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Thesis

THE EU ENERGY SERVICE MARKET: UNRAVELLING THE POTENTIAL

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SOLEMN DECLARATION

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Maria-Georgia Stylianou

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ABSTRACT

Energy Services can contribute to the European Union's (EU) green transition, reducing the environmental footprint of the primary energy consumers, namely, the Industry, the Transport, the Buildings and the Public. Being intrinsically linked to energy efficiency, Energy Services can also substantially augment energy savings and efficiency while lessening both private and public sectors' operating costs. Their maturity level differs significantly among the EU Member States. The thesis explores the EU Energy Service market's current status and its growth perspectives. To that end, it pursues a genuine Strengths-Weaknesses-Opportunities-Threats (SWOT) analysis, leveraging an extensive literature review and a subsequent qualitative study, which results in eight challenges clusters, commonly shared by Strengths and Weaknesses, and seven clusters, jointly attributed to Opportunities and Threats. As it is revealed, the three chief Strengths' clusters address Product, Technology and Sustainability & Climate Change aspects while those of Weaknesses are related to Economic, Product and Technology issues. As regards Opportunities, the three predominant clusters are associated with the Broader Market, Legislation and Social & Energy Transition while those of Threats with the Social & Energy Transition, Technical & Administration and Awareness & Communication challenges. Since the Opportunities prove to outperform all other SWOT pillars, recommendations are drawn for the paths that the EU should pursue, to unravel Energy Services' great potential. The Energy Services' positive impact, on both the EU's energy transformation and its collaborations within and outside Europe, is also being reflected.

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ABBREVIATIONS

AI: Artificial Intelligence

BEMS: Building Energy Management System

CHP: Combined Heat and Power

CO_2: Carbon dioxide

COP: Conference of the Parties

EaaS: Energy-as-a-Service

EC: European Commission

EED: Energy Efficiency Directive

EEMS: Enterprise Energy Management System

EPC: Energy Performance Contracting

ESC: Energy Supply Contracting

ESCO: Energy Service Company

ESP: Energy Service Provider

ETS: Emissions Trading System

EU: European Union

GDP: Gross Domestic Product

GHG: Greenhouse Gas

HVAC: Heating, Ventilation and Air-Conditioning

KPI: Key Performance Indicator

IEMS: Industrial Energy Management System

IoT: Internet of Things

OECD: The Organization for Economic Co-operation and Development

PV: Photovoltaic

SWOT: Strengths, Weaknesses, Opportunities and Threats

UN: United Nation

1. INTRODUCTION

1.1. Preamble

Energy plays a pivotal role in global economic and geopolitical dynamics. During the last 20 years, the significance of this role has further accentuated, principally due to the augmenting awareness universally of one vital challenge, the climate change (Organization for Economic Co-operation and Development [OECD], 2021). Failure to mitigate the risks of climate change is perceived as one of the most overwhelming risks worldwide. Despite the development of energy from renewable sources, 84% of the global energy supply is still derived from fossil fuels, the combustion of which generates approximately 75% of the world's greenhouse gas (GHG) emissions, rendering the production and use of energy the main reason of climate change. Consequently, it is mainly the energy itself than can alter the rules of the game and drive the way towards green transition (Ritchie et al., 2020).

At the same time, efforts to achieve the Paris Agreement objective of 2.0°C warming by 2100, with a tense inclination towards 1.5°C, leads to the logical reasoning that rapid and unprecedented changes are required, which makes the complete change of several business segments one of the highest priorities (Consultancy.eu, 2019). Evidently, the 1.5°C scenario demands not only a transformation of the global energy system, for reaching the world emissions objectives, but also a reconsideration of all life aspects. Furthermore, a zero-emissions planet by mid-century implies that perspicuous and coherent measures are fast integrated and rapidly rolled-out, exploiting all available technologies (Carnevale and Sachs, 2019).

In the context of this universal challenging effort, the European Union (EU) has a cardinal role to play. Being accountable for 10% of the global yearly emissions, it undisputedly needs to bring about an energy transformation (Eyl-Mazzega and Mathieu, 2020). Even more, ensuring that all citizens have access to modern and safe energy systems, benefiting from advanced and economically sustainable Energy Services, constitutes a principal socio-economic challenge and a significant move towards restraining poverty, decreasing inequalities and considerably assisting the green transition (Tagliapietra, 2020), while effectively responding to the soaring energy prices challenge. European governments and the European Commission [EC] strive to reach their targets of providing affordable, secure and clean energy to their citizens, as they put up with a fast-evolving energy landscape (International Energy Agency [IEA], 2020a).

Energy Services can be fundamental in both reducing energy costs and the carbon footprint, through the abatement of energy consumption or the efficiency increase of the energy consumed. Energy Services, leveraging state-of-the-art technology and exploiting innovation advancements, are already generating substantially positive results in the EU, as regards the strengthening of both energy savings and energy efficiency (Consultancy.eu, 2019).

It is true than in the recent years, companies have strived to foster their energy efficiency, primarily targeting to their long-term cost reduction and the achievement of their objectives regarding green transition. In a rapidly evolving business market, characterized by considerable volatility and by energy prices constantly increasing, companies seek to find ways to reduce their energy consumption costs while decreasing their environmental footprint. Energy Services can become key towards this target. What is more, companies recognize that business-as-usual cannot successfully lead them to a high performing energy system and, hence, inaction is not a sound solution for them (Consultancy.eu, 2019).

The increasing awareness of climate change and the technology evolution have raised the market for energy efficiency services in Europe to 25 billion euro approximately while the foreseen acceleration of this market in the years to come is expected to make it reach 50 billion euro by 2025 (Consultancy.eu, 2019). The potential of Energy Services is anticipated to be even greater, if the penetration of renewables through distributed generation services and new storage technology are also considered. This is why Energy Services are regarded as a fundamental market in the European industrial landscape (OECD, 2021).

It is worth noting though that the three pillars pertaining to the geopolitical, economic and social volatility continue to create uncertainty in the broader environment and impact on the different energy frameworks, influencing the decision making of the EU Member States regarding the architecture of their future energy system (World Economic Forum [WEF], 2014). All countries, independently from their development phase, need to define the effects of each pillar of this "energy triangle" (WEF, 2014) in their individual context. With these means, they will be able to set-up those policies that will facilitate the undertaking of energy efficiency measures along with the reinforced usage and penetration of the adequate Energy Services. For this to be achieved, fruitful implementation, solid governance and appropriate design are mandatory.

1.2. Scope of the Thesis

The present thesis aims to present the main Energy Services and their penetration evolution in the market of the European Union as a whole but also in reference to sample Member States, with a focus on Greece, and in comparison with other regions' respective markets. The ultimate objective is to examine Energy Services potential in the EU after considering their intrinsic characteristics and attributes along with the external forces impacting on them.

To that end, the thesis pursues its analysis in the context of the latest related EU legislative and regulatory developments, such as the European Green Deal and the Energy Efficiency Directive (EED), shedding light on their cardinal effect on the future growth of the EU Energy Service market as well as on the inherent relation between energy services and energy efficiency. The thesis' core part, based on an extensive literature review, comprises a strategic and genuine Strengths-Weaknesses-Opportunities-Threats (SWOT) analysis at EU-level, highlighting the strengths and weaknesses of the Energy Services, the external barriers to but also drivers for their future penetration and the emerging potential. The thesis also addresses several considerations in terms of the expected Energy Services impact on the Union's energy transformation.

1.3. Structure of the Thesis

The thesis includes 6 Chapters. Following the introduction, the thesis outline and the description of the pursued methodology presented in Chapter 1, the thesis unfolds with the presentation of the Energy Services background in Chapter 2. It addresses the different types of Energy Services and their value chain, the successful technologies behind them and their impact on energy savings. It also presents the core market players, the prevailing business models, the main end-user groups and the context implied by the energy efficiency directive and the conveyed principles. In Chapter 3, the thesis analyzes the initiatives for Energy Services around the globe, the way Energy

Services and energy efficiency are intertwined, their operating framework in the EU and the most prevalent financing mechanisms and tools. It also examines the Energy Service market evolution at EU-level and compares it with the corresponding markets of other geographical regions and of sample Member States. It showcases the principal barriers and drivers for the Energy Services further growth in the Union and the foremost benefits they may provide. In Chapter 4, the primary sets of the intrinsic and extrinsic challenges that Energy Services are called to face in the EU market are presented for a SWOT study to follow. The Chapter proceeds with the analysis and discussion of the aggregated SWOT results and with recommendations for the way forward. In Chapter 5, specific considerations are addressed congruent with the Energy Service' impact on the EU's path towards the green transition, energy transformation and collaboration both within the region and globally. Finally, in Chapter 6, the thesis draws the overall conclusions for the Energy Service market current status and prospects and extends recommendations for further academic research on the topic.

1.4. Contribution of the Thesis

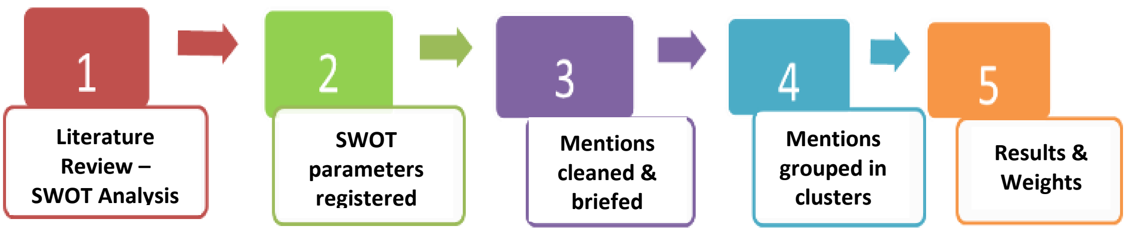
The thesis assumes a genuine SWOT analysis, considering that there is not any similar study encountered for the EU Energy Service market, in the reviewed literature at the time. The desktop research has shown that no SWOT analyses have been executed for the relevant market at the EU-level, but only for distinct domestic markets. Even at a global level, similar analyses have been assumed by for-profit organizations, solely for commercial purposes, and which can be obtained only at a price. Similar analyses have been also carried out in relation to market's sub-segments only, as for the building sector, or in the context of paid reports or written editions with a relatively niche end-user's rather than an Energy Service Company's (ESCO) perspective or for a part of the SWOT only, as for the opportunities and threats or for a combination of the above criteria, as for the challenges and opportunities for the relevant market in Sweden.

1.5. The Methodology

A study of secondary data, gathered through desktop research from both qualitative and quantitative surveys for the EU Energy Service Market, has been conducted. Data of different years, emanating from the same sources and studies, are being compared, as to depict its evolution in Europe, under the prism of the same metrics. These data are being coupled with information emerging from position papers, research and journal articles and annual reports along with other related literature from different researchers, consultancy firms and institutions. Results from recent fieldwork study in the domestic Energy Service market on behalf of a private utility, have been also exploited. As the thesis refers to contemporary technologies and innovations rapidly changing, the literature review is primarily focused on publications made in the past 5 years, counting for the 89% of the references used.

Leveraging on the aggregated information from the literature review, a SWOT analysis is undertaken to depict the status of the Energy Service market in the EU and to identify the perspectives regarding its further development (Figure 1). The analysis explores the internal strengths and weaknesses and external opportunities and threats that this market is called to face. All mentions-parameters that have been traced during the literature review and can be associated with one of the four SWOT pillars have been registered in a dedicated database, which has been exclusively devised for this thesis' purposes.

Figure 1: The 5-step Methodology



(source: self-developed, 2021)

The unique mentions per pillar have been identified, briefed to the extent possible to become easily tabulated and, next, grouped in key clusters that have been commonly traced within strengths and weaknesses. The clusters have been, next, color coded to facilitate the comparison. Another set of clusters, typically characterizing the Energy Service market's opportunities and threats, has been identified and utilized with a dedicated color coding accordingly. To both internal and external forces and their clusters a weight has been allocated, based on the number of mentions related to the specific force or cluster over the total number of mentions or the number of mentions for the corresponding force, respectively. However, it should be stressed out that these weights are indicative and depict a trend only, given that they are based on a qualitative analysis following a literature review on the topic.

2. THE ENERGY SERVICE MARKET BACKGROUND

2.1. Introduction

The EU Energy Service market is a multi-faceted playfield, expressed through multiple solutions, technologies and business models, with distinct players that address different end-user groups and diversified needs, within an evolving regulatory, financial and governance context. Therefore, the implied EU Energy Service market background has to be properly addressed and the related terms to be well defined.

2.2. The different types of Energy Services

Pursuant to the Energy Efficiency Directive (2012/27/EU), Energy Services refer to "the physical benefit, utility or good derived from a combination of energy with energy-efficient technology or with action" (European Parliament and Council Directive 2012/27/EU, cited in Glicker and Roscini, 2020, p. 12) that may include operation and maintenance services along with the adequate monitoring and control, in order to provide the service to the interested party. Energy Services are offered according to a set contract agreement and have dynamically proved that they lead to quantifiable energy efficiency developments and verifiable primary energy savings.

As Bertoldi et al. (2017, p.7) observe, "a wide range of activities fall under the umbrella term Energy Services". Actually, Energy Services may include activities such as energy inspections, engineering design, energy and equipment supply, implementation, project management, maintenance and operation, monitoring and savings evaluation versus pre-agreed KPIs.

It is noteworthy that although the terms energy services and energy efficiency services are often used synonymously, they should be examined separately, in order to showcase the primary emphasis that the latter gives on energy efficiency. Based on the standard EN15900, "energy efficiency services are defined as an agreed task or set of tasks designed to lead to an energy efficiency improvement and other agreed performance criteria" (Boza-kiss et al., 2017, p.7). According to Müller et al. (2019) of the Management Consulting Company Roland Berger, energy efficiency services have as main objective to assist businesses in improving the ways they use primary energy, through the introduction of innovative technologies and other measures. They could be practically categorized in four broad clusters, based on their nature and main objectives, namely the Energy Efficiency Audits and Consulting, the Engineering Services, the Operations and the Contracting Services.

Energy Efficiency Audits & Consulting address services that target to examine and evaluate the energy flows of end-users, in order to devise energy efficiency optimization measures adapted to customers' distinct needs and requirements. Such services include Energy Efficiency checks that measure existing energy losses through smart metering and monitoring tools in a certain system or building, whether commercial or industrial. The site audits constitute the introductory stage in recognizing energy efficiency opportunities and facilitating the understanding of the benefits they may provide. This coincides with the observation that these audits are an important vehicle to overcome data limitations and ease the decision with regard to the energy-efficiency measures to be adopted (Kalantzis and Revoltella, 2019).

Energy Efficiency Audits & Consulting also comprise energy efficiency improvements that focus on measures to reduce the effective price of consumer energy consumption and green energy consulting that provides businesses with a roadmap on how to meet their own sustainability and social responsibility strategy. They also embrace energy efficiency planning, which refers to the dimensioning of the respective solutions as well as training on the proposed measures (Müller et al., 2019).

The Engineering Services or, otherwise, the Engineering, Procurement and Construction contractual agreements foresee that the assigned contractor will deliver the requested construction completed within a pre-agreed time-frame and budget. This type of services includes Production Technology, that is to say engineering exclusively associated with the production process, and Building Technology, which refers to services related to buildings - industrial and commercial –, sites upgrades as well as building envelopes. Production Technology also embraces Process Technology, which relates to the production of energy and to the different industrial heating and cooling systems along with Mobility Technology, dealing with all charging-related infrastructure for electric vehicles (Müller et al., 2019).

Operations services deal with the reduction of a company's energy consumption by exploiting technology and operational strategies such as load management, which allows consumers to balance their energy consumption, and virtual power plants that aggregate production from several plants and distributed sources, such as Renewables

(Sleman, 2020). Likewise, both flexibility and scale can be achieved. Operations also include Energy Procurement Services, Facility Energy Management and Energy Sales Services assisting prosumers - energy users who consume the energy they produce - to manage their energy in excess. Last but not least, they comprise Facility Energy Management Services, providing the option to businesses to outsource the management of their own energy processes.

Contracting services refer to the conclusion of agreements for energy efficiency projects that include provisions for outsourcing the risk along with guarantees for the savings to be materialized through each project. Contracting Services comprise Energy Performance Contracting (EPC) that intents to maximize energy savings, in order to decrease the overall energy costs. They also include Energy Supply Contracting including cooling, heat, compressed air or electricity and Technical Plant Management Contracting, in the framework of which a contractor operates a plant on behalf of the customer (Müller K. et al., 2019).

More recently, storage technologies reinforced by the so-called ‘smart’ devices, such as the ‘smart’ thermostats for heating and cooling, have paved the way towards new business models in the power sector and the transformation of Electricity Providers to Energy Service Providers (ESPs), who also offer flexibility services to their customer portfolio. ESPs are examining alternatives to provide services that reduce the energy cost for end-users as well as to equip them with more sustainable propositions with reference to electricity supply, such as Photovoltaic Systems (PVs) for self-consumption, potentially coupled with battery storage.

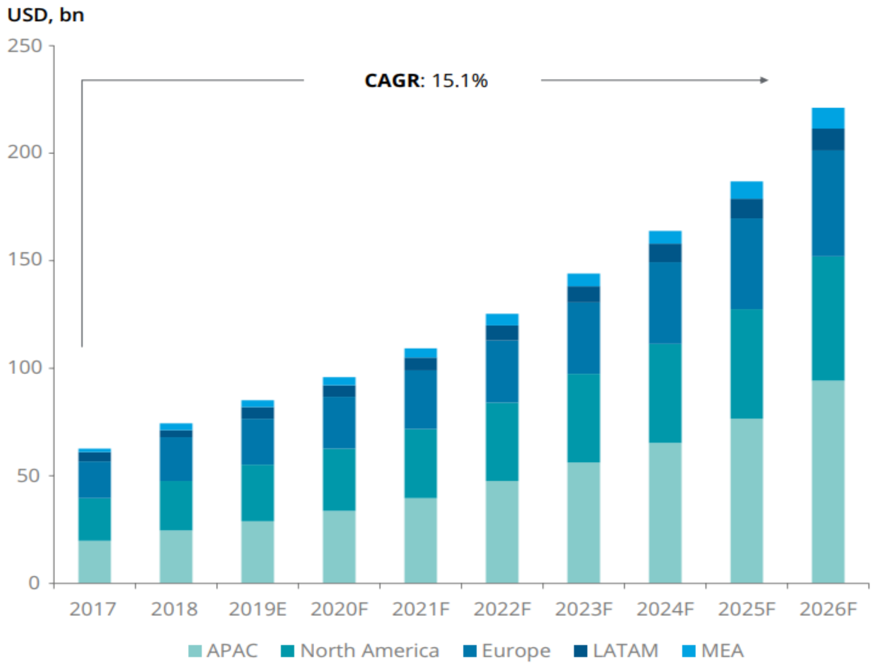
Moreover, the augmented use of digitalization and smart metering has allowed the aggregation and elaboration of huge volumes of data, which, subsequently, foster automation further (IRENA, 2020a). Digitalization is practically transforming energy data into real value for the power system. With growing digitalization in the segment, end-users are seeking new routes to optimize their consumption and better manage their electricity cost (Morley et al., 2018).

As it is pinpointed in the Energy-as-a-Service (EaaS) Innovation Landscape Brief of International Renewable Energy Association (2020a, p.7):

> considering new consumer needs and the shifting power paradigm to a renewable-based, decentralized and digitalized system, *there is a need for an integrated approach to delivering new energy solutions and services* (my italics).

EaaS is a disruptive business course of action whereby a service provider, such as an ESP, offers a suite of Energy Services rather than only plain energy supply (IRENA, 2020a). Precisely, ESPs can associate energy consulting with the provision of equipment, construction, financing of the measures and energy management propositions to extend a services portfolio to the users (IRENA, 2020a). ESCO services are much exploited by the EaaS business model, notwithstanding, there are more energy supply options provisioned through EaaS and administered through different integrated sites and systems. Commercial and industrial segments are expected to constitute the early adopters, accounting for USD 221 billion by 2026, according to Navigant Consulting (Deloitte, 2019, p.12), as depicted in Figure 2.

