



Exploring drivers for energy efficiency within small- and medium-sized enterprises: First evidences from Italian manufacturing enterprises

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HIGHLIGHTS

- ▶ Allowances, public financing and external pressures as major external drivers.
- ▶ Ambitious decision-makers with great entrepreneurial mind as major internal drivers.
- ▶ Effect of firm's size (even within SMEs) on drivers to industrial energy efficiency.
- ▶ Preliminary evidences of the effect of firm's internal and external complexity.
- ▶ Preliminary evidences of the effect of firm's innovation characteristics.

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ABSTRACT

Several studies have investigated the barriers to industrial energy efficiency, but few have focused on the most effective means (drivers) to promote the adoption of energy-efficient technologies and practices. In this respect, Small and Medium-sized Enterprises (SMEs) have been completely overlooked despite interesting consequences for their overall energy consumption and their concurrent low levels of adoption of energy-efficiency measures. Starting from insights garnered from the extant literature on the drivers of industrial energy efficiency, this paper presents an empirical investigation of 71 Italian manufacturing SMEs through a multiple case-study approach. The research highlights the importance of allowances or public financing for energy efficiency interventions, as well as the importance of external pressures such as increases in energy prices and the introduction or increasing of fees on both resources consumed and on emissions of pollutants. Moreover, enterprises look favourably upon energy-efficient technologies which are able to provide long-term benefits, evidence of their willingness to adopt seemingly radical solutions when these are able to improve their long-term competitiveness. Other drivers considered as strategic for increasing energy efficiency are the presence within the company of people with great ambition and entrepreneurial mind and the management sensitivity to the issue. This paper also provides a preliminary analysis of how factors such as firm size, sector, supply chain complexity, and innovation characteristics are or might be able to significantly affect drivers toward the adoption of energy-efficient technologies.

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1. Introduction

Future energy policies will by necessity be focused on increasing energy efficiency, as the objective of reducing energy consumption by 20% can hardly be achieved by 2020 solely through the adoption of current European policies [1,2]. Reducing energy consumption will of course also make a relevant contribution to the goal of realising a 20% increase in the amount of primary energy produced by renewable sources and a 20% decrease in greenhouse gas emissions.

The industrial sector can make a relevant contribution toward these goals, especially when considering the sector's share of the energy consumed and the fact that industry is responsible for consuming more than 56% of all energy delivered according to recent estimates [3]. The industrial sector, however, is largely comprised of Small and Medium-sized Enterprises (SMEs), with a very small percentage – usually less than 1% – consisting of Large Enterprises (LEs); this means that there exists a large number of small consumers and a very small group of large consumers. According to recent research led by the European Commission's Observatory of SMEs [4], the adoption rate of energy-efficiency measures is surprisingly unfavourable – while only 4% of European SMEs have put in place a comprehensive system to monitor and

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control energy consumption, more than 90% of SMEs have not yet or have only recently adopted a few measures to control their energy consumption.

In addition, according to a 2011 investigation led by the European Commission [5], SMEs are also strategic for the European domestic economy, responsible for approximately 60% of the Gross Domestic Product (GDP) produced and about 85% of new job opportunities.

Starting from this evidence, the need to investigate the so-called drivers of energy efficiency in greater depth is clear. This research is thus devoted to providing empirical insights into SMEs, in an effort to point out what they perceive as relevant in order to improve their energy efficiency.

This preliminary investigation was performed in Lombardy, the most industrialised region of Italy. Italy is a country which, according to the most recent statistics released by Eurostat [6], has approximately 440,000 industrial enterprises, 97% of which are focused on manufacturing activities and which employ approximately 3.5 million people. This figure ranks second in Europe, behind Germany and ahead of France (with 6 million and 3 million employees, respectively). Italian industry is primarily focused in sectors in which production is done by very small, usually family-owned, businesses; indeed, 63.4% of the production value generated in Italy is the result of SMEs and, concerning the manufacturing sector in particular, only 28.9% of Italian Earnings before Interest, Taxes, Depreciation and Amortization (EBITDA) is generated by LEs. When we zoom in on Lombardy, however, the picture becomes even more unique: the region is by far the most industrialised in Italy, encompassing 19.7% of all Italian enterprises [7]. Moreover, it is also the richest Italian region, and the sixth-richest region in Europe, with a per capita GDP of 33,900 € – this compared to a domestic average of 26,200 € – and it contributes 20.9% of domestic GDP.

In doing this first attempt to investigate drivers for industrial energy efficiency in Italian SMEs, we also want to highlight those factors which might affect their perceptions, with the aim of suggesting how future energy policies, specifically tailored toward SMEs, could be shaped so that they are as effective as is possible.

