This Programme is co-funded by
the European Union and Republic of Turkey

Project Name

Strengthening Communication and Data Sharing Network among Energy Efficiency Stakeholders

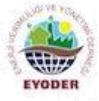
EuropeAid/139044/ID/ACT/TR
Reference: CFCU/TR2014/DG/04/A1-04

Activity 2.1.

Recommendation Paper on

Energy Efficiency, Energy Management, Energy Audits and Energy Performance Contracts

February, 2020



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"This publication was produced with the financial support of the European Union. Its contents are the sole responsibility of Energy Efficiency and Management Association (EYODER) and do not necessarily reflect the views of the European Union."

Editor: Ebru Acuner, MSc

Publisher: Yıldız Matbaa ve Dijital Baskı

Publication No: EYODER 2020.02.E

First Edition: February 2020, Ankara - Türkiye

This report is prepared by Energy Planning and Management Division of Energy Institute in Istanbul Technical University via ITU NOVA Technology Transfer Office under the project titled “Strengthening Communication and Data Sharing Network among Energy Efficiency Stakeholders” (EuropeAid/139044/ID/ACT/TR and Reference: CFCU/TR2014/DG/04/A1-04) conducted by Energy Efficiency and Management Association (EYODER).

ENERGY EFFICIENCY FROM THE PERSPECTIVE OF ESCOs IN TURKEY

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1. EXECUTIVE SUMMARY

In recent years, the world has become progressively complicated and subject to rapid adjustment that creates both opportunities and challenges. The strategic agenda, on the basis of crucial needs, provides an overall framework and direction for these responses, focusing on four core priorities:

- protecting citizens and freedoms
- developing a strong and vibrant economic base
- building a climate-neutral, green, fair and social world, regions, countries
- promoting partnerships at the global stage.

Generally expressed, energy policy addresses the political, economic, environmental, together with social aspects of these priorities that confront politicians, decision makers, managers, consultants, as well researchers. The following reinforcing dimensions can be specified by the world in the energy policy (EU, 2015):

- **Security, solidarity and trust:** energy security and cooperation among countries
- **A fully integrated internal energy market**: adequate infrastructure without technical or regulatory barriers
- **Energy efficiency**: reduction on the dependence on energy imports, lower emissions, and create jobs
- **Climate action, decarbonising the economy**: reduction of greenhouse gases emissions by economy-energy-environment strategy
- **Research, innovation and competitiveness**: supporting innovations in low-carbon and clean energy technologies leading the energy transition and improvement of competitiveness.

The policy keyword that includes all targets “energy efficiency”. This report examines energy efficiency considering “WHY, HOW, WHAT” circle. Starting with “why” is important to know the needs for the study. “How” can answer the method(s) of analysis. “What” refers to recommendations for the future. Under this framework, this report provides an overview of current situation on emerging energy efficiency policies in Turkey by comparing with European Union from the perspective of Energy Efficiency and Management Association (EYODER). After summarizing Sustainable Development Goals towards 2030, European Green Deal (2019 – 2024) and Turkish Eleventh Development Plan (2019 – 2023) in terms of energy efficiency, related regulations are analysed about the emerging energy efficiency policies both in EU and Turkey mainly in the context of energy service market. Then, a survey studies conducted in 2015 and in 2019 are explained in details. Especially the second survey, in order to see the energy service market situation Bayesian Belief Network analysis is utilized. By means of comparing the results obtained in both survey studies, the main findings and recommendations can be specified as follows:

- All strengths, weaknesses, opportunities and threats should be integrated on the basis of planning, doing, controlling and acting phases of the management for further improvement of the Turkish energy service market.

- Energy efficiency together with current hot subjects such as “carbon neutrality”, “circular economy”, “big data”, “digitalisation” and “industry 4.0” can be regarded as the central driver of innovation for the energy service market.
- New sufficient policy strategies based on measurement, data analysis, verification and continuous monitoring should be performed for sustainable business areas in the market.
- A clear direction for major technology and infrastructure investments in the market should be specified.
- An integration climate, energy, economic policies with social strategies, such as consumer behaviour analyses as a no cost energy efficiency measures, should be considered as a central component of the sustainability.
- It should be noted that criticizing constructively is always better than being destructive.

2. INTRODUCTION

The Sustainable Development Goals (SDGs) were adopted by all United Nations Member States in 2015 as a worldwide call by 2030. SDGs are the scheme to achieve a better and more sustainable future for all. They address the global challenges, comprising poverty, inequality, affordable and clean energy, climate change, gender equality, innovation, sustainability, peace and justice. The 17 SDGs (Figure 1) are all interrelated in order to "leave no one behind", hence, it is significant to succeed them all by 2030. For this reason, the creativity, know-how, technology and financial resources from all of society is required (UN, 2019).

Figure 1. Sustainable Development Goals - SDGs (UN, 2019)

Among SDGs, SDG 1 – no poverty, SDG 7- affordable and clean energy, SDG 8 – decent work and economic growth, SDG 9 – industry, innovation and infrastructure, SDG 11 – sustainable cities and communities, SDG 12 – responsible consumption and production, SDG 13 – climate action and SDG 17 – partnerships for the goals are all related to the energy sector considering their specific targets (Table 1). In case of SDG 1, production and commercialisation of efficient and renewable energy shall increase to access the electricity, as a pre-requisite for economic development and also create job opportunities. Furthermore, households shall save money and time due to reduced energy demand by means of energy efficiency. In terms of SDG 8 and 11 parallel to the SDG 1, energy access and energy efficiency shall enable enhanced productivity and inclusive economic growth. For SDG 9 and 13, modern and efficient energy technologies shall emit less carbon dioxide (CO_2). Through efficiency, SDG 12 shall contribute to the sustainable management and use of natural resources. SDG 17 can be understood as the tipping points of all the global goals, comprising policy coherence in all the fields based on high quality and reliable data and global partnerships among public, private and civil society institutions.

Table 1. SDGs and corresponding energy related targets

SDG	Energy Related Targets
01	- Ensure that all men and women, in particular the poor and the vulnerable, have equal rights to **economic resources**, access to **basic services**, **natural resources, appropriate new technology and financial services** - Build the resilience of the poor and those in vulnerable situations and reduce their exposure and vulnerability to **climate-related extreme events** and other **economic, social and environmental shocks** and disasters
07	- Ensure universal access to **affordable, reliable and modern energy services** - Increase **substantially the share of renewable energy in the global energy mix** - **Double the global rate of improvement in energy efficiency**
08	- Achieve higher levels of **economic productivity through diversification, technological upgrading and innovation** - Promote **development-oriented policies that support productive activities, decent job creation, entrepreneurship, creativity and innovation** - Improve progressively, **global resource efficiency in consumption and production** and **endeavour to decouple economic growth from environmental degradation**
09	- Upgrade **infrastructure and retrofit industries to make them sustainable, with increased resource-use efficiency** and **greater adoption of clean and environmentally sound technologies and industrial processes**, with all countries taking action in accordance with their respective capabilities - Enhance **scientific research, upgrade the technological capabilities of industrial sectors in all countries**
11	- Ensure **access for all to adequate, safe and affordable housing and basic services** and upgrade slums - Reduce the **adverse per capita environmental impact of cities**, including by paying special attention to air quality and municipal and other waste management - Support **positive economic, social and environmental links between urban, peri-urban and rural areas** by strengthening national and regional development planning
12	- By 2030, achieve the **sustainable management and efficient use of natural resources** - **Rationalize inefficient fossil-fuel subsidies that encourage wasteful consumption by removing market distortions**, in accordance with

	national circumstances, including by restructuring taxation and phasing out those harmful subsidies, where they exist, to reflect their environmental impacts, taking fully into account the specific needs and conditions of developing countries and minimizing the possible adverse impacts on their development in a manner that protects the poor and the affected communities
13	- Integrate **climate change measures into national policies, strategies and planning** - Improve **education, awareness-raising and human and institutional capacity on climate change mitigation, adaptation, impact reduction and early warning**
17	- Enhance **policy coherence for sustainable development** - Enhance the **global partnership for sustainable development**, complemented by **multi-stakeholder partnerships that mobilize and share knowledge, expertise, technology and financial resources**, to support the achievement of the sustainable development goals in all countries, in particular developing countries - Encourage and promote **effective public, public-private and civil society partnerships**, building on the experience and resourcing strategies of partnerships - By 2020, enhance capacity-building support to developing countries, to increase significantly **the availability of high-quality, timely and reliable data**

It can be easily observed that energy related targets are at the heart of many of these SDGs. Actually, one of these goals – commonly known as SDG 7 – is directly related to the energy issues and aims to ensure access to affordable, reliable, sustainable and modern energy for all by the end of 2030. With regard to SDG 7 targets (Table 1), the following improvements can be listed:

- From 2000 to 2018, the proportion of the global population with access to electricity increased from 78 per cent to 89 per cent, (number of people living without electricity will reduce below 1 billion).
- In 2018, the share of renewables increased to approximately 11% of total final energy consumption, since the 2000s. Nevertheless, an acceleration is necessary to achieve the desired level.
- In 2018, the energy intensity of the universal economy improved by 1.2%, slower than the 1.7% in 2017 and well below the rate required to meet the 2030 target (IEA, 2019).

Similar to SDGs, European Union (EU) has six priorities between 2019 and 2024, consisting of EU Green Deal, an economy that works for people, a Europe fit for the digital age, promoting European way of life, a stronger Europe in the world and a new push for EU democracy. Especially EU Green Deal can be stated as the most ambitious package of measures that should enable European citizens and businesses to benefit from sustainable green transition (Figure 2). Measures complemented with the roadmap of key policies range from transition to a circular economy, cutting emissions for zero pollution Europe, reaching clean, reliable

and affordable energy, investing in pioneering research and innovation and preserving Europe's natural environment. Sustained by development and investments in green technologies and new businesses, the Green Deal can be a new EU growth strategy in all policy areas under this framework. Involvement and commitment of the public, private and civil society institutions as well as the citizens is essential to its success (EU, 2019).

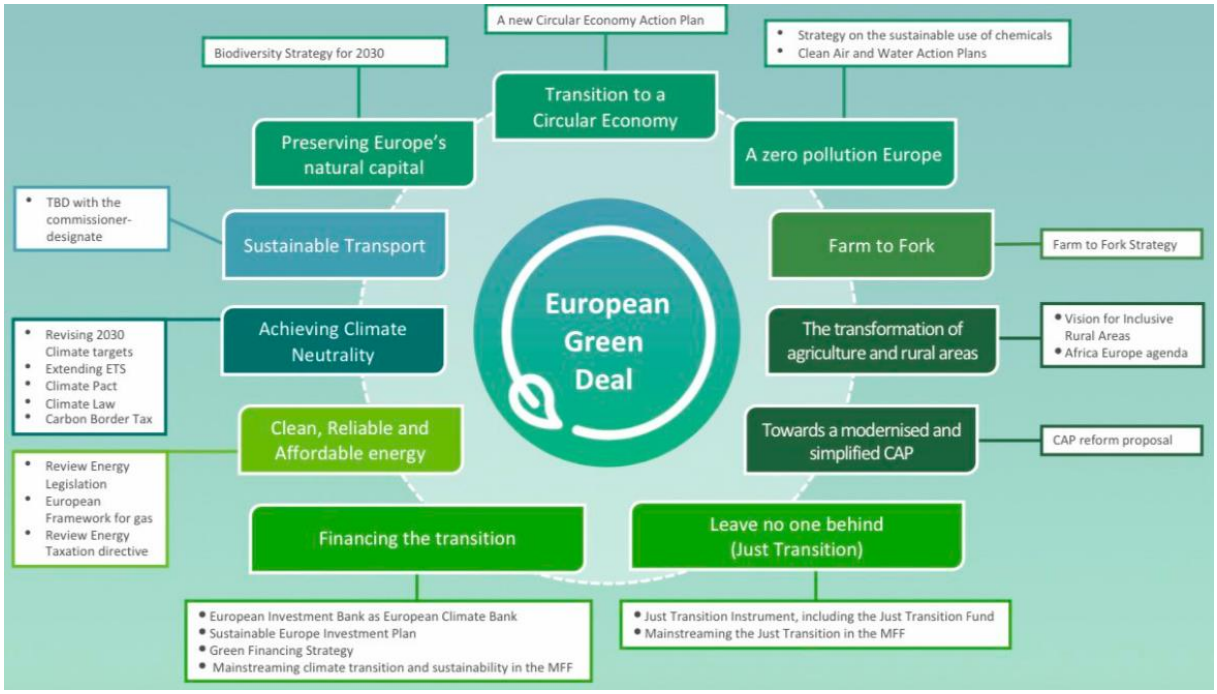

Figure 2. EU Green Deal (EU, 2019b)

Basic policy areas for the Green Deal is as follows:

- Clean energy: opportunities for alternative sources of energy
- Sustainable industry: developing more sustainable production cycles
- Building and renovating: more cleaner construction sector
- Sustainable mobility: promoting more sustainable means of transport
- Biodiversity: preserving fragile ecosystem
- Farm to Fork: more sustainable food systems
- Eliminating pollution: measures to cut all types of pollution efficiently.

