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The Energy Transition in SMEs: The Italian Experience

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Abstract: Encouraging energy transition (ET) has become a global imperative for nations and companies, and not just large ones. Not all economic organizations pursue this process with the same intensity. Particularly, the factors driving Small and Medium Enterprises (SMEs) towards ET are not yet clearly defined, despite SMEs representing most companies and bearing a significant responsibility for pollution. To shed light on this matter, this study presents a framework of the main drivers that stimulate SMEs placed in Italy to pursue energy transition. We conducted a Partial Least Squares (PLS) analysis on data collected from innovation-oriented SMEs enlisted in a specific register of the Italian Ministry of Economic Development. The research findings show a weak interest among SMEs towards ET. While country-specific conditions and social and psychological traits affect the decision to invest in ET, firm-specific factors and 'stakeholder' pressures seem to be almost irrelevant. Policy measures with a different focus are necessary. Specifically, the provision of facilitation emerges as the most effective tool for encouraging ET among SMEs.

Keywords: energy transition; SMEs; ecological investments; partial least squares

Citation: Thomas, A.; Castellano, R.; Punzo, G.; Scandurra, G. The Energy Transition in SMEs: The Italian Experience. *Energies* **2024**, *17*, 1160. https://doi.org/10.3390/en17051160

Academic Editor: Gabrial Anandarajah

Received: 26 January 2024
Revised: 18 February 2024
Accepted: 26 February 2024
Published: 29 February 2024

1. Introduction

The topic of energy transition is currently one of the most widely discussed and analyzed subjects in the scientific field because energy economics scholars consider it a mainstream for decoupling the convergence of the energy–growth–CO_2 emission nexus. Thus, researchers from different scientific backgrounds, such as environmentalists, engineers, and development economists, contribute to the debate, aiming to support the adoption of environmental and sustainable innovations; in a nutshell, energy transition processes (henceforth ET).

Within the field of economic studies, one of the main research streams concerns the identification of the drivers that accelerate or favor ET. In this context, ET is defined as the process of "integrating innovative smart technology and control systems to optimize the effective use of energy and minimize primary energy demand. This involves better control of energy use in buildings and the integration of city infrastructure and energy planning" [1]. However, the concept of a driver itself is inherently vague and requires contextualization. It should refer to specific parameters related to the context or the object of investigation. As specified in the next section, the risk lies in investigating aspects that may hold value in one territorial area, or type of company, but not in another. Hence, not surprisingly, empirical analysis on drivers promoting ET remains scarce [2–4].

Moreover, many of the studies conducted so far have analyzed ET from a macroeconomic perspective, establishing connections with quantitative variables such as GNP, employment levels, investment rates, and similar factors. Much less attention has been paid to understanding the reasons underlying corporate choices. That is, scholars predominantly approach ET from a macroeconomic perspective assuming that economic policy choices

could have indistinct and generic effects on the plurality of companies within the observed context. A more microeconomic perspective, specifically focusing on the behaviors of individuals managing companies, could lead to dissimilar results. The latter may also vary based on company category, location, sector of activity, size, technological intensity, or other endogenous factors (such as legal form, composition of the board, age, and so on).

With this in mind, this study aims to identify the drivers influencing a specific category of SMEs located in a well-defined geographical context, subject to relatively homogeneous rules and contextual conditions.

The choice to examine SMEs reflects an often-overlooked aspect by researchers. While it is true that large companies may have a greater environmental impact (e.g., [5]) due to their production type, most existing companies fall within the category of SMEs with up to 250 employees. Hence, as a whole, SMEs negatively contribute to pollution more than their larger counterparts do. Moreover, the challenges faced by SMEs differ from those of large companies; for instance, they typically have fewer resources to dedicate or invest in ET processes and are more vulnerable and responsive to contextual conditions. Conversely, SMEs often experience lower pressure from external stakeholders, as end-consumers are less aware about labels and trademarks of these SMEs. Policies in terms of incentives and regulations also tend to be less pervasive towards SMEs.

Additionally, the decision-making process connected to the governance system follows a different path. As company size decreases, strategic choices, including those related to ET, tend to depend more directly on a small number of owners guided by their subjective convictions, beliefs, or values (e.g., [6,7], rather than on choices discussed within the board and often result from compromises between different interests. These remarks could be extended to other typologies of companies, such as private or state-owned ones [8].

Thus, there are several reasons for conducting surveys on specific categories of companies and the approaches adopted by their management in the field of ET. These reasons often go beyond the mere calculation of economic convenience expressed in terms of immediate costs and higher revenues/lower costs expected in the future. This latter topic, frequently underestimated in macroeconomic surveys, is probably the main factor weighted by entrepreneurs and managers.

Business scholars also agree to sustain that the transition towards more efficient and sustainable energy systems relies on firms investing in the introduction of innovations aimed at reducing the energy–environmental impact [9–11]. As, despite global efforts, advanced countries are experiencing a slowdown in the growth of renewable energy shares, we can suppose a reason lies in the lack of adequate studies on the reasons encouraging companies, specifically SMEs, to invest in ET [12–14]. Under these assumptions, this study aims to improve the understanding about the state of ET and related research gaps by investigating the key factors affecting SMEs' decisions to pursue ET. To achieve this goal, following the specific scientific literature, we conceptualize a framework incorporating the main types of drivers that support the company's investments in ET.

