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Involvment Micro and Small Enterprises in Energy Transition

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Abstract: Energy transition is one of the greatest challenges facing humanity today. All micro, small, medium and large enterprises in operation will have to face it, and some can already boast the first successes in this regard. This paper focuses on the involvement of these smallest players in energy transition. Micro and small entities are the largest part of the economy, having a great influence on its development. Looking at the wide scale of their activities, these entities are distinguished by a specific owner-manager relationship. This means that the final decision-making is influenced by business goals, but also by the manager's approach, their awareness of changes, and personal and other factors. Based on a structured and standardized survey questionnaire, the research was carried out using the Computer-Assisted Telephone Interviewing technique between April and May 2022 among owners of micro and small enterprises operating in Poland. The survey showed that active engagement of micro and small enterprises in energy efficiency initiatives is related to their market success and financial health.

Keywords: energy transition; micro and small enterprises; energy efficiency; involvment to energy transition; market and financial results

1. Introduction

Transformation is a long-term process of change that is the result of economic, social, technological, institutional and/or environmental development. This process also involves energy systems, which, as we know, are not static. Energy transition is a complex and difficult process to describe [1–3]. It is expected to contribute to the goals within the realm of sustainable development and the European Green Deal. It will only be possible through industry's commitment to actions for a more sustainable economy [4–6].

In order to move smoothly through this process, innovative solutions must be promoted, and governments and companies must invest in technologies based on renewable energy sources. For these activities to be effective, all organizations must participate, including those in the micro and small business sectors [7]. The promotion of these processes from the viewpoint of micro and small-sized companies indicates the necessity of adopting a broad perspective on external conditions for developing any activities mainly related to the transfer and financing of technological solutions [8]. To strengthen their position in the market and increase the scope of energy transition, the indicated enterprises often have to seek assistance from external sources. Researchers point to the economic benefits of efforts to transition of energy. They opine that the digitization and efficiency of energy consumption activities have an increasing impact on the market and financial performance of pre-

enterprises. This is associated with a fairly fast payback period, which for small projects is only about 3 to 5 years [9]. From an economic perspective, environmental effects are important. The economic cost-benefit relationship focuses on the growth model associated with maximizing production or service delivery with less energy and resource consumption. Such a value-based approach leads to currently relevant considerations about the purpose of trade and the nature of what is simultaneously beneficial to the business development of the environment in which it operates. Such activities, supported by a broad range of tools and applications, will increase the potential of micro and small businesses to make a genuine and lasting difference in terms of reducing their impact on their part of the environment [10,11].

In light of this, a vital factor in determining the development of businesses in line with the energy transition is collaborating with the environment of these entities. In addition to external adaptation, the internal dimension of the environment of a given enterprise is also crucial in the literature. Being under the full or potential control of a given entity, it includes various resources used in the management process (i.e. financial, human, physical, information) that support the development of energy transition [4,12]. It is, therefore, necessary to strive to build open relations between different sectors to support activities aimed at energy transformation. Strong promotion of energy investments for micro and small businesses will arouse the involvment of their owners in these ventures.

Respecting features such as flexibility, entrepreneurship and innovation is therefore key to implementing environmental programmes and increasing the competitiveness of enterprises [13,14].

Therefore, promoting energy transition in micro and small companies is a direction that builds a new quality of their functioning in the market. Therefore, both the role and tasks of the entrepreneur himself are changing. You should also be aware that in crisis situations, these conditions may become key barriers that have a negative impact on energy transition [15–17].

Taking into account that micro and small entities are the largest part of the economy, having a great influence on its development, and looking at the wide scale of their activities, these entities are distinguished by a specific owner-manager relationship, this means that the final decision-making is influenced by business goals, but also by the manager's approach, their awareness of changes, and personal and other factors. Therefore, the area of energy transition for micro and small businesses should be intensively studied by researchers. The relationship between the management process, energy transition and sustainability has already been studied by Polish and foreign researchers [18–20]. Although the discussion of energy transition touches on financial and market issues and effects [20] more often in large companies, it rarely refers to micro and small companies. The discussion in this area is legitimate because it is important for the realization of environmental goals aimed at the development of energy transition.

