Attitudes of SMEs Toward the Elements of Eco-efficiency: The Turkish Case

Fatih Cemil Özbuğday, Derya Fındık, Sıdıka Başçı, and Kıvılcım Metin Özcan

1 Introduction

Eco-efficiency is one of the latest buzzwords in many subfields of economics. Its achievement requires creating more value with less environmental impact. Since small- and medium-sized enterprises (SMEs) are responsible for most of the production in the industrial output, their adoption of elements of eco-efficiency is crucial for green growth. The adoption of eco-efficiency practices by SMEs is especially valuable in emerging economies such as Turkey where environmental regulations are less stringent. However, studies that focus on the attitudes of Turkish SMEs toward elements of eco-efficiency are limited. In this study, we investigate the attitudes of Turkish SMEs over three items concerning eco-efficiency: (1) increasing resource efficiency investments, (2) producing more environmentally compatible "green" products or services, and (3) the consumption of energy from renewable resources.

According to the World Business Council for Sustainable Development (WBCSD), "*eco-efficiency is achieved by the delivery of competitively-priced goods and services that satisfy human needs and bring quality of life, while progressively reducing ecological impacts and resource intensity throughout the*

F. C. Özbuğday
Department of Economics, Ankara Yıldırım Beyazıt University, Esenboğa, Ankara, Turkey

D. Fındık
Department of Management Information Systems, Ankara Yıldırım Beyazıt University, Esenboğa, Ankara, Turkey

S. Başçı (✉)
Department of Economics, Ankara Yıldırım Beyazıt University, Esenboğa, Ankara, Turkey

Graduate School in Computer Science and Mathematics Engineering (EISTI), Cergy, France

K. M. Özcan
Department of Economics, Social Sciences University of Ankara, Altındağ, Ankara, Turkey

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life-cycle to a level at least in line with the Earth's estimated carrying capacity." In other words, eco-efficiency is concerned with creating more value with less environmental impact, which is also what green growth envisages. The OECD (2019) defines green growth as "*fostering economic growth and development, while ensuring that natural assets continue to provide the resources and environmental services on which our well-being relies.*"

In many countries, SMEs are the backbone of the economy and contribute considerably to economic growth (OECD 2013; IEA 2015). Consequently, it is not a stretch to say that SMEs can play a significant role in green growth and creating an industrial and economic environment that has a positive impact globally. SMEs can act to reduce the environmental impact of their energy consumption.

This study focuses solely on Turkish SMEs. Turkish SMEs play a significant role in the Turkish economy. They make up 91.9% of all enterprises, provide 78% of all employment, constitute 55% of the GDP, and 50% of total investment.[1] Here, we examine the attitudes of Turkish SMEs to resource efficiency investments, the supply of green products or services and on-site energy generation from renewable resources in a descriptive way. To our knowledge, this is the first study which uses a sample that can represent all SMEs in Turkey concerned with this issue. Previous studies on the attitudes of SMEs to renewable energy resources have used very limited samples constructed based on region and sector. Furthermore, although there are studies measuring Turkish SMEs' resource efficiency and examining their attitudes toward resource management, there has been no study of Turkish SMEs' views of resource efficiency investments from an economic perspective. Similarly, no existing study has yet addressed Turkish SMEs' attitudes toward green products or services.

The Flash Eurobarometer, Small and Medium Sized Enterprises, Resource Efficiency and Green Markets (GESIS) dataset includes extensive information related to Turkish SMEs. Therefore, using this dataset provides us with the opportunity to analyze the issue in a more general sense. Two hundred and ninety-nine (299) representative firms are included in the last wave (2017 wave) of the dataset. The findings indicate that despite the presence of a largely positive attitude toward resource-efficient actions, 40% of firms from the dataset commented on the difficulties arising from administrative and legal procedures. The results further show that most SMEs rely on their own financial resources to become more resource efficient. However, they still require external support such as new technologies, grants, subsidies, or consultancy to improve resource efficiency in their activities. Interaction with other enterprises is seen as particularly crucial since cooperation with other companies is regarded as the most important method when becoming more resource efficient.

The results of the attitudes of Turkish SMEs toward the generation of on-site energy from renewables demonstrate that a small fraction of the firms (around 11%) use renewable energy sources for self-generation. These results indicate that Turkish

[1] See Başçı and Durucan (2017) for a review study on Turkish SMEs.

SMEs do not place much emphasis on achieving eco-efficiency through energy from renewables despite legislation that provides generous subsidies to firms.

For the outcomes of resource efficiency actions, 37% of the firms report that they have slightly decreased production costs. The results also reveal that the majority of the firms are reluctant to produce green products or services. One reason for this finding could be a lack of incentives. A vast majority of the SMEs believe that the presence of financial incentives for future projects would help them develop new green products or services.