The study is organized as follows: Section 2 presents a theoretical framework concerning the drivers of ET. Section 3 outlines the methodology, while Section 4 presents the findings. Section 5 includes conclusions, limitations, and implications.

2. Theoretical Framework

Before specifying the drivers most covered by the literature, as mentioned in the previous section, it is appropriate to clarify the concept of drivers. In this regard, we present four general assumptions.

Firstly, drivers can be interpreted in positive terms as determinants, motivations (e.g., [15]), opportunities (e.g., [9]), facilitating factors (e.g., [16]), or expected benefits (e.g., [17]) that support ET processes. Conversely, drivers can also be interpreted as barriers hindering ET [18,19]. However, the two concepts of determinant and barrier cannot be considered as specular. For corporate behavior, the presence of a specific factor, for example, monetary incentives or fiscal benefits, does not have the same effect, albeit in the

opposite direction, as the absence of this element (e.g., [20]). Not surprisingly, researchers have not clarified whether ET should be considered a driving force that stimulates businesses and communities or a forced transition imposed by politics at a European and international level.

A second clarification concerns the type of change or innovation introduced. Various contributions have proven that drivers or barriers could differ for each type of change/innovation [21,22].

Third, multiple studies [2,8,23] have observed that drivers differ between various companies and subjects, such as householders, and types of geographical areas, e.g., urban industrial or mountain areas [24]. Similarly, sectoral specificities may exist; for instance, drivers related to companies operating in the primary sector can be different from those belonging to industry or services. Other differences can characterize the type of area or country investigated, for example, between developed or developing countries or transitional nations. These differences often include variations in the business climate, cultural model, economic situation, or policies [25,26].

Differences could also manifest within the same country, as homogeneous industrial systems are rare. More commonly, territorial disparities in development levels exist, due to the presence of structural components, such as large firms, government bodies, financial institutions, research centers, non-governmental organizations, and the networks through which they interact with relevant institutions.

Again, to organize the drivers themselves according to a logical framework that is as consistent as possible with the object of the investigation appears essential [27]. This is considering the multitude of existing drivers and their variable influence, which is contingent upon factors such as the concept of the driver itself, the context, and the type of innovations or tools involved. While the described four basic assumptions should guide more detailed studies, researchers also should minimize the simultaneous risk that the results of the investigation become excessively vague.

To mitigate the mentioned risks, in this study: (i) We refer to drivers in a positive sense as determinants; (ii) Changes or innovations falling within the definition of ET will be considered as undifferentiated; (iii) Empirical analysis is confined to a defined geographical scope and a specific type of SMEs, due to the wide heterogeneity within this category of companies; (iv) Determinants are grouped according to a rationale framework that mirrors the main research streams on this subject.

The Drivers: A General Taxonomy

A review of the scientific literature on the determinants of ET enables their classification into four main categories or dimensions (Figure 1). Consistent with this approach, we assume that these four groups of determinants positively affect investment choices in ET of the investigated SMEs:

- (Hp1) Country-specific conditions;
- (Hp2) Firm-specific factors;
- (Hp3) Social and psychological traits;
- (Hp4) Stakeholders' pressures.

(Hp1) A first basic category of drivers includes country-specific conditions in the investigated contexts. This specifically refers to elements that either encourage or impose investments in the direction of ET. A significant determinant is the presence of specific norms, regulations, and laws that not only promote but also oblige the transition toward ET, compelling specific investments [28,29].

Many scholars have underlined that a powerful instrument promoting ET is the existence of effective policies [30,31], differentiated according to contextual specificities [32]. These policies usually reflect environmental sensitivity or the commitments of political representatives who may decide to actively engage in policies by offering operational support (specialized support staff, leaner bureaucracy, associations, and collaborations between companies, etc.) to SMEs intending to pursue the pathway of ET [33].

The effectiveness of these policies is also influenced by the ability of institutions to communicate, fostering better acceptance of regulations and generating greater awareness and sensitivity towards environmental issues among citizens and businesses [4]. This, in turn, helps to shape the social and psychological variables discussed in the HP3.

A third significant parameter for SMEs concerns the level of technological innovation existing in each context [26,34]. This presence assists SMEs in overcoming their usual limits of specialized skills and the availability of financial resources, especially when SMEs lack an internal research and development function and rely on external institutional bodies (such as universities and research centers) or private bodies (consultancy companies) for the implementation of new techniques and technologies [35].

(Hp2) A second group of determinants concerns firm-specific factors that distinguish one company from another. A fundamental aspect guiding entrepreneurs' choices, especially for SMEs, is the economic condition relative to the balance between investment costs and expected outcomes. This includes both direct factors like higher revenues or profitability and indirect factors such as corporate image or customer retention [11,22,36]. In this regard, we remind that, until now, the business and managerial literature has not shown that adherence to transition processes supports economic benefits for companies. Realistically, based on the widely known three Porter's hypotheses, transitioning from traditional energy sources represents an additional burden on companies and economic systems as a whole.