In order to succeed in achieving targets under these policies, revision proposals of relevant legislative measures, such as Emissions Trading System Directive; Land Use Regulation; Energy Efficiency Directive; Renewable Energy Directive; etc. In parallel to SDGs, it can be claimed that energy issues, especially energy efficiency and renewable energy, is in the heart of the Green Deal to reduce emissions. While energy efficiency is of concern, the EU is presently on track to meet its 20 % target for 2020. Recent statistics present, conversely, that energy consumption is increasing vaguely. For example, the EU primary energy consumption was reduced 10.7 % between 2005 and 2015, but increased 1.4 % as compared with 2014. Achieving currently proposed 32.5 % energy efficiency target for 2030, primary energy consumption should be reduced 23 % in comparison with 2005. This can be succeeded if Member States make greater efforts to keep the EU on track towards its 2030 target (EU, 2018).

In Turkey, The Eleventh Development Plan (2019-2023) can be accepted as the main road map to meet the basic values and expectations, raise the international position of the country and increase the welfare, by revealing country's development vision with a long-term perspective. From the plan, five priority areas can be listed as follows:

- stable and strong economy
- competitive production and efficiency
- qualified people and strong society
- liveable cities and sustainable environment
- democracy and good governance

In the Plan, within the framework of these policy areas, main energy related issues can be summarized below with specified targets (Table 2):

- providing energy continuously with high quality and minimum costs
- meeting the increasing energy demand, by a competitive investment environment
- continuity of an energy market that is financially strong, stable, transparent, predictable, by taking sustainability into consideration (11th Development Plan, 2019).

Table 2. Turkish energy sector targets for 2023

Indicator	2023**
Total Primary Energy Demand (Thousand toe*)	174 279
Electrical Energy Demand (TWh)	375.8
Primary Energy Consumption (toe/capita)	2.01
Electrical Energy Consumption (kWh/capita)	4324

*toe is tonne oil equivalent

**please note that 2018-2020 economic situation will affect these figures.

The Turkish energy sector and energy policies need to evolve in step with the requirements to meet rising energy demand, foster sustainable economic growth for its cities and industries, and ensure the energy security needs of an emerging market located at the crossroads between Europe, Asia, and the Middle East in a period of significant geopolitical turmoil (IEA, 2016). In this process, due to tight supply and demand relation, energy efficiency has emerged as one of the most important agenda items in the energy sector, in terms of sustaining economic growth and reducing environmental impacts, particularly in relation to climate change.

3. WHY? – Background

As a rule of thumb, energy efficiency is the "first fuel" of all energy transitions. It is important to show that how energy efficiency alone could enable to achieve the related targets in EU Green Deal and Turkish Eleventh Development Plan at the end contributing the realisation of SDGs. For this purpose, regulations in EU and Turkey are analysed in the first and second section of this chapter with regard to energy service market development, respectively.

3.1. Energy efficiency market situation in European Union

Since the effects of climate change become more visible and widespread, EU urgently needs to make actions to manage this existential threat on the economy, considering green transition and technological evolution while making sure no-one is left behind as stated in SDGs. In other words, the EU must involve in-depth transformation of its own economy and society in a way that national circumstances of the Member States should be taken into account (EC, 2019).

Energy efficiency can be stated as a long-term priority for EU, and important for energy security, economic productivity, and environmental sustainability. Having accumulated a wealth of experience in developing energy efficiency programs, EU Member States should concentrate more on diversified energy efficiency investments.

In order to support the EU, towards its 20% energy efficiency target by 2020, 2012 Energy Efficiency Directive (2012/27/EU) (EED 2012) includes various mandatory measures. Under EED 2012, all EU countries have to use energy more efficiently at energy generation, transmission, distribution and end-use consumption. For this reason, the following measures have been adopted throughout the EU to consume not more than 1086 million tonnes oil equivalent (Mtoe) of final energy:

- obligation schemes for energy companies to achieve yearly energy savings of 1.5% of annual sales to final consumers
- national long-term renovation strategies for the building stock in each EU country
- making energy efficient renovations to at least 3% per year of buildings owned and occupied by central governments
- mandatory energy efficiency certificates accompanying the sale and rental of buildings
- the preparation of national energy efficiency action plans (NEEAPs) every three years
- minimum energy efficiency standards and labelling for a variety of products such as boilers, household appliances, lighting and televisions (energy label and eco-design)
- about 200 million smart meters for electricity and 45 million for gas by 2020
- large companies conducting energy efficiency audits at least every four years
- protecting the rights of consumers to receive easy and free access to data on real-time and past energy consumption (EED, 2012).

Under EED 2012, EU countries must prepare their NEEAPs every three years to show progress achieved concerning their national energy efficiency targets on an annual basis. NEEAPs basically specify planned energy efficiency measures in each sector under the framework with

estimated energy saving amounts and represent the efforts of individual EU countries to reach the overall target of 20%.

According to EED 2012, “energy service” means the physical benefit, utility or good derived from a combination of energy with energy-efficient technology or with action, which may include the operations, maintenance and control necessary to deliver the service, which is delivered on the basis of a contract and in normal circumstances has proven to result in verifiable and measurable or estimable energy efficiency improvement or primary energy savings. On this basis, the EED 2012 specifies what can be understood from energy services, energy service providers (ESPc), energy service companies (ESCOs) and energy performance contracting (EnPC). The following issues are included in EED 2012:

- a qualitative review of the market
- information about available energy service contracts together with related financial measures
- EnPC model contracts and list of available energy service providers
- dissemination of EnPCs’ best practices
- contact points for final customers
- independent mechanism for handling complaints and disputes
- independent market intermediaries, i.e. facilitators.

The EED 2012 provides additional basis to further support the development of the energy services market. For instance, calling for renovation of at least 3% of the national central government building stocks can, promote the use of energy services in the public sector, while the energy efficiency obligations (EEOS) enables ESCOs to contribute towards meeting the energy efficiency target. The obligation for large companies to do mandatory energy efficiency audits suggests the uptake of energy consultations on the management. It is also emphasized that member countries should take the necessary measures according to their national conditions to eliminate barriers to the development of the energy efficiency (Article 19). In case of energy performance contracting in the public sector with regards to public purchasing, annual budgeting and accounting, Member States can evaluate and take appropriate measures, if necessary. Finally, establishment of a National Energy Efficiency Fund may also involve dedicated streams of financing to support energy services projects (JRC, 2017). The relations among the articles of EED 2012 can be observed in Figure 3.

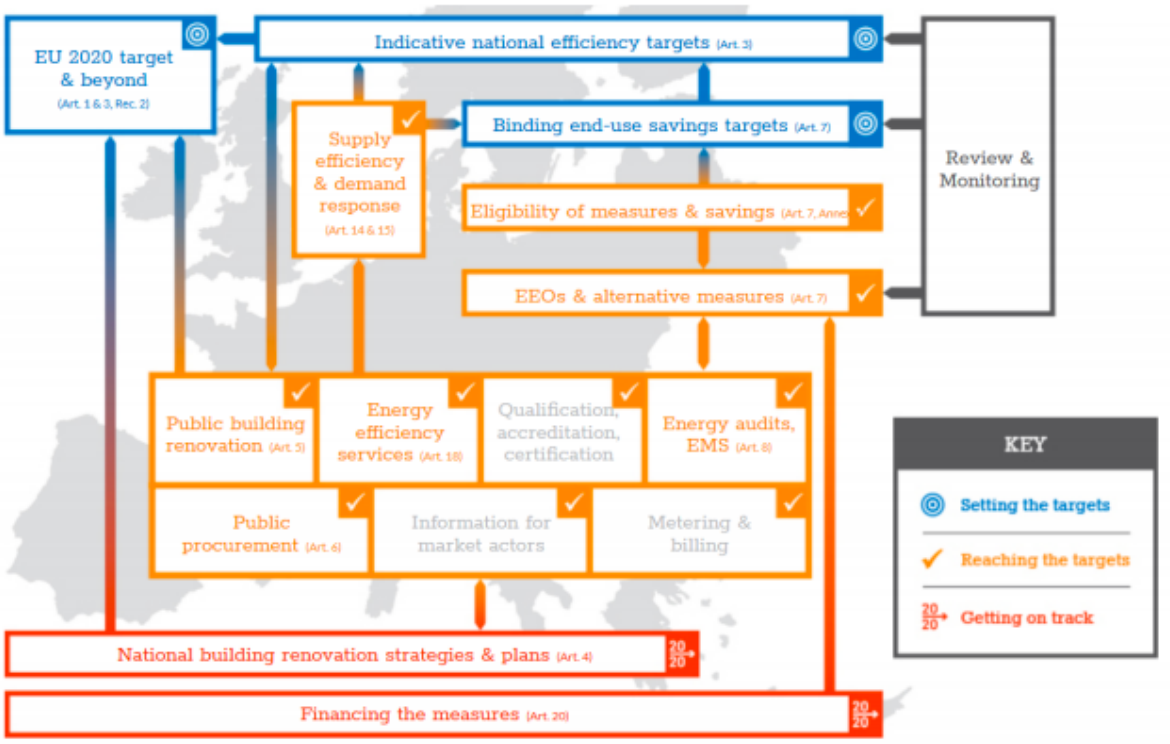

Figure 3. Articles in EED 2012 (JRC, 2017)

Within the framework of EED 2012, "energy service companies" (ESCOs) provide turnkey services covering a full range of activities: energy efficiency audit, design engineering, construction management, arrangement of long-term project financing, commissioning, operations and maintenance, savings monitoring and verification. Their distinct feature is associated with their remuneration structure, and in particular, their performance-based projects (i.e. energy performance contracts). On the other hand, "energy service provider companies" (ESPC) provide energy services for a fixed fee or as added value to the supply of equipment or energy (such as heating), also referred to as energy supply contracting (ESC). They operate on a design and build principle and their compensation is based on a predefined fee. All companies such as energy auditors, issuers of energy performance certificates or engineering firms that do not assume performance risk fall under this term.

Among ESCO companies, EnPC providers are often distinguished. These are ESCO companies, i.e. providers that implement energy efficiency or energy saving measures in the premises of a client repaying from the cost savings during operation phase (general ESCO), that also provide financial guarantee that the savings will be enough to cover the upfront costs and offer reimbursement should this prove wrong. In this meaning a savings guarantee links the ESCO/EnPC provider's remuneration to the achievement of the contractually set savings target. On the contrary, an energy service contract describes a contractual relationship between an energy service supplier/provider and the final energy user (client). These differences between the broader meaning of Energy Supply Contracting (ESC, selling the fuel itself) and EnPCs, shared or guaranteed are illustrated in Table 3.

Table 3. Key characteristics of EnPC and ESC (JRC, 2019)

	EnPC - Guaranteed savings model	EnPC - Shared Savings model	Energy Service Contracting (ESC)
Service provider	ESCO/EnPC provider	ESCO	Energy Service Provider Company (ESPC)
Key elements	Implementation of energy saving measures with ongoing monitoring & verification services to provide guaranteed energy savings.	Implementation of energy saving measures (mainly demand side) to provide cost savings associated with the overall energy/utility bill.	Efficient supply of useful energy such as heat, steam or electricity is contracted, measured and delivered in physical units.
Energy savings to be achieved	High priority - comprehensive and detailed approach covering both supply and demand side.	High priority - primary focus and incentive is for cost savings with technical operation requirements as secondary.	Low or no priority - limited to the supply side (boilers, chillers, etc.) without regard to demand-side equipment.
Guarantees provided by the ESCO	The ESCO guarantees the performance related to the level of energy saved throughout the contract life.	Not as standard. ESCO may guarantee a minimum performance related to cost of energy saved in current prices throughout the contract life.	No guarantees- May include incentives related to energy use reduction on the supply side without assuming any risk in case the expected efficiency improvement is not reached.
Payment	Payment derived from the energy savings achieved in constant prices of the base year.	Payment linked to the achieved change in energy costs.	Payment of a fixed rate/tariff, not considering energy performance.
Provider's risk	ESCO assumes technical design, implementation and performance guarantee risks.	ESCO assumes risk of energy price change (depends on current prices) and customer credit risk.	Provider usually does not assume technical or financial risk.
Energy savings transparency	High transparency – The more transparent energy savings requires more independent M&V.	Transparency varied - In general, the more transparent energy savings requires more independent M&V.	Low or no transparency - a specific energy bill reduction is established in monetary units.

Table 4 shows the change in the ESCO markets, in terms of the number of ESCOs and the volume of the ESCO markets between 2007 and 2018 within EU Member States. In terms of the energy service market volume, France and Germany have the largest markets, followed by Italy. Germany also has the biggest EnPC market in terms of the number of companies, projects and market volume.

