, as well as by the possession of specific competencies able to support and manage the innovative processes. Hence, external subsidies can be considered as apt for ET expansion, yet it might potentially miss the mark if public policy overlooks insights from the socio-cultural and value systems of the target population; the so-called *person and social norms*, that is the feelings of moral obligations to do 'the right thing'- (Asante et al., 2021; Sirin et al., 2022). Similarly, the use of external advice (networking) able to fill the SMEs' knowledge gap influences the benefits from the adoption of ET innovations (Bodas-Freitas and Corrocher, 2019). That is because most SMEs find the concept of ET very complex to navigate alone and need guidance throughout the process (Kiraly, 2024). Additionally, at least with reference to the Polish context, Bernat et al. (2024) underlined that another powerful stimulus to invest in ET is the expected benefit in terms of economic advantages or image and customer retention.

In recent years, however, some scholars (Sovacool and Enevoldsen, 2015; Goggins et al., 2022; Chaikumbung, 2023) have also noted that, particularly with regard to the needs of sustainable development, one aspect that can strongly influence the choices of the companies is the *corporate culture*. Here, because the company has developed the subjective sensitivity to environmental issues and sustainability internally, the corporate culture mirrors the life experiences in the community developed by owners and managers and all the staff in relation to external phenomena and problems (Hampden-Turner, 1990). Corporate culture can guide corporate choices and behaviours at the expense of profitability, at least within certain limits, and is the basis of the values, beliefs, and image the company intends to convey outside.

Maybe not by chance, the only significant factor in this investigation from the statistical analysis is corporate culture. This result may seem poor or limited, but in reality it contains an essential message when contextualized to the specificity of the sample analysed (see Section 3): namely, tiny companies mainly operating in the services sector, engaged in activities with a low environmental impact, recently founded (the database was established in 2012), and of innovative nature. This outcome may also be because many Italian companies have not fully

Table 6
Hypotheses, path coefficients, standard deviation, t-statistics, p-value.

Hypotheses	Path coefficients	Standard deviation	*t* statistics	*p*-value	*Confirmed/ not confirmed*
Regulation→ ET	0.214	0.235	1.032	0.302	No
Corporate Culture→ ET	0.244	0.105	2.320	0.020	Yes
Awareness→ ET	0.028	0.164	0.307	0.759	No
Internal Resources→ ET	0.110	0.106	1.032	0.302	No
Subsidies→ ET	0.051	0.136	0.371	0.711	No
Performances→ ET	0.049	0.158	0.312	0.755	No

grasped the strategic significance and indirect economic advantages of integrating ET into their policies (Ghisellini and Ulgiati, 2020).

Such SMEs are already beneficiaries of a series of *subsidies* that, finalized for specific regulations, accompany the constant investment in innovations that inevitably must respect the spirit of sustainable development. Even the aspect of the *expected performances* is, therefore, in some way already inherent in the constant investment decision of such SMEs, compared with other SMEs that may/could instead adopt managerial behaviours with a low propensity for innovation. This innovative process is certainly facilitated by personnel with high skill levels that cover the availability of *internal resources*.

Moreover, it is plausible that the small organizations considered here have a low 'visibility' with respect to the final customers or other stakeholders, reducing the need to meet external expectations (*awareness*). Similarly, carrying out service activities that, by nature, have a low environmental impact does not induce strong solicitations from other actors in the competitive system, such as suppliers (Schleich and Gruber, 2008; Chierici et al., 2021). Conversely, in line with a conspicuous literature that suggests that better-informed firms are more likely to promote sustainability transition (Chatzistamoulou and Tyllianakis, 2022), it is expected that the young age of the staff and high education of the members of the innovative SMEs reconcile well with a greater sensitivity towards sustainable development, encouraging the emergence of a *corporate culture* consistent with the needs of ET (Goggins et al., 2022; Chaikumbung, 2023).

6. Conclusion and policy implications

Energy transition (ET) has become an increasingly important, if not essential, issue that, in line with the principles expressed by the SDGs, requires both territorial contexts and economic organizations located in them to adapt their behaviour. Such adaptation presupposes new behavioural styles but also involves investments in sustainable innovations.

With this in mind, the present study has aimed to investigate the factors that most urge the push towards ET of a population of SMEs registered on a special database of so-called 'innovative' SMEs; that is, SMEs constantly oriented toward innovation. This choice is linked to the fact that the SMEs, in addition to representing a very heterogeneous universe, are often investigated less by researchers due to their unitary lower environmental impact (albeit greater at the cumulative level), and because of the high heterogeneity that characterizes them and makes the results difficult to interpret.