Consistently, as macroeconomic studies about countries (e.g., [8,37]) highlight the relevance of the variable "wealth", reflecting a greater willingness to bear the increased burden of sustainability policies, we can suppose that companies with the most prosperous balance sheets are more likely to invest in ET to maintain their competitive advantage [26,33].

A further aspect directly related to economic conditions is the ability to access monetary incentives, fiscal benefits, or public procurement [16,29]. Although such external resources are important pull-factors in encouraging early-stage investments, their occurrence is not likely to affect underlying strategic choices linked to more substantial reasons (as reported in Hp4).

Another influential firm-specific determinant is the technological capabilities of enterprises [4]. As often reminded, SMEs typically have both fewer financial resources and less specific skills to pursue complex investment choices independently.

(Hp3) Currently, active citizenship and participation in corporate choices play an increasing role in ET. Nevertheless, there is a shortage of understanding regarding the socio-psychological factors encouraging the decision to invest in this direction, arising from internal attitudes and experiences of employees and owners/managers [10]. That is as, until now, scientific research has predominantly focused on the technical and economic factors of ET. However, in recent years, researchers have been paying increasing attention to understanding the human dimensions of sustainability [6,33]. This aspect has multiple facets and can be declined along various perspectives.

The first perspective is related to the subjective sensitivity and conscientiousness of managers and entrepreneurs towards the issue of ET and sustainable development in general. When such personal traits are well rooted, it is assumed that the SME directs its management towards sustainability, primarily in response to the subjective needs of its owner [38].

A second perspective concerns the level of education of managerial staff. This is directly related to ET choices, as a higher level of education is believed to make them more aware of the need to slow down pollution caused by economic activities [8,27].

Another perspective appears to be linked to the international openness of the company [39], as this variable has been proved to act in a similar direction to psychological and cultural enrichment. Moreover, there is also the possibility that, in each context, a heightened awareness of environmental issues will develop thanks to effective communication processes transmitted by political authorities (see Hp1) or key figures (such as testimonials, instrumental and charismatic leaders, etc.). This awareness forges a cultural model

(*role model*) that encourages other individuals, specifically managers and entrepreneurs, to pursue a dynamic behavior in sustainability, perceived as the most appropriate for the company itself [7,40]. This tool can be particularly powerful [38,41], as further explained in the following Hp4.

As mentioned in Section 1, unlike many large companies, SMEs can more easily enjoy the freedom to embrace a long-term vision and pursue goals that evade simple short-term profitability. Many SMEs are directly managed by owners who perceive the business as an integral part and reflection of their lifestyle and values, maturing over the years. This attitude is conducive to a sustainable way of thinking and to the corresponding reporting that emphasizes the qualitative evolution of their behaviors, consistent with the respect of the external environment [42].

(Hp4) Prior research has shown that environmental management practices are influenced by existing and potential stakeholders, financial institutions, and public bodies in the form of external pressures [22]. Thus, the fourth group of determinants of ET considers pressures from various stakeholders with whom the company interacts, each bearing its environmental awareness gained through subjective paths. Hence, this dimension includes consumers and civil society in general, suppliers, customers, mass media, financial intermediaries, and so on [3,36].

Although relatively new, this category is increasingly relevant, as green ET must be understood as a complex process requiring the involvement of many actors. Stakeholders' opinions and civil society's stance on energy sources influence the formulation and implementation of energy policy. In this regard, the community plays a significant and complementary role alongside the actions of central governments in raising public awareness of green ET [26,43]. For companies, a greater understanding of civil society motivations towards promoting renewable energy presents both opportunities and challenges for implementing an ET policy aimed at sustainable development.