Table 4. Overview of the development of the size of the energy services, energy efficiency services, and ESCO markets across Europe (JRC, 2019)

Country	First ESCO	Number of ESCOs					ESCO Market, EUR million annual
		2007	2010	2013	2015	2018	2018
Austria	1995	30	5-14	over 50	41	400 (EnS); 27 (EES); 36 (ESC)	30-40 (only public buildings)
Belgium	1990	30	13-15	10-15	10-15	6-13	20-30
Bulgaria	1995	1-3 (12)	20	7-12	15	12	Less than 10
Croatia	2003	1-2	2	10	10	8-15	20 (EnS); 14 (ESCO)
Czech Rep.	1993	7 (15)	8-10	20	15	15	9-15
Denmark	2010	4-5	10	15-20	15-20	4	70
Estonia	2014	2	2	2-3	<10	4	5
Finland	2000	9-11	8	5-8	6-8	15	6.5
France	1800's/1937	100	10+100	350	300	45	13.5 billion (EnS); 40-60 million (EnPC)
Germany	1990-1995		250-500	500-550	500	560 (EnS); 138 (EnPC)	9 billion (EnS);7.7 billion (EnPC)
Greece	2003	0-3	2	5	47	86 (3 providing EnPC)	n/a
Hungary	1990s		20-30	10	8-9	10 (5 EnPC)	n/a
Ireland			15	30		25	20
Italy	early 1980s	15-20	50 (100)	50-100	200-300	1500 (EnS); 340 (ESCO)	2 billion
Latvia	2001	40	5	8	50-60	60 (EnS); 3-6 (ESCOs)	2-3
Lithuania	1998	6	6	3-5	6	n/a	n/a
Luxembourg	1990s	3-4	3-4	3-6	3-6	n/a	n/a
Malta	not yet	0	0	0	0	n/a	n/a
Netherlands	mid 2000	very few	50	50	100	57 (EnPC): 28 public, 27 private	90-150
Poland	1995	<5	3-10	30-50	3-4 (30)	25 (EnS); 20 (EnPC)	n/a
Portugal	n/a	7-8	10-12	n/a		12-15	50-100
Romania	1996	2	14	15-20	20	7-13	47
Slovakia	1995	30	5	6-8	8 (20-50)	40 (10 EnPC providers)	
Slovenia	2001	1-2	2-5	5-6	5-6	10 (4 EnPC providers)	25 million (EnPC in public sector only)
Spain	n/a	100	>15	20-60	1000	70	1-1.5 billion
Sweden	1978	12-15	5-10	n/a	4-5	~20	3.79 (public sector only)
UK	1966	20-24	20	30-50	>50	136 (EES); 62 (ESCOs)	108.3

Figure 4 presents distribution of cumulative energy savings per policy measure between 2014 and 2016, under EED 2012. It can be observed that approximately one third of energy savings were achieved through energy efficiency obligation schemes, 23 % due to energy or CO_2 taxes and 18 % because of financing schemes or fiscal measures.

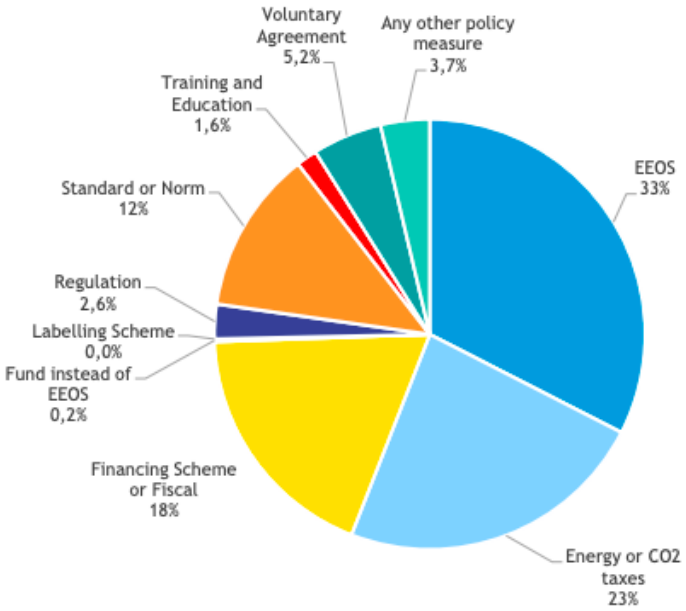

Figure 4. Distribution of cumulative energy savings in 2014-2016 (EC, 2019)

In 2018, within the framework of the "Clean energy for all Europeans package", Directive on Energy Efficiency (2018/2002) was agreed to update the policy framework to 2030 and beyond. The key element of the amended directive is setting energy efficiency target for 2030 of at least 32.5% which is to be achieved collectively across the EU relative to the 2007 modelling projections for 2030. In other words, EU energy consumption should not exceed 1273 Mtoe of primary energy and/or 956 Mtoe of final energy.

The directive allows for a possible update in the target in 2020, in case of substantial cost reductions due to economic or technological developments. It also comprises an extension to the energy savings obligation in end use sectors. Under the amending directive, EU Member States will have to realize 0.8% energy savings from final energy consumption in each year between 2021 and 2030.

The transition period for the Member States will end by 25 June 2020, except for metering and billing provisions by 25 October 2020. Under the Governance Regulation 2018/1999, Member States should draw up integrated 10-year national energy & climate plans (NECPs) defining how they plan to meet the energy efficiency and other targets for 2030. Other essentials in the amended directive can be listed as follows:

- Reducing greenhouse gases emissions at least 40% in comparison with 1990 levels
- Increasing renewable energy consumption proportion (at least 32%)
- Achieving energy savings (at least 32.5% improvement)

- Improving: energy security, competitiveness and sustainability
- stronger rules on metering and billing of thermal energy – consumers have clearer rights to receive more frequent, useful and transparent information on their energy consumption, allowing them enhanced understanding and control their heating bills
- requiring Member States to have in place transparent, publicly available national rules on the allocation of the cost of heating, cooling and hot water consumption in multi-apartment and multi-purpose buildings with collective systems for such services
- It will be necessary to renovate the house stock at a yearly rate of a 3%
- monitoring efficiency levels in new energy generation capacities - primary energy factor (PEF) is for how much primary energy is used to generate a unit of electricity or a unit of usable thermal energy) and it is advised to be 2.1 (reduced from the current 2.5)
- in 2024, a general review of the Energy Efficiency Directive (EU, 2018; Belotto, 2019).

3.2. Energy efficiency market situation in Turkey

Turkish Energy Efficiency Law has been developed for complying with the EU acquis in the field. The Law came into force on 2 May 2007 with the number 5627 and aims to achieve 25–30% savings in total energy consumption. The law comprises articles regarding efficient use of energy and administrative structuring, energy auditing, incentives, awareness raising, and the establishment of Turkish ESCO market for energy-efficiency services. In the Law, "ESCO" was denoted to as "EVD" company which is a direct translation for Energy Efficiency Consulting Companies in Turkish. According to the Law, any company providing energy efficiency related services and/or consulting can become EVD if it fulfils the requirements stated in not only the Law but also related secondary regulation as "Regulation on Increasing Efficiency in the Use of Energy Resources and Energy" (ENVER Regulation) in 2008 and 2011 with specific notification. In other words, in Turkey, EVD companies are to be state-authorized and are to be active under the specified legislation (Akman et al., 2013).

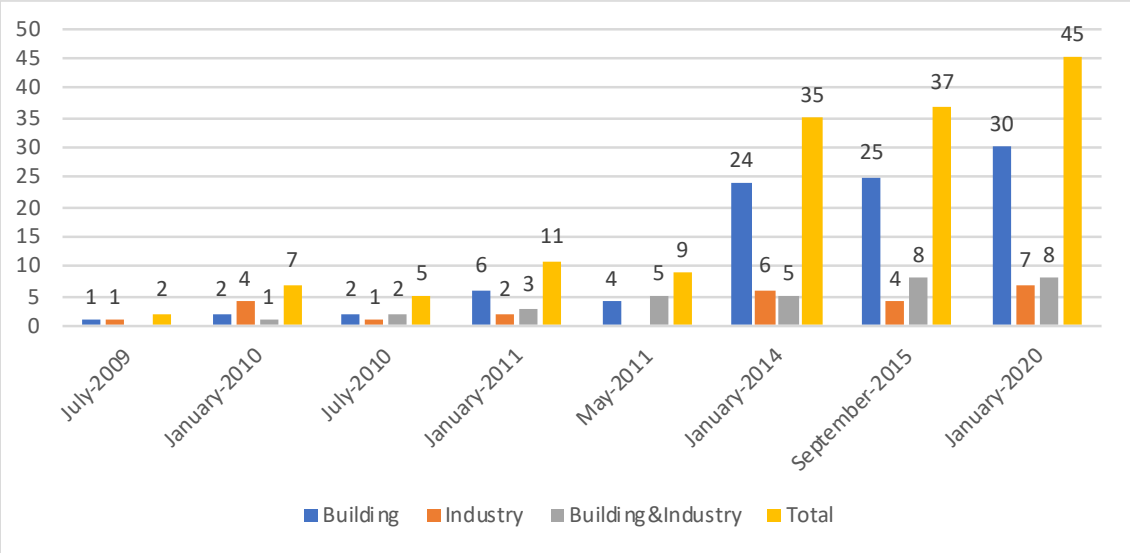

Figure 5. Number of EVD companies acting in the market between 2009 and 2020

Figure 5 shows the change in the number of EVD companies, acting in the market, in Turkey between 2009 and 2020. As of February 2020, there are 45 companies certified as EVD.

Among these companies, 35 is serving for the building sector; 7 is for industry sector, and 8 is active for both sectors. As can be seen from the figure, especially between 2014 and 2020, there is a sharp increase in the number of EVD companies, especially in 2014 and 2020. It is worth to mention that in 2011, due to changes in the structure of general directorate, issuing EVD licenses, under Ministry of Energy and Natural Resources (MENR), the authorization of companies had been ceased and started after 2012.

Within the scope of the legislation, **energy efficiency studies such as audits through service agreement and application projects by implementation agreement** are envisaged to be carried out through EVD companies. Figure 6 represents the number of studies for the industry and building sectors between 2015 and 2018. While the number of audits performed by EVD companies in the industry was 134 in 2015, it increased by 46% in 2016 to 196. The increase in the number in 2017 is 34% compared to 2015, and the number of services is 179. In 2018, 96 energy studies were conducted in the industrial sector (EVCED, 2019).

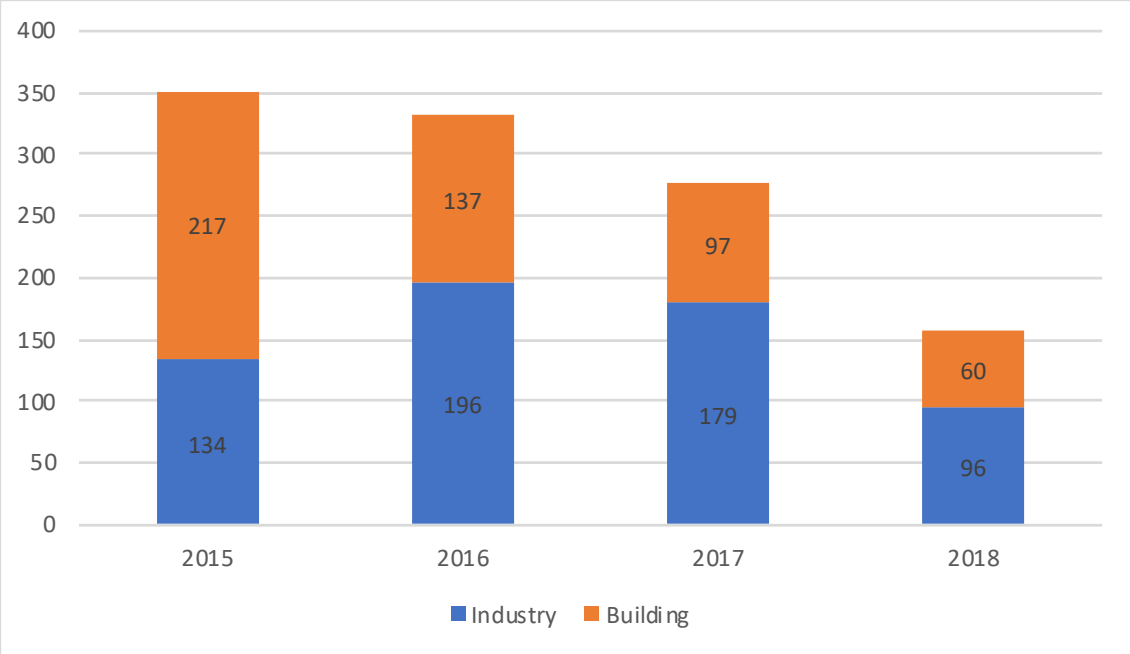

Figure 6. Energy efficiency audit studies between 2015-2018 (EVCED, 2019)

While the number of energy efficiency audits provided by EVD companies in the building sector was 217 in 2015, it was 138 in 2016 with a 36% decrease. In 2017, the number decreased by 30% compared to the previous year and reached 97. The number of energy studies conducted in the building sector in 2018 is 60, although most of the EVD companies has been serving for the building sector.

In Figure 7, the total saving potentials determined in the industrial energy efficiency audits are given in TOE / Year and TL / Year, and the investment amounts required for realizing these savings are shown, as well. While the energy saving potential determined in 2015 was approximately 200 thousand TOE/year corresponding 260 million TL /year, the amount of investment required to achieve these savings was approximately 520 million TL. In 2016, the monetary equivalent of the amount of energy savings potential was 295 million TL /year with

an increase, while its TOE equivalent was 191 thousand TOE/year. The amount of investment required to realize the savings specified in 2016 was around 630 million TL. In 2017, it is seen that savings were 85 thousand TOE/year and 137 million TL/year and the amount of investment required to achieve the savings mentioned in 2017 was close to 380 million TL. The monetary value of the saving potential determined according to the energy efficiency audits conducted in 2018 is 155 million TL/year and the energy equivalent is approximately 75 thousand TEP / Year. Approximately 310 million TL investment was required to achieve this savings. While the simple payback period of investments for 2015, 2016 and 2018 is around 2 years, the repayment period of investments in 2017 is close to 3 years.

