



# Understanding energy efficiency barriers in Ukraine: Insights from a survey of commercial and industrial firms



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## ABSTRACT

Improvement of energy efficiency is an important element of energy policy for a sustainable supply of energy in Ukraine. However, the country is facing several challenges to the large-scale deployment of energy efficient technologies. We conducted a two-stage quota sample survey of 509 commercial and industrial firms of all regions of Ukraine to understand the barriers to energy efficiency improvements. Our study finds that more than two-thirds of the commercial and industrial firms in the country view improvement of energy efficiency very important to their business. However, due to several barriers they are unable to realize the improvements of energy efficiency. Among the 19 potential barriers investigated in the study, the survey results show that high upfront investment requirement, lack of government policies to support energy efficiency improvements, higher cost of capital, and lack of information and awareness are the most critical barriers to the improvement of energy efficiency in the industrial and commercial sectors in Ukraine.

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## 1. Introduction

Ukraine is an Eastern European country located between Russia and Europe. Its geographic position has made it a natural gas transit country, whereby natural gas pipelines transfer Russia's natural gas to Europe via the Bratstvo and Soyuz pipelines (Soderberghn [1], Goldthau [2], Correlje [3], Cwiek-Karpowicz [4]). In 2012, 62% of the total domestic consumption of natural gas was supplied through imports (IEA (International Energy Agency) [5]). Although historically Russia supplied Ukraine with natural gas and petroleum at prices much lower than the market prices (Dimitrova [6]), the political events unfolding between Ukraine and Russia over the last few years are pushing toward higher prices of imported natural gas for Ukraine.

Although natural gas plays an important role in Ukraine's energy mix, more than half of the country's primary energy supply comes from uranium and coal resources; in 2012, these two energy commodities accounted for 54% of the total primary energy supply (IEA [5]). Ukraine depends heavily on nuclear energy, which accounts for almost 30% of the total domestic production of primary

energy commodities (i.e., coal, crude oil, natural gas, primary electricity).

Ukraine is facing two big challenges in terms of its energy supply. First, it is highly dependent on imports for its energy supply and most imports come from Russia; however, this relationship has been highly deteriorated since early 2014. Second, most of its energy supply and utilization infrastructure were built during the Soviet era and are highly inefficient because of aging and outdated (Ogaranko & Hubacek [7]); in addition, some existing infrastructure is inefficient by design. The inefficiency has been sustained due to prolonged distortions in the energy markets, such as low and subsidized energy prices for both consumers and industry and the sustained resistance to energy price reforms (ECS (Energy Charter Secretariat) [8]). This implies the importance of energy efficiency improvements in Ukraine. In a comprehensive review of Ukraine's energy policies in 2012, the IEA (International Energy Agency) found that improving energy efficiency was one of the three key milestones toward eliminating Ukraine's dependence on imports to meet its future energy demand (IEA [9]).<sup>1</sup> Improvement in energy

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<sup>1</sup> The other two milestones identified by the IEA are increased production of domestic gas through conventional and unconventional sources and development of biomass energy resources (IEA [9]).

efficiency is also a key concern of consumers as energy prices are expected to increase substantially because of energy sector reforms needed to attract FDI (foreign direct investment) in the energy sector in Ukraine (IEA [9], ECS [8]). Higher energy prices with low energy efficiency will increase consumers' energy expenditure burdens.

While existing studies, such as those from the ECS (Energy Charter Secretariat) [8] and IEA [9], strongly recommend that the government promote energy efficiency, including it as a key element of Ukraine's energy policy, realization of significant improvement in energy efficiency might be constrained by several factors. For example, do industrial and commercial firms understand the benefits of energy efficiency undertakings? How big are the benefits as compared to the opportunity costs of investment that firms need to allocate for energy efficiency improvements? Is financing available to invest in energy efficiency measures? If yes, at what cost? Is the Ukrainian government facilitating or planning to facilitate energy efficiency improvements? If yes, how? Answering these questions is necessary prior to formulating design policies or programs to deploy energy efficient technologies on a large scale.

A large number of studies has identified and analyzed barriers to energy efficiency in different countries. Examples include Annunziata et al. [10], Blass et al. [11], Costa-Campi et al. [12], Liu [13], Roding and Thollander [14], Sardianou [15], Schleich [16], Trianni et al. [17] Trianni and Cagno [18], Zhang et al. [19] DeCanio [20], DeCanio [21], DeCanio and Watkins [22].<sup>2</sup> These studies focused on different issues, including ranking different barriers, analyzing factors affecting the barriers, and attributing barriers to various characteristics of the firms (e.g., size, type).