Figure 2: Global Commercial and Industrial EaaS market by value

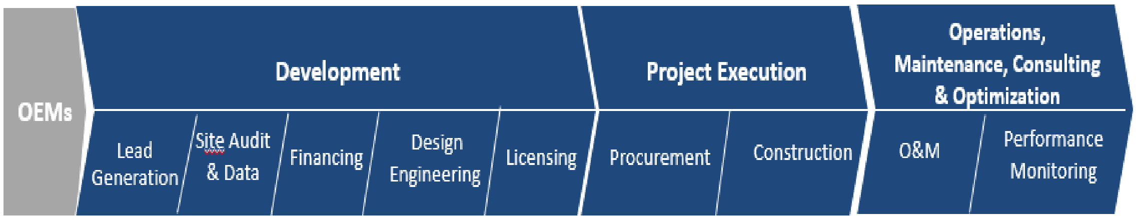


(source: Navigant, cited in Deloitte, 2019, p.12)

2.3. The Energy Services Value Chain

An energy efficiency service is designed aiming at bringing energy usage improvements and energy savings while satisfying other key performance criteria, such as safety, comfort and production output. Based on energy consumption data that are gathered both prior and following a site audit, the energy services value chain also embraces the identification, design and implementation of distinct measures, including licensing where needed as well as their financing based on different business models, the procurement of the necessary equipment, the system construction, operation and maintenance, results monitoring and verification along with energy consulting and services optimization (Figure 3).

Figure 3: The Energy Services Value Chain



(source: self-developed, 2022)

2.4. Successful Technologies for Energy Services

Innovative technologies, such as onshore and offshore wind turbines, PV systems, smart grids and demand response solutions constitute the basis for Energy Services. Other advanced technologies embrace vehicles with internal combustion engines harnessing sustainable energy resources, namely advanced biofuels and green hydrogen, batteries for electric vehicles and stationary storage, recycling and digital technologies (Eyl-Mazzega and Mathieu, 2020). They also embrace innovative lighting, heating, cooling and ventilation systems along with power quality optimization mechanisms. Renewable power-to-heat, power-to-hydrogen and mini-grids, flexibility in power generation units, large Datasets, Internet of Things (IoT), Artificial Intelligence (AI) and blockchain are also considered competent technologies for the supply of Energy Services (IRENA, 2020a).

Furthermore, heat pumps constitute a solid and efficient solution for the substitution of fossil fuels for space heating. Practically, they operate through the absorption of heat from a low-temperature heat source, usually "the outdoor air or the ground and supplying heat at a higher temperature, thanks to an additional energy input, usually electricity" (Hafner and Noussan, 2020, p.193). Upgraded district heating systems, integrating multiple technologies, synthesize an energy service with a foundational role in dense urban areas. Moreover, such systems can be coupled with the power grid, to exploit the availability of excess electricity generated from renewable sources, for supplying end-users (Hafner and Noussan, 2020).

Great emphasis is also given on the different Energy Efficiency Management Software typologies that assist in the enhancement of the various technological systems in use, through effectual data aggregation, monitoring and reporting. As it is projected by Müller et al. (2019), when evaluating the energy efficiency services market in Europe, the respective Software will reach a turn-over of 4.1 billion euro in 2025 versus 1.4 in 2017. Each software type is characterized by solid capabilities in respect of data science and AI but takes a different focus in the market. The segment's software comprises Enterprise Energy Management Systems (EEMS) that primarily address the Commercial segment, Building Energy Management Systems (BEMS) that provide customized solutions for buildings and the real estate sectors and Industrial Energy Management Systems (IEMS) for the industrial segment.

2.5. The impact of Energy Services in practice

The impact of Energy Services is validated and measured though the quantification of changes in consumption patterns, during a particular period, that emerge from a concrete intervention or combination of energy savings measures. According to Boza-kiss et al. (2017), the results are mainly determined by three parameters; the Baseline energy use, which refers to the baseline energy consumption before the implementation of any energy efficiency measure, the Adjustments to any alterations that are not related to the handled measures and the Post-implementation energy use, which practically addresses the energy consumption following the assumed projects. The interrelation among these parameters and the way they define the energy savings emerging from a specific measure is depicted by the following formula (Boza-kiss et al., 2017, p.33):

$$\sum Post\text{ - }implementation\ Energy\ Use \text{ - } \underbrace{\sum Baseline\ Energy\ Use \pm \sum Adjustments}_{Adjusted\ baseline\ energy\ use}$$

Consequently, in case of a building, whether commercial or industrial, the energy savings result from the variance of the Post-installation versus Adjusted baseline uses of energy, where the Adjusted baseline is an estimation of the way the building would have conducted if the energy efficiency measure had not been materialized.

2.6. The main Players

There are several hybrid forms of businesses that provide Energy Services. However, two primary organization models dominate the Energy Service market since several years, both within and outside Europe, namely the Energy Service Companies and the Energy Service Providers.

2.6.1. Energy Service Companies

Energy Service Companies (ESCOs) are organizations that extend energy solutions, which can incorporate production and supply, energy efficiency and upgrade projects. Practically, they provide efficiency based on contracts intrinsically linked to energy performance and constitute crucial investment drivers (IEA, 2021a). ESCOs assist end-users to trace, finance and undertake projects, hence reducing the threshold to invest. By these means, ESCOs can lower the burden of pursuing upfront capital expenses and, therefore, significantly ease the access to the necessary financing (IEA, 2021a).

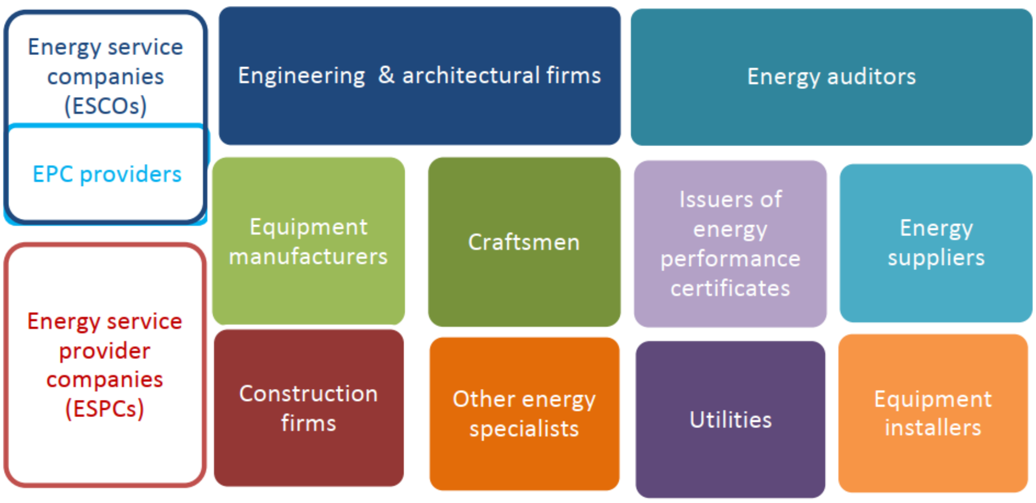
An ESCO is an entity that provides Energy Services, which may comprise the materialization of energy efficiency projects and renewable energy projects, often providing turn-key solutions, pursuing the entire energy services value chain. Precisely, ESCOs furnish the site inspection and initial evaluation, the investment grade energy audit, engineering design, the proposal presentation to the customer, guarantee of the results together with the respective clauses and service level agreements. They also provide equipment installation and construction, measurement and verification of the energy savings, operation & maintenance and, in several instances, project financing, most often through an EPC.

The investment grade audit deserves a special mention, since building on the standard energy audit, which assumes same conditions during the project’s life-time, the investment grade audit strives to foresee a building's prospect energy consumption, with the maximum possible accuracy, by integrating the pillar of a risk evaluation module that assesses conditions in a particular building or related procedure (European Energy Efficiency Platform [E3P], no date).

ESCOs, through EPCs, guarantee energy savings along with the provision of an equal quality level of energy service at a lower cost. A performance guarantee can get different forms. It can be associated with a project's actual energy savings stream, can ensure that the resulting energy savings will be sufficient to repay monthly debt installments or that the same level of energy service is safe-guarded for a decreased amount of money (Boza-kiss et al, 2019). In most of the cases, the remuneration of ESCOs is directly associated with the savings emanating from the energy efficiency project or renewable energy project (E3P, no date). On top, ESCOs can finance or assist in the conclusion of a finance agreement for the constructive management of an energy system by providing a savings guarantee.

Therefore, ESCOs undertake the risk of guaranteeing the accomplishment of a determined level of energy efficiency and they arrange their payment, whether partially or in full, based on the reached energy savings through the energy efficiency measures. The ESCOs that pursue Energy Performance Contracts are usually addressed as EPC providers. This way, they are differentiated from those ESCOs that do not supply performance guarantees. As depicted in Figure 4, ESCOs can be, inter alia, engineering companies, energy suppliers and equipment manufacturers (Boza-kiss et al., 2017).

Figure 4: The diverse landscape of Energy Services Suppliers/Providers



(source: Boza-kiss et al., 2017, p.8).

The critical role of ESCOs is geometrically increasing in view of the ambitious EU recovery initiative that aims at energizing economic growth while aligning investment with the European Green Deal objectives, a milestone for the whole continent, for decarbonizing the different business segments, eliminating all GHG emissions, triggering more funds, aligning all Member States and policies and exploiting all available low-carbon technologies (European Commission [EC], no date). Therefore, ESCOs are now called to play an instrumental role in the supply of energy savings solutions through the provision of Energy Services over long-term EPCs. That is the reason behind their growing number throughout the EU Member States (Boza-kiss et al., 2019).

2.6.2. Energy Service Providers

In parallel, Energy Service Providers comprise all those persons “who deliver Energy Services or other energy efficiency improvement measures in a final customer's facility or premises” (Boza-kiss et al., 2017, p.7), as per the EED (2012/27/EU). Therefore, the distinction between ESCOs and ESPs is not that well discerned and, in several cases, the terms are used interchangeably.

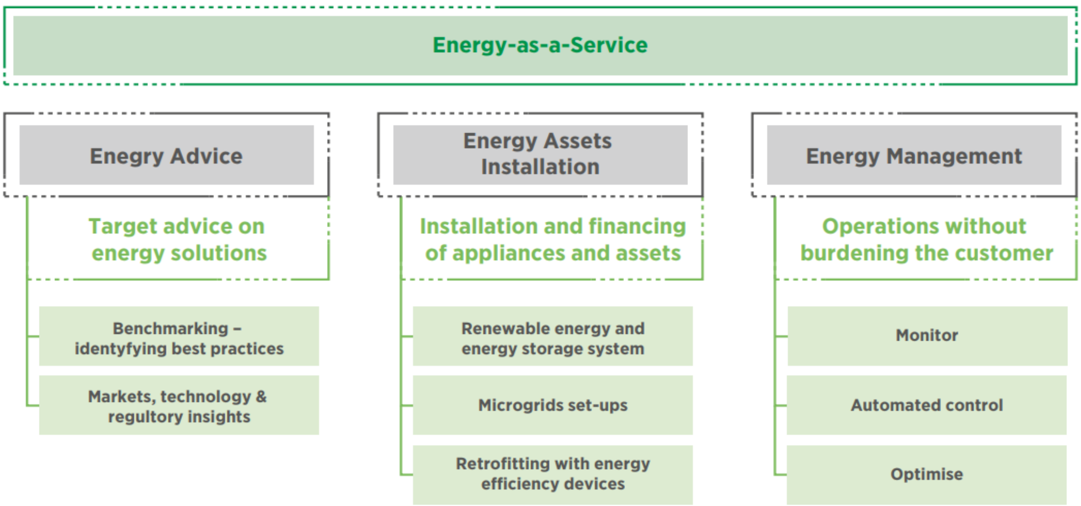
ESPs or, alternatively, Energy Service Provider Companies (ESPCs) may range from utilities to construction firms to installers (Figure 4). The EED's definition of ESPs is broad indeed, including businesses that do not undertake any performance risk for their projects. At the same time, it excludes those organizations that are solely involved in the design and construction of on-site power production or renewable energy projects without the materialization of energy-efficiency measures. These companies provide Energy Services for a fixed fee paid through installments on a tactical basis or as added value to the provisioned equipment or the energy supply. They may have concrete reasons to lower the consumption level of their customers, however such reasons are not as straight forward as in the ESCO model. In the vast majority of cases, the whole cost of Energy Services is reconciled through the fee paid by the customer and, hence, ESPs do not undertake any risk in case of underperformance (E3P, no date).

Admittedly, the role of ESCOs is critical within the energy services value chain, since they can provide turn-key solutions, addressing all intermediate steps, from the energy audit to the installation and consulting and to the operation of the system. Their main difference versus ESPCs is associated with the type of contract and financing sources they utilize (Boza-kiss et al., 2017).

ESPs are gradually becoming trusted energy consultants that can advise customers in formulating strategies matching their individual energy consumption needs (IRENA, 2020a). The ESPs can leverage end-users' load data, electricity price long-term estimations or historical data and a state-of-the-art energy modelling software to assist customers to identify best practices by comparing their costs versus the market, in order to trace optimization opportunities (IRENA, 2020a).

ESPs can also offer turn-key services related to their assets installation of onsite or offsite renewable energy projects and battery storage systems, namely engineering, procurement and construction. Such solutions can also embrace the set-up of micro-grids, installation of smart meters and energy-efficient equipment, to generate multiple options for clients for the lowering of electricity bills and revenues creation from self-generation (Figure 5), whether via net metering solutions or without injection into the grid (IRENA, 2020a).

Figure 5: Range of Services offered by Energy Service Providers



(source: adapted from Edison Energy, cited in IRENA, 2020, p.7)

Additionally, ESPs can facilitate the access to finance for projects including equipment installation and construction, on behalf of their customers. Furthermore, they offer energy management propositions through monitoring and verification, remote control and load optimization, without demanding any investment on technologies and platforms to the customer. Smart home offerings can be combined with energy monitoring and load balancing or management platforms, always considering end-users' comfort (IRENA, 2020a).

2.7. Energy Performance Contracts versus Energy Supply Contracts

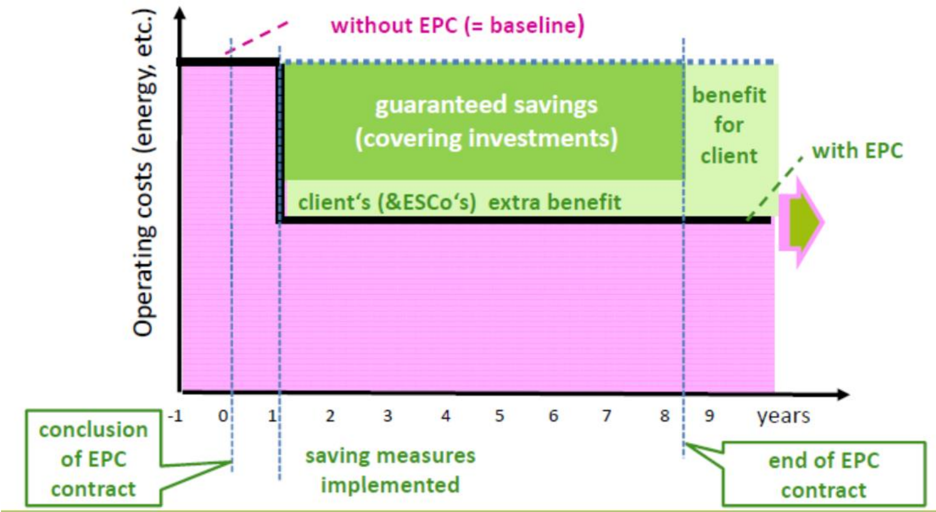
Energy Performance Contracts (EPCs) are considered essential for the energy transition, since they constitute one of the primary vehicles in delivering energy savings, leveraging third-party financing. Practically, they offer a viable financing mechanism for site upgrades to overcome the barrier of the upfront investment. EPCs are established on the basis of an agreement between the end-user and the energy service provider, who usually is an ESCO or a Technology Provider, with a pre-set financing term, a re-payment provision and an energy savings guarantee (Glicker and Roschini, 2020). They cover a broad portfolio of energy-saving measures, including heating, ventilation and air-conditioning systems (HVACs), lighting, passive systems which include roofing, shading, windows, insulation, as well as facility energy management, equipment upgrade and retrofitting (Glicker and Roschini, 2020). They may also comprise distributed power generation projects with renewables.

In the context of an EPC arrangement, the interested party-beneficiary undertakes a project to take advantage of energy savings or a distributed energy production system, such as a PV through net metering, in order to consume energy that he produces himself as a prosumer. To be added, the beneficiary exploits the generated income resulting from the energy cost abatement or the renewable energy produced, as to partially of fully compensate for the value of the project (Glicker and Roschini, 2020).

In case of an ESCO project, a feasibility study is a pre-requisite along with data aggregation, measurements of the baseline consumption, definition of key performance indicators (KPIs) as well as targeted consultations to the customer. Following the contract signing-off, the implementation of the agreed measures takes place, which is regularly shorter in duration than the preparation period, depending on the facility size, its complexity and the types of measures to be taken forward (Boza-kiss et al., 2019).

An EPC contract may be based only on the energy savings emanating from the investment that is being shouldered by the customer in full, where the ESCO has to guarantee the energy savings, undertaking the entire risk. However, it is more common that the investment is covered by the ESCO and the customer pays out the measure undertaken through the energy savings emerging, among others, from the increased efficiency and the optimized operations and maintenance. Throughout the respective contract’s life-time, the resulting savings are divided between the two parties, namely the ESCO and the beneficiary (Figure 6).

Figure 6: The costs and savings in an Energy Performance Contracting (EPC) Scheme



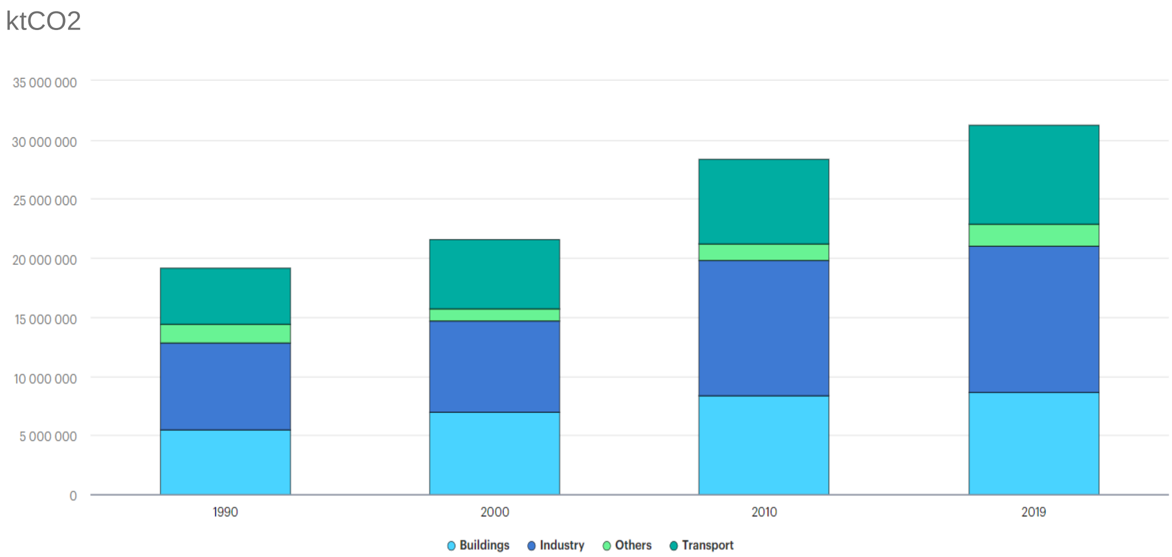
(source: Szomolanyiova and Sochor, 2013, cited in Boza-kiss et al., 2017)

Energy Savings can be also delivered through Energy Supply Contracting (ESC). In this case, the ESCO is responsible not only for upgrading the equipment but also for supplying the necessary energy volumes. The primary difference between ESC and EPC is that the former focuses mainly on the lessening of the supply costs, whereas the latter on demand-side decreases. The ESC business model incorporates all building blocks of the Energy Services, from upgrades to the energy delivery and is often encountered in Combined Heat and Power (CHP) services and renewable energy projects. The benefits of this model is that it offers reduced operation costs and increased security of energy supply, on top of energy savings on the supply side (Glicker and Roschini, 2020).