2. Drivers of energy efficiency

The large number of prescriptive, economic and supportive policies focused on increasing energy efficiency in the industrial sector has been analysed in a recent study by Tanaka [8]. On the one hand, this study identified the huge efforts being made to promote the adoption of energy-efficient technologies and practices; on the other hand, it also revealed the continued existence of barriers to the deployment of such technologies. Barriers to energy efficiency are not a particularly new topic, as a large body of literature can be found which dates as far back as the late 1970s, in the aftermath of the 1973 energy crisis. Several disciplines – including engineering, economics and behavioural and organisational studies – have made contributions by investigating barriers to energy efficiency, as highlighted by the recent study of Palm and Thollander [9]. Sorrell et al. [10] provided a relevant contribution with their efforts to formulate a comprehensive taxonomy of all barriers by identifying fifteen such barriers and dividing them into three groups – economic, behavioural and organisational. Considering the difficulties inherent to empirical investigations, a more recent study has reduced the taxonomy to six areas [11]. This research was subsequently integrated, in 2010, with the most recent contributions to the topic made by the United Nations Industrial Development Organisation (UNIDO) [12]. It is nevertheless difficult to find studies which present empirical investigations of barriers to energy efficiency within SMEs in the extant literature. Rohdin and Thollander [13] analysed 28 Swedish foundries (six of them

being medium-sized enterprises), finding that the major barriers were the costs/risks of production disruptions and the hassles and inconveniences; the lack of time or other priorities; the cost of obtaining information on the energy consumption of purchased equipment; other priorities for capital investments; the lack of sub-metering; and, the split incentives with the Energy Service Companies (ESCOs). Similarly, Thollander et al. [14] analysed less energy-intensive SMEs in the Swedish manufacturing sector which participated in an audit program, identifying as the main barriers, lack of time and low priority for energy efficiency. Trianni and Cagno [15] have analysed 128 Italian manufacturing SMEs, identifying, as the main barriers, lack of capital and information issues. This study nevertheless pointed out that relevant differences exist when investigating barriers to energy efficiency within SMEs, that therefore should not be bundled, at least in terms of sector and firm size. Moreover, from a methodological viewpoint, this study investigated the operational barriers which SMEs face when undertaking an investment in an energy-efficient technology, rather than the theoretical barriers, proposed by Sorrell et al. [10], which present remarkable difficulties when conducting empirical investigations. Taking inspiration from Sorrell et al. [12], Cagno et al. [16] proposed an innovative approach to the study of barriers to industrial energy efficiency. Following the framework proposed by Hirst and Brown [17], and adopting suggestions put forth in other studies which attempted to classify barriers [18–23], Cagno et al. identified the actors involved in energy-related purchases and operational decisions (i.e., external or internal actors, depending on the firm); they then grouped the internal barriers into seven categories: technology-related barriers; information; economic; behavioural; organisational; barriers related to competences; and awareness.

While the world of barriers has been widely explored, research into the drivers of energy efficiency seems to have lagged behind. The body of literature which has evaluated energy policies is quite large, however, with national or international studies covering all sectors (i.e., residential [24–26], industrial [27–30], and transportation [31–33]) while also investigating specific measures (see, e.g. [34–36]). Despite this broad-based effort, very little research has been performed into the investigation of specific drivers of energy efficiency which provide or incorporate SMEs' perspectives.

Drivers of energy efficiency, as defined by Reddy and Assenza [37], can be considered as the factors that promote private investment in energy efficiency. Thollander and Ottosson [38] defined driving forces as being the opposite of barriers, considering them to be “different types of factors that stress investments in technologies that are both energy-efficient and cost-effective”. It nevertheless seems that the definition remains unclear, which is why we propose here that drivers be understood as *factors facilitating the adoption of both energy-efficient technologies and practices, thus going beyond the view of investments and including the promotion of an energy-efficient culture and awareness*.

These drivers seem to still be unexplored in existing empirical studies. Indeed, Reddy and Assenza [37] have pointed out the existence of up to six specific drivers: awareness, decreases in technology price levels, increases in energy prices, the technology appeal, non-energy benefits, and environmental regulations. On the one hand, Reddy and Assenza [37] have clearly proposed these drivers as “examples”, thus recognising them as incomplete; on the other hand, these are purely theoretical, with no empirical evidence bearing on their relevance as drivers of energy efficiency.

A key contribution has been made by Thollander and Ottosson [38], who attempted to categorise the driving forces into different types such as: market-related driving forces, current and potential energy policies, and organisational and behavioural factors. This is in fact the first attempt, to the author's knowledge, to provide a

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