Consequently, there is a research gap in this area because while much has been written about the importance of this problem vis-à-vis the activities of large companies, there is still little research on micro and small companies. Taking steps to clarify the research gap, this study aims to assess the degree of involvement of micro and small enterprises in the energy transition and its relationship to the market and financial performance of these entities. Implementation of the adopted goal will allow to draw conclusions about the involvement of micro and small business owners in the energy transition.

The article consists of five parts. The first part describes the essence of energy transition, the second part presents the challenges of this transition for enterprises, the third part covers the methodology, the fourth part presents the research results, and the last part is a discussion of the results and their limitations.

2. Energy transition challenges for businesses

Since the beginning of the European Union - energy security - has been mentioned as a major strategic goal, which should be considered in a very broad context, referring to all users in the EU, ensuring their high quality of life, environmental protection, and sustainable economic development [15,25]. The European Union is thus a leading global pioneer in climate change mitigation efforts by reducing its carbon footprint and using renewable energy sources. Unlike in Poland, in the old EU

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countries, China, the US or the world in general, the energy transition was initiated, independently of climate policy, by strategic considerations (programmes) aimed at gaining a competitive advantage through it in the emerging new geopolitical system [21–24].

To date, the EU has based its energy architecture and planning on four major policy packages, namely:

- Strategy for an Energy Union [26]. The strategy, first published in 2015, aims to provide secure, affordable, and clean energy across five dimensions: 1) security, solidarity, and trust, 2) integration of the internal energy market, 3) improving energy efficiency, 4) decarbonizing the economy, and 5) supporting scientific research, innovation and competitiveness.
- Clean energy for all Europeans [27]. The package, first proposed in 2016, generated legislation on energy efficiency and renewable energy generation, creating a binding target of 32% of renewables in the EU's energy mix by 2030 and an increase in energy efficiency of at least 32.5%.
- European Green Deal [28]. The package, adopted in 2019, aims to reduce greenhouse gas emissions by 1990 percent from 2030 levels by 55 and make Europe the first climate-neutral continent by 2050.
- Fit for 55 [28].This packet, published in 2021, was generated to accelerate and strengthen measures to achieve the 55% reduction target by 2030.

The listed energy packages and environmental targets focus on energy transition, encouraging emission reductions by reducing fossil fuel consumption, using renewable energy sources and increasing energy efficiency. The most important element in this context is the transformation implemented in the form of a steady strategy to build energy independence and competitive advantage pursued by the EU for more than 20 years. The strategy, which consists of transforming energy into a factor of endogenous development, aims to eliminate the importance of energy as an exogenous factor. The realization of such far-reaching goals, viz: Eliminating the EU's dependence on fossil fuels through the use of RES sources, will support the construction, with its human resources, of technological superiority in the markets for meeting energy needs, which, as a result of the transformation, will replace today's sectoral WEK (co-fuel energy)[29]. Above all, these measures will lead to profound changes in the functioning of the European economy, society and businesses, including micro and small ones. At this point, it should be noted that the energy transition will not be realized solely by micro, small and medium-sized companies and other organizations - it must always result from the government's adopted policies and its cooperation with major companies and organizations. Such efforts can help micro and small businesses in particular to understand and take any initiatives in this area [30]. The addressees of the energy transition are therefore not only individual energy consumers, but also businesses, which contribute to counteract the negative effects of human activity on the environment. Business owners must therefore be aware that investing in renewable energy is a way to reduce business costs and improve the company's image. Customers who are aware of the energy transition are more likely to choose companies that care about the environment. In meeting their needs, companies stay in the supply chain, often working with other equally conscious stakeholders [31]. Such behaviour facilitates the planning of an energy strategy and the understanding of the range of factors that determine its development in a given sector or industry. This will translate into a positive impact on the planning of all activities supporting the energy transition for high- and low-carbon sectors, especially micro and small businesses. This is in line with Article 3(1) of Directive 2018/2001/EU, which stipulates that by 2030 at least 32% of gross final energy consumption in the EU should come from renewable energy sources (RES). In the context of the European Green Deal, this percentage has risen to 40% [32]. Accordingly, in May 2022, the European Commission launched the REPowerEU plan, which aims to increase the share of renewable energy to 45% by 2030, reaching a total renewable energy generation capacity of 1,236 GW [31].