2.8. The main Users

While power generation and transport together accounted for more than two thirds of total carbon dioxide (CO_2) emissions in 2019 and have been the generators for nearly all growth universally since 2010, the remaining volume was primarily attributed to the industry and buildings segments (IEA, 2021b). It is worth mentioning that industry proves to be the largest CO_2 emitting sector, accounting for more than 40% of the global emissions in 2019 (Figure 7), after allocating electricity and heat emissions to final sectors (IEA, 2021b). In regards to transport, in 2019 the respective emissions accounted for the 27% of the global volume (IEA, 2021b) and 30% of final energy consumption (COM (2021) 558, final), while emissions from buildings for the 25% of global emissions (IEA, 2021b), with 75% of the EU's building stock being characterized by a poor energy performance (COM (2021) 558, final).

Figure 7: Global CO_2 emissions by sector, World



(source: IEA, 2021b)

2.8.1. The Industry

The industrial segment is one of the sectors that has managed to achieve substantial energy efficiency improvements over the last years, nonetheless, there is still a considerable cost-effective savings potential (COM (2021) 550, final). The Industry is characterized by a large number of business activities, which have different targets and which demand dedicated decarbonisation strategies and technologies.

These strategies mainly focus on the demand and re-use of products and materials, both for industrial players and for end-consumers. The strategies also refer to the sources mix in respect of energy used, embracing electricity and hydrogen originating from RES, sustainable biomass or fuel combustion combined with carbon capture systems (Hafner and Noussan, 2020). Last but not least, the strategies address the energy efficiency of the industrial processes, which include an array of technologies that although available, are not affordable, due to the lack of nurturing incentives for low-carbon solutions (Hafner and Noussan, 2020).

It is for this reason that, for the different industrial segments, the decarbonisation limitations are rather economical than technological, since the technologies in need are considerably expensive. It is, however, expected that technology evolutions in the future might lessen these economic barriers (Carnevale and Sachs, 2019).

Furthermore, the generation plants' high production cost, resulting in lifetimes of more than 50 years, renders the materialization of new systems time-demanding in existing units while it requires the related implementations to be financially sound for new units. Additionally, considering that industrial complexes are solidly integrated, an upgrade of a section may also necessitate the retrofit and adaptation of the rest of the site, hence, demanding a structured and systematic approach (Carnevale and Sachs, 2019).

In respect of contribution to carbon emissions, the main industrial applications are the cement, iron & steel and petrochemicals. There are adequate energy efficiency technologies for all these three industrial segments. Indicatively, the multi-stage cyclon heaters for cement, the re-utilization of high-pressure gas for energy production, iron & steel, and, the energy efficiency in monomer production for petrochemicals, are some of the respective technologies that are available throughout EU, but still not affordable cost-wise in the vast majority of cases (Hafner and Noussan, 2020).

It should be stressed out that for these segments, any energy efficiency improvement should be pursued simultaneously with material efficiency and demand reduction. Indicatively, some material efficiency options addressing these three segments are, for cement, the optimization of the building design, the re-use of concrete and the materials replacement, for the iron & steel, the optimization of scrap recycling and the design of efficient products while for petrochemicals, the recycling, the utilization of renewable feed stocks and product eco-design (Hafner and Noussan, 2020). It should be also noted that certain aspects, pertinent to the said industrial segments and their related applications and technologies, may apply to other industries too.

In respect of Internet services, although normally not being regarded as an industrial segment, their significant augmentation during the last decades, mainly due to the exponential growth of internet traffic, demand particular focus on the accentuating energy consumption they require and, therefore, they should be also taken into account in any analysis and evaluation of future energy systems.

2.8.2. The Transport

Mobility demand showcases a continuous increase at global level, which, according to International Transport Forum (ITF, 2021a), is expected to continue augmenting for the next thirty years. Precisely, it is expected that the global transport of people and goods will more than double to 2050, due to the population growth and economic development, offsetting any decarbonizing initiatives and making transport CO_2 emissions to grow by 20% to 2050.

In consonance with ITF (2021b, slide 3), while "urban mobility has the highest potential, road freight and aviation are hardest to decarbonize". A transport segment that demonstrates significant decarbonisation opportunities is maritime shipping. As Hafner and Noussan (2020) observe, short distance shipping for freight and passenger transport is already enjoying the benefits of electrification in Norway and Denmark while different technologies are already under examination, such as hydrogen fuel cells and flow batteries. In all cases, the reduction of CO_2 emissions in transport necessitates demand abatement coupled with low-carbon alternative technologies and energy efficiency services along with targeted compensation measures.

2.8.3. The Buildings

In regards to Buildings, it is worth noting that the annual renovation rate account for only 1% of the actual building stock. However, in order to accomplish the 100% zero carbon target by mid-century, it is indispensable to safe-guard a retrofitting rate higher than 3% (Carnevale and Sachs, 2019). Carbon-neutral constructions and larger districts are feasible today based on the available technologies that can optimize facilities' energy efficiency through passive systems, such as insulation for the building envelope and for the windows (Carnevale and Sachs, 2019).

Adding to this, high-efficiency technical systems and advanced performance-based strategies that promote the adoption of low-carbon measures, such as district heating and heat pumps, are available in the majority of EU countries (Hafner and Noussan, 2020).

Furthermore, maximization of on-site production from RES and self-consumption, within the context of consuming the own energy produced, the well-known 'prosuming' concept (Pienkowski, 2021) along with the buildings' electrification, energizes proper energy management and storage at district level (Carnevale and Sachs, 2019). The Energy consumption in buildings may refer to several energy efficiency services and tools, such as heating and cooling, lighting and smart appliances. Different combinations of all these technologies can result in buildings resilient to the impact of climate change (IRENA, 2020b).

The largest volume of buildings are related to housing. In developed EU countries, the bigger integration of households with digital technologies and the IoT is expected to result to an optimized supply and use of services which will geometrically increase the respective power demand (IRENA, 2020b). Also, cooking is expected to play a role of paramount importance towards this increase.

The household sector, accounting almost for one quarter of the EU's final energy consumption, does matter a lot, since the behavior of citizens can critically impact on the energy consumption, especially so given the empowerment options that consumers are equipped with today. There is the need though for the design and provision of efficient incentives in order to implement energy efficiency ameliorations, properly face the high upfront costs and adequately address the split incentives issue for residential buildings, that is to say who undertakes the investment, the landlord or the tenant (COM (2021) 558, final).

Although many energy efficiency measures have been already pursued in the Building sector in EU developed Member States, there is still substantial space for incremental energy savings in the respective segment. To be noted that more and more countries are now adopting certain energy performance regulations for new buildings and renovations (Economidou et al., 2020).

2.8.4. The Public

Notwithstanding the fact that a large number of buildings is related to housing, there is a considerable number of services aiming to cover differentiating energy demands for public buildings, such as schools and hospitals (Economidou et al., 2020). The Public sector is a primary economic player too, accounting for 5% to 10% of the total EU's final energy consumption with Public buildings accounting for the 2% of the Union's final energy consumption (COM (2021) 558, final). Considerable energy savings prospects are observed in the broader public sector, not only in the upgrade and energy management of existing buildings but also in the forthcoming purchase of energy efficient buildings, products and services (COM (2021) 558, final).

2.9. The Energy Efficiency Directive

The Energy Efficiency Directive (EED) is fundamental for the Europe's efforts to move towards climate neutrality by 2050. Under the framework of the EED, energy efficiency is practically addressed as an energy source on its own. It is considered the guiding principle of the EU energy policy, 'the energy efficiency first principle' that has to be embraced by all sectors, at all levels, going well beyond the energy system (COM (2021) 558, final).

The growth of the Energy Service markets in EU is intrinsically associated with the EED of 2012 (2012/27/EU) and the amending Directive of 2018 (2018/2002/EU), which have undisputedly led to several energy efficiency developments throughout EU, thanks to the set objectives and the binding measures. The EED of 2018 poses an energy efficiency target for reducing energy consumption in 2030 by at least 32.5% versus 2007 respective projections for 2030. Although the energy efficiency target for 2020 was accomplished due to the extraordinary conditions resulted by the Covid-19 pandemic and the subsequent shrinking of transportation and energy demand, congruent with the EC's assessment the sum of the contributions of the National Plans that the Member States submitted seem to fall well behind the energy efficiency target set for 2030 (EC, 2021). Actually, the analysis of the results showcases that the accomplishment of the energy efficiency targets largely depends on the ambition of the Member States upon devising their respective national plans.

In order to achieve the indispensable transformation and further increase the reduction of the Union's greenhouse gas emissions by 2030, the Commission proceeded in 2021 to a proposal for the EED's recast (Climate Action Network Europe, 2021). The recast aims to impose a higher target for reducing primary energy consumption - the total domestic energy demand - by 39% and final energy consumption - what end-users actually consume - by 36% by 2030, up from the set target of 32.5% for both primary and final consumption (EC, 2021). Not only it proposes to augment the level of ambition with regard to the energy efficiency targets set but it also strives to make them binding at EU-level (COM (2021) 550, final).

Furthermore, it sets a benchmarking system for EU countries, a binding target and nearly double objectives for the Member States, in connection with their energy saving obligations towards the end-consumers. To bring the desired results, the recast proposal gives particular emphasis on sectors characterized by their high potential for energy-savings, namely the public sector, the industry, the transport and the buildings (EC, 2021). Special focus is given on heating and cooling, since they consume half of the EU's final energy consumption, which renders them by far the largest energy end-use segments. Consequently, their role into the EU's ambition for a clean and carbon-neutral economy by 2050 is of paramount importance (COM (2021) 558, final).

2.10. Chapter Conclusions

The different types of Energy Services are based on successful technologies that have already proven their positive impact on the reduction of the final energy consumption and, hence, the energy cost and CO_2 emissions abatement of the industry, the transport, the buildings and the public.

3. THE EU ENERGY SERVICE MARKET

3.1. Introduction

Energy has been at the core of the world's but also the EU's economy for centuries. The EU has been setting aggressive energy strategies, leveraging multiple initiatives such as the Green Deal. Energy Services are incessantly becoming essential for the materialization of the EU's energy efficiency targets, however the maturity level of the respective market differs significantly from Member State to Member State, with varying drivers and barriers.

3.2. The International Initiatives for Energy Efficiency Services

Indisputably, energy has considerably affected and is still greatly impacting on global geopolitics, defining great powers, alliances and conflicts. Throughout the years, energy resources have been determining every international order. In the nineteenth century, coal has been the foundation for the British Empire, oil has been the driving force for the 'American Century' while China is gradually becoming the twenty-first century's global superpower in renewable energy (Hafner and Tagliapietra, 2020).

But energy is also bringing nations together, striving for commonly shared goals. In 2015, all members of United Nations (UN) adopted the 2030 Agenda for Sustainable Development Goals, which embraces, inter alia, the objective to "ensure universal access to affordable, reliable and modern energy services" by 2030 (IEA, 2021c). Furthermore, the UN's sustainable development goal number 12 requires nations to safe-guard sustainable consumption and production patterns while the goal number 13 urges countries to undertake action to combat climate change and its impacts (United Nations [UN], no date).

Subsequently, the Paris Agreement signed in 2016 by 174 world leaders and the EU and counting with 194 members in 2021, has been addressing fundamental intertwined energy issues. Practically, this legally binding international treaty marks a step of paramount importance for the world towards the climate change fight. Actually, it showcases the recognized need for international cooperation and coordinated solutions among states and the commitment of both developed and developing countries in reducing the rise of the average temperature globally to levels below 2 °C compared to pre-industrial levels while striving to cease the rise even further, to 1.5 °C (UN, no date). It is verifiable that decarbonisation measures, including several energy efficiency services, projects and incentives have been and are being pursued in several countries worldwide, mainly in Europe.

In the meantime, technological advancements have fostered the competitiveness of RES technologies, batteries and electric vehicles. Low-carbon technology evolution and international decarbonisation policies are disrupting the global energy architecture (WEF, 2014), altering the political dynamics within and between countries. States with stronger ability to innovate in renewables, batteries and electric cars are better positioned for leveraging the industrial and economic benefits of this transition, producing substantial development (Hafner and Tagliapietra, 2020). As Eyl-Mazzega and Mathieu (2020) observe, the world must double the investments in RES and energy efficiency but also in the roll-out of a mix of solutions such as carbon capture utilization and storage, decarbonized hydrogen, biofuels and electric vehicles (Hafner and Tagliapietra, 2020). Also, the significant reinforcement of the adaptation measures funding is a global mandate.

It is also necessary to stress out the efforts that United Nations are placing during the last decades on the ways to combat the climate change, making almost every country in the world to join for global climate summits, named 'Conference of the Parties' (COP) (United Nations Climate Change Conference, 2021). In this context, the COP26 that took place in 2021 in United Kingdom, had as one of its main targets to tackle the ways and mechanisms for the parties to reach net-zero by 2050, maintaining the target of the 1.5 °C. The respective routes comprise, inter alia, the switching to electric mobility and the investments in renewables as well as in related Energy Services.

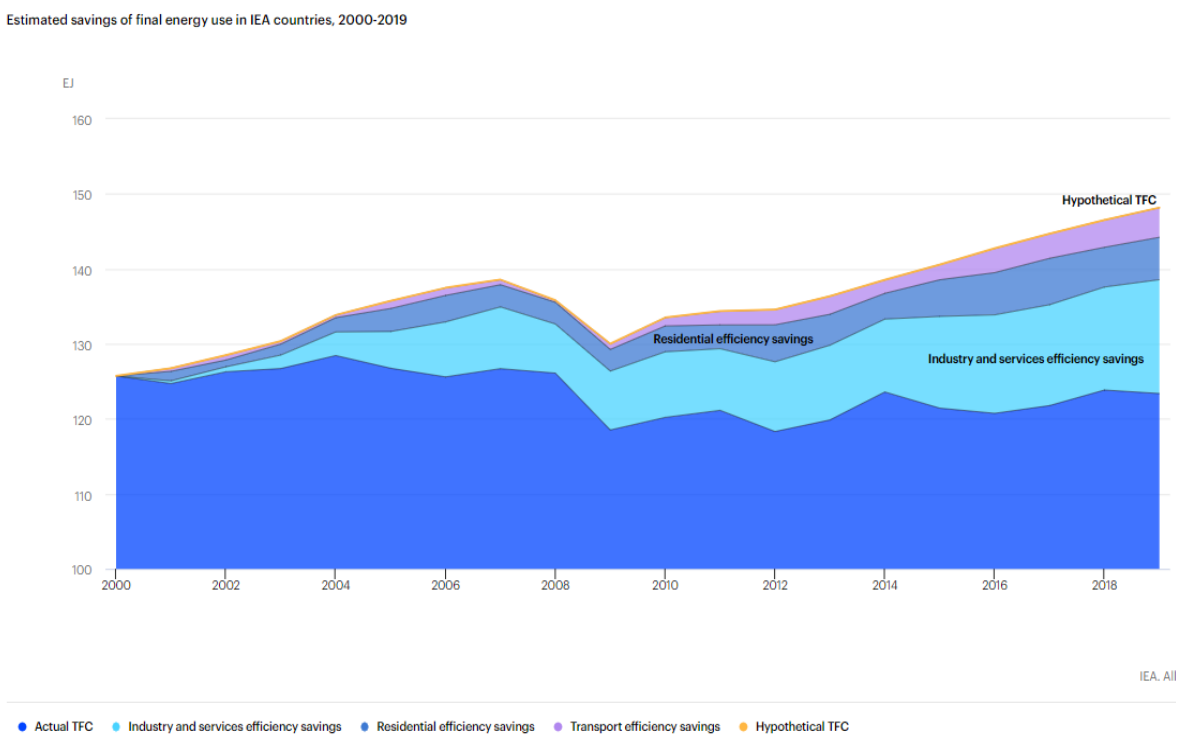
3.3. Energy Services and Energy Efficiency

Admitting that energy is at the core of the European economy, the EU has been setting aggressive energy strategies for years. These strategies, along with their objectives, target at achieving energy sustainability, competitiveness and security of supply. Evidently, energy efficiency is a fundamental part of the said strategies, playing a primary role in the reduction of the greenhouse gas emissions (Deloitte, 2016).

Improvements on energy efficiency generate considerable positive results for the climate and for energy consumers. For instance, equipment efficiency policies such as energy performance standards or energy labels have halved the average energy consumption of ordinary appliances such as lighting and air conditioners (IEA, 2021d).

According to IEA's (2021d) Energy Efficiency Indicators Overview, it is estimated that, since 2000, energy efficiency ameliorations have resulted approximately in 20% less energy consumed, where the industry and services segments contributed in the energy savings by 61%, the buildings by 23% and the transport by 16%, as also depicted in the decomposition analysis presented in Figure 8.

Figure 8: Savings from Energy Efficiency in IEA countries

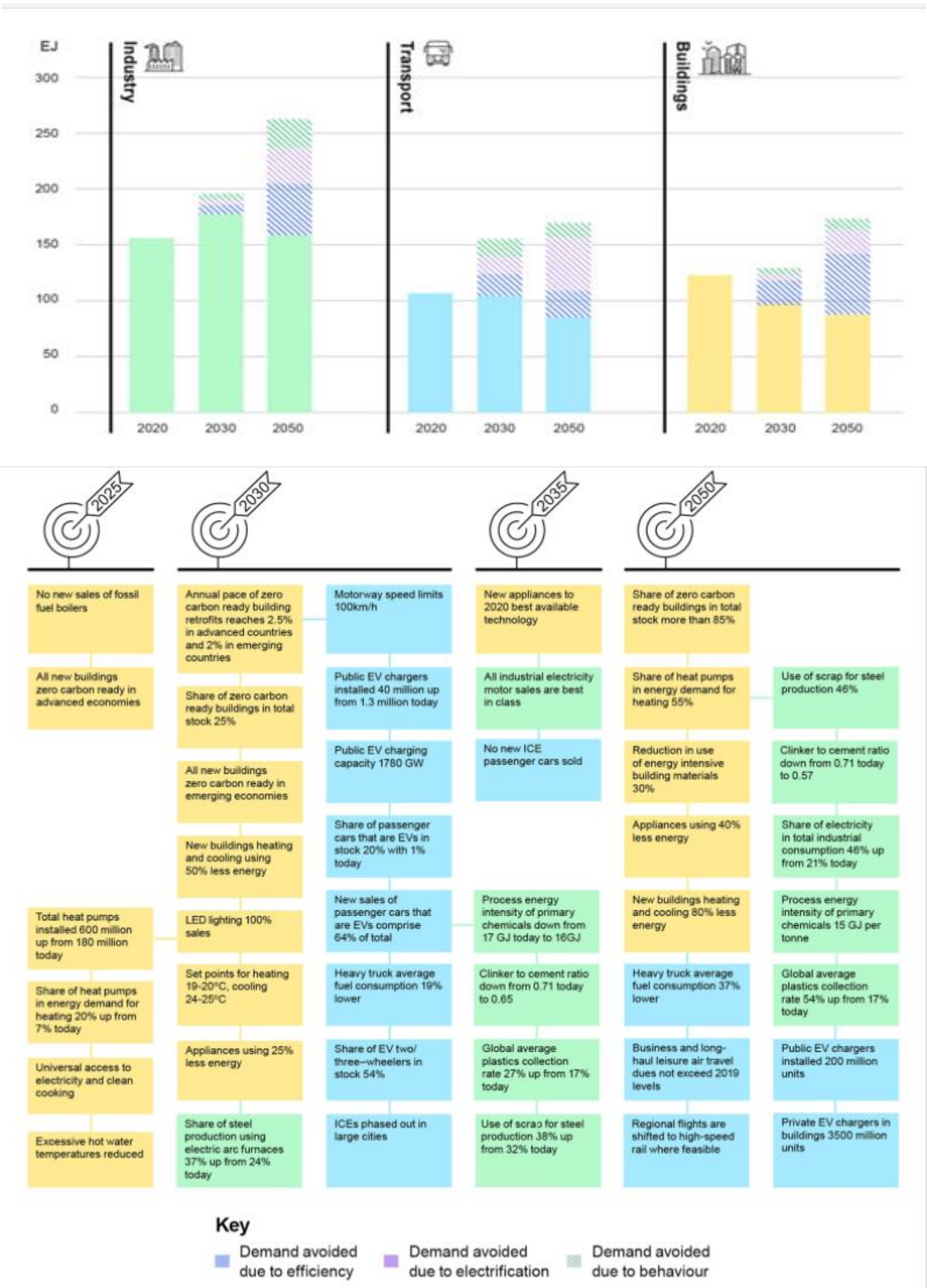


(source: IEA, 2021d)

Energy Services are key for the materialization of energy efficiency. A critical challenge for the forthcoming future is to trigger more investments in Energy Services, to achieve higher volumes of energy efficiency, without negatively impacting on residential customers nor on the Union's competitiveness globally due to a potential deindustrialization (Deloitte, 2016).