This chapter contributes to the literature as it is the first academic study to focus on the attitudes of Turkish SMEs to on-site energy generation from renewable resources, resource efficiency investments, and supply of green products/services by using a sample capable of representing all SMEs in Turkey. The findings of this study verify the predictions of the theoretical literature on barriers to the investments on the elements of eco-efficiency. Insufficient information, missing markets or transaction costs in the form of increased bureaucracy are preventing Turkish SMEs from investing in the elements of eco-efficiency even though these investments will eventually yield greater pecuniary or nonpecuniary returns. This finding also concurs with the findings of the empirical literature on barriers to eco-efficiency investments or practices by SMEs (e.g., Fleiter et al. 2012; Rizos et al. 2016; Potapenko et al. 2017; Ghenta and Matei 2018). The Turkish government should intervene to remove the market frictions that serve as barriers to eco-efficiency investments to correct for this type of market failure. One intervention could be designing leaner regulatory and administrative structures for eco-efficiency increasing investments.

The chapter proceeds as follows: Sect. 2 presents the relevant literature; Sect. 3 presents the institutional set up in Turkey; Sect. 4 provides the tables and data used in the study; and Sect. 5 concludes.

2 Literature Review

2.1 SMEs and Eco-efficiency

In this section, we provide a summary of the literature on barriers to eco-efficiency increasing practices or investments by SMEs. The theoretical literature on barriers to the investments on the elements of eco-efficiency focuses on market imperfections such as transaction costs, missing markets, or informational problems (see Sutherland 1991; Howarth and Andersson 1993; Rentschler et al. 2018). These market imperfections may obstruct the rational agent from investing in the elements of eco-efficiency even though these investments eventually bring about greater pecuniary or nonpecuniary returns. This strand of the literature proposes regulatory intervention to eliminate barriers to efficiency investments.

The empirical literature on barriers to eco-efficiency investments or practices by SMEs mostly revolves around energy efficiency investments. There is an abundance

of empirical analyses on the barriers to energy efficiency investments by SMEs in different markets in many developed and less developed countries. These articles can be classified as case studies, descriptive studies, and econometric analyses. The results of the related articles are summarized in Table 1.

As shown in Table 1, there are a number of common themes in the results of previous studies. The most important factors among them are the lack of energy efficiency among priorities, financial problems (access to capital, length of return of investment), and lack of information. Thus, it can be concluded that the empirical studies verify the role of market imperfections implied by the theoretical literature. This suggests that even though there is a widespread need for increased efficiency, empirical analyses indicate that required measures are not always taken.

A related concept in the eco-efficiency literature is the "circular economy," which means "*keeping resources in use for as long as possible, extracting the maximum value from them whilst in use, then recovering and regenerating products and materials at the end of each service life*" (WRAP 2019). Although SMEs are increasingly aware of the benefits of a circular economy, they face various challenges in their transition toward it. These challenges are a lack of financial resources and technical skills and increased bureaucracy in evaluating the compliance of the activities performed by SMEs (Rizos et al. 2016; Ghenta and Matei 2018). Thus, the recently emerged literature on circular economy verifies the role of market imperfections as well.

The recent literature on transforming business models into more environmentally friendly business models also indicate market imperfections such as insufficient information for the adoption of eco-efficiency practices. For instance, Potapenko et al. (2017) examine the barriers to "green" modernization of SMEs and look into possible ways to overcome them in Ukraine. The results indicate that nearly 40% of SMEs do not have sufficient information on the means by which to transform their business into a more environmentally friendly one.

Another strand of the literature focuses on the importance of developing an environmental responsibility orientation among SMEs that would positively affect the adoption of eco-efficiency practices. For instance, based on evidence from the Eurobarometer 381 Survey on SMEs, Resource Efficiency and Green Markets González-Moreno et al. (2016) analyzes the environmental responsibility of European SMEs operating in the hospitality industry in Spain. The findings show that having an environmental responsibility orientation produces a positive and significant effect on sales growth in this industry. Aguado and Holl (2018) analyze the factors that are related to SMEs' environmental attitude by measuring environmental attitude with Corporate Environmental Responsibility (CER). They focus on Spain and Norway, as the two different countries in this regard. By using The Flash Eurobarometer 381 Survey data, Aguado and Holl (2018) test the hypothesis that Norwegian and Spanish SMEs present significant differences toward the implementation of CER. The results show that there is a significant difference in environmental commitment in favor of Norway. However, even after controlling for such firm-specific differences, Norwegian firms still show a higher probability for a pro-environmental attitude. Moreover, estimation results reveal that the incentive

Table 1 Barriers to energy efficiency investments by SMEs

Country case studies				
Articles	Country	Sectors	Sample size	Basic findings
de Almeida (1998)	France	Electric motor market		The inconsistency of the incentives and the limited rationality are obstacles to investments that increase energy efficiency
Ostertag (2012)	Germany	Electric motor market	10	The inconsistency of the incentives, the lack of information and the high transaction costs constitute an obstacle to investments that increase energy efficiency
O'Malley and Scott (2004)	Ireland	Mechanical engineering industry	7	Projects on energy efficiency were considered as low priority
Rohdin and Thollander (2006)	Sweden	Energy-intensive manufacturing sectors	8	It was found that the projects on energy efficiency were a low priority, there were time constraints, and the cost of disruptions in production resulting from energy efficiency investments was high
Cooremans (2012)	Switzerland	Electricity-intensive manufacturing sectors	35	Lack of strategic dimension of energy efficiency was found, and financial factors were found to be less important
Descriptive studies				
Gruber and Brand (1991)	Germany	SMEs	500	Both the low priority of projects on energy efficiency and a lack of information prevent energy efficiency investments
Harris et al. (2000)	Australia	All sectors	100	Reimbursement time and rate of return are obstacles to investments
Sorrell et al. (2004)	United Kingdom	Brewery	53	Low priority of energy efficiency projects, time constraint, and inadequate technology undesirably affect energy efficiency