Generally speaking, we found these SMEs show a modest interest in policymakers' requests to accelerate the ET. Only 46% of innovative SMEs made specific investments in ET in 2021–2023.

Although the survey considered the influence of a wide range of push and pull elements, the only significant variable was corporate culture, which means that the economic organization's sensitivity towards energy issues and sustainability, in general, developed over time. That is, the sensibility of the owners and the whole staff, generally, is the main motor that induces the enterprises to invest in energetic transition rather than solicitations coming from stakeholders, regulations, or incentives.

Considering the sample's specificities of young, small, and very small businesses with a low environmental impact, already benefiting from subsidies, and with high staff skills, this result is extremely significant because it offers important policy implications to be further developed.

The first consideration is that, within the so-called 'developed economies', the ability to support ET could be directly correlated to the processes of industrial renewal with the transition from the so-called 'traditional' sectors to the most cutting-edge ones, or in any case, to the incorporation of increasing levels of innovation into thir activities. Rather than aiming to support the various categories of SMEs with benefits or force specific regulations, investing in economic activities with foreseeable future development is the best choice. This requires policymakers to implement government interventions and dedicated legislative tools to remove the main barriers these organizations are facing in the ET. In addition to being a beneficial choice for future national competitiveness, it could also be the most economical on a financial level since it does not require investments dedicated to ET, which would be a spontaneous consequence of innovation policies.

A second consideration is confirmation of the validity of investments in higher education, as it is related to the capacity to start-up SMEs of an innovative type. Moreover, this variable seems to emphasize the greater awareness of environmental problems present in younger generations of entrepreneurs (and citizens). Education initiatives can increase the awareness and understanding of ET concepts, technologies, and best practices among business owners, managers, and employees. This knowledge equips them to make informed decisions regarding energy efficiency measures, renewable energy adoption, and sustainable practices.

A third related consideration concerns the importance of individual cultural characteristics forged by elements connected to beliefs, role models, heroes, and knowledge of realities that develop in the basic training processes and whose power to influence behaviour can even overcome the availability of tangible resources. Encouraging innovation in SMEs could also be an approach to bypass the poor visibility and possible weak pressures of the stakeholders most sensitive to environmental sustainability, as often happens currently for many SMEs. A fifth reflection concerns the guiding role of the central authorities, which is confirmed as important if not decisive. Hence, not all sustainability decisions can be left to the discretion of the market alone. Therefore, we assume that the high inclination towards sustainable development of innovative SMEs mirrors their propensity for eco-environmental innovations. Nevertheless, it is likely that the financial and networking incentives offered to innovative SMEs enrolled in the special register make other reasons less obvious than those that might be more obvious for other categories of SMEs.

A general consideration concerns the need to conduct very detailed investigations. The fact that corporate culture is a pull factor related to innovative SMEs does not assure its validity for other types of SMEs. Similarly, every kind of SME should be involved in specific policies, as the policies adopted for innovative SMEs could not be effective elsewhere. Therefore, further effort is necessary to analyse the internal company dynamics that lead to the maturation of the corporate culture. Conversely, if another SME population has a high corporate culture of sustainability but does not invest in energy transition, this means that there are hindrances, such as a lack of financial resources or subsidies, or ambiguous regulations.

Hence, the focus on intangible aspects such as corporate culture sheds light on specific knowledge gaps related to the theory of SMEs and the reasons underlying their choices with regard to ET. A research gap emerges concerning under which circumstances individual and collective motivations mediated in an economic and organizational context acquire an overall greater strength than the instrumental variables notoriously highlighted byresearchers. This observation opens the way to a new strand of research that departs from merely material aspects.

Like any investigation, this one also has limitations, the first of which is that the results cannot be generalized to all SMEs. Investigating the driving factors of ET among different categories of SMEs would probably lead to dissimilar results, as their needs and/or obstacles to innovation and ET processes in general change. Similarly, to strengthen the study's outcomes, it would be appropriate to increase the investigated population, considering the variability detected, and delve deeper into the reasons underlying the choices not to invest in transition systems by a consistent share of SMEs.

Given these limitations, it would be extremely interesting to propose research into other territorial contexts on SMEs with similar characteristics, as well as to carry out comparisons with investigations that examine different populations of SMEs, in order to enrich the understanding of the SMEs' behaviour.

CRediT authorship contribution statement

Antonio Thomas: Writing – review & editing, Writing – original draft, Data curation, Conceptualization. **Giuseppe Scandurra:** Writing – review & editing, Methodology, Funding acquisition, Data curation, Conceptualization. **Alfonso Carfora:** Writing – original draft, Software, Formal analysis.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix A. Supplementary data

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Data availability

Data will be made available on request.

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