In IEA’s (2021a, p.15) report on Energy Efficiency**,** the ‘Net-Zero Emissions’ (NZE) by 2050 Scenario is presented, embracing more than 40 energy efficiency milestones, which can be translated, among others, in different Energy Services, incorporating technologically advanced solutions that can be fast scaled-up (Figure 9).

Figure 9: Energy Efficiency Milestones - The ‘Net-Zero Emissions by 2050’ Scenario



(source: IEA, 2021a, p.15)

Furthermore, the implementation of these services lead to energy demand reductions due to increased efficiency, grown electrification and behavioral improvements. It is worth noting that without the achievement of these milestones, the aggregated final energy consumption by 2030 would be increased by 30% (IEA, 2021a).

More analytically, within the framework of the NZE, energy efficiency undertakings in buildings generate some of the most critical energy savings heading towards 2030. Augmenting the share of actual zero carbon buildings from less than 1% in 2021 to approximately 20% by 2030, pursuing all essential site upgrades and retrofits, is a fundamental step (IEA, 2021a). The redrafting of the Energy Performance of Buildings Directive defines concrete measures to speed up the pace of buildings upgrades, contributing to energy efficiency and renewable targets achievement as well as to the reduction of CO_2 emissions in the respective segment (COM (2021) 550, final).

Regarding transport, heightening the efficiency standards of fuel of all different vehicle types is crucial, taking into account that 80% of private cars in 2030 still operate with internal combustion engines. It is indisputable that the sales of less efficient sports utility vehicles accounted for more than 40% of worldwide sales in 2020, while electric types only for 5% (IEA, 2021a).

On the other hand, in the NZE by 2050 scenario, the energy consumption of the industry segment increases by more or less 8%. In this context, crucial development is made in energy efficiency through several Energy Services taken on, to allow the global economy to generate annually 9% more steel, 21% more chemicals and 5% more cement by 2030 (IEA, 2021a).

3.4. The Operating Framework for Energy Services in the EU

Unquestionably, since the Lisbon Treaty, the EU has augmented its environmental policies and has been continuously inter-linking its energy and climate policies, moving towards unprecedented changes. This path has witnessed the integration and strengthening of longer-run decarbonisation targets along with an increasingly augmenting role of the climate pillar in EU's energy frameworks, both internally and externally (Eyl-Mazzega and Mathieu, 2020).

Practically, the EU has enacted an economy based on energy efficiency as the primary fuel and has been advancing towards sustainable energy and climate change mitigation strategies pursuing concrete regulations, new and improved policies, aggressive targets and keeping up the establishment of Energy Service market players that are expected to play a critical role (Boza-kiss et al., 2019). ESCOs have the proper expertise to provide turn-key solutions, materializing considerable energy cost reductions while addressing several market driven obstacles. When working on the basis of Energy Performance Contracting, ESCOs have the comparative advantage that they undertake performance risks by associating their compensation to the performance of the pursued projects, thus striving for delivering savings-generating solutions (Boza-kiss et al., 2019).

It is incontestable that the EED has been significantly contributing to the evolution of Energy Service markets across EU. Adding to that, the adoption of the European Green Deal in 2019 by the EC with its final approval in 2020 has set a bouquet of initiatives with the primary target of rendering the EU the first climate neutral continent by 2050. Having also established a Just Transition Fund to assist vulnerable regions, it practically sets a new trajectory, to couple the energy transition with the adequate economic and industrial transformation, while safeguarding social inclusion (Tagliapietra, 2020).

Therefore, the Green Deal constitutes a response of the EU Member States to climate challenges and environmental issues, providing a new enlargement strategy that targets to reshape the EU into “a fair and prosperous society, with a modern, resource-efficient and competitive economy” (COM (2019) 640, final), where by 2050 there will be zero-net CO_2 emissions and growth will be unbundled from the exploitation of resources. An arsenal of policies and measures, with a focus on energy efficiency, permeate the EU Green Deal Roadmap and paves the way for the Energy Services incremental growth within the territory, strengthening the welfare of Europeans and rendering “the new European raison d’être ensemble” (Eyl-Mazzegga and Mathieu, 2020, p. 34) tangible.

The Circular Economy Action Plan also complements the EED. Devising long-lasting products and equipment or recycling raw materials results in lessened energy consumption and greenhouse gas emissions. In overall, the overriding principles of

Circular Economy strengthen the efforts against climate change (COM (2021) 558, final). In parallel, the Renovation Wave strives to safe-guard that buildings throughout Europe are more sustainable, resilient and energy-efficient over their life-time.

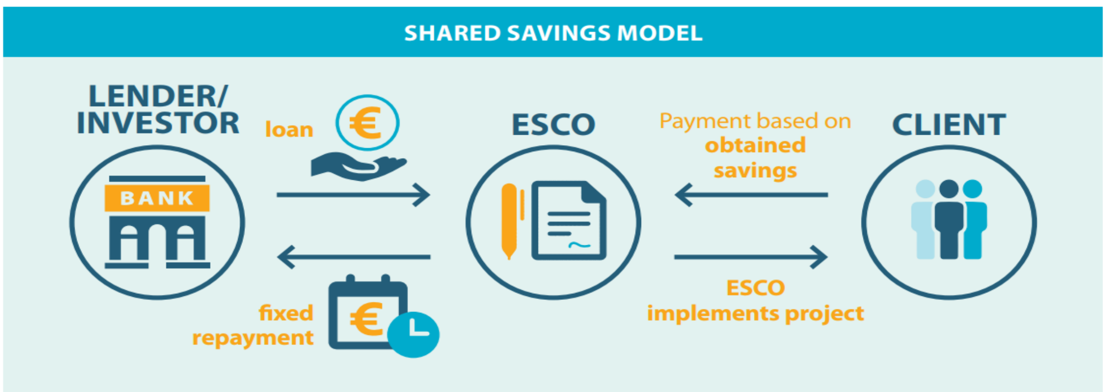
3.5. The Financing Mechanisms and Schemes

There is a plethora of mechanisms, tools and schemes currently active, recently announced or to be announced, aiming at the financing of distributed generation projects and the implementation of several energy services. In most of the cases, such mechanisms are designed at EU-level and then transposed in each Member State, where they are adapted in consonance with the respective National Plans.

3.5.1. The Financing Mechanisms

Energy Services are financed by third-parties such as financial and banking institutions as well as by the ESCOs themselves or by the customers' equity, depending on the clients' appetite, needs and economic position. In the context of an EPC agreement, the party that undertakes its financing is directly linked to the project's cash flow and, thus, it is common that the party assumes an operational risk. There are two primary models for EPC projects encountered throughout EU, namely the 'shared savings' and the 'guaranteed savings'. As far as the shared savings model is concerned, the ESCO guarantees the loan (Figure 10), while in a guaranteed savings model, it is the customer that secures the loan. Practically, the party that is financially responsible for the respective contract constitutes the principle difference between the two models.

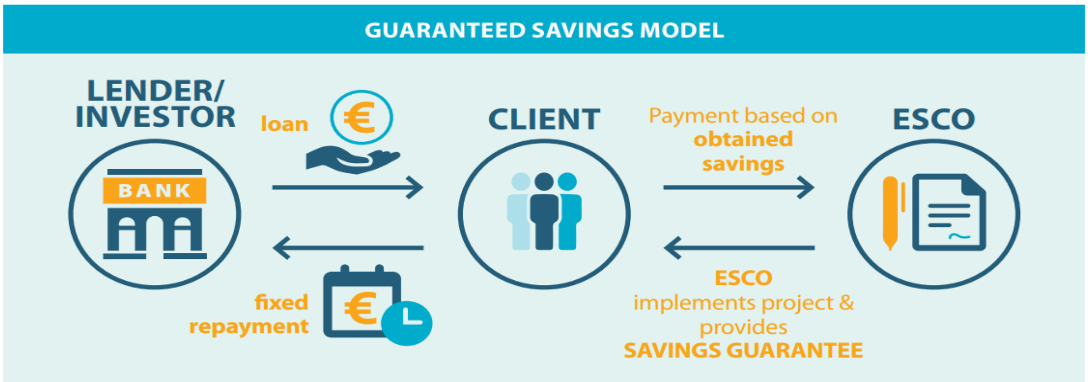
Figure 10: The Shared Revenues Model



(source: Glicker and Roschini, 2020, p.8)

It is observed that in established Member State markets with a well-structured banking system, guaranteed savings is the model mostly used (Figure 11). This is primarily attributed to the fact that in a guaranteed savings model, the financial risk is solidly related with the customer's creditworthiness. Consequently, it is more acquainted in markets with stronger businesses characterized by favorable credit, such as the EU, given that, in principle, financial institutions are more willing to lend to companies that have a good credit ratio (Glicker and Roscini, 2020). To be noted that there are incubating models providing energy savings insurance, to lessen both the technical and financial risk related to EPCs.

Figure 11: The Guaranteed Savings Model



(source: Glicker and Roschini, 2020, p.8)

3.5.2. The Financing Schemes

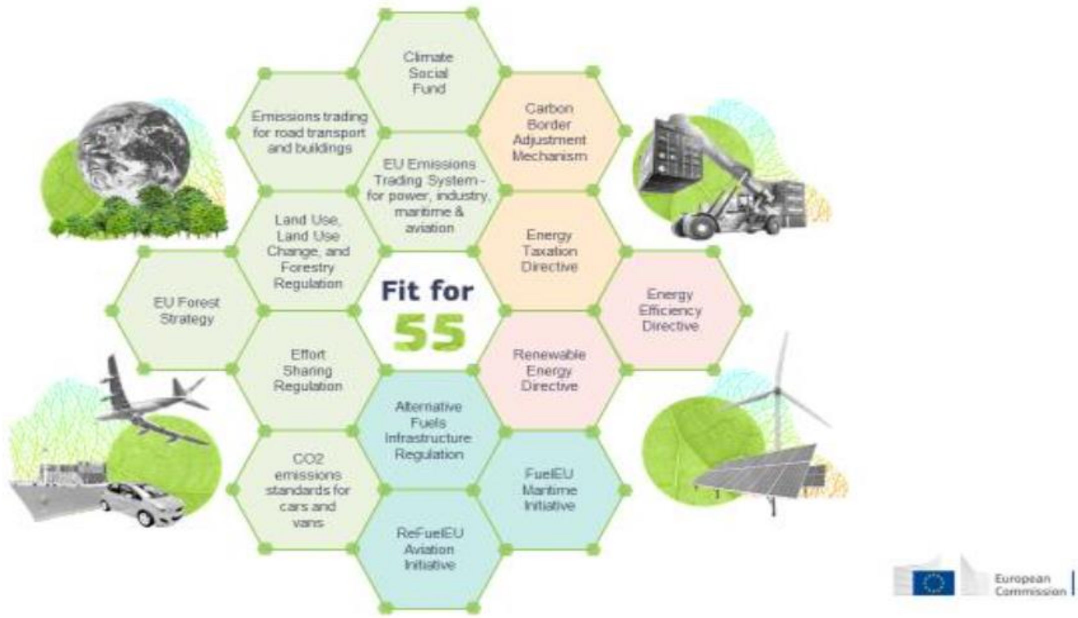
The European Green Deal that calls for the implementation of Energy Services and ESCO projects in order the green transition to be attained, requires significant funds. The one trillion package until 2030, for both public and private investments, is just an initial estimate. The Deal's materialization necessitates even higher amounts and an optimized exploitation of existing tools, technologies and innovations along with their retargeting towards climate challenges (COM (2019) 640, final). Aiming at climate neutrality by 2050 imposes Member States to select the most cost-competent trajectories, strengthening coordination of policies and investments within Europe (Eyl-Mazzega and Mathieu, 2020).

The European Green Deal is foreseeing, inter alia, an extensive renovation wave, cleaner transport and several measures for the digital transformation in cities.

Through the ‘Horizon Europe’ program, the Green Deal provides continued reinforcement to urban projects and platforms, in an effort to create climate-neutral and smart cities while with the ‘Next Generation EU’ program, the temporary tool formulated to facilitate the recovery post COVID19, it provides a financing line of 750 billion euro targeted at the pandemic recovery (European Energy Research Alliance [EERA], no date). It is worth bearing in mind that the EU’s long-term budget together with Generation EU is expected to constitute the largest incentives package ever financed in Europe, accounting for a total of 2.018 trillion euro to reshape a post-COVID-19 continent and ensuring “a greener, more digital and more resilient Europe” (EC, no date).

Besides, the so called `Fit-for-55’ Package, a portfolio of interlinked proposals and measures targeting at a just, socially fair, competitive and green transition by 2030 onwards (Figure 12), submitted to the Council on July 2021, extends concrete measures in the framework of the EED as well as new funding vehicles, exploiting the revenues from the new Emissions Trading System (ETS). The latter targets to mitigate the effects of higher costs for end-users, due to the application of a carbon price on the road transport and building segments (COM (2021) 558, final).

Figure 12: The ‘Fit-for-55’ Package



(source: COM (2021) 550, final)

The mitigation of these effects can be further assisted by the heightening of the energy savings obligation and the empowerment and protection of vulnerable customers, in the context of solidarity.

It is worth noting that revenues from the new EU ETS scope to finance measures for the improvement of energy efficiency and, thus, the development of Energy Services. Precisely, a portion of the revenues from the ETS for the road transport and buildings will be added to the EU budget for funding Member States' investments related to buildings' upgrades and energy efficiency, the decarbonisation of heating and cooling systems, the integration of distributed generation from RES and electro-mobility (OECD, 2021).

Furthermore, the Recovery and Resilience Facility constitutes another significant source of funding for energy efficiency investments, providing access to Member States to grants and loans, totaling 672 billion euro. Considering that 37% of these funds are destined to climate actions, it is expected that Member States will invest significant amounts on buildings' renovation, with a primary focus on poorly performing buildings and households characterized by energy poverty (European Parliament and of the Council Regulation (EU) 241/2021).

At the same time, the Cohesion Policy funds brace Member States with a gross national income per capita below 90% of the EU-27 average, to foster the economic and social EU coherence (IEA, 2021e). Even more, Member States continue dedicate significant part of the EU budget to energy efficiency and buildings upgrade. Precisely, InvestEU, via its dedicated financial schemes and tools, particularly the 'ELENA' (European Local Energy Assistance) facility, will trigger significant private and public investments in the Member States, with a focus on heat networks, street lighting and urban transport (IEA, 2021e).

The Just Transition Fund, with an overall budget of 17.5 billion euro, strives to mitigate the socio-economic costs emanating from the transition to a non-emissions economy, incorporating investments in energy efficiency and sites upgrade that will provide a double benefit of generating new jobs and tackling poverty in a more permanent mode (COM (2021) 558, final). Furthermore, centrally-driven programs, such as Horizon Europe, are expected to prioritize the funding of measures contributing to the green transition, targeting, among others, at technology innovation and best practices in energy efficiency strategies roll-out (COM (2021) 558, final).

3.6. Evolution of the Market in the EU

The development of Energy Service market differs substantially from country to country within EU. As per Boza-Kiss et al. (2019) Review for the Energy Service Market in the EU, a market survey they performed on behalf of the Joint Research Center (JRC) of EC leveraging an online expert survey, showcased a relatively stable or growing market trend with variations among countries.

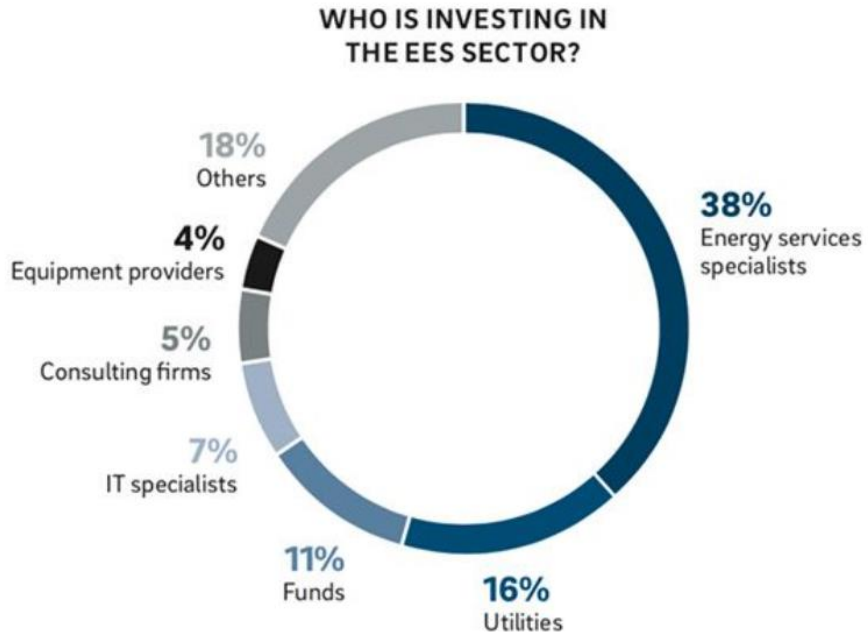
According to the survey, the main reason for these differences is attributed to the lack of knowledge and awareness for Energy Services. More solid knowledge is manifested in countries with a regulatory framework for EPCs and with already implemented projects that tend to become reference cases.

The specific results match those emanating from the report on European Energy Efficiency Services Markets and Quality by QualitEE (Szomolanyiova and Keegan, 2018), a project under the auspices of the EU's Horizon 2020, for the investments' increase in energy efficiency services in buildings and the augmentation of trust in energy service providers. More specifically, the development in the 15 European EPC markets, covered by the said report, seems to have been soaring in 2017, with more than half of the respondents (53%) admitting that their national EPC market had witnessed growth over the last 12 months (Szomolanyiova and Keegan, 2018).

However, it is essential to be stressed out that a consistent and reliable EU database is not yet a practice and, thus, a quantitative cross-country analysis cannot be fulfilled (Boza-kiss et al., 2019).

In accord with Müller et al. (2019), the appetite for investing in energy efficiency services differs among different stakeholders' groups in the EU market. Precisely, ES specialists are the most willing to invest, accounting for the 38% of the total, followed by utilities at 16% and investment funds at 11% (Figure 13). In order to succeed, they should set-up a sound and positive business case for their customers with short pay-back to the extent possible, enhanced software and optimization possibilities (Consultancy.eu, 2019). They must also focus on inorganic growth through mergers and acquisitions, paying attention on maintaining the entrepreneurial character of their newly acquired firms while ensuring the right internal structure themselves, with the necessary flexibility and agility to embrace solid growth businesses (Consultancy.eu, 2019).

Figure 13: Who is investing in the EES sector in the EU



(source: Roland Berger, 2019, cited in Consultancy.eu, 2019)

Apart from these parameters, societal trends can also significantly impact on the level of Energy Services demand. Brugger et al. (2021, p.2) categorize these trends in four different clusters, where the first two address the digitalization of the everyday life and new models transforming both the society and the economy, including "the sharing economy and prosumaging (combination of producing, consuming and managing of energy)". The other two clusters refer to the big changes through which the industrial sector is going through, characterized mainly by the decarbonisation, the circular economy, the urbanization and regionalization.