The European Union's current document on energy security is the RE-PowerEU Plan. It describes targets and financial and legal measures in three courses of action (energy conservation, clean energy, development and diversification of energy supply leading to a new energy system and new energy infrastructure) [31]. The European Commission emphasizes that the first course of action, "saving energy, is the cheapest, safest and cleanest way to reduce our dependence on imported fossil

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fuels", and that every citizen, household or organization (company) can have a big impact on achieving this goal, even through small daily actions, such as: lowering the heating temperature, reducing the use of air conditioning, using household appliances more efficiently, using public transport and active mobility, etc. [31].

Under the second course of action, which deals with clean energy production [33], the EU is proposing ambitious targets to motivate households and businesses to switch to solar PV. Under the REPowerEU plan [31], the strategy aims to deploy more than 320 GW of newly installed photovoltaic energy by 2025, twice as much as today, and nearly 600 GW by 2030. The additional capacity deployed initially will replace the consumption of 9 cm of natural gas energy per year by 2027.

The third course of action - diversification of energy supplies - involves a gradual but rapid shift away from energy from Russia and replacing it with the import of liquefied natural gas (LNG) supplies from the US, Canada, Norway, Egypt and Israel, increasing gas imports from Azerbaijan, Qatar, Australia and resuming imports from Algeria, exploring the export potential of sub-Saharan African countries, i.e. Nigeria, Senegal and Angola, and coordinating with gas consumers such as Japan, China and Korea [34].

The steps planned for the transition to clean energy are very complex. During their implementation, there are many factors that can affect their success: technological, social, geostrategic, legal, financial, behavioural, cultural, etc. It is also important to be aware that every action taken opens the way to new opportunities, as well as to the emergence of new problems or barriers. In these processes, special attention must be paid to anticipating potential risks and barriers, and the watchword in this regard must be a "comprehensive EU energy transition policy framework". Decision makers must constantly analyze the consequences of the actions taken, taking into account all elements that may affect the implementation of these actions [34–36,38–41,43,44,47].

The main barriers to the energy transition process include: lack of knowledge and awareness, lack of trust on the part of consumers, energy illiteracy, technical barriers (little experience in managing the reversal of power flow from high-generation photovoltaic (PV) installations in the system and the fact that the growing number of prosumers may lead to an increase in grid overhead), investments with high financial costs, entrenched patterns of energy consumption that may cause resistance to change, opacity of the energy market, etc. [39,48–50].

In addition, the interests of companies producing and distributing traditional forms of energy may deliberately motivate some decision-makers to delay implementation of this strategy. The reason for this is that there are too few subsidies given to businesses and the public to cover current energy costs. Poorer consumers remain wary of the investment required to make the transition to new technologies [35].

In order to remove the barriers that have arisen, it is necessary to create access for entrepreneurs to a wide range of financing for investments made in energy efficiency improvements [51].

Accordingly, energy efficiency measures can be supported by both state and local government bodies, as well as other entities such as associations or foundations. Government intervention is an essential element of the ongoing debate that shapes policy in this area. The literature lists many forms of regulation that can support such activities, such as various types of subsidies and taxes, targeted credits, legal regulations, guarantees for specific risks, or offering id insurance using an objective, non-detailed product information system (such as energy labelling). The rationale and degree of government intervention are subject to debate and regulation in the European Union and internationally.

As shown by Trianni et al. [17,47,52], two main factors have been identified that spur the involvement of micro and small businesses in overcoming barriers to implementing energy transition measures. The first is lowering energy costs, and the second is developing and implementing a long-term energy efficiency strategy [52]. The authors also point out that more than just an economic factor is needed to make positive energy transformation decisions, especially for low-energy companies, where energy costs are a small part of costs. Accordingly, other values should be promoted that favour activities that produce energy transformation.

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Introducing support policies and incentive initiatives to encourage business owners to use renewable energy technologies will significantly increase renewable energy generation capacity. It is therefore necessary to work with various partners including entrepreneurs, industry organizations, consultants and energy certification companies to support energy transition activities. It is also necessary to provide training, advice and easier access to financial mechanisms aimed at entrepreneurs, and to reduce a number of barriers in the process.