(continued)

Table 1 (continued)

Country case studies				
Articles	Country	Sectors	Sample size	Basic findings
Thollander et al. (2007)	Sweden	SMEs for nonenergy production	47	Low priority of energy efficiency projects, time constraints, access to capital, and problems of capital use prevent investments in energy efficiency
Rohdin et al. (2007)	Sweden	Foundry industry	28	The difficulties in accessing capital and technical risks affect energy efficiency investments negatively
Thollander and Ottosson (2008)	Sweden	Pulp and paper industry	40	Technical risks and possible disruptions in production hinder energy efficiency investments
Thollander et al. (2015)	Japan and Sweden	Manufacturing industry	3139—Japan 74—Sweden	Subsidies for energy audit programs are the most-effective policy for SMEs in industrial sector
Catarino et al. (2015)	Portugal	Food, agriculture, ceramic and glass, timber, furniture, metal, and textile	549	In this paper, the barriers to energy efficiency were listed as lack of information and lack of time, economic and financial barriers. In addition, organizational, training/behavioral barriers can be seen in lack of employees' knowledge and aptitude
O'Keeffe et al. (2016)	United Kingdom	Several manufacturing sectors		Green Deal's energy-efficient methods were applied. The biggest gain is the employment in the green sector creation
Rahbauer et al. (2016)	Germany	Electricity sector	8996	This article provides solutions to the barriers that prevent the implementation of green electricity in 8996 firms in Germany
Tallini and Cedola (2016)	İtaly	Industry and service sector manufacturing		Implementation of energy efficiency methods in Italian manufacturing industry and service sectors and achieving cost-effective solutions

(continued)

Table 1 (continued)

Country case studies				
Articles	Country	Sectors	Sample size	Basic findings
Fresner et al. (2017)	Austria, Bulgari, Cyprus, Italy, Romania, Slovakia, Spain	Several manufacturing sectors	280 Firms	Six thousand five hundred toe of primary energy savings and a reduction in 13,500 tons of greenhouse gas emissions are achieved
Econometric analyses				
Velthuijsen (1995)	Netherlands, Slovakia, Czech Republic	Manufacturing Industry	313 (NL), 40–55 (SK), ~40 (CZ)	Problems in accessing capital, high risk, very long turnaround time, and poor market conditions are the obstacles to energy efficiency investments
de Groot et al. (2001)	Holland	9 Manufacturing industries	135	The low priority of projects related to energy efficiency and investments made negatively impact on energy efficiency investments
Diederen et al. (2003)	Holland	Greenhouse	603	Uncertainty about future energy prices is considered a negative factor
Anderson and Newell (2004)	USA	Manufacturing SMEs	>9000	Return time, costs, lack of personnel and liquidity constraints negatively affect energy efficiency investments
Schleich and Gruber (2008)	Germany	Service industry and small industries	Per sector 57–291 firms	Lack of information on energy consumption and the inconsistency of incentives is an obstacle to energy efficiency investments
Schleich (2009)	Germany	Service industry and small industries	>2000	Lack of information on energy consumption, energy efficiency measures, time constraints, and different priorities pose an obstacle to energy efficiency investments
Muthulingam et al. (2011)	USA	Manufacturing SMEs	>9000	Energy efficiency investments are shaped by the institutional hierarchy within the company

(continued)

Table 1 (continued)

Country case studies				
Articles	Country	Sectors	Sample size	Basic findings
Kostka et al. (2011)	China	SMEs	479	Lack of information is an obstacle to energy efficiency investments
Trianni and Cagno (2012)	Italy	Manufacturing SMEs	128	Access to capital hampers energy efficiency investments

Source: Table 1 is taken from Fleiter et al. (2012) and is reorganized by adding new literature which appeared after 2012

for firms to go beyond environmental legislation is not the same in Norway and Spain. Norwegian firms are more market-driven than Spanish firms in their pro-environmental attitude.

In brief, the related studies in the theoretical and empirical literature indicate various market imperfections as barriers to eco-efficiency investments or practices. In addition, institutional background and cultural differences also explain SMEs' environmental responsibility orientation that has an influence on the adoption of eco-efficiency practices.

2.2 Turkish SMEs and Eco-efficiency

Studies that focus on the attitudes of Turkish SMEs toward elements of eco-efficiency are limited. Although there are studies measuring Turkish SMEs' resource efficiency and examining their attitudes toward resource management (Önüt and Soner 2007; Ates and Durakbasa 2012), no study exists on Turkish SMEs' views of resource efficiency investments from an economic perspective. Similarly, there is no study addressing Turkish SMEs' attitudes toward green products/services. Furthermore, previous studies on the attitudes of SMEs to renewable energy resources (Uslu and Türkmenoğlu 2016) are also limited in the sense that they have used inadequate samples constructed on the basis of region and sector.