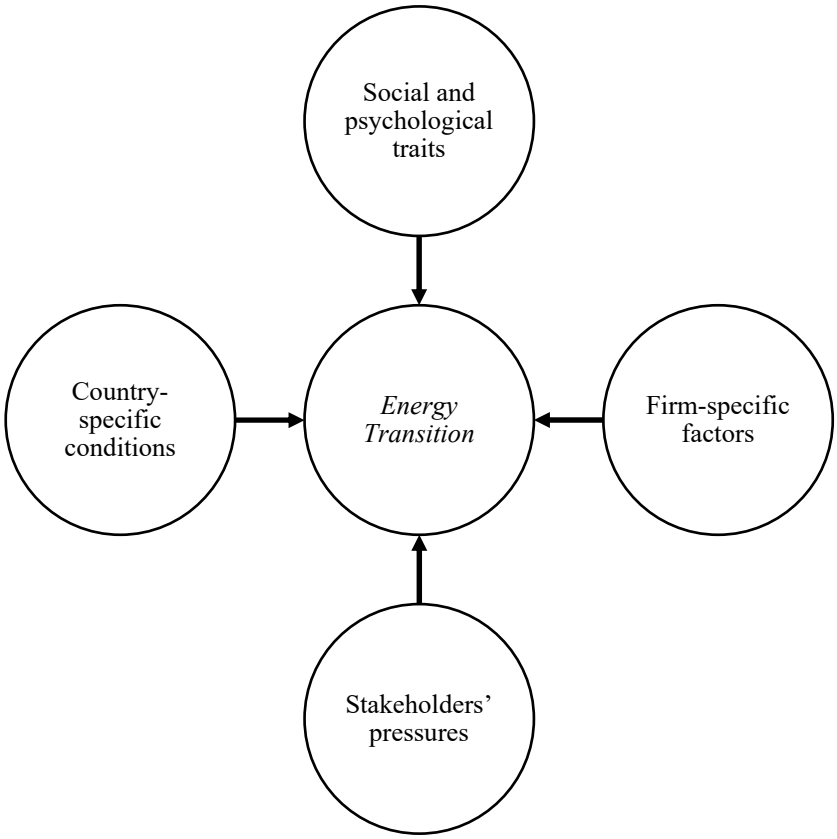

Figure 1. The four dimensions of ET affecting company investments.

The rapid proliferation of new forms of reporting on company performance, such as the social balance sheet, sustainability report, and integrated report, indicates an unequivocal expectation from civil society and other corporate stakeholders for increasingly robust commitments from all types of companies, SMEs included. New regulations on the mandatory nature of these forms of accountability, in addition to or integrating traditional financial statements, already mandatory for large companies, are also being studied for SMEs. Among them, for instance, *The Global Reporting Initiative* published as *Ready for the report? Introduction to sustainability reporting for SMEs* (2014), the *Integrated Reporting for Small and Medium Entities* (2015), and the *Chartered Institute of Management Account* wrote the *Integrated reporting for SMEs—Helping Business growth: Case studies* (2015).

3. Method

3.1. Sample Survey

To achieve the objectives outlined in this paper, a survey was conducted targeting a cohort of SMEs enlisted in a specific register of the Italian Ministry of Economic Development devoted to innovative SMEs. This register was stablished in 2015 to favor the diffusion of small businesses with a high level of innovativeness, believed to contribute to the economy's transition towards cutting-edge activities and support the competitive capacity of the surrounding area (e.g., [44,45]).

Inclusion in this registry is contingent upon meeting specific criteria linked to technological innovation, such as investment allocation towards knowledge and research and development (R&D), patent ownership, and the entrepreneurial team's educational background. The ministry provides a range of incentives to eligible firms, including credit loans, monetary and fiscal benefits, and the opportunity to raise capital through equity crowdfunding [46]. These advantages have led to a rapid increase in the enrolment of SMEs into this registry.

The focus on this database derives from the consideration that SMEs often show a very low propensity to innovate, while SMEs enrolled into this specific database are characterized by a broad tendency to adopt product and process innovations. Thus, this research aims to assess the ability of these SMEs to adopt processes, methods, and technologies related to ET specifically.

For this purpose, we planned a questionnaire with 12 closed-ended questions (group items) with multiple choice on a Likert scale. The questionnaire was structured to inquire about the types of investments, motivations, objectives, tools applied, and the request for possible support measures. The questionnaire was previously discussed, involving experienced researchers and company managers. Their insights helped enhance the clarity of the survey questions, ensuring they were straightforward and valid (*soundness*). Anonymity was maintained to encourage participants to provide honest responses, particularly when reporting their motivations. Cross-checking of the data was conducted wherever feasible [47,48]. Furthermore, the questionnaire underwent a pretesting phase that involved five innovative SMEs to fine-tune its effectiveness and ensure its suitability for the study's objectives.

The choice of sample units was based on probabilistic sampling, necessitating an exhaustive population list. This approach ensures a representative sampling strategy, laying the foundation for a robust analysis of the factors influencing entrepreneurial transformation among the innovative SMEs enrolled in this registry.

On 1 March 2023, the Italian Register of Innovative SMEs listed 2514 companies. We adopted a comprehensive approach to address potential limitations associated with administrative data, known for introducing biases due to incorrect selections and subsequent coverage errors [49]. Initially, we contacted all SMEs in the register. Subsequently, we excluded 569 companies from the list due to the unavailability of essential contact information, such as a website, email, or telephone number. This refinement resulted in a final population size of 1945 SMEs.

Recognizing the spatial heterogeneity in the distribution of these firms, we employed a stratified sampling strategy based on the geographical region where each SME was registered. Then we selected a random sample of firms from each stratum, with the selection proportionate to the representation of every subgroup in the overall population.

The sample size, determined considering the variability in structural characteristics such as employee classes, capital, and production, was initially set at 400 units. This represented approximately 20% of the reference population and included service, manufacturing, and trade firms. We invited all SMEs extracted to participate in an online questionnaire. A comprehensive email outreach was undertaken, presenting the survey's objectives and the concept of ET and including a direct link to the questionnaire.