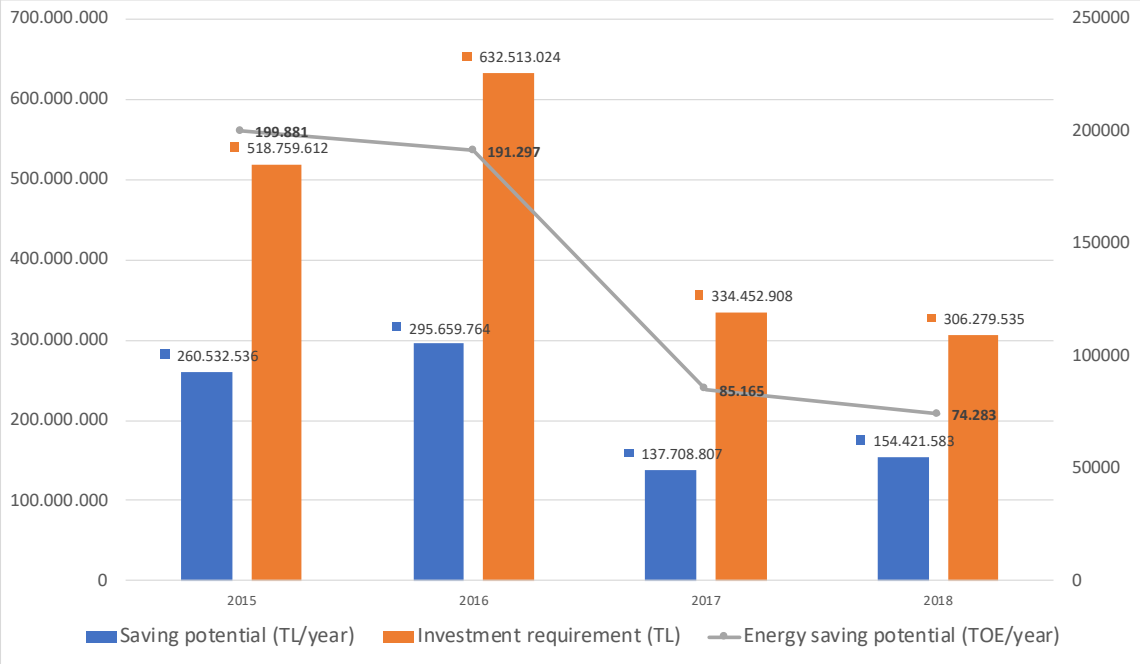

Figure 7. Industrial energy efficiency audits with saving potentials and investment requirements (EVCED, 2019)

In the evaluation made over the energy saving potential for industry and the projected investment amounts it can be stated that it was in 2.595 TL/TOE in 2015, 3.306 TL/TOE in 2016, 3.927 TL/TOE in 2017 and 4.124 TL/TOE in 2018. In this context, the most important reasons for the change in the amount of investment required per unit energy saving are the increase in initial investment costs due to the increase in exchange rates, the inclusion of projects with long payback periods according to the needs of the industrial enterprise, and the difference in the project composition (heat / electricity) within the scope of the study.

The amount of total saving potential determined in the energy efficiency audit studies in the building sector is given in Figure 8 together with the investment amounts required for realizing these savings. While the energy saving potential determined in 2015 was approximately 20 thousand TOE/year and 88 million TL/year, the amount of investment required to achieve these savings was 208 million TL. After a decrease in 2016 and 2017 about 44% and 66% in terms of energy saving potentials as compared to 2015, respectively, there was 11.5% increase in 2017-2018 period. This can be justified from the number of audits, observed in Figure 5.

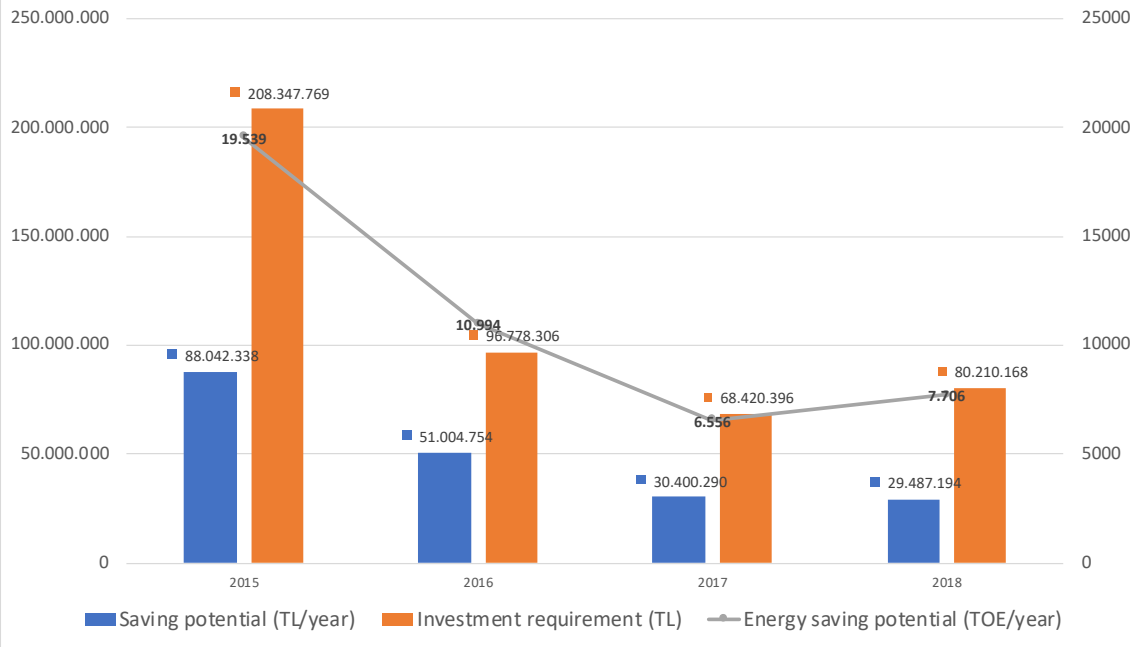

Figure 8. Building sector energy efficiency audits with saving potentials and investment requirements (EVCED, 2019)

While the simple payback period of investments for 2015 and 2018 is close to 3 years, it is about 2 years for 2016 and 2017. The amount of investment needed to save one TOE energy can be calculated as 10.663 TL/TOE in 2015, 8.803 TL/TOE in 2016, 10.436 TL/TOE in 2017 and 10.408 TL/TOE in 2018. The same reason stated for the industry sector can be accepted for the building sector for explaining the changes in the required investment per unit of energy saved.

Energy management services consisting of training, auditing, measurement, monitoring, planning and implementation activities are carried out to ensure the efficient use of energy. Within this scope, the following services are provided to commercial and service buildings by EVD companies:

- Establishing an energy policy defining goals and priorities in energy management
- Establishment of energy management systems in buildings in accordance with TS ISO 50001 Energy Management System-User Manual and Conditions Standard
- Determining measures for improving consumption behaviours, preventing unnecessary use and organizing training programs to increase the level of knowledge and awareness of employees
- Monitoring and evaluating energy consumption and costs with periodic reports
- Making audit studies, preparing and implementing energy efficiency projects
- Identification and implementation of modifications on energy consuming systems, processes or equipment
- Monitoring the efficiency of energy consuming equipment and systems considering required maintenance and calibration on time
- Allocation, installation and calibration of measuring devices needed to monitor energy consumption on time

- Preparing and implementing measures to protect the environment, reduce harmful emissions and not exceed the limit values by changing the energy mix and to investigate the possibilities for alternative energy sources
- Preparation of risk mitigation plans to reduce the use of oil and natural gas to be implemented in case of energy shortages
- To send annual information on energy use and energy management to MENR until the end of March every year.

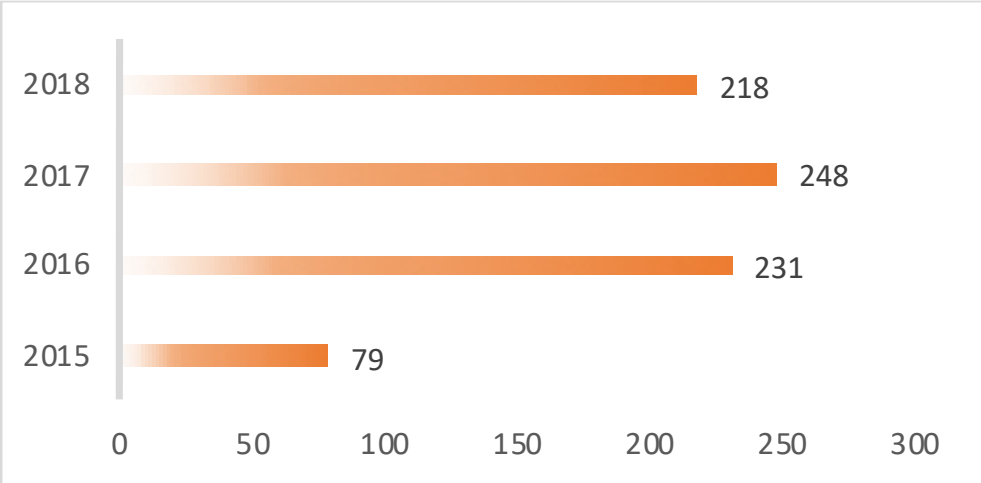

Figure 9. Number of building energy manager service given by EVD companies (EVCED, 2019)

Figure 9 represents the number of building energy manager service given by EVD companies. As can be observed, from 2015 to 2016, the number increased almost three times. For the following years until 2018, it can be said that the service continued, steadily.

Energy efficiency projects (VAPs) cover studies such as the use of energy efficient equipment and systems, modification, rehabilitation and process regulation, including solutions on issues such as preventing or minimizing unnecessary energy use, waste energy recovery, energy losses and leakages. To date, 23.1 million TL has been paid to 210 projects in total by MENR as a grant. While the total investment amount of these projects was 96.5 million TL, an annual financial saving of 84 million TL was achieved. In addition to VAPs which were prepared by EVD companies and supported by MENR, other special projects are prepared and implemented between either industrial enterprise or building management and EVD companies. Hence the total number of energy efficiency projects can be seen from Figure 10 with an increasing trend.

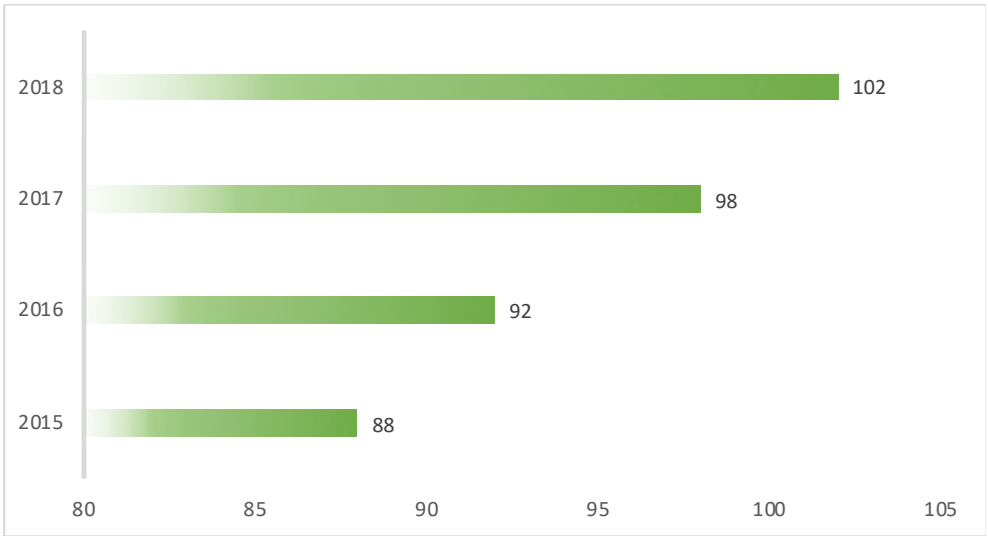

Figure 10. Number of energy efficiency projects conducted by EVD companies (EVCED, 2019)

The total savings potential determined in the applied energy efficiency projects is given in Figure 11 together with the investment amounts required to realize these savings. While the simple payback period of investments for 2015, 2016 and 2017 is close to 2 years, this is around 2.5 years in 2018. One of the main reasons for this difference can be concentrating especially in the building sector in 2018. The savings potential gained in the building sectors with relatively low energy intensity with regard to energy intensive industry sectors may be low in amount.