Among the studies examining Turkish SMEs' attitudes toward resource management, Önüt and Soner (2007) perform a data envelopment analysis (DEA) on the energy efficiency of 20 medium-sized enterprises in the metallic goods industry. Ates and Durakbasa (2012) present multiple case studies of SMEs in energy-intensive industries (iron, steel, cement, paper, ceramics, and textile) to investigate industrial energy management practices in Turkey. Their findings indicate that few of the surveyed SMEs actually implement corporate energy management in Turkey.

Uslu and Türkmenoğlu (2016) investigate the perception of SMEs in the central and eastern Black Sea region of Turkey to renewable energy. They focus on

renewable energy trends in SMEs situated in major cities in these regions. Ninety-two medium SMEs enterprises in the cities of Samsun, Ordu, and Trabzon took part in face-to-face interviews and online reviews. The results show that most of the businesses are aware of renewable energy; however, the government needs to do more to encourage SMEs to pursue renewable energy sources.

3 The Legal and Institutional Background for On-Site Electricity Generation from Renewables and Energy Efficiency Investments in Turkey

In this section, we present the legislative framework for the two elements of eco-efficiency in Turkey: on-site electricity generation (distributed generation) from renewables and energy efficiency investments. The reason for focusing on energy efficiency is that among the legislation and policies on resource efficiency, the most relevant and developed one relates to energy efficiency. Likewise, on-site electricity generation from renewables is brought forward by policymakers, and the relevant legislation is highly advanced.

3.1 Distributed Generation (On-Site Electricity Generation from Renewables)

The Turkish electricity market has experienced a radical transformation in the last two decades. Once organized around a vertically integrated public monopoly, the sector has transformed into a model of regulated competition with unbundled enterprises. All network operators and associated supply companies, as well as some of the generation assets, were further privatized. While the public transmission company (TEİAŞ) was preserved under public ownership, access to the grid has been regulated. Organized wholesale markets such as day-ahead and intraday markets were established in addition to a residual balancing market. The electricity generation and retail sale markets have been gradually liberalized. An essential element of the liberalization of the generation and retail electricity markets was the introduction of the unlicensed electricity generation (UEG) in 2010, of which the primary objective of the UEG is to meet the electricity needs of consumers at the closest generation assets.[2]

As a rule, all market activities in the supply chain of electricity must be licensed by the Energy Market Regulatory Authority (EMRA) in Turkey. However, unlicensed electricity generators are exempted from obtaining a license. Article

[2]By-Law on Unlicensed Electricity Generation in the Electricity Market, Turkish Official Gazette, 02.10.2013, No. 28783.

Table 2 Feed-in-tariffs for unlicensed electricity generation based on a renewable energy source

Production plant type (based on a renewable energy source)	Rate (US dollar cent per kWh)
Hydroelectric power plant	7.3
Wind power production plant	7.3
Geothermal power production plant	10.5
Biomass power production plant (incl. landfill gas)	13.3
Solar power production plant	13.3

Source: The Law on the Utilization of Renewable Resources to Generate Electric Energy (Law No. 5346)

14 of the Electricity Market Law (EML, Law No. 6446) outlines activities that are exempt from obtaining a license.[3] These license-exempt activities provide many administrative advantages to investors and consumers. For instance, there is no mandatory guarantee by the investor at the application stage. The measurement of performance parameters is not required for wind and solar power investments, unlike licensed electricity generation investments. Thus, UEG investors avoid massive hurdles for electricity generation investments. Furthermore, UEG allows consumers to become prosumers[4] by enabling them to feed any excess electricity they generated from renewable resources back into the grid at predetermined feed-in-tariffs.[5] This, in turn, allows easier financial investments. Thus, among the license-exempt activities, the most attractive and popular option is to establish power plants based on renewable energy sources (such as solar or wind power) with a capacity up to One Megawatt (MW). The feed-in-tariffs provided for different renewable energy sources are displayed in Table 2. These tariffs are defined under the YEK Support Mechanism, and outlined in the Law on the Utilization of Renewable Resources to Generate Electric Energy (Law No. 5346). These rates are offered for a 10-year period that starts with the commissioning of the UEG asset.[6]

Thus, UEG is, in many ways, similar to distributed generation (DG). Both enable generating electricity at the point of consumption in smaller scales. Renewables such as solar and wind power are the most common sources used when generating electricity in both UEG and DG. Therefore, when counting the benefits of UEG, one can readily refer to the benefits of DG. Ozbugday and Ozgur (2018) briefly explain the benefits of DG. It reduces the load on the network and becomes a substitute for sizeable investments in distribution and transmission lines, and the

[3]Article 14 of the Electricity Market Law (EML, Law No. 6446) constitutes the legal basis for the By-Law on Unlicensed Electricity Generation in the Electricity Market. The By-Law regulates the provisions for UEG. The Communique on the Implementation of the By-Law on Unlicensed Electricity Generation in the Electricity Market, offers clarifications and explanations concerning the implementation of the provisions in the By-Law.