Considerations based on the above analysis show that energy cost reduction and a long-term energy efficiency strategy are key motivators. However, other values are needed to convince people to take efficiency measures, especially for companies with low energy efficiency. In this context, the EU's Energy Transition Regulations reinforce this perspective by forcing innovation, supporting renewables and creating partnerships. This combination of theory and EU regulations underlines the key role of economic and regulatory benefits in increasing commitment to energy efficiency. In this context, there is interest in the issue of energy transition highlighting the various aspects, barriers and substance of the EU's efforts for micro and small businesses. On this basis, the study's main hypothesis is as follows:

Active engagement of micro and small enterprises in energy trnsition initiatives is related to their market and financial success.

3. Research methodology

Based on a structured and standardized survey questionnaire, the research used the Computer-Assisted Telephone Interviewing (CATI) technique between April and May 2022. The questionnaire consisted of a metric and a main part. The metric contained five questions for characterizing the surveyed enterprises by age, size measured by the number of employees, type of business, dominant market area, and development phase. The main part of the questionnaire was divided into four thematic blocks. The first related to the competitiveness of the surveyed entities, the second to the degree of compliance of their activities with environmental objectives, the third to barriers to introducing solutions related to environmental goals, and the fourth to changes in market and financial performance related to energy transition.

The study targeted owners of micro and small enterprises operating in Poland. These enterprises met the domestic criteria, employing up to 49 individuals and operating across various industries. The sampling frame was the REGON Register of National Economy, a comprehensive database of companies in Poland. The sample size was set at 1,750 companies, with 400 in the primary sample and 1,350 in the reserve sample.

The research aimed to obtain a representative sample to enable result generalization. The selection of companies to participate followed a dependent sampling process, meaning that once a population element was chosen, it was not returned to the pool. Every 30th record from the sampling frame, which included a numbered list of all entities in the surveyed population, was selected. The sample selection for micro and small enterprises was random, ensuring an equal probability of inclusion for each sampling unit within the population.

A reserve sample was used when respondents refused to participate in the study or when database records were outdated. Ultimately, 407 completed questionnaires were collected, with 400 remaining after verification to address data inconsistencies.

Given the significant variation in the number of micro and small enterprises in Poland, there was an overrepresentation of small companies in the sample. Post-stratification weighting was applied to align the sample structure with the population structure concerning employment size to account for this disproportion. These post-stratification weights also considered the varying response rates within the sample. Thanks to the post-stratification weights, micro and small business population generalisations were conducted with a type I error risk of less than 5%. Furthermore, to assess the similarity of the sample structure to the population for critical variables, a random sample test was conducted to verify the randomness of the sample. A series test (the Stevens series test or the Wald-Wolfowitz series test) was used for this purpose. The results of the randomness test for the key variables, which measures company development, competitive advantage, and alignment with

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environmental goals, confirmed the randomness of the sample - at the assumed significance level of $p<0.05$. The sample surveyed consisted of 400 business entities operating in Poland, comprising 75% microenterprises with fewer than ten employees and 25% small enterprises employing between 10 and 49 employees. Regarding company age, most of the sample represented enterprises operating in the market for 10 to 15 years (36%), followed by those with 5 to 10 years of market presence (31.8%).

Young enterprises with 2 to 5 years of market experience were the least represented, at 8.3%. The largest share of micro enterprises has operated in the market for 10 to 15 years, while among small enterprises, the majority have over 15 years of market experience (see Table 1). Regarding the dominant activity type, service and commercial enterprises were prevalent, accounting for 59% and 22.7%, respectively. Regarding market operations, most surveyed entities operated in the domestic and regional markets, with 79% in total (41% and 38%, respectively), while only 6.2% operated in the international markets.

Respondents also assessed their companies' developmental stages. The analysis revealed that more than 78.4% of the surveyed entities were in the maturity phase, characterised by a strong reputation, a stable market position, and consistent economic and financial performance. Only 19.5% of the companies were in the dynamic growth phase, while start-up companies represented a mere 0.3%. The distribution of micro-enterprises mirrored that of the entire population, but in the case of small businesses, there were fewer entities in the dynamic growth phase and more in the decline and renewal phase.

Table 1. Characteristics of the surveyed enterprises.