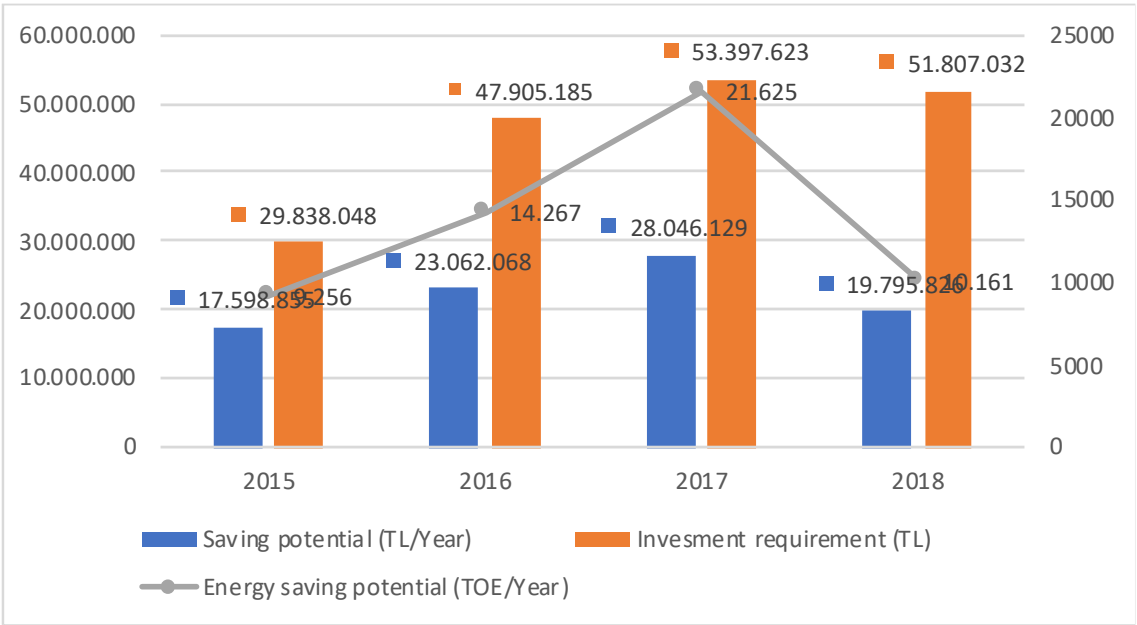

Figure 11. Energy efficiency projects with saving potentials and investment requirements (EVCED, 2019)

TS ISO 50001 Energy Management System is the standard that provides the determination, prioritization and reporting of energy performance improvement opportunities by means of action plans for setting targets to reduce specific consumptions and creating energy performance indicators. The main aim is to enable organizations to establish the systems and processes necessary to **continually improve** "energy performance", including energy

efficiency, energy use and energy consumption. Successful implementation of an energy management system (EnMS) supports a culture of energy performance improvement that depends upon commitment from all levels of the organization, especially top management. In many instances, this involves cultural changes within an organization. With the TS ISO 50 001, it is also aimed to establish energy policy, manage energy consumption with a systematic approach, protect the environment, use resources effectively, reduce greenhouse gas emissions, ensure compliance with legislation and carry out energy efficiency and management activities by integrating with other management systems. Energy performance indicators (EnPIs) and energy baselines (EnBs) are two interrelated elements addressed in the document to enable organizations to demonstrate energy performance improvement. In the context of energy management, the Plan-Do-Check-Act approach can be outlined as follows:

- Plan: understand the context of the organization, establish an energy policy and an energy management team, consider actions to address risks and opportunities, conduct an energy review, identify significant energy uses (SEUs) and establish energy performance indicators (EnPIs), energy baseline(s) (EnBs), objectives and energy targets, and action plans necessary to deliver results that will improve energy performance in accordance with the organization's energy policy.
- Do: implement the action plans, operational and maintenance controls, and communication, ensure competence and consider energy performance in design and procurement.
- Check: monitor, measure, analyse, evaluate, audit and conduct management review(s) of energy performance and the EnMS.
- Act: take actions to address nonconformities and continually improve energy performance and the EnMS.

Effective implementation of this standard provides a systematic approach to improvement of energy performance that can transform the way organizations manage energy. By integrating energy management into business practice, organizations can establish a process for continual improvement of energy performance. By improving energy performance and associated energy costs, organizations can be more competitive. In addition, implementation can lead organizations to meet overall climate change mitigation goals by reducing their energy-related greenhouse gas emissions. EVD companies can provide consultancy services for institutions, facilities and organizations to obtain TS ISO 50001 Energy Management System in line with their goals and objectives.

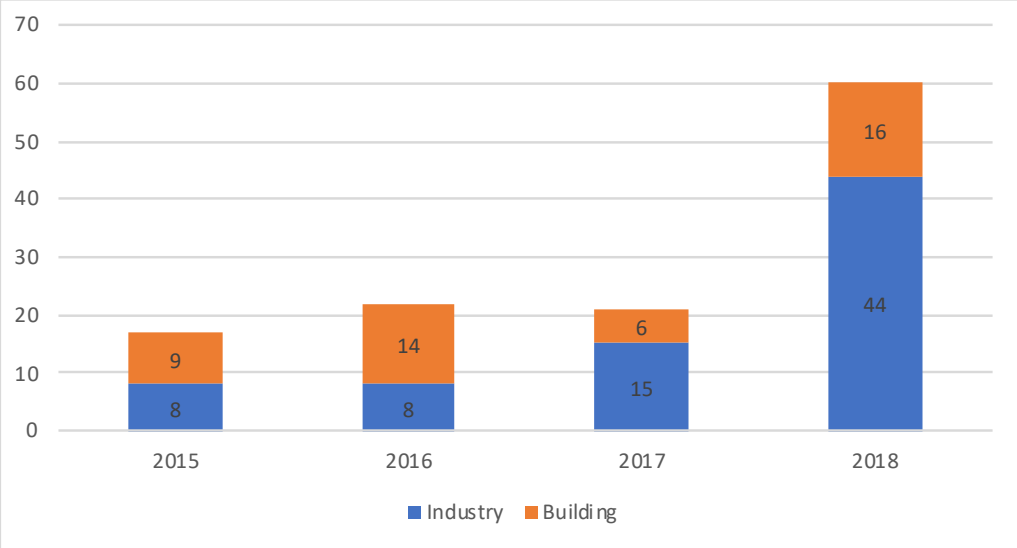

Figure 12. TS ISO 50 001 services given by EVD companies for industry and building sectors (EVCED, 2019)

The numbers of ISO 50 001 consultancy services provided by EVD companies are given in Figure 12. While the number of industrial enterprises served in 2015 was 8, the number of buildings served was 9. The number of industrial enterprises served in 2016 remained constant, while the number of buildings served increased by 5 to 14. The number of buildings served in 2017 fell significantly to 6, and the number of industrial enterprises served increased to 15. In 2018, ISO 50 001 consultancy services were provided to 44 industrial enterprises with significant increase and 16 buildings by EVD companies due to being mandatory especially for applying VAP project incentive as well as for some procurements, for which it is stated either in the qualification requirement or reason for the preference.

With the energy performance contracts (EnPC) signed between the contractor and the customer, a financing mechanism is established based on the reimbursement of the first investment costs of energy efficiency or renewable energy projects with the savings to be provided in the following years. The energy efficiency project is based on the principle of making payments to the EVD company as much as the difference between the reference energy consumption and the actual consumption for a certain period of time, in return of the investment that is made. Savings are guaranteed with the contract and the savings are left to the customer at the end of the contract period. With EnPC, the first investment costs are provided by the contractor and the savings to be achieved with the project implemented are guaranteed. Since the comfort conditions and production quality are defined in the contract, the risks that may occur in the project implementation are secured on behalf of the customer. The number of EnPC made by EVD companies is given in Figure 13.

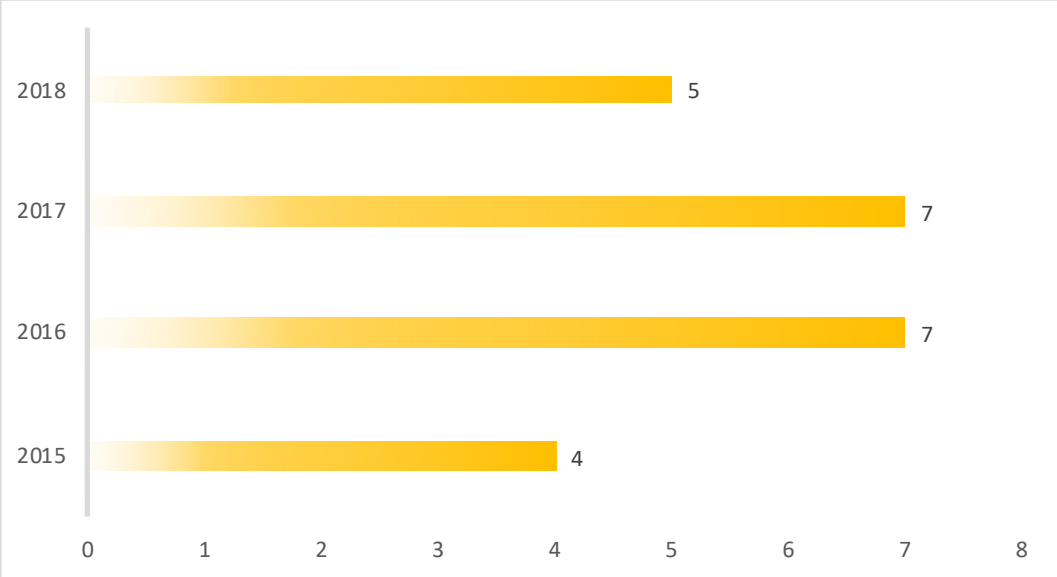

Figure 13. Number of energy performance contracts made by EVD companies (EVCED, 2019)

The total amount of savings potential determined in EnPCs issued is given in Figure 14 with the investment amounts required for realizing these savings. In 2015, while the energy saving potential is around 980 TOE/year corresponding 1.1 million TL/year, the amount of investment required to achieve these savings is around 2.1 million TL. In 2016, the monetary equivalent of the amount of energy savings potential detected was 89 million TL/year with an increase of 89%. Between 2015 and 2017, saving potentials determined in EnPCs was increased, sharply about 196%. On the other hand, there is a severe decrease between 2017 and 2018 and the saving potential decreased nearly 76%. Though the simple payback period of investments for 2015 and 2016 is less than 2 years, this period is slightly above 2 years for 2017, and in 2018, this period exceeds 4 years.

In line with the data obtained from EVD companies, along with the increasing number of EVD companies, the number of technical staff working on energy efficiency has also increased over the years. The number of employees, which was 222 in 2015, was 269 with an increase of 21% in 2016 and 326 in 2017 with an increase of 21% compared to the previous year. In 2018, the number of technical personnel working on energy efficiency in companies was 329.

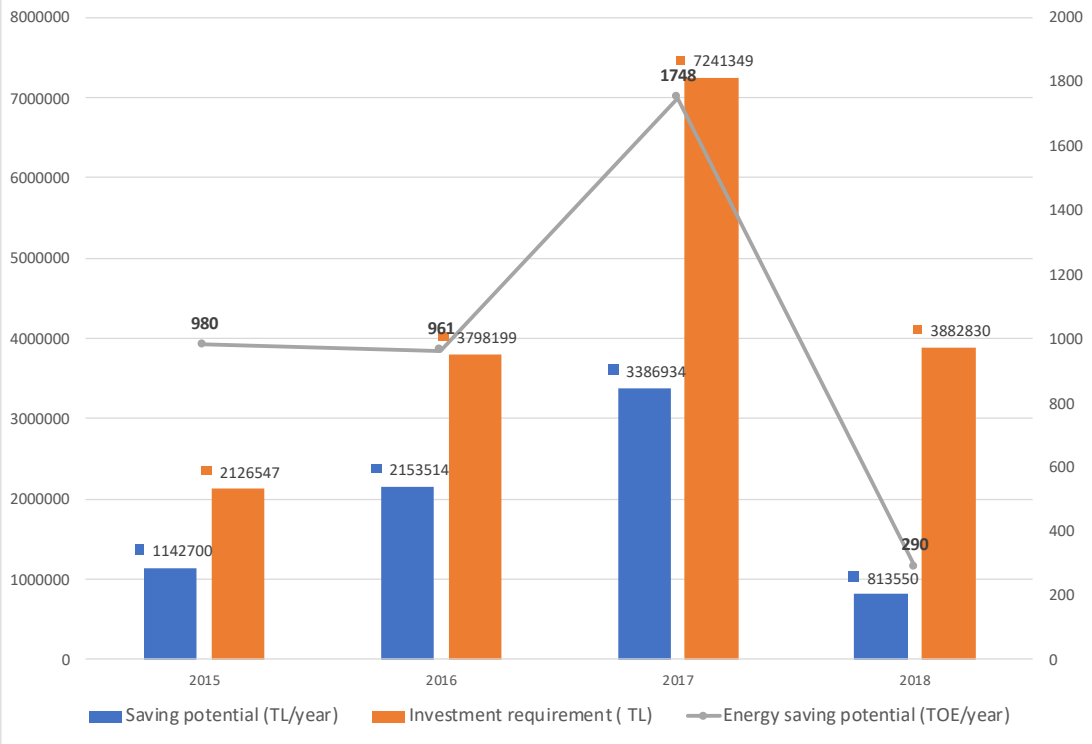

Figure 14. EnPCs with saving potentials and investment requirements (EVCED, 2019)

3.3. Needs assessment

For the harmonization of the legislation with the EU, Turkish National Energy Efficiency Action Plan (NEEAP) was prepared and published in 2018. Under the NEEAP, it is aimed to reduce the primary energy consumption of Turkey by 14% through 55 actions defined in 6 categories as buildings and services, energy, transport, industry and technology, agriculture and cross-cutting (horizontal) areas between 2017 and 2023. It is also expected to achieve 23.9 MTOE cumulative energy savings with 10.9 billion USD investment by 2023. These cumulative savings shall be extended by 2033 and the required investment will be 30.2 billion USD at 2017 prices, in order to continue the effect of energy savings until 2040. It should be noted that the average payback period for actions is around 7 years (NEEAP, 2018). Depending on the Development Report of NEEAP, between 2017 and 2018, 1.35 billion USD was invested and 900 000 TOE was saved (EVCED, 2019). In NEEAP, the actions that is needed to be improved and associated with EVD companies can be summarized in Table 5.