[4]Prosumer is a new concept in the energy economics literature. It refers to consumers who generate their own energy for self-consumption.

[5]Article 22 of the By-Law.

[6]Previously, an extra premium was added to these feed-in-tariffs, if generators use domestically produced components. This has been changed with a recent alteration in the legislation.

construction of giant generating plants (El-Khattam and Salama 2004). DG enhances energy security owing to the diversification of energy sources (Lopes et al. 2007), alleviates environmental problems due to the use of renewable sources (Akorede et al. 2010), and improves the quality of supply (Bayod-Rújula 2009).

In addition to those macro-level benefits, UEG can provide new opportunities for electricity consumers in Turkey. Households, commercial or industrial enterprises, and agricultural facilities can generate electricity to meet their energy needs without obtaining a license from the EMRA. They further benefit from feed-in-tariffs, should they generate electricity from renewable resources. In this respect, UEG is particularly attractive for SMEs with large electricity bills. A case study below explains how UEG can contribute to a reduction in an SME's electricity bill and an improvement in its cash flow.

3.1.1 Case Study: A Wind Power Plant in the Backyard of a Factory

Let us consider a manufacturing SME that established an unlicensed wind power plant with a capacity of 500 kW in its backyard. If the capacity factor is 30%, we can calculate that this asset can generate $500 \times 0.30 = 150$ kWh of electrical energy per hour. Let us further assume that this power plant can work 8 h per day depending on weather conditions. Thus, a daily total of $150 \times 8 = 1200$ kWh of electricity is generated by this wind power plant. If the daily electrical consumption of the factory is 3000 kWh, then $3000 - 1200 = 1800$ kWh of electricity is withdrawn from the system (as a result of netting). Let us further assume that the power plant operates with a capacity factor of 20% following day. Then the hourly electricity generated is $500 \times 0.20 = 100$ kWh. If electricity is generated for 4 h, then a daily total of $100 \times 4 = 400$ kWh of electrical energy is produced. Once again, if the factory consumes 3000 kWh of electricity on the same day, then $3000 - 400 = 2600$ kWh of electricity will be withdrawn from the system. If the factory operates 26 days each month, and the power plant works with a capacity factor of 30% for half of these days and operates with a capacity factor of 20% for the remaining half, the total savings of electricity through the wind power is equal to $1200 \times 13 + 400 \times 13 = 20{,}800$ kWh. Considering that the industrial rate for electricity is 0.2834 TRY per kWh, we can calculate that the total monetary value of savings is equal to 5894.72 TRY.

Let us also suppose that the factory does not work 4 days in a month (say, on Sundays). The wind plant still generates electricity. Let us assume that on two of these 4 days the wind plant operates with a capacity factor of 20% (and 4 h a day), and on the other two days it operates with a capacity factor of 30% (and 8 h a day). Thus, the total electricity generated on these free days is equal to $2 \times (500 \times 0.3 \times 8) + 2 \times (500 \times 0.2 \times 4) = 2400 + 800 = 3200$ kWh. The feed-in-tariff for wind power plants is 7.3 US dollar cents per kWh (see Table 2). Thus, the total income for owner of the wind power plant equates to $3200 \times 0.073 = 233.6$ USD. As of October 2018, the USD is worth approximately 6 Turkish Liras. Then, the total monthly income is equal to $233.6 \times 6 = 1401.6$ TRY.

Combining these figures, we can compute that the monthly contribution of the power plant to this factory equates to 5894.72 + 1401.6 = 7296.32 TRY. If other items such as distribution and transmission fees and various taxes are included, then the total monthly contribution nears 9000 TRY. Of course, this figure is a lower bound for the estimation of the benefits, since there might also be indirect benefits such as abatement in CO_2 emissions.

There are approximately three million SMEs in Turkey. If only 1% of these companies (30,000 enterprises) could make similar investments from generating electricity through renewable resources, the total monthly contribution would be approximately 270,000,000 TRY (3.24 billion TRY annually).

3.2 Energy Efficiency Policies in Turkey

Among the legislation and policies on resource efficiency, the most relevant and developed one relates to energy efficiency. Energy efficiency policies in Turkey are based on the Energy Efficiency Law (No. 5627), passed in 2007. The essential aim of the Law is to prevent waste and to increase the efficiency of energy resources and energy use in order to ease the burden of energy costs on the economy and protect the environment. The Law consists of different sections on the organization of the administrative structure, educating the population on energy efficiency matters, sectoral subsidies, and administrative fines.

The National Climate Change Strategy Document for 2010–2023 backs up the policies laid down in the Energy Efficiency Law. Within the scope of the Document, it aims at increasing energy efficiency and reducing greenhouse gas emissions in building, industry, transportation, and energy sectors. Another relevant strategy document is the Energy Efficiency Strategy Document for 2012–2023. The Document plans the determination of a policy set supported by result-oriented targets and actions needed to be taken to reach the targets. Furthermore, energy efficiency measures to be taken during the period 2014–2018 are described in the Program for Improving Energy Efficiency section (No 1.14) of the 10th Development Plan. In addition, energy efficiency targets are defined in the 2015–2019 Strategic Plan of the Ministry of Energy and Natural Resources, under "Theme 2: Energy Efficiency and Energy Saving."