Respondents were requested to complete the questionnaire using the individual most informed about the issue under investigation or, if applicable, the email's recipient. Despite multiple invites, 52 SMEs did not provide any feedback, resulting in a final sample size of 348 units.

The first question in the questionnaire was a filter question in which companies had to answer whether, in the previous three years, they had invested in environmental and sustainable innovations or technologies to facilitate energy transition. The key features distinguished using the answer to the first question are detailed in Table 1.

Table 1. Sample characteristics based on whether SMEs invested in environmental and sustainability innovations (Yes) or not (No).

	Frequency (n_i)			**Percentage by Column (%)**			**Percentage by Row (%)**		
	Yes	**No**	**Total**	**Yes**	**No**	**Total**	**Yes**	**No**	**Total**
Activity sector									
Trade and manufacturing	43	56	99	33.6	25.6	28.5	43.4	56.6	*100.0*
Service	85	163	248	66.4	74.4	71.5	34.3	65.7	*100.0*
Total *	*128*	*219*	*347*	*100.0*	*100.0*	*100.0*	36.9	63.1	*100.0*
Employees									
0–4	31	78	109	25	37.3	32.7	28.4	71.6	*100.0*
5–9	28	43	71	22.6	20.6	21.3	39.4	60.6	*100.0*
10–19	34	33	67	27.4	15.8	20.1	50.7	49.3	*100.0*
20–49	22	38	60	17.7	18.2	18.0	36.7	63.3	*100.0*
≥50	9	17	26	7.3	8.1	7.8	34.6	65.4	*100.0*
Total *	*124*	*209*	*333*	*100.0*	*100.0*	*100.0*	37.2	62.8	*100.0*
Capital									
[1–10,000]	14	37	51	11	17.1	14.8	27.5	72.5	*100.0*
]10,000–50,000]	35	71	106	27.6	32.7	30.8	33.0	67.0	*100.0*
]50,000–100,000]	22	33	55	17.3	15.2	16.0	40.0	60.0	*100.0*
]100,000–250,000]	20	34	54	15.7	15.7	15.7	37.0	63.0	*100.0*
]250,000–500,000]	12	15	27	9.4	6.9	7.8	44.4	55.6	*100.0*
>500,000	24	27	51	18.9	12.4	14.8	47.1	52.9	*100.0*
Total *	*127*	*217*	*344*	*100.0*	*100.0*	*100.0*	36.9	63.1	*100.0*
Production (*thousands of euros*)									
[0–100]	*10*	*28*	*38*	7.9	12.8	11.0	26.3	73.7	*100.0*
]100–500]	*29*	*61*	*90*	22.8	28	26.1	32.2	67.8	*100.0*
]500–1000]	*16*	*38*	*54*	12.6	17.4	15.7	29.6	70.4	*100.0*
]1000–2000]	*21*	*26*	*47*	16.5	11.9	13.6	44.7	55.3	*100.0*
]2000–10,000]	*42*	*55*	*97*	33.1	25.2	28.1	43.3	56.7	*100.0*
>10,000	*9*	*10*	*19*	7.1	4.6	5.5	47.4	52.6	*100.0*
Total *	*127*	*218*	*345*	*100.0*	*100.0*	*100.0*	36.8	63.2	*100.0*
Localization									
Northwest	51	82	133	39.8	37.3	38.2	38.3	61.7	*100.0*
Northeast	25	37	62	19.5	16.8	17.8	40.3	59.7	*100.0*
Central	27	52	79	21.1	23.6	22.7	34.2	65.8	*100.0*
South	19	41	60	14.8	18.6	17.2	31.7	68.3	*100.0*
Islands	6	8	14	4.7	3.6	4.0	42.9	57.1	*100.0*
Total *	*128*	*220*	*348*	*100.0*	*100.0*	*100.0*	36.8	63.2	*100.0*

* The totals may not always add up to the overall sample size due to partial non-response.

The initial salient consideration is related to the share of companies that have invested in environmental and sustainable innovations in the previous three years. From the analysis of the data shown in Table 1, it is observed that they are about 37% of the sample. A large percentage of the investigated SMEs (71.5%) belong to the service sector. Among these, 34.3% have invested in ET, while 43.4% of enterprises in the trade and manufacturing sector have declared such investments. Slightly over half of the enterprises (54%) have fewer than 10 employees. Within this subgroup, much less than half have engaged in initiatives related to ET. This pattern aligns with larger enterprises in terms of workforce, except for enterprises with 10 to 19 employees, where there is a heightened propensity for such investments.

Approximately three-quarters of the total enterprises fall within the capital class up to EUR 250,000. Businesses showing a greater commitment to ET are in the capital class exceeding EUR 250,000. It is evident that enterprises displaying a higher inclination to innovate when they fall into the production class exceeding EUR 1,000,000, constituting approximately one-half of the total. One-fifth of the investigated companies are located in the Southern and Islands regions, with no significant disparities across the national territory regarding their propensity to invest in ET.