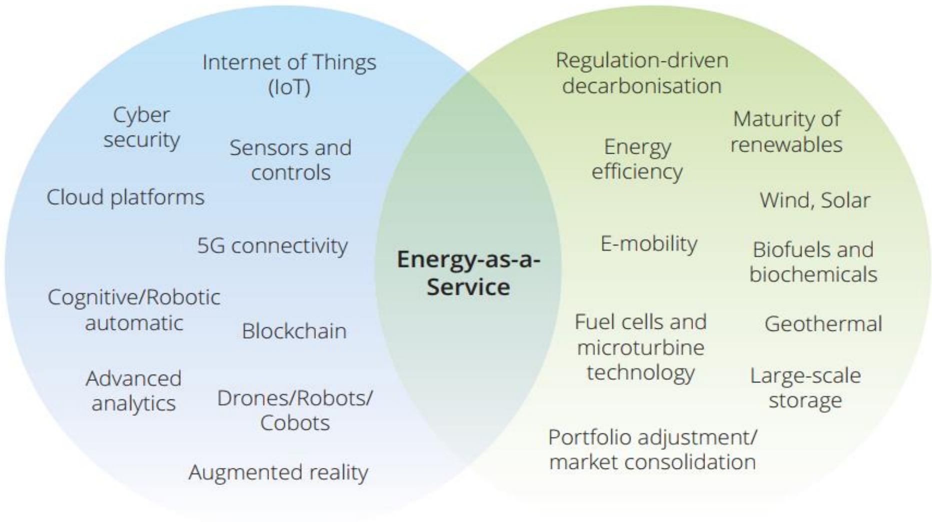
It is worth mentioning that digitalization may also become the driver for the rest of the trends. A characteristic example is the penetration of mobile applications that considerably ease electric vehicles sharing. The past has proved that, in several instances, the gains emanating from energy efficiency initiatives had been restrained by societal trends that inflated respective activities. This fact has resulted in considerably smaller energy use decreases or, in some cases, even increases. A characteristic example is the penetration of larger vehicles in the private transport sector (IEA, 2021c). Hence, it is critical to assess actual and future societal trends for their potential impact on the demand of Energy Services.

With reference to forthcoming developments in the EU Energy Service market, it is expected that in the next decade there will be more changes than there have been in the previous century, considering that the grid is becoming ‘smart’, encompassing smart buildings, smart transport, a large array of smart devices and several other developments (Deloitte, 2019). These will include the roll-out of distributed generation, the introduction of connected technologies, the installation of storage units, big data and the augmented penetration of energy efficiency (Deloitte, 2019).

3.7. The New Model: Energy-as-a-Service

As it has been already contemplated (paragraph 2.1), a delivery model that connects all hardware, software and services, named Energy-as-a-Service (EaaS), is foreseen by Deloitte (2019) as the model matching the ‘new normal’, combining energy efficiency with electro-mobility, demand management, distributed generation sources, while optimizing the demand-supply balance. Customers seeking for a holistic energy solution agent will be willing to be served for all their energy needs by providers delivering a streamlined proposition for a fixed monthly installment. The benefit of EaaS resides in the simplification of a growing multilateral proposition (Figure 14).

Figure 14: Tech+Energy = Energy-as-a-Service



(source: Deloitte, 2019, p.4)

Traditional energy production, generation from RES, distribution points and clients will form a highly automated system with a bilateral flow of electricity and information, through the use of advanced communications, such as cloud platforms and digital technologies, primarily IoT and Augmented Reality (Deloitte, 2019).

It is expected that consumers will be at a position to self-manage exceeding supply, through peer-to-peer markets (Hahnel et al., no date). Energy will be bundled with energy efficiency services, such as an electric vehicle and promoted as a secondary product (Deloitte, 2019).

3.8. The EU Energy Service Market perspectives

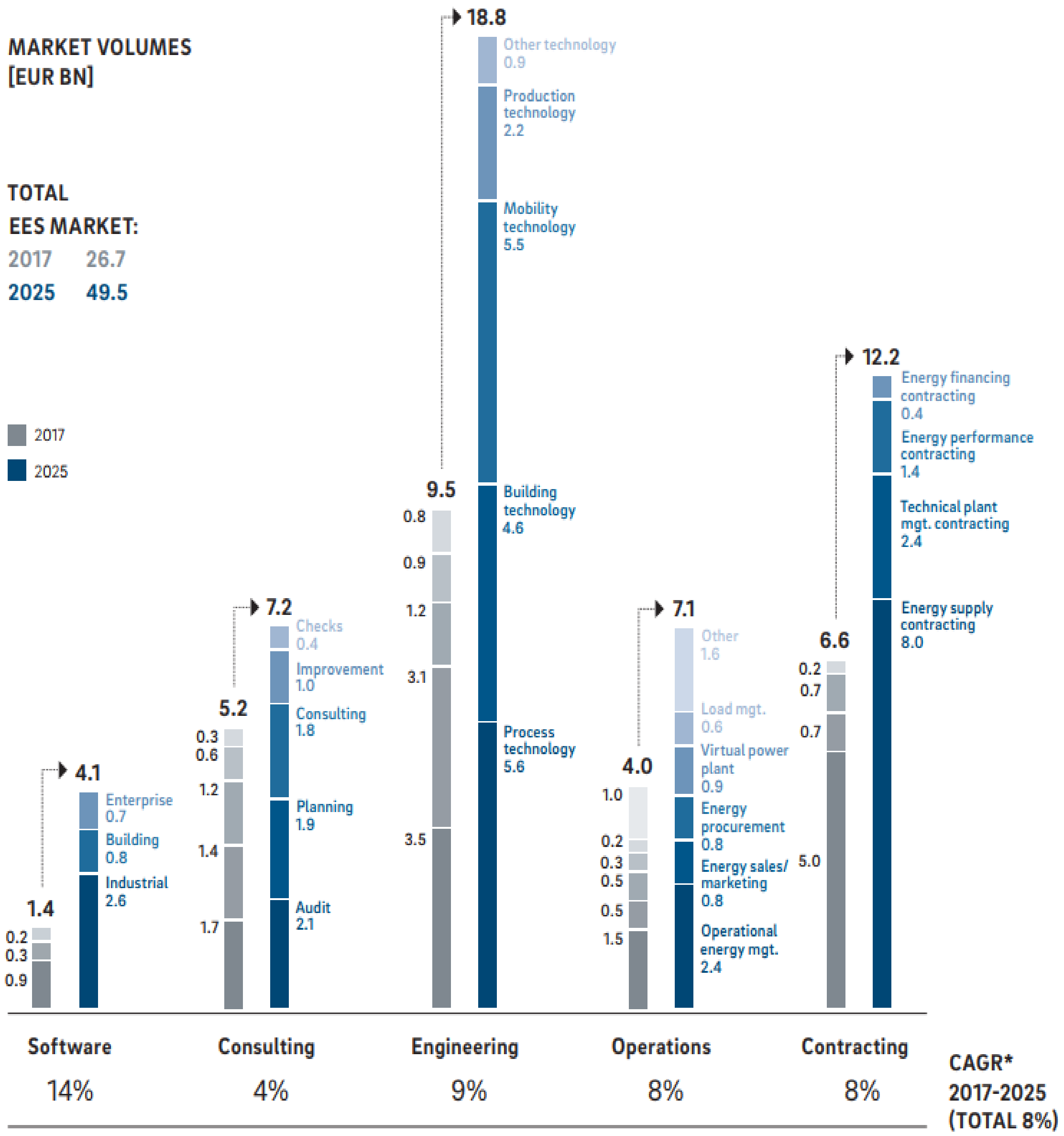
Müller et al. (2019), in their report dedicated to the EU Energy Services and products strive to motivate readers for enhancing the energy efficiency of buildings, assets and business operations. As they observe, the most requested service is engineering, embracing mobility, building technology and process technology, expected to account for 18.8 billion euro by 2025 versus 9.5 billion in 2017.

Contracting, focusing mainly on energy supply, shows to increase from 6.6 billion euro in 2017, to 12.2 billion euro (Figure 15). Among all sectors, software is expected to enjoy the highest % increase during the period 2017-2025, at a compound annual growth rate (CAGR) of 14%, followed by engineering at a CAGR of 9% (Roland Berger, cited in Consultancy.eu, 2019).

As Europe pursues the way towards green transition, the demand for Energy Services is expected to augment considerably during the same period, at a CAGR of 8%, making the market to rise from 26 billion euro in 2017 to almost 50 billion euro by 2025 (Figure 15).

This increase will render Energy Service market a fundamental one within Europe, of a truly pivotal role (Roland Berger, cited in Consultancy.eu, 2019).

Figure 15: EES is set to become a key European market



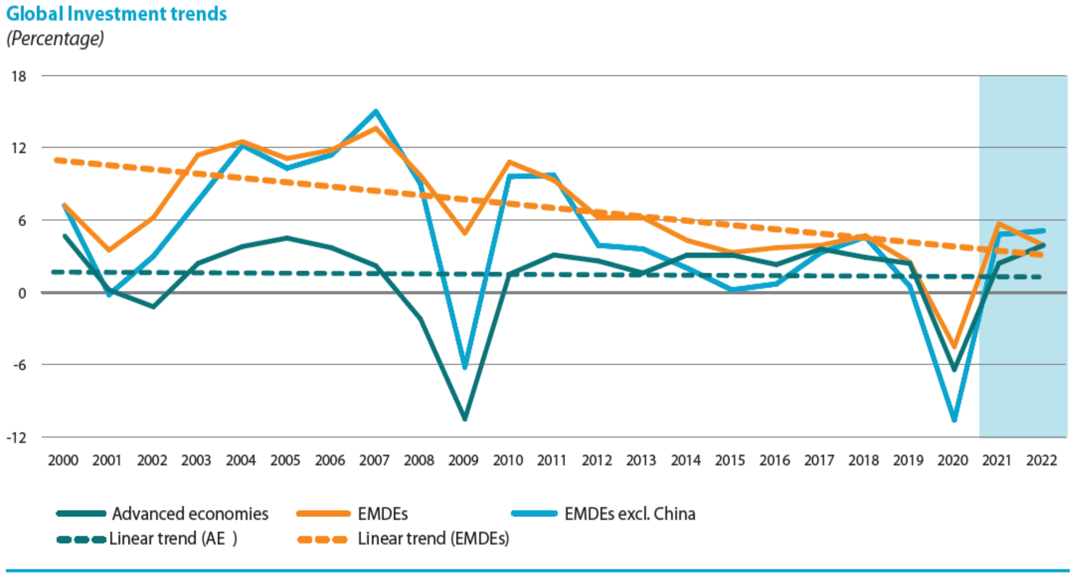
(source: Roland Berger, 2019, cited in Consultancy.eu, 2019)

3.9. The EU Energy Service Market vs other Regions' Markets

As it was expected, the pandemic impacted negatively on global investment in 2020, exacerbating the significant decline in productivity worldwide. As per UN's (2021) Financing for Sustainable Development Report, the gross fixed capital decreased by 6.4% of Gross Domestic Product (GDP) in advanced economies and 4.5% in developing economies, with decreases witnessed by all regions, to a smaller or larger extent.

Even further, when China is not taken into consideration, the decline of investment in developing countries records 10.6% , an abatement that subsets a ten-year period of foible global investment and slow productivity growth and which is even larger than that testimonied during the global financial crisis (Figure 16). After Covid-19 recedes, it is most probable that losses in investments attributed to the pandemic will have a long-run effect, as inflated uncertainty about the prospects and lack of willingness for risk taking may hinder the undertaking of private investments.

Figure 16: The Global Economic Context & Implications on Sustainable Development



Note: EMDEs = emerging market and developing economies. Data for 2020 are estimates and for 2021-22 are forecasts (shaded area). Investment refers to gross fixed capital formation. Aggregate growth is calculated with investment at 2010 prices and market exchange rates as weights. Sample includes 97 countries, consisting of 34 advanced economies and 63 EMDEs.

(source: Haver Analytics, World Bank 2021, cited in UN, 2021, p.5)

Congruent with the same Report of UN (2021, p.4), "a rebound in investment is expected in 2021". The pandemic is also expected to speed-up "structural shifts in global supply chains" (UN, 2021, p.4), potentially strengthening strategic sectors, such as the production of technologically advanced inputs.

While it would be expected that the rise of investment in technology aspects would also foster the implementation of Energy Services and their penetration worldwide, investments in efficiency have not heightened substantially since 2017. This results to a large extent from the slow developments in reinforcing efficiency policies but, mainly, to the challenges tied with access to finance, which remains a predominant constraint (Ashak and Jihyun, 2021).

ESCOs can lessen the load of the upfront investment and ease the access to the respective financing. It is undeniable that the global ESCO market continued to steadily increase since 2015, accounting for USD 33 billion in 2020. The larger part of the increase is attributed to China, where estimated revenues grew 12% despite Covid-19 negative implications (Ashak S. and S. Jihyun, 2021).

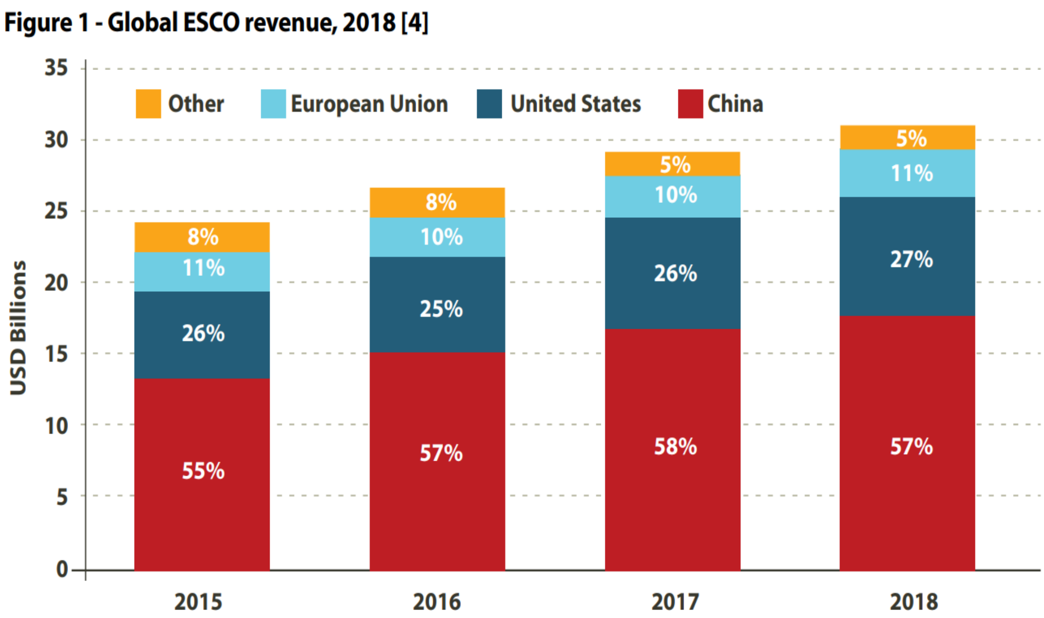
The significant increase in China over the last five years is due to the introduction in the market of aggressive government incentives, such as dedicated funds for ESCOs, and policies, such as tax incentives, that promote and energize the ESCO market growth (Glicker and Roscini, 2020). The United States and United Arab Emirates markets also grew in contrast with the markets in Europe and emerging Asia that somewhat diminished. According to IEA (2021c), without adequate policy support, ESCOs could stay behind, especially so those that still find themselves at an early development stage.

Looking at China more closely, it is worth mentioning that it has pursued “a Made in China 2025 strategy” (Cyrill M. 2018), which strives to safe-guard as well as promote China’s position as a “global powerhouse in high-tech industries” (Harvard University, no date). The principal objective is to decrease the country’s dependency on imports of technology and make it to dynamically invest in its own innovations creating highly competent businesses that can excel both globally and within the Republic, obtaining dominant position in the technologies and related services addressing the energy transition.

Practically, this initiative results from a dynamic strategy combining internal reinforcement for innovation with an industrial policy, foreseeing the transfer of technology as a condition for Foreign Direct Investment (Eyl-Mazzega and Mathieu, 2020). It is worth observing that in 2019, almost the 40% of patents in low-carbon technologies worldwide come from China (IRENA, 2021). The dominance of China can be also partly attributed to the fact that most of the EU Member States have been transferring polluting industries to China by obtaining technology know-how and expertise transfers (Eyl-Mazzega and Mathieu, 2020).

For the EU energy service market to be compared to that of other regions, it is indispensable to define the size and value of the respective markets. In accord with Glicker and Roscini (2020), there are many ways to define this market’s size and value, considering the number of EPCs, contract volume and level of total revenues. It should be stressed out though that, as it has been observed, the different countries, particularly in Europe, follow different methodologies to assess the respective market size. With regard to revenues, as per IEA's (2019) Report on Energy Efficiency, Europe is the third largest market and the second oldest after the US, reaching USD 3 billion in 2018, following the US at USD 8.3 billion and the world ESCO-leader, China, at USD 16.4 billion (Figure 17).

Figure 17: Global ESCO Market Growth 2015 – 2018



(source: IEA, 2019, p.56)

The perspectives for the global ESCO market are substantial, as the respective revenues are expected to enjoy a compound annual growth rate of 4.5% from 2020 to 2029 (Boulder, 2020). This growth will be challenged by new energy service models, evolving customer needs and augmenting expectations.

The growth that the EU ESCO market has witnessed during the last two decades is largely associated with the public sector, as it is also the case in the US, where 85% of the ESCO market is allocated to municipalities, hospitals and universities. It is worth mentioning that in the US, the Federal Energy Management Program offers training, guidance, legal consultation and contract templates for the different types of EPC projects.

Although the total market of the EU Member States has increased by 11% in 2018 versus 2015, it has not experienced the growth that the US or China have enjoyed mainly thanks to the significant increase of their public sector engagement. The largest volume of ESCO projects in Europe takes place in business buildings. It is worth noting that although the markets of the different Member States differ as regards maturity and development, they are characterized by the same key actors, value chains and delivery models (Glicker and Roscini, 2020).

Looking at the EU Energy Service market in more detail, it is noted that there is a steady growth throughout the period 2015-2018, which, in consonance with Bertoldi et al. (2017), has been in principle observed over the last decades, even overcoming the financial crisis of 2008, turning the financial limitations of the era into opportunities for the specific segment.

Bertoldi et al. (2017) also observe that the EU domestic Energy Service markets attract both local and foreign companies, with French and German ESCOs to be mainly encountered in Eastern and Southern Europe while Danish ESCOs to be found in Northern Europe. On the other hand, US companies, leveraging their long experience and lessons learnt from early market failures, are becoming increasingly interested in the EU Energy Service market, envisaging that there will be significant momentum in the longer run. Such growth is expected to be energized by the demand for capital and the need for more cohesive energy management strategies (Boza-kiss et al., 2017).

What will also play a significant role in the EU's market growth is the control over the supply chain of critical metals, taking into account their paramount importance in devising low-carbon technology value chains and exceling versus foreign players (Eyl-Mazzega and Mathieu, 2020). However, EU's dependency on respective imports is a fact, even though the region maintains some good reserves, with those in Finland being the most substantial ones along with its lithium refining industry, which is expected to transform the country into a battery hub in the years to come. Worth mentioning mining projects are gradually appearing in other European countries, such as Portugal, Serbia, Hungary and Germany, representing though only 5% of the global annual investment (Eyl-Mazzega and Mathieu, 2020) while players from Asia are dominating the market. In this context, the European Battery Alliance that aims at strengthening the region's efforts to create fertile grounds for investing in manufacturing capacity, to transform Europe into a world leader in sustainable battery production and use, is an initiative of substantial importance (European Battery Alliance [EBA], no date).