In line with the Directive 2012/27/EU of the European Parliament (also known as the Energy Efficiency Directive), the National Energy Efficiency Action Plan was approved by the High Planning Council on December 29, 2017 (decision number 2017/50) and entered into force on January 02, 2018. The targets of the National Energy Efficiency Action Plan are linked to the legislation outlined above and are also involved in the scope of the National Energy and Mining Policy prepared by the Ministry of Energy and Natural Resources in 2017.

The government provides generous subsidies to achieve the targets specified in the legislation outlined above. For instance, investments in energy efficiency by existing manufacturing industry plants with a minimum annual energy consumption

of 500 toe (tonnes of oil equivalent) to save energy at a minimum rate of 20% per unit and with a maximum payback period of 5 years will benefit from subsidies such as value-added tax exemption, customs duty exemption, tax deduction, employer's share of insurance premium support, interest rate support or investment place allocation (Council of Minister's decision no. 2014/6058).

More generally, efficiency-improving projects have been systematically supported by the government since 2009. Projects prepared in accordance with the procedures and principles published by the General Directorate of Renewable Energy are considered as EfficiencyImproving Projects (EIP) and for EIPs with a total cost of less than one million Turkish liras and with a payback period of less than 5 years, at most 30% of the project fee is conferred as a grant.

Another subsidy is known as Voluntary Agreement (VA) supports. These are grants given to enterprises that reduce energy intensity levels by at least 10% according to a pre-committed reference energy density level, which is the average of the 5-year energy densities, following a 3-year monitoring period. Should an enterprise make a voluntary agreement and fulfill its commitment, 20% of its energy expenditures (so long as they do not exceed 200,000 TRY) in the year of the agreement is provided to the enterprise in cash.[7]

To sum up, the legislative background in Turkey provides SMEs a number of ways to benefit them from generating electricity by using renewable resources and energy improving investments. The success of the relevant policies depends on whether the Turkish SMEs truly understand the value of energy from renewable resources and energy-improving investments, and relevant government subsidies to boost these.

In the following sections, the attitudes of Turkish SMEs to on-site energy generation from renewable resources, resource efficiency investments, and supply of green products/services will be examined in a descriptive way.

4 Data and Methodology

4.1 Sample Selection

In this study, we analyze the perceptions of SMEs in Turkey toward resource efficiency, green products or services, and the use of renewable energy sources in their production by using the last wave of Flash Eurobarometer, Small- and Medium-Sized Enterprises, Resource Efficiency and Green Markets (GESIS) Survey (2017). This survey includes a set of questions ranging from firm-specific variables as firm size, age, sector, and turnover to SMEs' perceptions of resource efficiency. Additionally, in the survey, there are questions revealing SME's potential to produce

[7] http://www.enerji.gov.tr/tr-TR/Sayfalar/Enerji-Verimliligi-Destekleri (last accessed on 11 March 2019).

green products and services. Firms, therefore, are asked whether they involve themselves in green production, or whether they have a certain level of intention to produce such products or services.

This survey was conducted in 2012, 2013, 2015, and 2017, respectively. Each wave includes questions measuring SMEs' perceptions of resource efficiency and green production. In this study, we use the last wave of the survey due to the difficulty of capturing the same information throughout the entire survey period. The last wave elaborates all questions related to resource efficiency and green production extensively.

The main reason for selecting Turkish data is that there has been an increasing trend among SMEs in Turkey to apply resource-efficient tools in their production. There are 299 observations in the sample. Nearly a quarter of the sample is composed of medium-sized firms (24%) while 40% of the sample consisted of small firms. There are 12 sectors defined in the questionnaire from mining to professional, scientific, and technical activities. Among these, the wholesale and retail trade sector has the largest share in the sample. Manufacturing and construction sectors have shares of 28% and 16%, respectively. A significant portion of the sample is composed of firms established before 2010 (77%). Considering the perceptions of firm performance, a large proportion of the sample has a positive evaluation of the current year's performance; nearly half (49%) indicate an increase in their companies' performance in comparison to the previous year.

4.2 Descriptive Analysis

From a methodological point of view, we use descriptive analysis and cross-tabulations to put forth the current situation of energy efficiency and distributed generation in Turkey.

4.2.1 Resource Efficiency

As far as the questions on resource efficiency are considered, topics could be summarized as resource efficiency, effects of resource efficiency on production, types of support for resource efficiency, use of environmental management system, difficulties of following resource-efficient strategy, and the tools required to be more resource efficient.

As shown in Table 3, firms use (and plan to use according to Table 4) different alternatives to achieve resource-efficient production. However, three of them come to the fore, which are minimizing waste, saving water, and selling scrap materials to other firms. Designing a new product, on the other hand, has the smallest share compared to other actions suggesting that firms in the sample rely on existing resources rather than generating new solutions.