Table 5. Actions related to EVD companies stated in NEEAP

Sector	Action
Cross-cutting areas	Establish and increase effectiveness of energy management systems (TS ISO 50001)
	Develop standard guides and contracts containing technical, legal and financial aspects for energy efficiency projects
	Perform more energy efficiency audits
Building sector	Improve energy performance of existing public buildings
Industry sector	Mapping energy saving potential
	Improve voluntary agreements
Energy sector	Improve energy efficiency in public lighting

Taking this analysis of energy service market between 2015 and 2018 and the targets specified in the NEEAP into account, ENVER Regulation (2011) was revised in 2020. Table 6 demonstrates the main differences amongst these two versions.

Table 6. Main differences between ENVER Regulation 2011 and 2020

Subject	Change
Measurement & verification definition is added	TS ISO 50006 - Energy management systems — Measuring energy performance using energy baselines (EnB) and energy performance indicators (EnPI) — General principles and guidance by using either TS ISO 50015 - Energy management systems — Measurement and verification of energy performance of organizations — General principles and guidance or The International Performance Measurement and Verification Protocol
ENVER portal definition is added	In order to disseminate energy efficiency studies, increase their efficiency and monitor the development of energy efficiency; The energy management information system of the Ministry, which includes features such as information collection, storage, analysis and reporting.
TS ISO 50001 is mandatory	Industrial enterprises, public buildings, commercial and service buildings responsible for having energy manager and power generation facilities and industrial enterprises and organized industrial zones responsible for establishing an energy management unit should establish TS ISO 50001 Energy Management System until the end of 2023.
Employees of EVD companies can act as an energy manager	In cases where it is not possible to assign the job among its employees, energy manager services are obtained by making contracts with energy managers or EVD companies. Each energy manager or energy audit-project specialist working within the EVD companies can provide energy manager services for up to three buildings or industrial enterprises in total. The energy manager, who is assigned among his employees, cannot provide energy manager services other than the building or industrial enterprise he/she is responsible for.
Measurement-verification trainings are started	In addition to the energy manager and audit-project training, the Ministry may organize or have a training, examination and certification program for measurement verification expertise.
Energy efficiency audits are closely monitored	If necessary, the Ministry may have EVD companies conduct audits in the sectors or sub-sectors. Among the measures determined with these studies, implementation projects for which payback period is less than three years are prepared by the institutions, organizations or businesses being audited, and the implementation plans for these projects are sent to the Ministry. Within the first year after the termination of the project, the related data is going to be entered to the energy efficiency portal.
	Industrial enterprises with annual total energy consumption of 1000 TOE (previously 5000 TOE) and above conduct energy efficiency audits either by their own sources if their employees have industry audit-project certification or by means of EVD companies and audits will renew every 4 years.
	The management of commercial and service buildings with a total construction area of 20000 square meters or annual total energy consumption over 500 TOE, in the absence of building management, the owner of the

	building do energy efficiency audits by either their staff with a building audit-project certificate or EVD companies and the audits will renew every 7 years.
VAP projects application is changed	For both VAP and Voluntary Agreement grants as of the application date, the industrial enterprise is registered in the ENVER portal and has 50001 certificates.
	Industrial enterprises that want to benefit from VAP supports submit their project applications, prepared in accordance with the application procedures and principles by EVD companies, to the Ministry whenever it is convenient.
	If deemed necessary, on-site preliminary examination is carried out on the project component by the personnel of the Ministry or the real or legal persons determined by the Ministry for receiving the service. In case of on-site pre-examination by real or legal persons, service costs as well as the cost of VAP project preparation are covered by industrial enterprises.
	Within the scope of the implementation report, the project or project components whose applications are made different from those specified in the project, and the project or project components, whose implementation has been made in accordance with the project, but which have been determined less than ninety percent of the amount of component energy gain at the end of the implementation, are not supported.
Public buildings should do energy efficiency audits and implementation projects	Public buildings with a total construction area of at least 10000 m^2 or an annual total energy consumption of 250 TOE and above have to be audited, and if they have audit-project certified personnel, they can do it themselves. (Energy manager certificate is not enough) in every 7 years (previously 10 years). It is necessary to prepare an implementation projects for those whose payback period is 3 years or less, and to implement these projects within 4 years.

As can be understood from all these improvements for both regulatory and implementation points, the success of energy service market in Turkey is crucial. Since EVD companies can be stated as the major players in the market, their opinions about the current situation as well as the future improvements should be taken and analysed.

4. HOW – Survey Studies

4.1. 2015 Survey Study

In order to get the overview of Turkish ESCO/EVD market in 2015, firstly all ESCOs/EVD companies were searched in detail and then a general questionnaire shown in Table 7 was prepared and sent to 35 EVD companies, which was active in the market. 12 of them were replied (Table 8).

Table 7. The general questionnaire for the determination of the Turkish ESCO/EVD market overview

1. **Information about Company/Institution/Association**
   If you are an ESCO/EVD; how many years have you been conducting your activities?

2.	**Comments about ESCO/EVD concept** a. Theoretically what are expected from ESCOs? b. What have been EVD companies doing in the market?
3.	**What are other important key players in the market?**
4.	**ESCO/EVD market overview** **a. Energy Efficiency Audits** i. In which sectors/sub-sectors (industry, building) do you make audit studies? ii. What are the main energy efficiency measures that you realized during audit studies? **b. ESCO/EVD Projects** i. How many projects in which sectors have you been done so far? ii. What are the major implemented energy efficiency measures in the projects? iii. Sample projects that you were/have been/are applied in either industry or building sectors or in both of them together with the results obtained (especially realized energy saving potentials and related financial gains), if applicable.
5.	**Financing** a. What is the common type of the contracts? b. How do you get required financing? c. In your opinions, what are the crucial factors affecting the costs and benefits?
6.	**Evaluation and Final Comments** a. What are the crucial sectors/sub-sectors for EVD companies in the future? b. How do you evaluate current market what will be in the future? c. What are the recommended financial methods? d. Any other comments.

Up to January 2015, there are 35 companies certified as EVD company of which 6 is for industry sector, 24 is for building sector and 5 is active for both sectors. According to results obtained, major expectations and related recommendations by the EVD companies, acting in the sector in 2015, can be explained as follows:

- At the government side, more effective institutional capacity should be established for the sake proper management, control, verification, validation and database formation. This institution should apply incentives/punishments, effectively.
- In the market, incentives by the government are for industry sector; specifically, the large ones. Other specific incentives should be developed and applied to SMEs and especially building sectors. Because, the governmental incentives have leverage effects.
- In case of the best practices, more crucial buildings are governmental/public ones.
- Standard EnPC scheme should be developed and used in demonstration projects for recovering as much energy saving potential guaranteed as possible with 10-15 years contract durations.
- "National energy efficiency fund" should be developed by not only the government but also international and national funding institutions for the efficient usage of allocated funds in long terms and low rates.
- For comparison within the sectors, reference performance indicators should be developed and calculated by user-friendly, verified tools/programs and their result should be publicly available.
- Local banks should be trained or cooperate with energy efficiency experts to gain knowledge about energy efficient products, systems and technologies for evaluating related projects on the basis of true performance criteria.

Table 8. Answers obtained from 12 EVD companies about their services, financing, implementation areas and additional comments

Name	**Total years in market**	**Major services**	**Financing**	**Implementations**	**Comments**
EVD A	5 years	Energy Consulting EE audits EE projects development EE projects implementation Energy certification of buildings Green building certification	Standard sale contract Sale of own product	Waste heat recovery Insulation of building envelope/installations Replacement of inefficient equipment with EE ones in HVAC, electric motors, lighting systems	There should be; incentives in building sector minimum price for EE audits (for preventing very low prices) inspection/control for the punishments control of the quality of EE implementation projects application of EnPC
EVD B	5 years	EE consulting Energy managers' and energy certification training EE project development EE project implementation Solar energy implementation Carbon foot printing	Standard contract	Heating and steam system improvements	minimum price for EE audits inspection/control for the punishments control of the quality of EE implementation projects application of EnPC
EVD C	5 years	Energy managers' training Electro-mechanic installation projects EE audits EE projects development EE projects implementation Energy certification of buildings	Self-financing Costumer financing	Waste heat recovery Replacement of inefficient equipment with EE ones in HVAC, lighting systems	applications of EnPC implementations in the public/governmental buildings usage of development agency funds

EVD D	2 years for building 1 year for industry	EE consulting EE audits EE projects development EE projects implementation Installations' control/flue gas analyses Solar, wind, biogas energy applications Carbon management	Special type of EnPC	Energy consuming systems' renovation/replacement	applications of EnPC implementations in the public/governmental buildings
EVD E	5 years	EE consulting EE audits Carbon management	EnPC (with customer financing)	Waste heat recovery Energy monitoring Steam turbines, efficient cooling systems, heat pumps Cogeneration/ tri-generation	
EVD F	5 years	EE audits EE projects development EE projects implementation Energy certification of buildings Energy managers' training		Flue gas, heating, steam, electricity systems and insulation	minimum price for EE audits incentives in building sector applications of EnPC implementations in the public/governmental buildings
EVD G	5 years	Energy consulting EE audits Energy certification of buildings EE project development	Financing thru costumers' bills		minimum price for EE audits incentives in building sector applications of EnPC implementations in the public/governmental buildings

EVD H	5 years	Energy consulting EE audits Energy certification of buildings EE project development EE project implementation	Self-financing		minimum price for EE audits incentives in building sector
EVD I	2 years	Energy consulting EE audits Energy certification of buildings EE project development EE project implementation	Credits from banks		control of EE project implementations applications of EnPC increase in the awareness of all stakeholders
EVD J	5 years	Energy consulting Energy managers' training EE health checks (audits) EE project development EE project implementation	Credits from banks Costumers' bills Sales of products	Energy consuming systems' renovation/replacement	control of EE project implementations applications of EnPC increase in the awareness of all stakeholders
EVD K	5 years	Trainings of energy managers and energy certification	Self-financing		more international grants more acceptable conditions for credits
EVD L		EE consulting EE audits EE project development EE project implementation Energy certification of buildings	Energy audit contract EnPC Costumer financing Bank credits Private equity	Energy consuming systems' renovation/replacement in buildings (commercial/service) and industry sectors (especially lighting and HVAC systems) Green buildings certification	control of EE project implementations applications of EnPC implementations in the public/governmental buildings

4.2. 2019 Survey Study

In November 2019, an online survey study was conducted to determine the current status of EVD companies in Turkey. Out of 45, 13 of them responded. The details of EVD companies participating to the survey are given in Table 9.

Table 9. Details of EVD companies participating in the survey

EVDs	Sector	Sub-sectors
EVD-1	Industry and Building	Energy, Metal, and Trade (Sales and Marketing)
EVD -2	Building	Residential
EVD -3	Building	Automotive, Health and Social Services, Community and Personal Services, Tourism, Hospitality, Food and Beverage Services
EVD -4	Building	Construction and Residential
EVD -5	Industry	Energy
EVD -6	Industry	Woodworking, Paper, Glass, Cement and Soil, Energy, Food, Chemical, Petroleum, Rubber and Plastic, Mining, Metal, Automotive, Textiles, ready-made clothing, Leather, Tourism, Hospitality, Food and Beverage Services
EVD -7	Building	Construction
EVD -8	Building	Energy and Residential
EVD -9	Building	Justice and Security, Information Technology, Residential
EVD -10	Industry, Building and training	Woodworking, Paper, Glass, Cement and Soil, Education, Electric - Electronics, Energy, Food, Chemical, Petroleum, Rubber and Plastic, Mining, Metals, Automotive, Health and Social Services, Textiles, ready-made clothing, Leather
EVD -11	Industry and training	Glass, Cement and Soil, Education, Energy, Metal, Automotive, Textiles, Clothing, Leather
EVD -12	Industry and Building	Woodworking, Paper, Glass, Cement and Soil, Electric - Electronics, Energy, Food, Business and Management, Chemical, Petroleum, Rubber and Plastic, Mining, Metal, Automotive, Textiles, ready-made clothing, Leather
EVD -13	Building	Information Technology, Energy, Residential, Culture&Arts and Design, Health and Social Services, Tourism, Hospitality, Food, and Beverage Services

In the survey, in order to reveal the current situation of the energy service market and to evaluate the Energy Service Market Success, EVD companies were asked about their opinions on;

- Control authority of the Turkish energy service market
- Sub-sectors carrying out the energy efficiency audit and implementation projects
- Possible measures and energy-saving potentials determined after audits
- The main focus of implementation projects and the achieved saving potentials
- Main financing sources in audits and implementation projects
- The impact of factors on the energy service market success and on each other

On the basis of their answers, the obtained results are as follows:

-Control of the ESCO market

46% of companies said that the main controller of the EVD market can be Possible National Energy Agency, 31% stated that it can be the Ministry of Energy and Natural Resources (MENR) and 23% said that it can be an umbrella organization. Besides, some of companies proposed that the market can be controlled with the partnerships of MENR, "possible" National Energy Agency and the umbrella organizations. In addition, 84% of participants declared that the control of the market would be crucial to system success.

