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Empirical investigation of energy efficiency barriers in Italian manufacturing SMEs

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ABSTRACT

The paper identifies and evaluates barriers to industrial energy efficiency through the investigation of 48 manufacturing Small and Medium-sized Enterprises (SMEs) in Northern Italy. The research provides interesting suggestions both for enterprises and energy policy-makers. Firstly, economic and information barriers are perceived as the major obstacles to the adoption of energy-efficient technologies, whilst behavioural barriers do not seem to affect enterprises very much. Nonetheless, despite what declared, the most relevant barriers are the lack of interest in energy efficiency and the existence of other priorities, thus showing that decision-makers tend to downgrade energy efficiency to a marginal issue. Furthermore, perceived barriers do not take place exclusively in implementing energy-efficient technologies, but, with comparable importance, also in generating the interest and knowledge of the opportunities. Moreover, the study highlights that relevant differences can be appreciated for both perceived and real barriers even among SMEs, that thus should not be bundled together. In addition to that, other factors affect barriers, stimulating future research: indeed, lower real barriers can be observed with higher complexity of the production, high variability of the demand and strong competitors.

1. Introduction

Despite the strong effort of energy policies in Europe, the target of reducing the energy consumption of 20% by year 2020 seems unachievable. Indeed, recent estimates revealed that, with current trends, only 10% of the reduction will be obtained, on the one side showing the existence of barriers towards the diffusion of energy-efficient technologies, on the other side moving the European Commission towards a new set of measures to increase energy efficiency [1].

The industrial sector plays a major role, as, according to the most recent estimates [2], covers more than 50% of the total energy delivered. In this regard, reducing energy consumption in this sector should be seen as strategic by policy-makers to achieve energy efficiency targets.

Within the industrial sector, according to a recent study by the European Commission [3], when looking at Small and Medium-sized Enterprises (SMEs), "the picture is surprisingly unfavourable: close to two thirds of SMEs operating in the European Union (EU) do not even have simple rules or devices for energy saving (63%). Less than three out of 10 SMEs (29%) have instituted some measures to preserve energy and resources at their enterprise. Only 4% of EU SMEs have a comprehensive system in place for energy efficiency". The Italian picture is even worse, with 74% of SMEs neglecting to adopt measures for energy saving. This acquires even greater importance if compared with the same statistics for Large Enterprises: indeed, 29.8% of them do not have simple rules for energy saving, and 18.9% of them adopt a comprehensive system for energy efficiency. Nonetheless, SMEs are crucial also from the point of view of industrial energy consumption: indeed, as an example, according to the most recent estimations in Italy, SMEs cover about 60% of the Italian industrial energy consumption [4]. Moreover, as reported by a recent investigation in Europe, SMEs have generated in the last decade about 85% of new job opportunities and about 60% of the European Gross Domestic Product [5], thus revealing to be really crucial for the future of the European industrial sector as a whole.

Hence, SMEs are strategic since they represent the large majority of the enterprises, cover a major share of the domestic industrial consumption, and are quite inefficient [6–9]. One reason for the low adoption of energy-efficient technologies within SMEs is represented by the lack of proper means to address their barriers towards energy efficiency.

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At the moment we can find very few contributions in the literature addressing barriers to energy efficiency specifically in industrial SMEs. Nonetheless, understanding the barriers to energy efficiency seems to be crucial to propose the most effective means to overcome them. In order to do this, a holistic approach to barriers to industrial energy efficiency is needed, i.e. having a taxonomy able to understand and classify the wide spectrum of issues that enterprises have to deal with when deciding to perform energy efficiency investments.

In the literature it is possible to find a large number of contributions, providing different perspectives on the taxonomies on barriers to industrial energy efficiency, and showing that the debate is still open [10–16]. Nonetheless, most of the studies tend to look at the barriers more from a theoretical viewpoint, rather than from an empirical one, i.e. by the enterprises' perspective.

In recent studies Cagno et al. [17,18] have proposed an innovative taxonomy encompassing the major contributions in the previous literature, but, at the same time, providing useful insights to empirically investigate the barriers to industrial energy efficiency. Indeed, the new taxonomy aims at contributing to fulfil the need of having a tool – in terms of theories and practices – useful both for enterprises and policy makers in order to clearly point out where the difficulties are rooted. In this study we adopt their approach investigating the new taxonomy in manufacturing SMEs located in Northern Italy.