Table 3 Attitudes toward resource efficiency

What actions is your company undertaking to be more resource efficient?	Freq.	Percent
Save water	53	17.73
Save energy	30	10.03
Use predominantly renewable energy	33	11.04
Save materials	43	14.38
Minimize waste	57	19.06
Sell your scrap material to another company	48	16.05
Recycling by reusing material or waste within the company	30	10.03
Designing products that are easier to maintain, repair, or reuse	5	1.67
Total	299	100.00

Table 4 Additional resource efficiency actions

Over the next 2 years, what are the additional resource efficiency actions?	Freq.	Percent
Save water	50	16.72
Save energy	20	6.69
Use predominantly renewable energy	26	8.70
Save materials	26	8.70
Minimize waste	52	17.39
Sell your scrap material to another company	53	17.73
Recycling by reusing material or waste within the company	50	16.72
Designing products that are easier to maintain, repair, or reuse	22	7.36
Total	299	100.00

Table 5 Target population

Is your company selling its products or services…?	Freq.	Percent
Directly to customers	214	71.57
Other firms	46	15.38
Public administration	35	11.71
n.a.	4	1.34
Total	299	100.00

This sample is largely composed of firms selling their products directly to customers. However, other firms or public administration agencies also constitute a target population for a considerable number of firms in the sample (see Table 5).

Despite the presence of a positive attitude toward taking resource-efficient actions, as shown in Table 6, 40% of the sample comment upon the difficulties arising from administrative and legal procedures. In the questionnaire, we do not observe any specific example for administrative and legal procedures. Thus, we assume that these procedures could be related to bureaucratic operations that assess whether firms in the sample are eligible for resource-efficient actions. Additionally, there are some problems concerning firms' adaptability to environmental regulations

Table 6 Difficulties of undertaking actions to achieve resource efficiency

Did your firm encounter the following difficulties when trying to set up resource efficiency actions?	Freq.	Percent
The complexity of administrative and legal procedures	109	40.07
Difficulty in adapting environmental legislation to your company	26	9.56
Technical requirements of the legislation not being up-to-date	26	9.56
Difficulty in selecting the right resource efficiency actions for your company	28	10.29
Cost of environmental actions for your company	28	10.29
Lack of specific environmental expertise	32	11.76
Lack of supply of required materials, parts, products, or services	14	6.15
Lack of demand for resource-efficient product or services	9	3.31
Total	272	100.00

Table 7 Type of support for resource-efficient production

Which type of support does your company rely on in its effort to be more resource efficient?	Freq.	Percent
Not mentioned	86	31.62
Its own financial resources	186	68.38
Total	272	100.00

implying that these firms may not have the required internal precautions to sustain environmentally friendly production.

In today's world, rapid technological changes necessitate a gradual update in production systems. If the technical requirements of the legislation are not updated according to the changes in the production systems, firms will show a reluctance to implement these requirements. This result is observed in this study in which 10% of the firms declare that outdated requirements threaten their actions toward resource efficiency. Moreover, in this sample, some firms have difficulties in selecting the best strategy to achieve resource efficiency. The costs of environmental actions and absence of expertise in related environmental effects are other challenges that firms need to overcome.

Another question in the survey is the type of support needed to achieve resource efficiency in SMEs' production processes. Table 7 reveals that a large proportion of the firms in the sample rely on firms' own financial resources.

Although firms sustain their production activities largely by relying on their own resources, they do require external support such as new technologies, grants, subsidies, or consultancy that enable them to improve resource efficiency in their activities. Among these, cooperation with other companies is stated as an essential tool in being more resource efficient (see Table 8).

Another relevant question relates to the effects of resource efficiency actions on production costs. Of the sample, 37% indicate that it has slightly decreased. However, there is a considerable share of negative perceptions among firms that point out increasing production costs (see Table 9).

Table 8 Type of tools for resource efficiency

Which of the following would help your company to be more resource efficient?	Freq.	Percent
Not mentioned	206	68.90
Better cooperation between companies	93	31.10
Total	299	100.00

Table 9 Impact of resource-efficient strategy on costs

What impact has resource efficiency actions had on the production costs over the past 2 years?	Freq.	Percent
Significantly decreased	23	9.46
Slightly decreased	101	37.13
Slightly increased	54	19.85
Significantly increased	36	13.24
Not changed	20	7.35
DK/NA	38	13.97
Total	272	100.00

4.2.2 On-Site Electricity Generation from Renewable Resources

Tables 3 and 4 also provide information on the attitudes of Turkish SMEs toward generating on-site energy from renewables. As can be seen from Table 3, only 11% of the firms use renewable energy sources for self-generation. These results indicate that Turkish SMEs do not put much emphasis on achieving eco-efficiency through energy from renewables despite legislation that provides generous subsidies to firms. As exemplified in the case study in Sect. 3.1.1, an SME with an unlicensed power plant that uses renewable resources can decrease its energy bill, avoid transmission and distribution fees and various taxes, and abate CO_2 emissions. Furthermore, as the feed-in-tariffs displayed in Table 2 are much higher than the market-clearing electricity prices in Turkey, SMEs could also earn extra income by selling the excess electricity they generate back to the grid. However, the results indicate that these benefits do not accrue since very few Turkish SMEs are interested in renewable energy sources for self-generation.