Specification	Enterprises (in %)		
	Micro	**Small**	**Total**
Age of the entreprise:			
- between 2 and 5 years	8.3	0.0	6.2
- over 5 to 10 years	35.3	21.0	31.8
- over 10 to 15 years	38.7	28.0	36.0
- over 15 years	17.7	51.0	26.0
Dominant type of business activity:			
- production	12.7	35.0	18.3
- services	62.0	50.0	59.0
- trade	25.3	15.0	22.7
Dominant scope of the company's market activity:	18.3	4.0	14.8
- local			
- regional	41.7	27.0	38.0
- national	38.3	49.0	41.0
- international	1.7	20.0	6.2
Enterprise development phase:			
- setting up	0.3	0.0	0.3
- dynamic growth	19.7	19.0	19.5
- stabilization	77.7	81.0	78.4
- declining	2.3	0.0	1.8

Source: own elaboration.

4. Results

The first research area was the analysis of implemented solutions for improving energy transition in the surveyed entities in 2019-2021, which shows that the most frequently implemented were energy-efficient machinery and equipment 82% of indications and conducting an energy audit 72.3%, while the least frequent was the use of hybrid/electric cars only 1.2% of symptoms. The reasons for this state of affairs should be seen in the limited financial resources of those entities that engage their resources in solutions necessary for their business. As a detailed analysis shows, in the case of

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micro-enterprises, these were mainly energy-efficient machinery and equipment, and in the case of small conducting an energy audit (see Table 2). This is also confirmed by the Flash Eurobarometer Survey 426, indicating that European SMEs rarely use renewable energy RES [53]. At the same time, they most often apply such solutions as replacing lighting, insulating buildings thermally, using energy-efficient electric motors, recovering heat from production processes or lowering indoor air temperature. In this context, it is possible to draw attention to the phenomenon described in the literature called the "energy efficiency gap," meaning the discrepancy between the potential for energy efficiency and the solutions implemented, resulting from the various types of barriers encountered in the implementation process [17,54].

Table 2. Structure of implemented energy transition improvement solutions in the surveyed micro and small enterprises in 2019-2021.

	Enterprises		
	Micro	**Small**	**Total**
Energy-efficient machinery and equipment	86%	70%	82%
Renewable energy generation	6.3%	49%	17%
Implementation of energy management systems	6.0%	33%	12.8%
Thermal modernization of the building	30%	52%	46.5%
Modernization of lighting	39%	69.3%	61.8%
Conducting an energy audit	35%	83%	72.3%
Monitoring of energy consumption	19%	62%	52%
Energy storage	2.5%	25%	17.5%
Use of hybrid/electric cars	0.7%	3.0%	1.2%

Source: own elaboration.

In the next stage of the conducted analysis of the data obtained in the research process, an attempt was made to answer the question of whether there are dependencies between the variables describing the types of implemented energy transition improvement solutions in the surveyed companies and the characteristics of these entities (see Table 3). A chi-squared test of independence or Fisher's test was used to assess the statistical significance of those dependencies. The chi-squared test of independence showed significant differences in the implementation of energy transition improvement solutions for the age of the surveyed enterprises: energy-efficient machinery and equipment, renewable energy generation, and implementation of energy management systems. Most such solutions have been implemented in enterprises operating in the market for 6 to 10 years and more than 15 years. Analyzing the predominant type of activity, respondents' answers varied in the case of monitoring of energy consumption, most often indicated by manufacturing companies, and in the case of the predominant market reach, respondents' answers varied for the use of hybrid/electric cars operating in a predominantly domestic market. On the other hand, analyzing the phase of development, it turned out that only in the case of energy-efficient machinery and equipment were the results differentiated, that is, most often indicated by entities in the stabilization phase.

Table 3. Results of a chi-squared test/Fisher's test for the relationship between implemented energy transition improvement solutions in the surveyed micro and small enterprises and the characteristics of these entities.

	Characteristics of the surveyed enterprises			
	Age	**Dominant type of**	**Dominant scope of the**	**Development phase**

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			business activity		market activity			
	χ^{2*}	p**	χ^{2*}	p**	F***	p**	F***	p**
Energy-efficient machinery and equipment	15.798	0.001	6.627	0.0036	3.969	0.0265	43.675	<0.001
Renewable energy generation	15.828	<0.001	11.444	0.003	4.682	0.0197	5.065	0.167
Implementation of energy management systems	14.220	0.003	1.053	0.591	4.705	0.0195	4.580	0.2205
Thermal modernization of the building	1.188	0.756	0.585	0.746	4.094	0.0251	5.901	0.117
Modernization of lighting	5.944	0.114	7.786	0.020	1.176	0.759	4.725	0.193
Conducting an energy audit	0.240	0.971	7.778	0.020	3.896	0.0273	5,924	0.150
Monitoring of energy consumption	5.387	0.146	11.068	0.004	3.062	0.0382	5.091	0.117
Energy storage	2.753	0.431	2.846	0.241	5.824	0.0121	8.954	0.030
Use of hybrid/electric cars	2.928	0.403	2.465	0.292	13.345	0.004	0.103	0.991