The structure of the paper is as follows: in Section 2 we describe the theoretical framework that represents the starting point for this research. This section will perform a brief review of the characteristics of the taxonomy adopted, pointing out the issues emerging for the application to SMEs and considering the transferability of the taxonomy to SMEs. In Section 3 we describe the methodology adopted to empirically investigate the barriers. Section 4 and 5 will be devoted, respectively, to the presentation and discussion of results.

2. Theoretical approach

Cagno et al. [17] propose a taxonomy in which the barriers are classified according to the responsible actor in which they originate, as reported in Table 1.

Considering the need to empirically investigate the barriers among enterprises, Cagno et al. have developed a taxonomy for field investigation [17], as reported in Table 2, in which they point out the origin of the barrier, that, with respect to the enterprise, might be either internal or external. In fact, it is apparent that the enterprise is not able to evaluate the real value of the external barriers, e.g. is not able to evaluate the value of the Lack of Interest for Energy Efficiency for technology suppliers, but rather the enterprise will provide how this barrier reflects on itself, i.e. the perception that energy-efficient technologies are not available.

Moreover, in the studies of Cagno et al. [17], the taxonomy proposed is capable of evaluating barriers on the decision-making process of the enterprise, attributing each of them to one or more actions of the process, respectively the Generation of Interest (Action 1), Knowledge of inefficiencies and opportunities (Action 2), Investment Analysis and Intervention Implementation (Action 3), as reported in Table 2.

A third feature of the proposed taxonomy is the classification of the barriers with respect to their effect on the enterprise (the so-called *spectrum of influence* on the enterprise), i.e. affecting any investment, only energy efficiency investments, or even depending on the specific investment in energy efficiency under consideration. This classification allows to understand that some barriers vary according to the considered technology: as a consequence, it will not be possible to obtain a real value, limiting the research to obtaining a general perception of those barriers.

Table 1
The taxonomy adopted in this study, with a clear distinction of the origin (external, or internal, with respect to the firm), and the actors affected by the barriers. Source: Cagno et al. [17].

Origin	Actor/Area	Barriers
External	Market	Energy prices distortion
		Low diffusion of technologies
		Low diffusion of information
		Market risks
		Difficulty in Gathering External Skills
	Government/politics	Lack of proper regulation
		Distortion in fiscal policies
	Technology/services suppliers	Lack of interest in energy efficiency
		Technology suppliers not updated
		Scarce communication skills
	Designers and manufacturers	Technical characteristics not adequate
		High initial costs
	Energy suppliers	Scarce communication skills
		Distortion in energy policies
		Lack of interest in energy efficiency
	Capital suppliers	Cost for investing capital availability
		Difficulty in identifying the quality of the investments
Internal	Economic	Low capital availability
		Hidden costs
		Intervention-related risks
	Behavioural	Lack of interest in energy efficiency interventions
		Other priorities
		Inertia
		Imperfect evaluation criteria
		Lack of sharing the objectives
	Organisational	Low status of energy efficiency
		Divergent interests
		Complex decision chain
		Lack of time
		Lack of internal control
	Barriers related to competences	Identifying the inefficiencies
		Implementing the interventions
	Awareness	Lack of awareness or Ignorance

Nonetheless, when considering Small and Medium-sized Enterprises (SMEs), previous studies have pointed out that the structure of those enterprises, quite different from Large Enterprises (LEs), also affect empirical investigation [6,9,18]. Indeed, in the case of SMEs the organizational structure is very simple, and quite often the decision belongs exclusively to a single person, i.e. the entrepreneur him/herself. Therefore, with the exception of Lack of Time, organizational barriers like Divergent Interests (between who decides on energy efficiency and who invests), Complex Decision Chain, Lack of Internal Control or even Low Status of Energy Efficiency may fade.

3. Methodology

Due to the explorative nature of the study, the research has been carried out as case-studies using semi-structured interviews and questionnaires. The 48 Small and Medium-sized Enterprises (SMEs) investigated (according to the definition provided by the European Commission [19]) are located in the Lombardy Region,[1] one of the most industrialized in Europe, had all participated in a project on financing energy-efficient technologies carried out in 2010, and contributed voluntarily to this research.

[1] The Lombardy Region has almost 10 million inhabitants and is located at Northern Italy, 800 thousand enterprises and 1.2 million employees in the manufacturing activities. The Gross Product for the region is 296 billion euros, representing about 25% of the total Gross National Product, and being +29% and +37% higher of respectively the National and EU-25 per capita gross product [20].