-Audits and energy efficiency measures

EVD companies were asked about the energy efficiency measures that they identified as a result of their energy efficiency audits. According to given answers, determined energy efficiency measures as a result of the audits in the industrial sector are given below: (from most to less)

1. Efficiency in motor systems
2. Use of EE Technologies depending on the sub-sector
3. Integration of renewable energy sources
4. Efficiency in lighting systems
5. Heat insulation
6. Awareness and behaviour change

Determined energy efficiency measures as a result of the audits in the building sector are given below: (from most to less)

1. Heat insulation
2. Use of EE Technologies depending on the sub-sector
3. Efficiency in lighting systems
4. Efficiency in heating, cooling and air conditioning (HVAC) systems
5. Integration of renewable energy sources
6. Efficiency in motor systems
7. Awareness and behaviour change

EVD companies were asked about their energy-saving potentials that can be realized as a result of their energy efficiency audits. 5 clear responses were received from 13 companies. According to the answers, the energy-saving potential varies between 20% and 90% in the industrial sector and between 20% and 70% in the building sector. 85% of companies stated that getting the benefit of the determined energy efficiency saving potentials is of great importance for the market success. Furthermore, 92% of EVD companies considered the impact of the energy efficiency audits on the quality of the implementation projects as positive.

- Implementation projects

EVD companies were questioned concerning the main focus of their implementation projects. When the results of the survey are evaluated, the following areas are declared by the companies: (from most to less)

1. Efficiency in HVAC systems
2. Efficiency in motor systems
3. Efficiency in lighting systems
4. Heat insulation
5. Integration of renewable energy sources
6. Waste heat recovery
7. Awareness and behaviour change

85% of EVD companies specified that the success of implementation projects is very important and will play a critical role in the success of the energy service market.

Moreover, companies were asked about their energy-saving potentials obtained from their implementation projects. 9 clear responses were received from 13 companies. According to the answers, the energy-saving potential varies between 15% and 30% in the industrial sector and between 10% and 50% in the building sector.

-Financing

EVD companies were requested to give information about the main sources of finance in their energy efficiency audits and implementation projects. According to the answers, the main financing sources are;

1. Customer
2. Resources of EVD
3. Public supports (either customer or EVD can take)
4. Third party financing (either customer or EVD can take)

According to 77% of EVD companies, financing energy efficiency audits would activate the market by increasing the interest of the industry and building sector representatives. Additionally, 92% of EVD companies stated that the sustainability of the EVD companies will be ensured through implementation project financing, especially, the ones with high energy saving potentials. When financing methods' suggestions were requested from the companies, the obtained answers are as follows:

1. The National Energy Efficiency Fund
2. Energy Performance Contracts
3. Public supports
4. Negawatt Sales.

Bayesian Belief Network Analysis

This study takes advantage of Bayesian Belief Networks (BBN) which enable a theoretical framework for uncertainty and integrate principles from graph and probability theory as well as computer science, and statistics in order to reflect and explain the complex system, under discussion with expert knowledge data. For the analysis, first, factors that can have an impact on the energy service market success and interrelationships among factors were identified and their relations are shown in Figure 15.

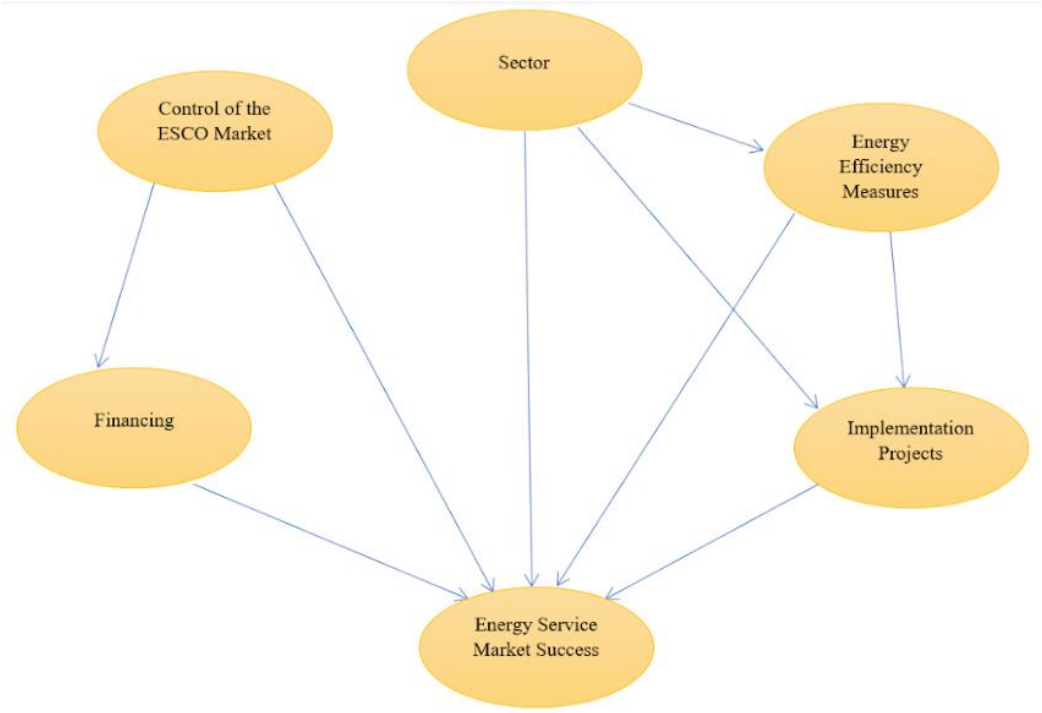

Figure 15. Causal map of energy service market in Turkey

The energy service market success is analysed considering the impact of five factors which are sectors to be served, control authority/mechanism of the market, energy efficiency measures determined after audit studies, implementation projects, financing methods for both audits and implementation projects. By using BBN, how these factors affect the success of the energy service market was investigated and the obtained BBN result is shown in Figure 16.

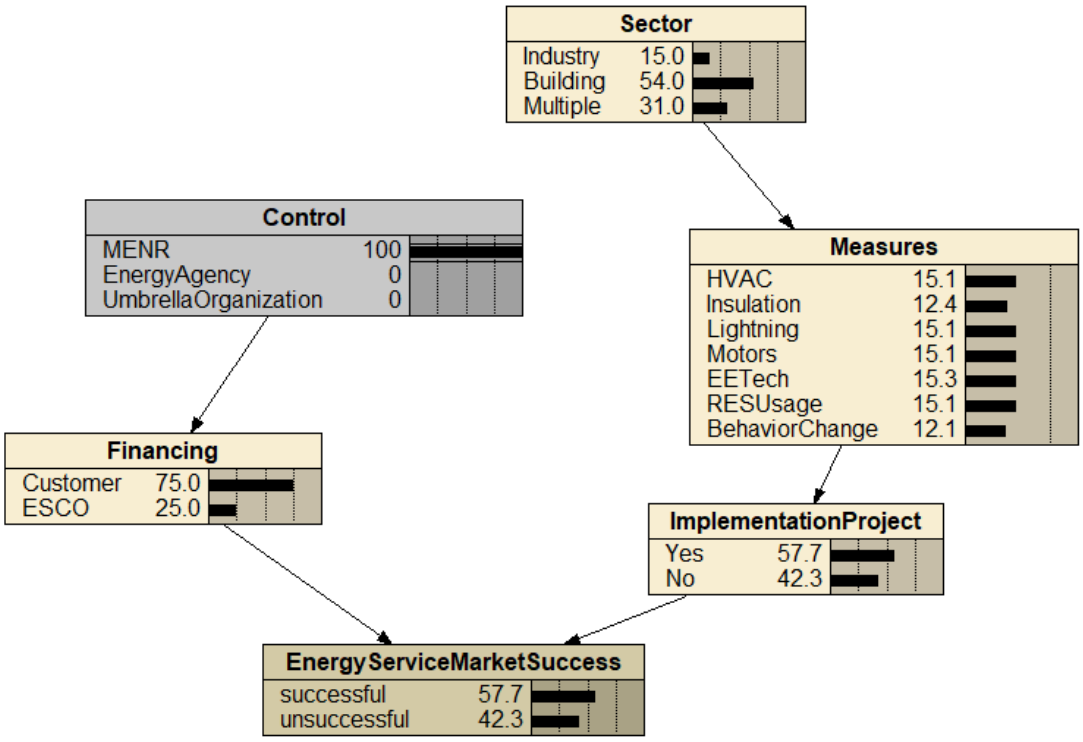

Figure 16. BBN analysis for the energy service market in Turkey

Considering BBN results on the basis of the survey, in the current situation, the success of the energy service market is 57.7%.

In order to improve success, the following issues can be identified:

1. In the current energy service market, most of EVD companies are serving in the building sector. For improving the success, diversification of implementation projects in the building sector as well as the share of the industrial sector (especially small and medium size enterprises) should be increased.
2. Implementation projects should be improved both in the number and the quality by diversifying the energy efficiency measures, such as renewable energy integration and behaviour change.
3. The main control mechanism of the energy service market should be a combination of MENR, possible national energy agency and umbrella organization.
4. National Energy Efficiency Fund and EnPC should be the major financing methods for energy efficiency audits and the implementation projects.

5. WHAT to do next? Recommendations

When the results of the survey studies in 2015 and 2019 are taken into account together with the recent improvements in the regulations, the following advances in the energy service market can be indicated:

- 25 EVD companies continue their activities both in 2015 and 2019.
- Building sector is mostly preferred due to diversified characteristics, such as residential, commercial, service and public buildings. Moreover, EVD companies have been also active for the energy performance certification of the buildings. And also, industrial enterprises, specially the larger ones, have their own energy managers. On the other hand, in the new revision of ENVER Regulation, it is declared that certified experts of EVD companies can serve as an energy manager for industry and building sectors, this means for small and medium sized enterprises, EVD companies can be more active, as well.
- In 2019 the amount of governmental incentives is increased. This is also important for more varied projects including combination of different measures, process changes for being more efficient and integration of renewable energy.
- Governmental/public buildings are included in energy efficiency audit and implementation projects' scope by the revision of the related regulation. Additionally, audit obligation is stated, implying their energy saving potentials can be determined and more implementation projects can be made.
- Although it is few in number, EnPC was started to be applied in the projects. Especially for the public buildings, secondary legislation is expected to be prepared.
- Energy efficiency portal by MENR has started to be used more actively and more publicly available reports are produced by the government to see the changes in the market on sectoral basis.
- For controlling the quality of the audits and implementation projects, measurement and verification trainings is going to be started.

On top of these improvements, Table 10 can summarize the SWOT analysis of Turkish current energy service market.

Table 10. SWOT analysis of Turkish EVD market

Strengths:	**Weakness:**
• Presence and revision of legislation • Mandatory energy efficiency audits • ISO 50001 • Defined incentives for at least industry sector • In the market, about 25 EVD companies continuously acting from 2009 meaning sustainability • Training of technical staff through EE manager, EE audit-project topics • Presence of ENVER Portal which is mean of properly collected, analysed and used as a data bank and reference studies for specific sectors to determine EE measures easily • Learning not only from know-how but also by doing	• Wide scope energy efficiency legislation which is very difficult to implement • Lack of governmental incentives for building sector • National energy efficiency fund is desired but not in the scope of new revisions • High investment cost for the initial development • Not very efficiently utilized EE evaluation tools (i.e. building energy performance) • EE projects are considered "high risk" • Due to need of monitoring after the termination, long implementation periods of EE projects (10 - 15 years) which is unusual for Turkey (i.e. max. 3-5 years in Turkey) • Lack of awareness by the costumers (they usually want to see best practices as real examples of gains) • Lack of project financing and other requirements for EnPC • Lack of understanding behaviour changes and non-energy benefits towards energy efficiency
Opportunities:	**Threats:**
• Variety of international financial institutions allocating funds for Turkish market improvement • If best practice projects can be possible for the new EE technology applications, there is a big chance to widespread easily • Very few examples of the studies including increase in buildings' energy performance hence it is an open area • Opportunity for good example of EnPC especially in public buildings with minimum 15% energy saving target in 2023 by Presidency Circular dated 15/08/2019 and No. 2019/18 • Revisions regarded measurement and verification protocols • Presence of national smart cities strategy and action plan by Ministry of Environment and Urbanism towards 2023	• Economic situation in Turkey • Due to not effective usage of international funds, threat of resignation of related institutions for Turkish market • Risk of large companies to finish their EVD activities in the market • Risk of inaccurate evaluation of energy efficiency performance because of inefficient tools, (current energy performance evaluation tools could not cover all types of buildings not only in Turkey but also in Europe) • In NEEAP, for some applications, the duration for the realization is very close could bear risks of not performing them

Considering the progresses and the potential of the Turkish energy service market, to be evaluated, it should be noted that criticizing constructively is always better than being destructive. All strengths, weaknesses, opportunities and threats should be integrated on the basis of planning, doing, controlling and acting phases of the management for further improvement of the Turkish energy service market. Moreover, current hot topics such as "carbon neutrality", "circular economy", "big data", "digitalisation" and "industry 4.0". Energy efficiency together with all of them can be regarded as the central driver of innovation for the energy service market. Therefore, it presents not only a central challenge, but above all an opportunity considering the following concerns:

- The establishment of climate-neutral and circular value chains in energy service market
- New sufficient policy strategies based on measurement, data analysis, verification and continuous monitoring for sustainable business areas along the value chains (i.e. TS ISO 50001)
- A clear direction for major technology and infrastructure investments in the market
- An integrated climate, energy, economic and social policies as a central component of the sustainability.