Numerous studies have focused on ranking the barriers so that the most important ones are identified and appropriate policies can be formulated to address them. For example, through a survey of 48 manufacturing SMEs (small and medium-sized enterprises) in Northern Italy, Trianni et al. [17] finds that SMEs in Northern Italy perceive economic and information barriers as the major obstacles to their adoption of energy efficient technologies, while behavioral barriers do not seem to affect enterprises very much. Using a multiple-case study of 98 industrial firms in Fujian, China, Liu [19] identifies 17 barriers, classifying them into four categories (structural, regulatory, cultural, and contextual) and reports that lack of financial incentive is the most common barrier across the firms. Based on a survey of 480 SMEs along with semi-structured interviews, Kostka et al. [25] reports that informational barriers are the key hurdles to energy efficiency improvements in the small and medium-sized enterprises in Zhejiang province, China.

Surveying the largest eight non-energy-intensive manufacturing firms in Oskarshamn municipality in Sweden, Rohdin and Thollander [14] reports that risk of production disruption, information search costs related to energy efficient appliances/devices, and higher opportunity costs of investment were the main barriers to adopting increased energy efficiency. Using cross-sectional data from SMEs that participated in a German energy audit program between 2008 and 2010, Fleiter et al. [26] finds that high investment costs and lack of capital are the main barriers to energy efficiency in SMEs in Germany. In another study of Northern Italy, a statistical analysis based on a dataset of 322 municipalities conducted by Annunziata et al. [10] shows that capacity building through training

courses and technical support provided by energy audits positively affecting the adoption of energy efficiency in municipal buildings. DeCanio [21] points out that bounded rationality, principal-agent problems and moral hazard could be the main factors for the slow deployment of energy efficient technologies by firms. DeCanio [20] and DeCanio and Watkins [22] evaluates energy-saving investment decisions in the US, and show that the decision to join the US Environmental Protection Agency's voluntary Green Lights program is affected by economic reasons, instead organizational and some other firm-specific characteristics. Investigating the barriers to and the driving forces for the implementation of energy efficiency measures in Ghana's largest industrial area, Apeaning and Thollander [27] reveal that the most important barriers to energy efficiency improvements in the firms are economic (or market) barriers (e.g., lack of budget, no access to capital). Similarly, Brunke et al. [28] finds that internal economic and behavioral barriers are the biggest obstacles to energy efficiency improvement in the iron and steel industry in Sweden.

A number of studies point out that energy efficiency improvement is not a priority for firms. For example, based on a survey of 2848 German commercial and service firms, Schleich [16] finds that priority-setting of upper management, who often do not consider energy efficiency as a strategic priority, is one of the main barriers to energy efficiency improvement in Germany. Low priority for energy efficiency improvements is also reported in Sardianou [15] which surveys 779 industrial firms in Greece and finds that 62% of the firms did not consider energy saving a priority. However, low priority perceived by the top management itself might not be the barrier; instead, the factors causing the management to ignore energy efficiency might be the main culprit. For example, top management may not be well informed about the benefits of energy efficiency (i.e., information barrier). Relaxing the information barrier by involving the right managers may help. For example, based on 5779 energy efficiency recommendations made to 752 SME manufacturing firms under the US Department of Energy's Industrial Assessment Centers Program, Blass et al. [11] finds that involvement of top managers and more specifically of top operations managers in the adoption of energy efficiency practices significantly increases the adoption of energy efficiency measures, while involvement of general top managers without an operational role has little or no effect.

Some existing studies explore the relationship between size of the firms and adoption of energy efficiency measures. For example, using panel data from the Community Innovation Survey in Spain for 2008–2011 in a logit model, Costa-Campi et al. [12] show that firm size facilitates energy efficiency innovation. Using semi-structured interviews and questionnaires in 20 primary metal manufacturing SMEs in Northern Italy, Trianni et al. [29] finds that a firm's size, market innovativeness, and product and process innovation are the key factors affecting barriers to energy efficiency. Investigating the barriers to energy efficiency at 65 foundries in Europe, Trianni et al. [30] finds that smaller enterprises have a greater perception of the barriers than larger ones, mainly due to organizational issues.

Although several empirical studies have examined barriers to energy efficiency measures in various countries, to the authors' knowledge, to date no study has been carried out on Ukraine to identify barriers to energy efficiency improvements. This study aims to fill this gap.

To understand the barriers to energy efficiency improvements in Ukraine, we undertook a two-stage quota sample survey of 500 industrial and commercial firms located in all regions of Ukraine. The survey results suggest that lack of information, lack of awareness, and financial barriers are the main factors impeding investment in energy efficient technologies in Ukraine.

<sup>2</sup> Our brief review of literature focuses on barriers to energy efficiency faced by commercial and industrial firms. We have not included literature specific to barriers to energy efficiency in the household sector as this topic is beyond the scope of our paper. For detailed reviews of the literature on barriers to energy efficiency, please refer to Ruparathna et al. [23] and Cagno et al. [24].

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