3.10. Energy Services in sample Member States Markets

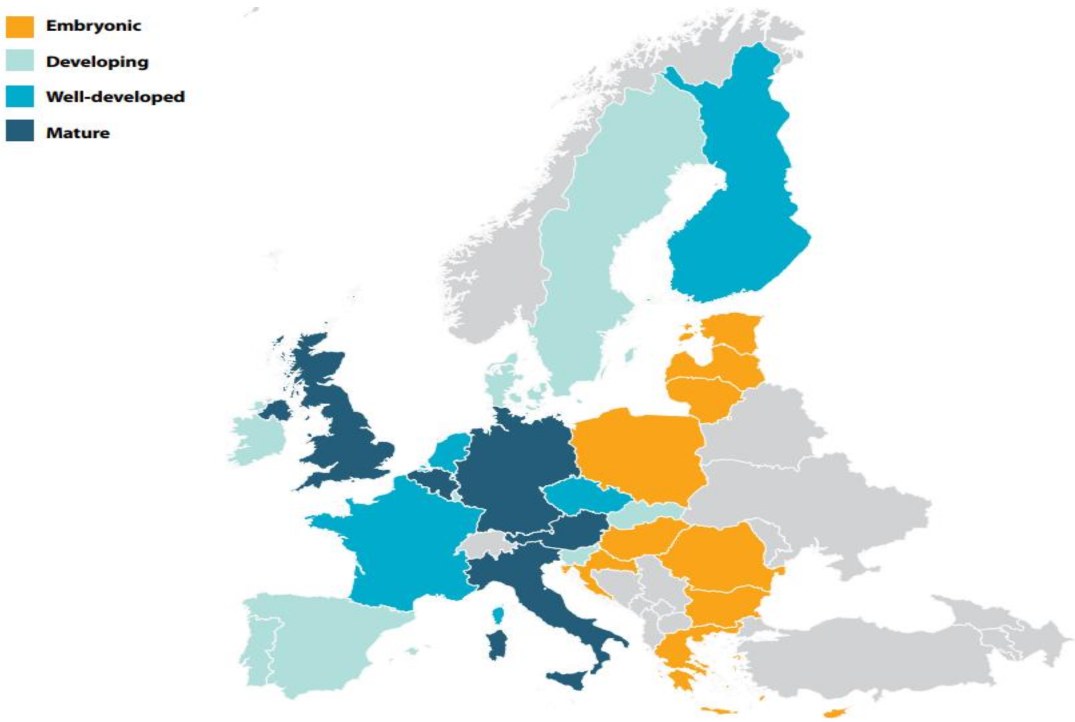
As it has been already addressed, the EU countries are characterized by different level of maturity in terms of their Energy Service market development. Boza-Kiss et al. (2019) strive to overcome the challenges posed by the varying definitions from one Member State to the other as well as by the lack of a regularly shared methodology as regards the market size definition.

Since 2005 onwards, Boza-kiss et al. (2019) leverage a review produced in collaboration with the JRC, the European Commission's science and knowledge service, which assesses the market size along with the market potential of domestic Energy Services, the ESCO as a stand-alone market and the EPC market, depending on respective data availability. The review authors propose a 'maturity indicator', practically based on the results emerging from the grading of specific key success factors across the EU Member States, that aim to evaluate the maturity level of a country's Energy Service market.

Precisely, the study of the JRC surveys undertaken in the EU (Bertoldi et al. 2014; Bertoldi et al. 2017; Boza-Kiss et al. 2019) reveals the main parameters that demonstrate the level of maturity of the corresponding EU countries' markets. These factors embrace the knowledge and awareness about the ESCO model and the resulting benefits, the trust for Energy Service Providers, the availability of different contract templates and alternative financial schemes and the extent to which the market under study is demand driven, with customers seeking for energy service suppliers. Other maturity indicators are associated with the existence of transparent monitoring and verification methods, of facilitators who can assist customers in deciding about the adequacy of services and technical designs and of quality labels and certificates that reinforce trust while differentiate qualified service providers (Bertoldi et al. 2014; Bertoldi et al. 2017; Boza-Kiss et al. 2019). Last but not least, an essential parameter is the level to which the energy procurement policy in Member States is favorable to the deployment of ESCO projects and an ESCO project solution is considered a reasonable way towards a sustainable economy rather than a legislation objective (Bertoldi et al. 2014; Bertoldi et al. 2017; Boza-Kiss et al. 2019).

In accord with the JRC survey 2018 results, the countries pertaining to a "Mature Market" (Boza-kiss et al., 2019, p.22), that is to say to already large Energy Service markets or currently growing with the highest scores of 9 and 10, are those of the United Kingdom, the Netherlands, Germany, Italy, Spain, Austria, Belgium, Slovakia and Slovenia. The "Well-Developed" (Boza-kiss et al., 2019, p.22) market cluster, scoring from 6 to 8, embraces France, Finland, Luxembourg and the Czech Republic. The "Developing Market" (Boza-kiss et al., 2019, p.22) cluster refers to Denmark and Ireland, with scores from 4 to 5 while the "Embryonic Market" (Boza-kiss et al., 2019, p.23) addresses small or not growing markets, scoring up to 3 points. The "Embryonic Market" seems to be the largest one, including Greece, Cyprus, Bulgaria, Romania, Hungary, Poland, Croatia, Estonia, Hungary, Latvia, and Lithuania. Furthermore, Glicker and Roscini (2020), following the grading of these factors, they recognize and map the split of the EU Energy Service markets in four principal categories (Figure 18).

Figure 18: The ESCO market development across the EU



(source: adapted from JRC 2019, cited in Glicker and Roschini, 2020, p.15)

The first two categories practically address developed markets, whereas the remaining two refer to developing markets. Looking into more detail, Table 1 depicts the evolution in the different EU Energy Service markets as far as the number of ESCOs and the value of projects are concerned, for the years 2007, 2010, 2013, 2015 and 2018, leveraging on data emanating from the JRC surveys.

Table 1: Level of maturity of the EU Member States Services Markets

MS	first ESCO[9]	Number of ESCOs[10 11 12]					ESCO market, EUR million annual [13]
		2007	2010	2013	2015	2018	2018
Austria	1995	ca. 30	5-14	over 50	41	400 (EnS); 27 (EES); 36 (ESC)	30-40 (only public buildings)
Belgium	1990	ca. 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)
Cyprus	2016	0	0	0	19	22	0
Czech Rep.	1993	7 (15)	8-10	20	15	15	9-15
Denmark	ca. 2010	4-5	10	15-20	15-20	4	70
Estonia	ca. 2014	2	2	2 (3?)	2-3 (<10)	4	5
Finland	2000	9-11	8	5-8	6-8	15	6.5
France	1800's /1937	3 (100)	10+100	350	300	45	13.5 billion (EnS); 40-60 million (EnPC)
Germany	1990-1995		250-500	500-550	ca. 500	560 (EnS); 138 (EnPC)	9 billion (EnS); 7.7 billion (EnPC)
Greece	ca. 2003	0-3	2	5	47	86 (3 providing EnPC)	n/a
Hungary	1990s		20-30	10	ca. 8-9	10 (5 EnPC)	n/a
Ireland			15	ca. 30		25	20
Italy	early 1980s	15-25	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	ca. 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	ca.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

9 Data based on Vine (2005), Geissler (2005), and previous JRC reports on energy services, unless otherwise indicated.
10 In some cases, the contradicting values found had to be consolidated based on expert knowledge. If information was available about the registered number (of e.g. ESCOs) vs. the actually active ones, both of these are indicated – with the previous value in parenthesis: ()
11 Depending on the countries, information on EnS, EPC and EES is available. These data are provided accordingly.
12 Number of ESCOs in 2007, 2010, 2013 and 2015 is based on Boza-Kiss et al. (2017a)
13 These values are not comparable throughout MS due to data scope. For more information, please refer to the country chapters.

(source: Boza-kiss et al., 2019, pp.15-16)

Austria is characterized by a positively evolved market but with significant regional differences (Boza-kiss et al., 2019). Belgium shows a higher interest pushed by public ESCOs (Glicker and Roschini, 2020) while the Danish market is slightly lagging behind its previous evolution, mainly due to the transfer of activity from the public building sector to the private one (Boza-kiss et al., 2019). Slovenia and Croatia have boomed instead, thanks to internal grants and the demand coming from the public sector while the respective market in Italy is evidently the most developed of all related markets. Amongst the growing markets but at a slower pace, those of Finland, France, Germany, the Netherlands and UK are discerned, primarily due to their functional operation and maturity level (Boza-kiss et al., 2017; 2019).

The same survey characterizes the markets of Hungary, Latvia, Croatia, Estonia, Poland, Romania, Bulgaria and Greece as embryonic markets. The markets of Luxembourg, Cyprus and Malta are characterized as stagnating. This is mainly due to the fact that they have no or very limited activities in the service segment during the said period (Boza-kiss et al., 2017; 2019). On the other edge, Sweden has been facing a declining trend from 2015 to 2018 (Boza-kiss et al., 2019).

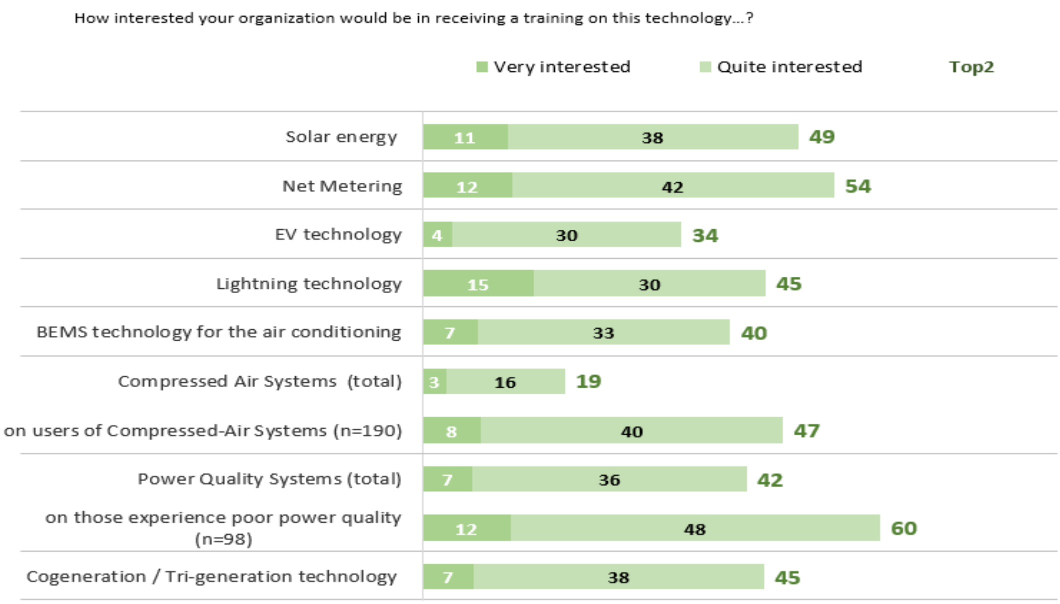
3.10.1. Energy Services in Greece

Focusing on Greece, Boza-kiss et al. (2019) identify through the JRC survey that the economic instability had obviously negatively impacted the ESCO market evolution since 2015. To shed more light in the Greek market, a quantitative study that ran in the domestic business segment by the Research Agency MRB Hellas (2020) on behalf of a private utility, has been leveraged accordingly. For the needs of this research, MRB ran face-to-face interviews with 500 businesses. with more than 10 employees.

According to the study's results (MRB, 2020), only 6% of the total interviewees, as of the last trimester of 2020, participate in an Energy Efficiency support scheme. This percentage becomes higher in large companies, with 51-250 and 250+ employees. As it emanates from the study, just few of the organizations (34%) in the country have an appointed energy manager, who is practically is the one aware of the business's energy consumption needs and respective spending while very few use energy performance indicators (7%). However, the vast majority of companies recognize that energy saving is a goal and part of their overall policy (87%). Even more, according to MRB Hellas (2020), 8 in 10 companies believe that there is a possibility of further decreasing their energy costs through energy services, with the belief being stronger in large, energy-intensive organizations. Big companies also consider the obligations for energy efficiency arising from the institutional framework. It is believed that the financial benefits of energy savings are mainly translated into fostered competitiveness (56%) rather than enhanced company reputation (15%).

However, the study (MRB Hellas, 2020) shows that Greek companies seem not to be that much aware of the international trend of zero energy footprint and on how this may affect their overall competitiveness. Although it is well-accepted that energy saving policies must be intensified, it is recognized that the cost of installing energy saving systems is a key deterrent to investment (71%). In parallel, the larger portion of companies in Greece opine that any energy saving proposals and solutions should be forward-looking and should have an immediate financial effect. They also identify the need for the benefits to be well communicated and for the businesses to become trained regarding the available funding opportunities and the respective funding processes (MRB Hellas, 2020). With regard to services, it is the distributed energy production where the majority of business customers wish to invest and become trained, with the PV net metering systems being the spearhead (Figure 19).

Figure 19: The Greek Businesses' interest in Energy Services Training



(source: MRB Hellas, 2020)

This is practically the service cluster that is considered as the one to be the most successfully implemented across the globe by 2030, followed by lighting technologies and electro-mobility.

3.11. The main drivers observed

In consonance with Müller et al. (2019), the Energy Service market evolution in Europe is principally attributed to five parameters, namely regulation, innovation, the energy transition, an augmenting emphasis on sustainability as well as digitalization. As already highlighted, the EED creates a fertile ground for the undertaking of energy efficiency measures in segments with high energy-savings potential, with specific Articles that can act as catalysts for energy efficiency.

Pursuant to the EC (2021c), Articles 5 and 6 have proved to be critical for leveraging the role of the public segment through renovations and public procurement, although still at a relatively limited scale. Article 7 constitutes a driver for creating energy savings, mainly in the buildings sector. Article 8 dynamically promotes the use of energy audits across the Union, in spite of significant limitations in connection with the audits' follow-up and the adoption of energy management systems. Furthermore, Article 14 assists in the augmentation of the significance of assessments on heating and cooling throughout the EU Member States, despite the several allowed exemptions and the delay in implementing the corrective actions emerging from the respective assessments. Article 18 contributes to the further development of EPCs.

As it has been observed, in several EU countries, positive alterations in the legislative framework have helped the ESCO market development in Denmark, Germany, Ireland, the Netherlands and Latvia (Boza-kiss et al., 2019).

Developed Energy Service markets have been based on particular drivers that have some common characteristics. However, the combination of drivers that contributed to the kick-start of certain markets differs considerably among the EU Member States. As Bertoldi et al. (2014) and Boza-Kiss et al. (2019) observe, Energy Service markets may be energized by demand, supply or policies.

In the case of demand-driven markets (Boza-kiss et al., 2019), interested customers recognize the benefits of Energy Services and are actively seeking for alternative project solutions, even for quotations from competing ESCOs, in order to conclude with the most opportune techno-economic proposition. In such markets, successful projects become reference cases and create positive word-of-mouth in both the public and the private sector. In other markets, ESCOs in the Public segment trace new projects and hand them to implementing companies on the basis of partnership agreements. Also, facilitating entities, such as ESCO associations, deliver trainings and provide networking.

Moreover, quality labels and assurance systems guarantee the desired service quality while project financing solutions, such as guaranteed-savings system, foster liquidity. Driving factors can be also considered the lack of customers' expertise and know-how that make them demand information and consultation from ESCOs, the increasing energy prices along with the need for a more extensive renovation.

Markets that are mostly driven by supply forces are in principal less developed and are energized by ESCOs, Energy Service associations or by other market facilitators. Trust is more difficult to be established, the costs are higher due to the need for promotion and lower rate of project materialization and the fostering of awareness becomes essential for the markets' further development. In such cases, markets need a supportive policy framework for energy efficiency measures, as it has been the case in UK and Sweden (Boza-kiss et al., 2017). Notably, the most crucial driver in such instances is the energy savings guarantee, which although more complex, it establishes the security that an investor needs in order to pursue a measure (Szomolányiová and Keegan, 2018).

What is more, successful reference cases can augment awareness, as it has been the case in Belgium, Bulgaria, Denmark, Finland, Ireland, Latvia and Romania (Boza-kiss et al., 2019). Facilitators can arrange project financing, by these means becoming the interface between the customer and the energy service provider, easing the whole process (Bertoldi et al. 2017). Also, mandatory audits can become the 'Trojan horse' in a customer for proceeding next with more Energy Services, as the respective markets in Austria and Germany have demonstrated (Boza-kiss et al., 2019).

In case of policy-driven markets, the regulatory and legislative framework usually buttress the development of both Energy Services and ESCOs. In this case, the core drivers are the obligation to renovate as implied by the EED and the available grands, such as the Energy Efficiency Fund in the markets of Croatia, Czech Republic and Germany (Boza-kiss et al., 2019).

Furthermore, the ‘White Certificates’ - certifications guaranteeing that a certain volume of energy savings has been attained - constitute a substantial driver, as in the case of Italy since 2012, where incremental energy savings commenced being allocated as a premium for large-scale energy projects undertaken in the industry (Boza-kiss et al., 2017).

Last but not least, the procurement framework may become key, as in the case of United Kingdom, where the market is satisfactorily deployed in the public sector, mainly thanks to the well-developed procurement framework for EPCs (Boza-kiss et al., 2017).

Apart from the drivers emanating from the development status per Energy Service market, electro-mobility constitutes a driver on its own. Precisely, the net-zero emissions by 2050 scenario estimates that 300 million electric cars will be on the road accounting for more than the 60% of new car sales versus 4.6% in 2020, while early market data for 2021 reveal considerable growth in weighty markets, where the European market plays a protagonist role (IEA, 2021b).

Essential parameters determining this scenario include, among others, the cost of batteries, the autonomy of the electric vehicles, the availability of the essential charging equipment and road infrastructures, the vehicle increased autonomy, the availability of sufficient fast-charging support, the adequate biofuels, proper commercial strategies and underpinning regulations (Eyl-Mazzega and Mathieu, 2020). It is worth noting though that the penetration of electric cars alongside internal combustion engine cars demonstrates that the fuel mix is considerably triggered by customer preferences rather than the availability of alternative fuels, with the option for end-users to augment their demand for integration among alternative fuel options and energy services (BP, 2022). Furthermore, technological evolutions provide the most optimistic path towards a greener, non-urban passenger transport (ITF, 2021b)

Significant drivers to be added is innovation and technology. In accord with Müller et al. (2019), this consideration addresses the development of new energy-saving technologies along with the re-engineering of determined production processes. In keeping with the multinational professional services company Deloitte (2019), the same technological trends that have disrupted retail, transport and consumer electronics are seemingly entering the energy market: digital technologies ceasing intermediation while rising the many-to-many markets trading and the heightening of Energy Services allowing for the creation of autonomous energy platforms and systems. Deloitte (2019) further advocates that businesses will be called to find the opportunities they can best take advantage from, the requested capabilities and the market segments offering the strongest potential to drive their future development.

3.12. The main barriers observed

Despite the numerous drivers, there are persistent barriers, occasionally intertwined, that impede the opportune growth of the Energy Services industry. However, as an increasing number of projects is taking off, it is expected that some of these barriers will be overcome, although certain segments and countries present constraints that should be addressed in a distinct way for the respective markets to reach their entire potential (Boza-kiss et al., 2017).

The lack of information and awareness about the benefits related to ESCO projects and energy savings constitutes a significant barrier for further growth and development, as in the cases of Austria, Estonia, Lithuania, Spain and Sweden (Szomolányiová and Keegan, 2018).

Practically, the energy efficiency benefits are often considered less secured and, therefore, energy efficiency is underestimated in contrast to other investment alternatives. When it comes particularly to the industrial segment, most of businesses seem not to have the expertise and knowledge to identify the potential energy saving opportunities or the implied economic benefits (COM (2021) 558, final).

Furthermore, the different stakeholder groups involved need to deal with different levels of complexity regarding markets and contract forms. For example, in the case of energy performance contracts, energy service suppliers need to operate within a clear framework and specific user behavior, in order to safeguard that an energy project investment will become break-even. It is irrefutable that, in principle, this is well expected with commercial and public service end-users while households often demonstrate an unpredicted behavior, as it is observed throughout the EU Member States (Bertoldi et al., 2014).

To be added, that as experts observe, due to low competition, inexperienced customers, lack of reference cases and standardized measurement and verification methods, end-users demonstrate a level of distrust for Energy Services and ESCOs (Szomolányiová and Keegan, 2018). This dubiety is further accentuated in the vast majority of the EU Member States due the inhomogeneity of ESCO offers in the market (Bertoldi et al. 2017, Boza-Kiss et al., 2019).