Besides, the conclusions that can be derived from the "**Energy Efficiency International Search Conference**" organized by EYODER in 4 October 2019 under the project titled "Strengthening Communication and Data Sharing Network among Energy Efficiency Stakeholders" can be summarized as follows:

- It is important to apply "the energy efficiency cycle" in the projects as shown in Figure 17.

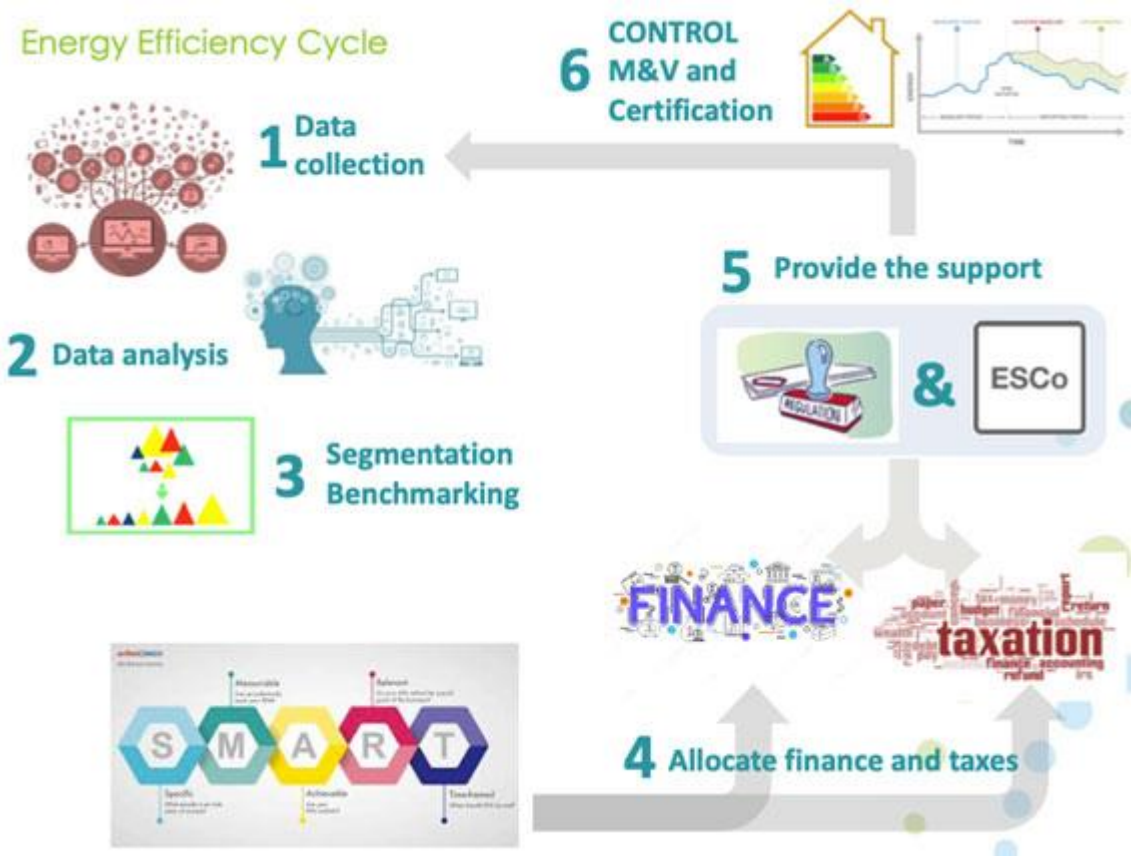

Figure 17. The energy efficiency cycle (Belotto, 2019)

- The required skills of ESCOs in each phase of the energy efficiency cycle can be explained in Figure 18. It can be understood that project management, financial, technical and legal skills are crucial for any ESCO, which would like to conduct energy efficiency activities.

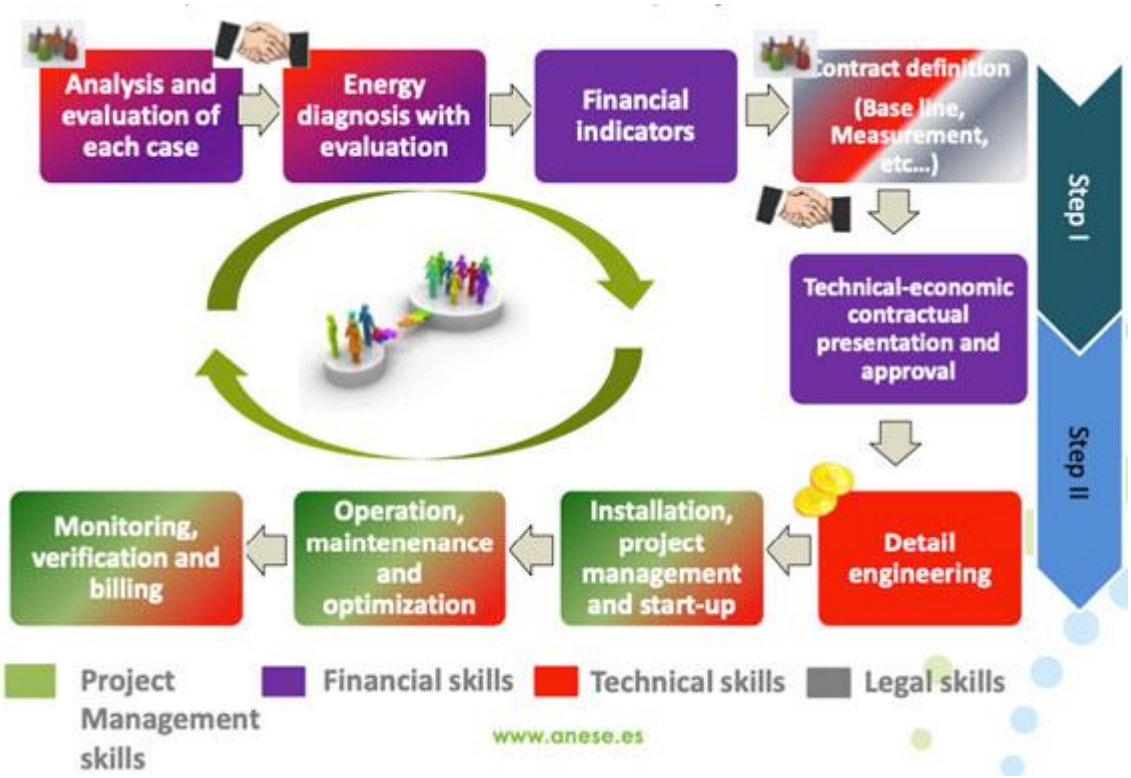

Figure 18. The required skills of ESCOs concerning the energy efficiency project cycle (Belotto, 2019; Saygın, 2019)

- While preparing an energy efficiency projects, the below-mentioned subjects should be taken into account, attentively.
    - The target and its unit should be set. For example, if energy saving is of concern, it can be primary or final or monetary saving. In addition, methods for energy saving calculation should be checked. These are: Deemed savings: standardized energy savings ratios per action type, Scaled savings: specific engineering calculations, Metered savings: e.g. billing analysis, on-site measurements
    - Additionally, targets can be yearly or multi-yearly. Yearly targets are useful for ensuring actions are delivered from the start, whereas multi-year targets are for providing more visibility to stakeholders, and thereby time to develop strategies.
    - Definition of the quality requirements like quality of the EE audits, actions, products, etc. and standardization, especially energy management and EnPC, is essential.
    - For the success of the energy efficiency actions, reporting, monitoring and verification as well as on-site inspections should not be ignored (Gudbjerg, 2019a; Oikonomou, 2019a).
- It is worth to mention that 55% of people on the world live in cities and this percentage is expected to increase, 68% in 2050. Cities consume 75% of the world's resources and energy and generate 80% of greenhouse gases, occupying only 3% of the territory on our planet. For this reason, the capacity of the local authorities in terms of energy

efficiency applications are very critical. Figure 19 presents the main barriers faced by local authorities.

Figure 19. Main barriers faced by local authorities (Oikonomou, 2019b)

As can be seen from the figure, especially lack of technical expertise and limited financial sources are two main barriers. For improving the technical expertise, the capacity building in the local authority and also taking consultancy, for example from ESCOs, can be stated. Usually, grants from international, national or regional donors are the principal source of the financing in the local authorities (Figure 20).

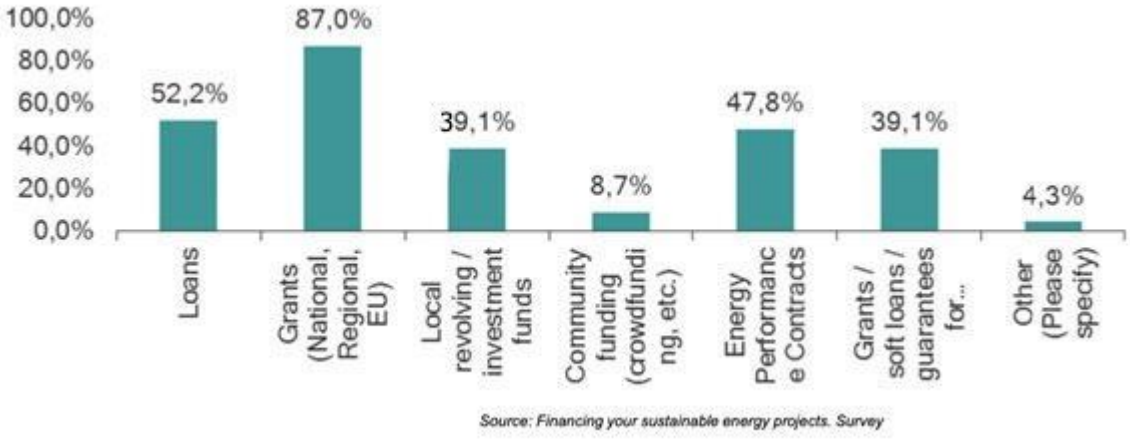

Figure 20. Financing sources for local authorities (Oikonomou, 2019b)

Table 11 shows innovative financial mechanisms' alternatives for the local authorities on the basis of building type and the sector.

Table 11. Innovative financial mechanisms for local authorities (Oikonomou, 2019b)

Public Buildings	Private Buildings	Public Lighting	Transport	Cross-Sectoral
Revolving funds	Revolving funds	Revolving funds	Revolving funds	Revolving funds
Energy performance contracting (EPC)	EPC	EPC	Joint public procurement	EPC
Third party financing	Private ESCOs or Energy Retrofit Operators	Third party financing / investment	Third party financing (loans, leasing)	Joint public procurement
Cooperatives	Cooperatives	Cooperatives	Cooperatives	Cooperatives
Financial and fiscal (dis)incentives	Energy efficiency obligations (white certificates)	Energy efficiency obligations (white certificates)	Energy efficiency obligations (White certificates)	Energy efficiency obligations (white certificates)
Soft loans	Financial and fiscal (dis)incentives		Financial and fiscal (dis)incentives	Crowdfunding
Guarantee funds	Green bonds	Green bonds	Green bonds	Green bonds
Crowdfunding	On bill / on tax financing			
	Guarantee funds			
	Soft loans			
	Pay-as-you-save schemes			

Among these financing sources, **revolving funds** are to finance a continuing cycle of investments through initial amounts received from its shareholders, creditors or donors and later on by means of amounts received from reimbursements of provided funding or loans to projects. These funds can be available for further reinvestment in similar projects. In other words, revolving funds formed by sustainable energy projects will use to finance new sustainable energy projects. **Cooperative** can be defined as a self-sufficient association of persons who voluntarily cooperate for their mutual, social, economic, and cultural benefit. Cooperative grows equity capital through a diversified number of investors and take debt capital from cooperative bank or subsidized loans. **Crowdfunding,** on the other hand**,** is a collective effort by people who network and pool their money together, in order to support and invest in efforts started by other people or organizations (Oikonomou, 2019b). Additionally, Oikonomou, 2019b states that energy efficiency obligation scheme is an important tool as a financial mechanism.

- The other key subject is **non-energy benefit (NEB)**, which is any benefit other than energy saving received from an energy efficiency activity. It can be specified that 2.5 times more non-energy benefit can be obtained as compared to energy benefits. Although, NEB is not a new thing, there has been research for more than 25 years, the concept has been very slow to be recognised (Gudbjerg, 2019b). For example, behaviour change can be regarded as a NEB. By providing consumers with accurate information about their consumption

habits, it can be possible to efficiently manage the energy grids and to efficiently reduce the consumption (Belotto, 2019).

This report is prepared to summarize and share the knowledge about Turkish energy service market from the perspectives of EVD companies. As a conclusion, it can be observed that advances in the current energy service market in Turkey are in harmony with the EU, declared by the international experts. Furthermore, more improvement on the standardization in the energy efficiency audits and implementation projects (i.e. EnPC) in common with the measurement and verification practices and opportunity to establish national energy efficiency funding mechanisms can be identified as essential to increase the market success.

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