* chi-squared statistic, ** level of statistceal significance, ***Fisher's statistics - unfulfilled assumption of the chi-square indepenence test, so that the expected counts in all cells of the contingency table are greater than or equal to 5. Source: own elaboration.

The market and financial situation of the surveyed entities over the past three years (2019-2021) was then analyzed. Changes in this situation were assessed using an index consisting of 8 items, each measured on a 5-point Likert scale, where 1 meant a significant decrease in a given measure, 2 - a slight decrease, 3 - no change, 4 - a slight increase and 5 - a significant increase. In the case of measures describing the market situation, a slight and significant increase was recorded for the number of customers 44.6% and improvement in condition compared to the competition 41.1%, while in the case of financial measures, revenue volume 42.8% and profit 37.3% (see Table 4.).

Table 4. Assessment of the change in the company's market and financial situation in 2019-2021.

Changes in the market and financial situation of the firm	Assessment*				
	1	2	3	4	5
Revenue volume	-	16.7%	40.5%	41.0%	1.8%
Profit	-	20%	42.8%	35.8%	1.5%
Market share	-	16%	47.5%	34.8%	1.8%

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Number of customers	-	16.8%	38.8%	42.8%	1.8%
The condition of the company compared to the competition	-	18.0%	41%	39.3%	1.8%
Effectiveness of strategic actions	0.3%	24.5%	41%	33%	1.3%
Implementation of innovations	-	14.8%	52%	32%	1.3%
Financial liquidity	-	13.8%	53.8%	30.8%	1.8%

Source: own elaboration.

For further analysis, changes in the company's market and financial situation in 2019-2021 will be measured in aggregate. This is possible due to the very high reliability of the scale - the coefficient of alpha-Cronbach's coefficient has a value of 0.904. In assessing the accuracy of this indicator, exploratory factor analysis was used. The analyzed statements show correct relations from the point of view of this method - Bartlett's test of sphericity is significant ($p < 0.001$). The Kaiser-Mayer-Olkin (KMO) index is 0.896, while Bartlett's test of sphericity took the following values: approximate value 2= 4180.539 number of degrees of freedom (df)= 28 and significance level $p<0.001$. The values of these statistics allow further procedure of factor analysis. Next, the number of factors of the created index was determined based on the Kaiser criterion (according to this criterion, dimensionality is determined by the components in which the eigenvalues exceed 1. In this case, such a situation occurred only in the case of one component explaining a total of almost 85% of the variance (Table 5), which proves the unidimensionality of the created index. The analysis of the values of individual factor loadings showed that all of them obtained a reference value above 0.5. Thus, the measurement of the change in the company's market and financial situation in 2019-2021 can be carried out on the basis of the full set of eight variables.

Table 5. Values of total explained variance and initial eigenvalues based on the Kaiser criterion.

Total explained variance						
Component	Initial eigenvalues			Sums of squares of charges after isolation		
	total	% variance	% cumulative	total	% variance	% cumulative
1	6.780	84.744	84.744	6.780	84.744	84.744
2	0.318	3.975	88.719			
3	0.250	3.122	91.841			
4	0.202	2.529	94.370			
5	0.152	1.895	96.265			
6	0.117	1.464	97.729			
7	0.107	1.333	99.062			
8	0.075	0.938	100.000			

Source: own elaboration.

A summary measurement of the change in the company's market-financial situation in 2019-2021 will be made on the basis of a variable (SFR), determined as the sum of scores for all 8 sub-questions. This variable can take values from 8 to 40, with higher values indicating positive changes in the market-financial situation of the enterprise as a result of efficiency-energy improvement solutions. Analysis of this indicator showed that the changes in the market-financial situation of the enterprise in 2019-2021 are significant or unchanged - the average score obtained is 25.7 with a possible maximum of 40. The highest score of 40 points was recorded by only 5 enterprises, and more than 52% of the sub-entities obtained a number of points below the average. Such a situation can be caused by a number of factors, both external, e.g. the crisis related to the COVID-19 pandemic, as well as internal related, e.g. the lack of a clearly delineated strategy for operation and development, resource shortages.