3.2. PLS—SEM

The evaluation of factors influencing ET involves the analysis of latent variables (LVs) that are not directly observable but captured through various manifest variables (MVs), grouped into domains. To examine the relationships between these latent variables and their impact on ET, the Partial Least Squares (PLS) was employed.

The PLS approach uses a recursive system for estimating the latent variables, incorporating two sub-models: (i) The structural, or inner, model, focusing on relationships between LVs; (ii) The measurement, or outer, model, exploring relationships between each LV and its set of MVs.

To validate the model, a three-stage process was followed [13]:

a. Assessment of the reliability and validity of the measurement model (factor loadings, Cronbach's alpha, and average variance extracted).
b. Assessment of the structural model (R^2).
c. Significance of the estimates (bootstrap).

In the first step, the assessment of the measurement model involved MVs, which serve as informational components reflecting facets of the latent construct. Acceptable factor loadings typically exceed the minimum threshold of 0.4 and are preferably at 0.7 or higher [50]. However, a more conservative threshold of 0.5 is advocated for by some scholars (e.g., [29,51]) to address validity concerns.

The approach follows an iterative estimation procedure. In the initial stage, a model was constructed where 23 MVs were allocated to 4 latent constructs described in Section 2, while 3 MVs explain the ET. During this process, if certain MVs exhibit factor loadings below the threshold they are excluded, and the model is re-estimated. This iterative refinement is repeated until all factor loadings are greater than 0.5.

The iterative procedure also led to the exclusion of the following items: 8b, 5d, 5e, 3k, 3m, 3n, 3q, 8c, and 8d. At the conclusion of this refinement, all the items considered in the measurement model demonstrate factor loadings greater than 0.5 (Table 2), affirming a robust relationship with their respective LVs.

Internal consistency is further established using Cronbach's alpha. This index's value indicates that the proposed latent constructs reliably measure the intended information (Table 2), confirming the validity of the MVs integrated into the proposed model. Additionally, the model meets the criteria for both internal consistency/reliability and convergent validity. As illustrated in Table 2, composite reliability values exceed 0.6, attesting to a high level of consistency/reliability among the latent constructs. Convergent validity, gauged through the average variance extracted, surpasses the 0.5 threshold, as recommended by [52], further validating the model's convergence of measurements.

Table 2. Summary of the outer model.

Latent Constructs and Items	Factor Loading	Cronbach's Alpha	Composite Reliability	Average Variance Extracted (AVE)
Country specific conditions		0.830	0.884	\
Legal and legislative impositions have motivated the company to invest in environmental and sustainable innovations	0.565			
The company has a documented environmental and sustainability management plan or rules	0.906			
Firm specific factors		0.798	0.872	0.698
Aspiring to obtain savings in production costs has motivated the company to invest in environmental and sustainable innovations	0.951			
Wanting to cope with energy price increases has motivated the company to invest in environmental and sustainable innovations	0.840			
The presence of tax and fiscal benefits have motivated the company to invest in environmental and sustainable innovations	0.696			
Social and psychological traits		0.708	0.798	0.798
Environmental awareness of the staff has motivated the company to invest in environmental and sustainable innovations	0.628			
Reducing the impact of SME activities on the environment has motivated the company to invest in environmental and sustainable innovations	0.882			
Improvements in the safety and well-being of employees has motivated the company to invest in environmental and sustainable innovations	0.897			
Stakeholders' pressure		0.881	0.895	0.634
The solicitations/expectations of suppliers have motivated the company to invest in environmental and sustainable innovations	0.850			
The solicitations/expectations of the public administration have motivated the company to invest in environmental and sustainable innovations	0.788			

Table 2. *Cont.*

Latent Constructs and Items	Factor Loading	Cronbach's Alpha	Composite Reliability	Average Variance Extracted (AVE)
The solicitations/expectations of lenders and investors have motivated the company to invest in environmental and sustainable innovations	0.673			
The solicitations/expectations of the media/community in general have motivated the company to invest in environmental and sustainable innovations	0.697			
The solicitations from universities and research institutions have motivated the company to invest in environmental and sustainable innovations	0.943			
Energy Transition		0.902	0.931	0.772
Let us set the total investment you have made at 100; how much have you invested in renewable generation systems?	0.680			
Let us set the total investment you have made at 100; how much have you invested in systems for energy efficiency and reductions in energy consumption?	0.683			
Has your company been able to achieve its goals by adopting environmental and sustainable innovations?	0.705			

In a nutshell, the measurement model evaluation confirms the reliability and validity of the latent constructs. Factor loadings, Cronbach's alpha, composite reliability, and convergent validity all meet the established thresholds. This rigorous validation process ensures the robustness of the proposed model for analyzing the intricate relationships within the field of entrepreneurial initiatives and their impact on the ET performances of companies.

In the subsequent phase, attention was turned to the structural model. This evaluation involved multicollinearity and determination coefficients (R^2 and Adjusted R^2) for the endogenous latent constructs. The method introduced by [53] was employed to assess multicollinearity, utilizing the full collinearity test, which comprehensively evaluates both vertical and lateral collinearity (Table 3).