Accounting and legislative issues may also hamper the market's growth. Primarily in the Public sector, EPC projects are often not regarded as off-the-balance-sheet investments, fact that makes their accounting treatment somewhat rigid while legal issues, related to the ownership of the installed equipment or to the tenancy law, seem to create ambiguity.

For instance, in Germany, problems have been noted in connection with the tenancy regulation for projects targeting energy modernization in reconciling financial motives for building owners vis-à-vis the protection of social housing tenants (Boza-kiss et al., 2017; Boza-Kiss et al., 2019).

Market obstacles, such as energy price volatility, can significant impact on the development pace of Energy Service markets. Higher energy costs create the need for energy savings and, thus, for the undertaking of ESCO-type projects. Apparently, for smaller companies, the energy cost parameter is usually less significant when compared to larger companies and industrial customers with higher energy intensity (Boza-kiss et al., 2017). It is also noteworthy that energy performance contracting mostly addresses large-scale projects due to high transaction costs, fact that makes such projects non-attractive for smaller businesses or for many municipalities (Bertoldi et al., 2014).

Lack of sufficient capital is another impeding factor, which may force investors to increase credit lines in order to pursue energy efficiency measures or render investments non attractive for the investors (Boza-Kiss et al. 2019).

This becomes even worse considering that in many cases the benefits resulting from energy efficiency projects are not well-known or perceived when comparing two or more investments. Such lack of knowledge or limited awareness is also observed in the banking sector, which is next translated into a limited financing for investments on Energy Services (Boza-kiss et al., 2017).

Furthermore, financial issues such as high purchase prices of energy efficient equipment seem to make the Public sector hesitant to comprise energy efficiency requirements systematically in its procurement (COM (2021) 558, final). On top, high transaction costs associated with the aggregation of information and the identification of the optimized solution for the end-user from an economic but also technical point of view creates another financial obstacle (Bertoldi et al., 2014). The same is observed when setting-up a project, from its submission to the respective request, to the contracting and the project implementation. Diminishing the transaction costs could significantly contribute to the Energy Service market further growth (Bertoldi et al., 2014).

Moreover, technical and administration related barriers, are also negatively impacting on this market's augmentation. Technical barriers are mainly dealing with risks related to complex technical solutions in both developing and developed markets while unexpected costs, related to non-scheduled maintenances or need for training on the new tackled energy efficiency measures, reduce the resulting savings (Boza-kiss et al., 2017; Boza-Kiss et al, 2019).

Administration barriers particularly in the Public sector seem to significantly impede the market's further growth (Szomolányiová and Keegan, 2018). What is more, municipalities' decision making usually takes place within a concrete political context with a quite big number of decision makers and a short-term horizon, disregarding long-run benefits (Gynther and Eichhammer, 2016).

3.13. Benefits for the main Users

The benefits of energy efficiency are many and of great significance for all societies and economies, for both households and businesses, including lowered energy costs, increased comfort and productivity, improvements in health, augmented asset value, fostered public image, just to name few. Evidently, the resulting benefits are not only economic but are, also, intrinsically related with the incremental value emanating from the improvement of energy performance (Boza-kiss et al., 2019).

Furthermore, the possibilities that energy efficiency opens up with regard to jobs creation due to its job intensive character and the fact that is heavily dependent on skilled work-force and the availability of energy-efficient equipment and services, becomes even more critical now that economies, such as the European one, are striving to recover from the repercussions of Covid-19 trough economic impetus. Energy efficiency is job intensive, heavily dependent on the availability of skilled personnel and the supply of energy-efficient products and services (Brown M. et al., 2020). Unquestionably, the benefits for the main users, namely the Industry, the Transport and the Public, are numerous and emphatic.

Considering that energy is a significant operating cost for a large number of businesses, it is strongly reasonable for the highly energy-consuming industrial sector to enjoy substantial benefits when implementing energy service projects, reducing its energy costs and augmenting its energy savings. Practically, energy efficiency assist companies in applying new technologies and advancements to render their use of energy more efficient, thus managing to achieve reduced energy consumption, lower operational costs and, thus, energy bills (Müller K. et al., 2019). Market practices and experience have demonstrated that Energy Services, when bundled, can bring energy savings up to 30% on the electricity bill of businesses, or, even higher. Likewise, industries' competitiveness increases, technological innovation is reinforced and the security of energy supply is fostered (Oki and Salamanca, 2021). Furthermore, industries can have enhanced corporate strategies, promoting their contributions to environmental protection and reduction of CO_2 emissions.

For the Transport, the lessening of CO_2 emissions is the prime benefit. This obtains an increased importance when considering the expected augmentation of transport of people and goods as moving towards 2050, due to the population growth and economic evolution (Lapillone et al., 2021).

A new business model in electro-mobility, called Mobility-as-a-Service, ties multiple public transport modes with commercial mobility services, such as car sharing and taxis, into an integrated, multifaceted mobility proposition with unified payment systems through the different service suppliers (ITF, 2021b). It has been estimated that ambitious energy efficiency measures and policies could reduce transport CO_2 emissions by almost 70%, which could then render the target for limiting global warming to 1.5˚C feasible (ITF, 2021a). At EU-level, a regular reduction is observed throughout the period 2004 to 2012 and then up to 2019 but at a slower pace, mainly attributed to the expanding usage of biofuels, accounting for the 0.7% of the energy mix in 2004, 5% in 2012 and 5.5% in 2019 (Lapillonne et al., 2021).

In order to battle the rise of CO_2 emissions of new cars during the last 6 years, primarily due to the more significant share of SUVs, for the ambitious targets for years 2025 and 2030 to be met (Figure 20), measures on new vehicles have been already taken combining European standards, measures at EU country level and labels on particular emissions (Lapillone et al., 2021).

Figure 20: CO_2 emissions of new cars in EU

(source: ODYSSEE-European Environment Agency data, cited in Lapillonne et al., 2021, p.2)

Energy Services such as electro-mobility and related standards increase sustainability, which in turn heightens resilience. Safe-guarding a sustainable transition to lower emission vehicles can foster consumer confidence and lead to a cleaner energy grid (ITF, 2021a).

In respect of Energy Services benefits for the Public sector, it should be first considered that the Energy Efficiency Directive gives to the latter an exemplary part depicting its multi-faceted role both as an end-consumer via public buildings and as facilitator for different groups, as in the case of purchasing by the side of the different public entities. As Gynther and Eichhammer (2016) observe, heating and cooling from RES can be used in urban planning allowing third parties to use the respective roof surfaces for self-production, for example via PV Net Metering systems. Gynther and

Eichhammer (2016) also pinpoint that the Eco-Design Directive (2009/125/EC) has a positive effect on the energy efficiency of the public segment for street lighting, indoor lighting as well as appliances. What is more, ‘smart cities’ provide to residents the benefits of good planning, all-things-connected and Energy Services deep expertise, while urban structure and electro-mobility are intertwined, enhancing connectivity. (Gynther and Eichhammer, 2016).

It is worth-noting that the importance of cities is constantly augmenting, while also considering their fundamental role in the societies’ decarbonisation. Approximately 75% of the EU‘s population resides in cities, of which the 55% in small and medium sized ones. Even more, it is in the cities where the 85% of the EU‘s GDP is generated (EERA, no date). At the same time, cities generate jobs, growth, resilience, investments, innovation and CO_2 reduction and are at the forefront of the COVID-19 crisis. This is why EU selected 100 cities to envisage its mission for climate-neutral and smart cities by 2030, to rapidly reduce their emissions and introduce innovative models for their residents and opinion makers (Eurocities, 2022).

3.14. Chapter Conclusions

Multiple financial mechanisms and schemes along with the disruptive EaaS model contribute to the EU Energy Service market evolution, combining energy savings, cost reduction and efficiency with electro-mobility, building retrofits, AI and IoT, demand management and renewables. The market development, noticeably varying through the EU, is to reach 50 billion euro by 2025, mainly thanks to innovation, digitalization, the energy transition, emphasis on sustainability and the need to reduce energy costs. In parallel, it needs to potently tackle the lack of awareness, financial limitations, complexity and technical and administrative issues.

4. SWOT ANALYSIS OF THE EU ENERGY SERVICE MARKET

4.1. Introduction

The research literature has revealed a wide portfolio of forces that may trigger or impede the further growth of the EU Energy Service market in the years to come. Clustering these forces into the four pillars of a SWOT analysis and identifying sub-groups of forces along with their weights, sheds light in the focus areas where the EU and its Member States should pay the utmost attention for this market to flourish.

4.2. SWOT Analysis Overview

Following the literature review undertaken, 239 entries have been registered in a dedicated database, which has been exclusively set-up for the purposes of the SWOT analysis performed. From those, the 223 have been identified as unique mentions and have been allocated to the respective pillars of strengths, weaknesses, opportunities and threats. Precisely, 43 different strengths have been traced along with 42 weaknesses, 81 opportunities and 57 threats, leading to the identification of some trends with reference to the primary clusters of forces per each different SWOT pillar.

Mentions related to strengths and weaknesses have been grouped in eight main clusters, namely Product, ESCO model-related, Standardization & Certification, Regulatory, Technological, Economic, Sustainability & Climate Change and Communication & Awareness. In parallel, opportunities and threats, based on their nature, have been grouped in seven different clusters, namely Broader Market-related, Legislative, Social & Energy Transition, Financial, Technological, Technical & Administration and Awareness & Understanding.

4.3. Strengths of the Energy Services

Energy Services have considerable strengths, which, if properly exploited, can significantly contribute to the further growth of the EU Energy Service market. The literature review has showcased 43 distinct strengths that, based on their nature, can be practically categorized in the eight identified clusters respectively. In principle, energy efficiency services are becoming a substantial market in the European industrial playground (Müller K. et al., 2019). Key to that is their intrinsic **Product** characteristics and the fact that energy efficiency is being addressed as an autonomous energy source in the context of the EED (COM (2021) 558, final). In accordance with Szomolányiová and Keegan (2018), the relatively long life-cycle of the EPC contracts, evolving from five to ten years, creates bonds with customers, setting-up a solid basis of a strategic partnership, although even shorter durations and payback periods are also accepted (Guarantee, 2016). In their Report on European Energy Efficiency Services Markets and Quality, Szomolányiová and Keegan (2018, p.14) also observe that Financial Institutions consider that energy service contracts in broad are solid when they are properly structured, with step-in rights, service level agreements and receivables and that the business case of an energy service project can be considerably attractive. Furthermore, Szomolányiová and Keegan (2018) pin-point that well-defined procurement specifications augment the Energy Services quality level. From the other side, the Energy-as-a-Service market embraces an even wider portfolio of energy supply options than ESCO-type projects, integrating them across several sites while exploiting digital technologies and platforms (Deloitte, 2019).

The **ESCO model** per se, based on which a large part of Energy Services are rendered, establishes several positive drivers. In essence, the competence to provide a holistic customer service through an integrated audit, monitoring and understanding of customer consumption patterns over time are considered key (Deloitte, 2019) and highly critical for the overall quality of the EPC projects' deliverables (Szomolányiová and Keegan, 2018). Furthermore, the subsequent phases of the ESCO model value chain, namely the measurement and verification stage plays a pivotal role in the overall projects' success (Boza-kiss et al., 2017). To be noted that the highest willingness to invest in the ESCO model is manifested by the Energy Services specialists, followed by utilities and investment funds (Müller K. et al., 2019). Within this context, customers do not need to remain on top of technology, since they can seek ESCO-type vendors that provide design, installation, maintenance and performance management services, likewise shifting the responsibility to the service provider (Deloitte, 2019, p.12).

In all cases, service **standards** have the potential to define and better the quality of the Energy Service markets (Bertoldi et al., 2014). Energy standards and labels allow for enhanced communication and transparency for clients and investors while fostering competition and innovation for businesses. Particularly so, the eco-design and eco-labelling are of high potential. Also, the 'White Certificates' constitute a targeted market instrument for energy efficiency (Deloitte, 2016). To be added, the European standard EN 16212 permits energy efficiency and energy savings calculations via certain methods, equal for all the EU Member States, allowing them to quantify the energy savings achieved through the different technical and behavioral measures undertaken (Szomolányiová and Keegan, 2018, p.16).

Also, Energy Services **Regulatory** provisions represent a significant force for the development of the respective markets, since, among others, they provide support schemes for EPC almost in all the EU Member States, such as green loans and subsidies (Guarantee, 2016). Undoubtedly, the Energy Efficiency Directive sets several requirements for EPCs, however the EU countries with more robust legislation, moving ahead EED's minimum requirements, enjoy even faster growing ESCO markets. For instance, regulations related to building renovation is a critical measure for recovering from Covid-19 consequences and for energizing stimulus for the Energy Service market development, while also generating positive environmental and climate impacts (Glicker and Roschini, 2020).

Technological strengths are associated, inter alia, with innovations linked to the broader service cluster of electro-mobility, to the upscale of lithium batteries for EVs, leading to competitive solutions in several EU countries as well as to hydrogen-fired vehicles that permit larger ranges and decreased charging periods (Eyl-Mazzega and Mathieu, 2020, p.188). At the same time, as value shifts from centralized power generation and delivery, distribution platforms assist in the injection into the grid of the augmenting volumes of '"behind-the-meter distributed energy resources" (Deloitte, 2019, p.17), resulting into the transition from a consumers' model to a prosumers' one (Hafner and Noussan, 2020). At the same time, smart technologies exploited in the energy management of facilities is key (Bertoldi et al., 2014), along with innovative technologies that can reinforce future preparedness (United Nations, 2021).

The strengths emanating from Energy Services are also well-associated with **Sustainability & Climate Change**, considering their high contribution towards this EU critical objective. It is indisputable that Energy Services provide some of the quickest and optimum vehicles cost-wise, to abate CO_2 emissions (IEA, 2021f) and a fundamental pillar for undertaking energy saving measures in most of the EU Member States (Boza-kiss, Toleikyté and Bertoldi, 2019). Decreased energy consumption allows the reduction of emissions as well as energy costs for both the end-users and the broader business community (EC, 2021). At the same time, energy efficiency represents an overriding concept in the fight against climate change (EC, 2021d), with more than 40 milestones to 2050 while it offers a large potential for the generation of new job positions (IEA, 2020a).

From an **Economic** perspective, financial upsides and reduction of maintenance costs are the most critical motives for pursuing Energy Services (Guarantee, 2016) along with energy savings, since they can substantially reduce the bill (EC, 2021d). In this context, the energy savings guarantee is considered a principal ES strength, convincing interested parties to pursue a related measure (Szomolányiová and Keegan, 2018), while it is also the main driver for EPC contracts (Guarantee, 2016; Glicker and Roschini, 2020). This turns to be even more critical when taking into account that EPCs are one of the core vehicles for delivering energy savings, thanks to the third party financing they provide, that much critical during the economic crisis era that has followed Covid-19 pandemic (Glicker and Roschini, 2020).

Last but not least, adequate **Communication and Promotion** of energy service projects convince peers, even more so in the public sector, to implement similar projects as to enjoy energy saving benefits (Boza-kiss, Toleikyté and Bertoldi, 2019).

4.4. Weaknesses of the Energy Services

Forty two distinct weaknesses have been identified and further elaborated. **Product** related ones, such as the hard commitment implied by the Energy Services contractual terms and rather low flexibility, constitute a hinder for the respective markets' growth (Marino et al., 2014) as well as the somewhat complex nature of the EPC concept (Szomolányiová and Keegan, 2018). Also, the small size of some energy projects results in a limited interest by the side of the banking segment and a lack of interest by the side of financial institutions (Bertoldi et al., 2005). Another weakness is the fact that guaranteed prices for renewable projects exist only for long-term contracts while there are no such price incentives for long-horizon investments related to low-carbon electricity production capacity (Eyl-Mazzega and Mathieu, 2020, p.32). Efficiency gains on their own cannot lead to energy demand decrease if are not combined with incremental measures (Brugger et al., 2020).

Energy Services' **Technological** characteristics can also generate weaknesses. Although electro-mobility is undisputedly energy efficient, it would not be at a position to significantly evolve up to 2030, if the availability of charging points does not considerably augment (Hafner et al., 2020), the autonomy is not increased and the thermal engine is not removed (Eyl-Mazzega and Mathieu, 2020). For the carbon footprint of EVs to be significantly lower than that for conventional vehicles, they must operate on the basis of low-carbon energy (EU, no date). Furthermore, although the role of cooling is progressively augmenting and is expected to continue growing due to increasing per-capita income in developing countries, the cooling technologies are sort of narrow today. Practically, the vast majority of cooling solutions is provided by distributed electricity-powered chillers, with few exceptions only comprising, inter alia, district cooling networks or solar cooling units (Hafner and Noussan, 2020, p.194). Actually, reducing the rising cooling demand is a challenge that could be constructively faced through the proper design of building strategies targeting to minimize cooling needs through cool roofs, shading systems and night ventilation. In countries with higher temperatures, such solutions could have an even bigger impact (Hafner and Noussan, 2020, p.194).

Economic weaknesses, such as the high purchase price in some instances that makes public sector reluctant in systematically integrating energy efficiency requirements in procurement (COM (2021) 558, final) along with the public sector's accounting treatment of EPC projects, addressing them as off-balance sheet investments, hinder the expansion of the Energy Service markets in the EU territory. Actually, the administration of ESCO projects within the public sector as part of the public debt seems to be the most critical barrier that emerged in the last years (Boza-kiss et al., p.34). Even more, EPC implies high transaction costs for the data to be aggregated and for attractive solutions to be technically, financially and contractually identified and, hence, are not compatible with small scale projects (Boza-kiss et al., 2017; Boza-kiss et al., 2019). Practically, it creates high exposure for energy suppliers and service providers and necessitates comprehensible context and well-defined user behavior to safeguard that the investment will break-even. At the same time, hidden costs, such as non-scheduled maintenance and training needs, may also occur, impacting on the savings from the efficiency measures taken on (Boza-kiss et al., 2017). It is also worth mentioning that micro-grids and tools for distributed energy resources management cost considerably, making related investments unattractive in several cases (Deloitte, 2019).

Weaknesses related to the nature of the **ESCO model** are also impeding Energy Services further penetration into the EU market. In essence, the lack of technical knowledge and management of technical risks in the different stages of the ESCO value chain may render Energy Services unattractive (Boza-kiss et al., 2019). The same applies for the complex procurement process and the long-time frames of the corresponding projects (Guarantee, 2016). Also, the collaboration between the provider and the client is perceived resource-consuming (Marino et al., 2011) while inadequate implementation, lack of enforcement and the relatively large number of available methods delay EPCs growth (Deloitte, 2016).

Energy Services seem that have not yet managed to create the proper **Awareness** in the market through promotion nor to communicate the several benefits associated with their usage. For example, there is still low awareness of the benefits resulting from building certification schemes as well as very few information related to EPC project cases (Szomolányiová and Keegan, 2018). Another example is the fact that customers are unaware of the benefits related to the Measurement & Verification protocols that override performance guarantees (Bertoldi and Rezessy, 2005). It has been observed that the lack of communication of positive examples and success stories can be a critical obstacle, especially so in markets with little experience (Boza-kiss et al., 2017; Boza-Kiss et al., 2019) along with the lack of transparency (Müller K. et al., 2019) and customer-focused information (COM (2021) 558, final; Szomolanyiova and Keegan, 2018). It is also noteworthy that, mainly due to insufficient reliable data, the energy service benefits are often perceived as insecure and energy efficiency benefits, such as the increased asset value and the augmented comfort or productivity, are underestimated versus alternative investments' outcomes (Boza-kiss et al., 2017).

Although Energy Services dynamically contribute to **Sustainability & Climate Change**, they are characterized by precise weaknesses that may decrease their potential in this area. In this context, it has been noted that innovations related to Energy Services and energy efficiency have a considerable socio-economic impact that may augment some people resilience but, at the same time, accentuate the vulnerability of others (UN, 2021b). For example, big data and AI, although highly contributing to the evolution of the Energy Service market, may deteriorate new forms of social exclusion through hazy algorithms and distortive historical data (UN, 2021, p.169). In transport, the potential reduction of energy demand by an increased efficiency is countervailed by an ever-heightening demand for private cars and larger vehicles (Brugger et al., 2021). Even more, if the batteries density of electric vehicles does not largely ameliorate, the need for bigger autonomy will imply economic and technical limitations that may lessen the contribution of electro-mobility to a sustainable development (Eyl-Mazzega and Mathieu, 2020, p.41).