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The next stage of the analysis focuses on answering the question of whether there is a relationship between the implemented changes in energy transition hijack in 2019-2021 and the market and financial situation analyzed during the same period. To assess this relationship, a nonparametric Mann-Whitney U test was used due to the level of measurement of the analyzed variables. The results of this test (see Table 6) showed that there were no significant differences in terms of the change in the market-financial situation of the analyzed companies, which implemented and did not implement 7 of the 9 analyzed solutions for improving the financial-market situation during the period under study. Only in the case of implementation of such solutions as monitoring of energy consumption and energy storage it turned out that there are significant differences in the change of the market-financial situation in the case of enterprises that have and have not introduced these solutions.

Table 6. Results of the Mann-Whitney U test.

	Statystyka U	*p*-Value*
Energy-efficient machinery and equipment	11063.500	0.397
Renewable energy generation	9496.500	0.037
Implementation of energy management systems	8179.000	0.345
Thermal modernization of the building	19017.000	0.438
Modernization of lighting	17229.500	0.134
Conducting an energy audit	19093.00	0.444
Monitoring of energy consumption	13187.00	0.005
Energy storage	8345.00	0.001
Use of hybrid/electric cars	509.00	0.060

** level of statistceal significance, Source: own elaboration.

5. Discussion and Conclusions

The culmination of our study in the energy transition sphere, mainly focusing on the role of micro and small enterprises, has brought forth several critical insights and implications. The journey began with a deep dive into the historical context of energy transition, tracing back to global efforts against climate change. This historical backdrop is crucial as it sets the stage for understanding the energy transition's current dynamics and challenges. The seminal moments in this journey, such as the Rio de Janeiro Conference of 1992, the Kyoto Protocol of 1997, and the Paris Agreement of 2015, have been instrumental in shaping the global and European agendas on climate change and sustainability. These international commitments have highlighted the urgency of addressing climate issues and laid the groundwork for policy frameworks within which micro and small enterprises operates today.

The concept of stakeholder capitalism, mainly influenced by the work of Klaus Schwab [55], emerged as an essential background in our study. The approach challenges conventional profit maximization models by emphasizing the balance between economic returns and social and environmental responsibility. We found that the concept increasingly resonates with companies, especially SMEs, as they navigate the complexity of energy transition. The integration of stakeholder capitalism into micro and small enterprises business models signifies a transformative shift in how companies view their role in society and the environment. This shift is not just a theoretical construct but is practically implemented by companies as they seek to balance profit-making with broader social responsibilities.

Our empirical analysis centred on understanding the extent to which micro and small enterprises are involved in energy transition and how this involvement impacts their market and financial performance. We discovered a substantial engagement of micro and small enterprises in adopting energy-efficient practices, such as using energy-efficient equipment and conducting energy audits. These findings are not just numbers, but they reflect a proactive stance among micro and small

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enterprises towards energy efficiency and sustainability. The significant adoption rates of these practices indicate a conscious effort among micro and small enterprises to align their operations with broader energy transition goals. Furthermore, our study revealed a clear relationship between the characteristics of micro and small enterprises and their chosen energy efficiency measures. This relationship is vital as it suggests that micro and small enterprises are not merely adopting energy efficiency measures at random but are strategically aligning their energy transition activities with their specific business contexts and needs.

The statistical analyses conducted, mainly using the Mann-Whitney U test, unveiled significant relationships. These relationships were observed between the implementation of specific energy efficiency measures, such as renewable energy generation, energy consumption monitoring, and energy storage, and improved market and financial performance in micro and small enterprises. This positive correlation is a robust endorsement of our hypothesis that micro and small enterprises' involvement in energy efficiency improvements is closely associated with favourable market and financial outcomes. The implications of these findings are multifaceted. For micro and small enterprises, it reinforces the value of integrating energy transition initiatives into their business strategies. For policymakers, it underscores the importance of supporting micro and small enterprises in their energy transition efforts, as these contribute to broader climate goals and enhance economic vitality.