Table 3. Collinearity Statistics.

	Hypotheses	VIF
Hp1	Country specific conditions → ET	1.178
Hp2	Firm-specific factors → ET	1.143
Hp3	Social and psychological traits → ET	1.115
Hp4	Stakeholders' pressures → ET	1.154

Unlike established rules of thumb for the variance inflation factor (VIF) threshold in the literature—such as [54]) proposing no specific guidelines, ref. [55] suggesting a maximum acceptable VIF of 10, ref. [56] considering values above 5 acceptable, and [57] recommending VIF values close to 3 or lower—in this analysis, all LVs exhibit VIF values lower than 3. This value indicates the absence of multicollinearity in all latent constructs.

The model also addresses potential endogeneity issues. As known, two broad classes of statistical methods have been proposed in the literature to correct for simultaneity: instrumental variable and instrumental variable-free approaches [58]. The instrumental variable-free approaches offer several advantageous features, especially in the structural equation framework (e.g., [59]). For this reason, we use one of the most popular methods among the instrumental variable-free approaches—the Gaussian copula approach [60,61].

The R^2 values for the regression within the structural model inform about the explanatory power of the model, illustrating the extent to which the independent variables contribute to the variability in the endogenous LVs. In this analysis, the R^2 and adjusted R^2 coefficients, which account for the number of predictors in the model, were, respectively, 0.143 and 0.115. While the R^2 values are relatively low, they still reach a satisfactory level of explanation for the variance in the endogenous latent constructs (see, e.g., [62,63]). The range suggests that the structural relationships within the inner model are robust and adequately capture the dynamics between the independent and dependent variables. This outcome reinforces the correctness and reliability of the structural model, indicating that the specified relationships are statistically significant and contribute meaningfully to the understanding of the underlying dynamics in the context of this study.

4. Findings

The assessment of both the measurement model's reliability and validity and the structural model's quality led us to conclude that the model was accurately specified. It effectively elucidated the envisaged relationship among the determinants and the ET behavior of innovative SMEs.

Due to the absence of distributional assumptions in Partial Least Squares (PLS), significance levels for parameter estimates relying on normal theory are inappropriate. Resampling techniques such as blindfolding, jack-knifing, and bootstrapping were employed to gather insights into the variability of the parameter estimates. These robust resampling procedures offer a more reliable approach to assessing the significance and reliability of the estimated parameters in PLS modeling. A robust bootstrapping technique involving 6000 sample replications was adopted to test the significance of the estimated path coefficients.

Table 4 shows detailed information on estimated path coefficients, standard errors, and *p*-values.

Table 4. Research hypotheses and path coefficients.

	Hypotheses	Path Coefficient	Standard Error	t-Statistic	*p*-Value	Confirmed/Not Confirmed
Hp1	Country specific conditions → ET	0.241	0.139	1.728	0.086	Confirmed
Hp2	Firm-specific factors → ET	0.110	0.100	1.097	0.272	Not Confirmed
Hp3	Social and psychological traits → ET	0.212	0.096	2.201	0.028	Confirmed
Hp4	Stakeholders' pressures → ET	0.001	0.146	0.010	0.992	Not Confirmed

Using the analysis of Table 1, as discussed in the previous section, only 37% of the responding SMEs have invested in ET systems, indicating a relatively low propensity for this type of investment among these companies. With regard to legal form, they are basically limited liability companies (106/128 units), followed by cooperatives (19).

Regarding the determinants affecting the choice to invest, the results in Table 4 show that only two latent constructs have a significant relationship ($p < 0.10$) with ET. In particular, *country specific conditions* (Hp1) and *social and psychological traits* (Hp3) affect ET, confirming

the research hypotheses. Conversely, *firms-specific factors* (Hp2) and *stakeholder pressures* (Hp4) do not present a significant relationship.

Therefore, the presence of regulations, specific policies, and the level of technological innovation in a given context support SMEs to invest in ET. It is not surprising to find that exogenous country-specific factors linked to the localization area have a greater influence than firm-specific factors. In fact, SMEs are inherently more sensitive to contextual conditions and economic events as well as responsive to the surrounding innovative environment, such as the presence of universities and research centers, suppliers, and customers already on the pathway towards ET. Similarly, SMEs are often more attracted by the possibility of obtaining benefits linked, for example, to fiscal or monetary incentives, due to their potentiality fragile economic equilibrium.

Among the interviewed SMEs, 48% applied for the incentives, receiving them for 76% of applicants. The remaining 52% did not apply or were unaware of these facilitations. This outcome indicates that the Italian context offers adequate benefits to stimulate investments in ET, although not all SMEs are equally proactive in seizing this opportunity. The 48% of SMEs that requested facilitations also supports the idea that the ET is basically driven by the availability of external resources, rather than being an autonomous choice. This is because, conversely, SMEs often lack the financial resources and expertise to proceed on the path to innovation independently. ET processes also fall into this scope. This situation could also indicate that the level of sensitivity among SMEs towards ET is low.