4.2.3 Green Production

When looking at green products and services, 11% of the sample is involved in the providing products and services relevant to the industry. Additionally, there is a considerable number of firms intending to become involved in green production in the future. However, the majority of firms are reluctant to produce green products or services (see Table 10).

Table 10 Green production

Does your company offer green products or services?	Freq.	Percent
Yes	33	11.04
No, but you are planning to do so in the future	43	14.38
No, and you are not planning to do so in the future	200	66.89
DK/NA	23	7.69
Total	299	100.00

Table 11 Duration of production activities

	Percent	Cum.
Less than 1 year	5	15.15
Between 1 and 3 years	8	24.24
More than 3 years	20	60.61
Total	33	100.00

Table 12 Type of market

In terms of turnover over the past 2 years, what were the main markets	Freq.	Percent
Not mentioned	8	24.24
National market	25	75.76
Total	33	100.00

Table 13 Type of financial resources

What type of support does your company rely on for its green production?	Freq.	Percent
Not mentioned	15	45.45
Financial incentives for developing production	18	54.55
Total	33	100.00

Only a small percentage of the firms selling green products and services for more than 3 years implement green production activities (see Table 11). They predominantly sell their products to national markets (see Table 12). In terms of financial and technical resources, they rely on their own financial resources and technical expertise (see Table 13). However, as shown in Table 14, 55% of them believe that the presence of financial incentives for future projects would help them develop new products. This dimension is also supported extensively by firms that do not produce green products and services.

Table 14 Alternative support for green production

What type of support would help most in expanding your range of green production?	Freq.	Percent
Not mentioned	15	45.45
Financial incentives for developing production	18	54.55
Total	33	100.00

5 Conclusion

In this study, we provide empirical evidence on the attitudes of Turkish SMEs toward the elements of eco-efficiency and descriptively examine their approach to on-site energy generation from renewable resources, resource efficiency investments, and the supply of green products or services. We use Flash Eurobarometer, Small- and Medium-Sized Enterprises, Resource Efficiency and Green Markets (GESIS) 2017 dataset for this purpose. There are 299 observations in the sample. Our observations show that only 19% of the firms try to minimize waste to be more resource efficient. On the other hand, the usage of predominantly renewable energy is 11%, which is not very high when compared with other actions undertaken for this purpose. When asked about resource efficiency plans for the next 2 years, firms respond with the following priorities: saving water, minimizing waste, selling their scrap material to another company, and recycling by reusing material or waste within company. Using predominantly renewable energy is not among the main concerns (11%).

Regarding the difficulties when trying to set up resource efficiency actions, firms declared the complexity of administrative and legal procedures as the most significant difficulty, noted by 40% in the survey. Sixty eight percent of the firms rely on their financial resources while trying to be more resource efficient. Nearly a third (31%) of firms believe that this difficulty can be solved by external supports such as new technologies, grants, subsidies, or consultancy. In order to solve this, cooperation with other firms can be a viable method. One interesting observation is about the production costs over the past 2 years when resource efficiency actions had been undertaken by the firms. Survey results show that only 9% of the firms think that their costs significantly declined, which is very low.

Finally, 11% of the sample produces green products or services, 14% of the sample is planning to do so in the future, and 67% of the firms are not planning to produce green products or services.

Based on these observations, we can say that the usage of predominantly renewable energy and production of more green products or services are not among the priorities of the firms. The two leading causes mentioned are the complexity of administrative and legal procedures and financial problems. Firms are looking for new technologies, grants, subsidies, or consultancy to change this situation and believe that this can better achieved by cooperating with other firms.

These results imply that there is a distance between Turkish SMEs and the elements of eco-efficiency. They still need external support to improve resource efficiency. Only a small fraction of Turkish SMEs introduces green products or services into the market, and most of them are not interested in electricity generation from renewable energy resources. Insufficient information, missing markets, or transaction costs in the form of increased bureaucracy are preventing Turkish SMEs from investing in the elements of eco-efficiency even though these investments will eventually yield greater benefits. These findings concur with the predictions of the theoretical literature and the findings of the empirical literature on barriers to the investments on the elements of eco-efficiency. As SMEs construct a sizeable portion of the output in the economy; the findings indicate that the contribution of SMEs to green growth will be lacking in the coming years unless further action is taken, and support provided by the Turkish government.

One intervention could be designing leaner regulatory and administrative structures for eco-efficiency increasing investments. It is evident that Turkish SMEs perceive legal and administrative barriers to resource efficiency investments. The reduction in red tape and simplification of administrative procedures eventually decrease transaction costs and make Turkish SMEs more eager to invest in resource efficiency.

Furthermore, the external support needed by firms about the technical and financial aspects of resource efficiency investments could be provided by the government. Similarly, public consultancy programmes on electricity generation from renewable resources could also be constructive for Turkish SMEs to overcome transaction costs and informational problems which prevent them from reaping the benefits of green energy.

Finally, in addition to consultancy services, to increase the share of SMEs that offer green products or services, the Turkish government could make these products or services more attractive by reducing taxes. The decrease in the taxes on green products or services makes the demand for these products or services increase which, in turn, makes the green market more profitable for SMEs.

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