The study also opens several avenues for future research. One key area is exploring the causality between energy efficiency measures and financial outcomes. Understanding this relationship's directionality is crucial for policy formulation and business strategy development. Another area is cross-industry comparisons to understand how different sectors respond to and benefit from energy transition. Such comparisons could provide nuanced insights into sector-specific challenges and opportunities in the energy transition landscape. Additionally, investigating the role of emerging technologies like artificial intelligence (AI), the Internet of Things (IoT), and blockchain in supporting energy transitionin micro and small enterprises could offer a fresh perspective. These technologies are rapidly transforming business landscapes, and their potential to facilitate energy transition in micro and small enterprises is an area ripe for exploration.

In a broader societal context, our research emphasizes the crucial role of micro and small enterprises in reducing environmental impacts and contributing to sustainable practices. This aspect is particularly relevant in the face of global ecological challenges. Micro and small enterprises, by their sheer number and cumulative effects, can significantly drive sustainability and environmental conservation. This societal significance extends beyond compliance with environmental standards to a more integrated approach where environmental stewardship becomes a core aspect of business operations.

Furthermore, the study has specific implications for the Polish economy and provides insights into economic policy. The key finding that micro and small enterprises plays a substantial role in achieving energy transition goals is particularly relevant for emerging economies and countries in transition, like Poland. Their ability to adapt, innovate, and be flexible in response to changing economic and environmental conditions is valuable. This finding suggests that economic policy should focus more on supporting these enterprises by encouraging them to continue investing in energy efficiency and providing them with the necessary tools and incentives. The study also found that the choice of energy efficiency actions is closely linked to the type of economic activity. This finding has important policy implications, suggesting that government policy should be flexible and tailored to the diverse needs and characteristics of different sectors of the economy.

In conclusion, our study has provided practical insights for micro and small enteprises owners, managers, and entrepreneurs and laid the groundwork for further academic research. It holds a broader societal significance in the context of global ecological challenges, emphasizing the role of micro and small enterprises in reducing negative environmental impacts and contributing to sustainable business practices. The study's findings can inspire new initiatives, support programmes, and evidence-based approaches, helping to accelerate the transformation towards a more sustainable

economy. Therefore, conducting such research should remain a priority for academia, business, and policymakers to achieve a better future for our planet and future generations.

Key Achievements of the Study:

1. Historical Contextualization: Successfully traced the evolution of energy transition policies, connecting current trends to their historical roots in global climate change initiatives.

2. Integration of Stakeholder Capitalism: Highlighted how the concept of stakeholder capitalism, championed by thought leaders like Klaus Schwab, is becoming integral to micro and small enterprises strategies in energy transition.

3. Empirical Evidence of micro and small enterprises Involvement: Provided concrete empirical evidence of micro and small enterprises' significant engagement in energy transition by adopting energy-efficient practices.

4. Correlation between Business Characteristics and energy transition Measures: Uncovered a strategic alignment between the specific characteristics of micro and small enterprises and their selected energy efficiency measures, indicating a bespoke approach to energy transition.

5. Statistical Validation of Hypothesis: Advanced statistical techniques such as the Mann-Whitney U test were used to validate the hypothesis that Active engagement of micro and small enterprises in energy efficiency initiatives is related to their market success and financial health.

6. Practical Implications for Policy and Business: Offered actionable insights for policymakers and business leaders, emphasizing the need for tailored support and strategic alignment in energy transition initiatives.

7. Roadmap for Future Research: Identified critical areas for future research, including causality studies, cross-industry comparisons, and the role of emerging technologies in energy transition.

8. Societal and Economic Relevance: Underlined the study's broader societal and economic importance, particularly in the context of global ecological challenges and sustainable business practices.

9. Policy Recommendations for the Polish Economy: Provided specific recommendations for economic policy in Poland, emphasizing the need for support and incentives tailored to the diverse needs of micro and small enterprises.

10. Foundation for Further Academic Research: Established a solid base for future academic inquiry into the role of micro and small enterprises in energy transition, setting the stage for more detailed and comprehensive studies.

These key achievements encapsulate the essence and impact of our research, highlighting its significance in business practice, policy-making, and academic study. The study contributes to a deeper understanding of energy transition among micro and small enterprises and catalyzes further exploration and innovation in this vital field.

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