As mentioned in Section 2, the lower visibility of labels and trademarks, and the lower average impact in terms of pollution or CO_2 generation make SMEs less noticeable to customers and the community in general. For this reason, stakeholder pressure is expected to be lower than that exerted on large companies, particularly those of manufacturing type. It is also important to note that the selected SMEs are mainly active in the service sector.

The group of determinants *social and psychological traits* affecting ET reflects, on the one side, emerging issues related to awareness of environmental problems caused by energy production and consumption, and its importance is rapidly growing. The new generations of young entrepreneurs, typically owners of these innovative SMEs with higher qualifications, bring a cultural background acquired through educational paths where environmental issues are increasingly marked. It is, therefore, reasonable to expect a greater awareness among these entrepreneurs, managers, or employees compared to older generations. On the other side, the new forms of accountability for company performance, not only from an economic and financial perspective but also in terms of social and environmental impacts, serve as a striking example of the evolving awareness of companies.

These considerations related to sustainability represent the future, and their importance is destined to further increase. SMEs, like all other companies, must demonstrate that their value generation process aligns with sustainable development principles, ensuring the reproducibility of resources, especially energy resources, and adhering to ethical principles, codes of conduct, and moral values.

5. Conclusions and Implication

This study aimed to assess the inclination of innovation-oriented SMEs towards energy transition (ET). The emerging picture is not particularly comforting, as only a small percentage of SMEs are actively engaged in ET. Moreover, SMEs are highly attracted by the availability of fiscal and monetary benefits, as well as by the support offered by public institutions. There are very few cases in which SMEs spontaneously decide to adopt the processes of ET standing on their own resources. It is also true that the staff of these SMEs exhibit a growing awareness of environmental issues, likely influenced by their educational background. This emerging trend is a positive indicator for the future.

The results of this study have contextual limitations and cannot be generalized to geographical contexts or industries outside of Italy nor to SMEs that are not specifically innovation-oriented or to large enterprises, which represent a small fraction of Italy's

industrial landscape. However, implications can be drawn from the results, specifically pertaining to the target population of innovation-oriented SMEs within the Italian context.

A first observation highlights the significant appeal associated with the presence of facilitations related to compliance with specific laws of environmental protection. The presence of facilitations, of course, does not ensure the adoption of ET. Although investments in ET are strongly driven by economic factors, the role of subjective convictions of decision makers is rapidly increasing. Similar concerns about compliance with mandatory laws also persist. These regulations may be inadequate to compensate the lack of individual awareness of managers and entrepreneurs. Consequently, the implementation of ET measures by SMEs could be figurative without a real contribution to energy saving or to sustainable sources. In this circumstance, we will fall into a situation of *impression management* (or *greenwashing*).

The second correlate implication concerns the need to reinforce the cultural model of sustainability, which should be taught and spread to increase the awareness of future entrepreneurs and employees. This approach is probably the most effective and potentially cost-effective means to reach ET's targets, even though it may take a longer time.

Consistent with the effectiveness of country-specific factors, creating a favorable climate for implementing environmental systems and innovations—such as by strengthening links between universities, research centers, and SMEs—would greatly facilitate ET. More generally, the whole institutional framework needs to drive the development of a context favorable to ET. This climate would likely produce more results for SMEs, given their greater vulnerability and sensitivity to contextual conditions compared to larger companies.

Institutions at various levels—national, European, or global,—should propose coherent and unified frameworks. Currently, there is a lack of coherent directions, often guided by occasional choices without a long-term strategy. The acceleration of electric cars, the dilemma between new energy-saving devices and recycling old obsolete ones in line with circular economy objectives, and the adoption of more sustainable but often costly energy sources outside the budget of most citizens are clear examples that create confusion and uncertainty among individuals and companies, especially smaller ones.

From this perspective, it would be appropriate to accelerate the adoption of integrated sustainability or social reporting to highlight and reward, towards the whole community, companies that make the greatest efforts in terms of ET, regardless of size. However, this direction should be ensured through a strengthening of the planned incentive system or fiscal measures, as the adoption of new non-financial accountability systems entails costs that could potentially exclude a broad segment of SMEs. Greater bureaucratic simplification can lead companies toward a resolute investment in ET, in order to actively contribute to the achievement of the SDGs. Thus, the above-described presence of facilitations goes back to being a priority, more so than the mandatory regulations.

Author Contributions: Conceptualization, A.T. and G.S.; methodology, G.S.; software, G.S.; validation, G.P., G.S. and R.C.; formal analysis, G.S. and G.P.; data curation, A.T., R.C. and G.S.; writing—original draft preparation, A.T. and G.P.; writing—review and editing, R.C. and G.S. All authors have read and agreed to the published version of the manuscript.

Funding: The research was supported by the Italian Ministry of University and Research (DM 737/21) and project "Strategic and competitive drivers of the energy transition in Italian SMEs" (PI: G.S.).

Data Availability Statement: The data presented in this study are available on request from the corresponding author.

Conflicts of Interest: The authors declare no conflict of interest.

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