To be also stressed out that although **Regulation** in principle may foster the development of Energy Services, its lack or non-thoughtful formulation and adaptation to each EU Member State's internal needs, may delay the efficacious growth of the respective market. For example, it is being noted that national regulatory barriers characterize energy efficiency investments in rented and multi-ownership buildings (COM (2019) 640, final) or that adaptation measures still need to be considerably fostered. Furthermore, performance contracting is a business with significant financial exposure for energy suppliers and service providers. Thus, it necessitates crystalline regulatory framework in order to safe-guard that the investment will be successfully paid-back (Boza-kiss et al., 2017).

As regards **Standardization & Certification**, the promotion of voluntary specifications and lack of mandatory standards reduces Energy Services reliability and credibility (Guarantee, 2016). Notwithstanding, the parallel availability of several certification schemes for the same issue renders benchmarking among them quite difficult (Szomolanyiova and Keegan, 2018). This is the case with the building segment, where six such schemes exist, with BREEAM (Building Research Establishment Environmental Assessment Method) being the EU market leader in environmental and energy aspects.

4.5. Opportunities for the Energy Service Market

The number of the identified opportunities through the pursued literature review, counting with 81 different mentions, seems to be considerably higher than any other of the three SWOT pillars and, most importantly, much higher than its adversary awe, that of threats.

With regard to the Opportunities' most populated identified cluster, the one related with the **Broader Market**, it should be stressed out that "Energy is at the heart of the European Economy" (Deloitte, 2016, p.17) and Energy Services along with energy efficiency measures could substantially assist in the decrease of the energy consumption and dependency. EU accounted for 12,5% of global energy consumption that reached 13,508 Mtoe in 2020, having contracted by 7% vs 2019, due to the lockdown measures that severely impacted on economic activity (Enerdata, 2021). What it is being observed is that the development of the EPC market throughout EU is claimed by more than 50% of the respondents, for their domestic EPC market prior to the pandemic, in a respective survey that ran in 2015 and 2017 (Szomolányiová and Keegan, 2018, p.11). This growth not only helps EU to recover after Covid-19 but also assists towards the decarbonisation of the building stock (Glicker and Roschini, 2020). The untapped economic potential behind energy efficiency is considered of paramount importance. It is worth noting that in consonance with IEA estimations in the context of the New Policies scenario, two-thirds of the economically profitable investments for energy efficiency will remain unexploited in the years to come up to 2035, which demonstrates the strong and long-lasting potential of the Energy Service market to further expand (Deloitte, 2016). To capitalize on that, global undertakings strive to introduce overriding guidelines for the conceptualization and implementation of EPC projects (Szomolányiová and Keegan, 2018), for which the public sector is the most critical player for both the well-developed and the emerging EU markets (Guarantee, 2016; Szomolányiová and Keegan, 2018). Moreover, an alignment among the Member States guarantees the quality of the national policies and a level of standardization in connection with Energy Services. For example, in the case of heating and cooling, it leads to a market with regularly shared standards for the manufacturers as well as suppliers of highly efficient equipment for district heating and cogeneration, driving them to innovate and further develop their service propositions (COM (2021) 558, final).

Notably, for market players with an interest in Energy Services, the fact that there is already considerable market fragmentation constitutes a core opportunity. Also, the soaring energy prices, dominating the market playground during the last years, are rendering energy efficiency undertakings more attractive and economically more solid, particularly so for businesses (Müller K. et al., 2019). This is the reason for the intensive proliferation of ESCO associations that target to build an increasing capacity for the nurturing of the ESCO markets (Bertoldi et al., 2014). Also, alliances are created, such as the European Battery Alliance, in order to mobilize private players and achieve synergies between industrial European actors (EU, no date). The challenge though is to robustly accentuate efforts in households and transport (Eyl-Mazzega and Mathieu, 2020) and rationalize energy use in the building segment (Hafner and Noussan, 2020).

Legislative opportunities, if properly exploited, may fundamentally nurture and drive the growth of the EU Energy Service market. Unquestionably, the European legislation for the development of the ESCO industry has been gradually increasing, creating new possibilities (Boza-kiss et al., 2017). More precisely, the EU regulatory context intends to fortify the demand and competitive supply of technologically advanced low-carbon solutions, in order to also counter-face competent schemes from both established and emerging states, such as USA or China with its 'Made in China 2025 strategy' (Eyl-Mazega and Mathieu, 2020, p.36) that harnesses investments in research and development (R&D) as well as on technological innovation for clean energy (Cyrill M., 2018).

In all cases, the Directive for Energy Efficiency has significantly served the growth of the EU Energy Service market and EPC (COM (2021) 558, final) and it still provides several critical drivers for furthering both. Practically, it targets to safeguard that energy market players - distributors, system operators and suppliers - do not in any way limit the demand for Energy Services and the mode they are delivered. It demands Member States to eliminate regulatory and non-regulatory hurdles to energy efficiency, also in connection with public purchasing, budgeting and accounting. It imposes certain obligations on the EU Member States to underpin the Energy Service

Market and access for SMEs via concrete actions. It also dictates energy audits for large businesses, which accentuates the need for consultancy on energy issues (Guarantee, 2016; Szomolányiová and Keegan, 2018) that is also further extended by the request for performance certificates for buildings and by the growing volume of energy management systems, such as ISO 50001 (Guarantee, 2016).

Furthermore, the proposal for a Directive of the European Parliament and of the Council on energy efficiency (recast) (COM (2021) 558, final) on July 2021 requires each Member State to define their national contribution, utilizing a formula of objective criteria and benchmarks, mirroring domestic conditions. It also gives great emphasis on high energy-savings potential segments, such as heating and cooling, with an incremental focus on the public sector (EC, 2021). It is admitted that long-term and credible commitment by a country's government and its public administration to sustainable energy, energy efficiency and the ESCO concept constitute fundamental factors that can kick-start a market (Bertoldi et al., 2014). Governments setting-up the principles of energy transition based on solid governance, market rules and public involvement, will enjoy the benefits in the long run (WEF, 2014).

The legislative proposals of the 'Fit-for-55 package', that has been adopted by the EED, embraces a set of intertwined proposals, which lead towards a fair, competitive green transition by year 2030 onwards (COM (2021) 550, final), therefore paving the way for Energy Services. Apart from the EED, the Eco-Design Directive (2009/125/EC) may also have a fundamental impact on energy efficiency of street lighting, indoor lighting and related equipment used in businesses or households (COM (2021) 550, final; Gynther and Eichhammer, 2016). Moreover, adequate regulation for Energy Services can lead to fostered transparency of innovations and of new digital platforms (UN, 2021) that can further trigger the respective market's growth.

Vital opportunities for the EU Energy Services are also related to **Social** challenges **and** the continent's **Energy Transition** objective. The EED may succinctly address not only economic but also social challenges like reinforcing vulnerable customers and end-users, alleviating energy poverty. In this context, energy efficiency investments are expected to run also amongst the most vulnerable societal groups (COM (2021) 558, final, p.15). At the same time, the accentuating interest in climate change along with the technology evolution that has resulted in the EU's 25 billion euro Energy

Service market as of 2019 (Consultancy.eu, 2019) as well as to the fact that EU is responsible for 10% of global yearly emissions (Eyl-Mazzega and Mathieu, 2020) drive the need for the EU's respective market further development.

Even more, because the challenges of climate change require global response, the EU will continue getting actively engaged with its partner countries to brace the climate and energy transformation globally (COM (2021) 550, final) and, thus, Energy Services will continue to play a fundamental role towards energy savings and energy efficiency. The European Commission stresses out the need for a fundamental rethink of energy efficiency and for treating it as an energy source itself (Deloitte, 2016). The predominant challenge of the power segments' decarbonisation globally, considering the augmenting electricity demand, along with the required efforts on heating, cooling, industry and CO_2 emissions reduction, is expected to drive Energy Services heightening (Eyl-Mazzega and Mathieu, 2020).

Financial opportunities emerge for the EU Energy Service market in several aspects. The National Energy Efficiency Fund provisioned by the EED, foresees concrete financing streams to foster the proliferation of Energy Services projects. Furthermore, grants offered at EU and domestic level, financial incentives, subsidies and preferential loans create new options (Bertoldi et al., 2014; Guarantee 2016). InvestEU provides guarantees for ESCOs and, thus, pushes renovations on the basis of performance contracting (Glicker and Roschini, 2020). Especially for Utilities, financing programs on the electricity bill can be used to trigger customers to invest in energy efficiency measures, such as lighting and air-conditioning (Deloitte, 2016). Also, a price set on carbon that discourages high emission transport can render greener alternatives more attractive to the end users (ITF, 2021). The EC economic recovery package, including the Multiannual Financial Framework and Next Generation EU, concedes that building renovations are crucial green investments, which can greatly assist EU's economic betterment after the pandemic (Glicker and Roschini, 2020, p.18). Also, the Cohesion Policy funds are expected to continue dedicating considerable part of the EU budget to energy efficiency measures including facilities renovation (COM (2021) 558, final).

Even more, the Green Deal foresees continued fostering of urban projects to create climate-neutral and smart cities and with the Next Generation EU, provides a considerable financing line for the pandemic recovery, which coupled with the EU's long-term budget leads to the largest incentives package, ever financed in Europe, for a total of 2.018 trillion euro (EC, no date).

It is worth mentioning that since biofuels and hydrogen are the only pragmatic way to decarbonize the aviation segment, considerable innovation funding is expected to be invested towards this objective too (Eyl-Mazzega and Mathieu, 2020, p.198).

Opportunities associated with **Technology** are fundamental for the Energy Service market. Vital decarbonisation paths across industry are no more limited by technological barriers (Hafner and Noussan, 2020). The evolution of new energy-saving technologies and the re-engineering of new production processes are key (Müller K. et al., 2019). New platforms can allow energy management, operations and maintenance, and optimization of all energy service related equipment. The most critical opportunities reside in innovative, whether single or combined services, that not only reinforce customer loyalty but also provide high margins due to the customized, turn-key solutions they offer (Deloitte, 2019). The development of new technologies, such as the IoT, blockchain and AI, allows EES providers to further strengthen their solutions and offer customized optimization services to their clients (Müller K. et al., 2019). The technological evolution also provides considerable opportunities for electro-mobility, especially as regards the decarbonisation of non-urban passenger transport (ITF, 2021). Furthermore, it is to be seen whether decarbonized hydrogen will play a fundamental role in the passenger car segment but also in storage and households' heating, in order to respond to seasonal fluctuations (Eyl-Mazzega and Mathieu, 2020, p.33). As it is noted by Hafner and Tagliapietra (2020, p. xviii), EU Member States competent in renewables, batteries and electro-mobility innovations, will also be able to take advantage of the green transition's industrial and economic benefits.

Technical and Administrative related opportunities can also assist. For example, the Investor Project Confidence Europe provides standardized protocols for the documentation of building and single technology energy efficiency projects (Szomolányiová and Keegan, 2018). Moreover, quality assurance may foster project quality and optimize them in terms of design (Szomolányiová and Keegan, 2018). Also, the adaptation of procurement to regular procurement procedures could dramatically open the market (Guarantee, 2016). The renovation of schools and hospitals is argued to be the single way to go in order to capitalize on the money saved from building efficiency on education and public health (COM (2019) 640, final). Despite several actions already implemented in developed EU Member States, there is still untapped energy savings potential in the building segment (Hafner and Noussan, 2020). However, energy efficiency investments in sites upgrade, properties and buildings can be further triggered by common refurbishment (Bertoldi et al., 2014). Furthermore, the mandatory energy audits and energy performance certificates for facilities and the growing number of energy management systems, such as ISO 50001, further drive Energy Services (Guarantee, 2016). The incremental development of the Energy Service market can be also brought about by the integration of disruptive and successful startups in ESCOs, which should be treated as "an art rather than a science" (Müller K. et al., 2019, p.13).

Last but not least, the opportunities related to **Awareness & Understanding** of Energy Services should be also mentioned. Stakeholders interviewed in all the EU Member States pinpoint that a financing guide would create common understanding among customers, EES providers and banks about Energy Services and respective financials while EPC providers would get to know all possibilities to financially prop up their projects via sale of claims (Szomolányiová and Keegan, 2018). Companies are gradually understanding the benefits of Energy Services and foster their internal processes for environmental protection while devising new sustainability goals to harmonize with political requirements (Müller K. et al., 2019). Adding on that, the EU proposal for the EED recast on July 2021 requires each Member State to define their tentative national contributions based on a formula of explicit and objective criteria and benchmarks, which mirrors internal conditions per country, fostering both awareness and understanding (EC, 2021).

4.6. Threats for the Energy Service Market

Contrary to the Opportunities, from the 57 identified threats, the bigger portion seems to be allocated to **Awareness & Understanding**. Precisely, it is observed that there is lack of trust towards ESCO industry and ESCO providers (COM (2021) 558, final; Szomolányiová and Keegan, 2018), especially so in developing Energy Service markets, where there is a preference for in-house solutions (Boza-kiss et al., 2017). As regards the business community, most companies seem not to have the proper information about Energy Services nor awareness. They do not possess the know-how to understand what energy saving opportunities are available nor the benefits coming out of them (COM (2021) 558, final). Also, the limited technical knowledge and awareness, lack of know-how for technical risks handling and of experience in procurement are challenges faced by several countries, where the EPC and ESCO concepts are comparatively new (Boza-kiss et al., 2017). At the same time, there is lack of trust by the side of contractors towards customers, due to a soared risk of unstable and defaulting clients (Bertoldi et al., 2014). Furthermore, lack of related and coherent information is limiting the interest of traditional private investors in financing energy efficiency measures. Also, end-users are still characterized by low energy efficiency behaviors (Deloitte, 2016). Some resistance against outsourcing is observed in the household and public sector, which impedes the exploitation of performance contracting. Likewise, in the tertiary segment, there is resistance against outsourcing energy services and operations to third parties (Guarantee, 2016, p.17).

The second category of threats is associated with **Social** challenges and the **Energy Transition**. Past results prove that gains generated out from energy efficiency may be out-scaled by societal trends that augment respective activities (Brugger et al., 2021). Even more, the energy transition route incubates new industrial risks and threats for the control of the low-carbon technologies value chain and of the systems' operation (Eyl-Mazzega and Mathieu, 2020). Margins on individual technologies, such as PVs, Solar and Storage, is expected to decline and, hence, building a sustainable business in any service segment will not be easy, except for companies that enjoy economies of scale (Deloitte, 2019).

The supply of ‘critical metals’ and rare earths utilized for the technologies underpinning Energy Services is emanating from few countries only, most of which do not pertain to OECD and do not either comply with ESG standards. Thus, although the consolidation of the European Battery Alliance and the set-up of a proper mineral strategy to face the “critical metals challenge” (Eyl-Mazzega and Mathieu, 2020, p.37) will be key, the scarcity of resources still remains an issue. Concurrently, the global economic slowdown is transforming the context in which the energy transition is being rolled-out (WEF, 2014).

Admittedly, Coivd-19 brought a massive reduction to global investment in 2020, exacerbating productivity decrease and accentuating the perception of a lost period of ten years (UN, 2021). Furthermore, in several emerging economies, electricity supply security and economic growth are recognized as top priorities that are placed higher than CO_2 emissions while many other countries have not yet commenced a low-carbon transition route and in the best case, they simply avoid setting-up incremental coal-fired energy production capacity (UN, 2021).

It is also critical to address some of the identified **Technical and Administrative** threats. One critical barrier for the public segment to agree on EPCs has been for a prolonged period Eurostat's policy on public debt and deficit. Based on that, energy efficiency measures under energy service contract are regarded as deficit in the national account, even if they are organized under ESCOs (Glicker and Roschini, 2020). Companies in principle incorporate energy costs under overhead costs and, therefore, energy consumption is regarded as a non-priority in respect of investment decisions (Boza-kiss et al., 2017).

Also, there are persistent administrative obstacles, such as complex procurement procedures (Bertoldi and Rezessy, 2015). In the household building segment, the large majority of property owners are individuals and, thus, they can hinder investment decisions (Guarantee, 2016).

Furthermore, “the landlord-tenant problem” (Deloitte, 2016, p.10) is a critical obstacle to energy efficiency in the building sector along with the fact that the market for voluntary building certification schemes is still at its early stage (Szomolanyiova and Keegan, 2018). Unrealistic energy saving calculations need quantification standards and, thus, a harmonization of existing schemes is indispensable for a larger and more efficient market to be created (Deloitte, 2016). The Energy Service market is highly fragmented, hence, further growth could be reached through acquisitions

(Müller et al., 2019). It should be noted though that the ownership of the assets is expected to be diffused among customers, companies and communities, so it is critical that service providers deploy large-scale projects in order to capitalize on this growing market (Deloitte, 2019). The common EU countries' policy of Municipal mergers, been observed for many years now, is a factor leading to uncertainty upon decision making (Gynther and Eichhammer, 2016). The public sector is highly dependent on political support (Guarantee, 16) and where policies do not buttress ESCOs, especially those within developing Energy Service markets, they could become time-lagged even further (Ashak S. and S. Jihyun).

There are significant threats related to the **Broader Market** too. This is mainly attributed to the fact that the composition of the national ESCO markets differs significantly across Europe, with the reasons of this variance differing considerably among the EU Member States (Boza-kiss et al., 2017; Szomolányiová and Keegan, 2018).

Actually, there are countries that have very little in common, such as the corresponding markets of Germany, Austria and Spain (Boza-kiss et al., 2017. This is why it is being observed that there are fundamental discrepancies among Member States' priorities and their submitted national climate plans prove that the developments toward the common targets set are not consistent nor even (Eyl-Mazzega and Mathieu, 2020).

Characteristically, the vast majority of the Member States seem not to have defined a solid path for the renovation of their domestic building stock (Deloitte, 2016). One threat that could further accentuate such discrepancies can be the lowered energy prices when they apply. To be added that players in the EU Energy Service market diverse considerably too, which creates fragmentation and complexity (Müller K. et al., 2019). Another issue is that although SMEs represent 99% of all companies in the EU, only 64% out of them are taking action to save energy, compared to 82% of larger companies (Deloitte, 2016).

Financial threats are also worth-noting. As observed in the Report on European Energy Service Markets and Quality (Szomolányiová and Keegan, 2018, p.51), the general perception of EPC providers and facilitators that participated to the survey (66%) across All Countries is that safeguarding "viable finance" (Szomolányiová and

Keegan, 2018, p.51), is not easy. Energy-efficiency projects fight often for insufficient capital with more usual investments, hampering the development of the former (Boza-kiss et al., 2017). Grants or preferential loans do not favor nor disqualify ESCOs (Boza-kiss et al. 2019). Even more, issues such as long payback periods, uncertain energy prices and lack of understandable information demote the attractiveness of financing energy efficiency projects in the eyes of traditional investors (Deloitte, 2016). In the industry segment, top management usually opts for income generating projects rather than cost reduction driven ones, while in the residential building segment, ESCO financing costs a lot and generates high exposure (Guarantee, 2016).

In many EU Member States, the financing of ESCO projects constitutes a problem, even in cases where credit is available, considering customer or ESCO liquidity problems or limited credit lines availability (Boza-kiss, Toleikyté and Bertoldi, 2019). Even more, most of the EU Member States are delayed in providing their long-term renovation strategies, which could hinder the allocation of reinforcing funds to the proper strategic targets and milestones (Glicker and Roschini, 2020).

The **Technological** threats identified in the pursued literature review number less than the encountered Technological opportunities, however they are critical. As it is being observed, disruptions in the supply chain of critical metals and rare earths generate risks for the value chains of the technologies behind Energy Services. In parallel, the e-vehicles value chain is largely dominated by Asian actors, primarily China, Japan and Korea, exploiting subsidies and economies of scale, particularly in battery cells production.

It is undeniable that although the EU set objectives for 2030 will mobilize electro-mobility, will not take the thermal engine away (Eyl-Mazzega and Mathieu, 2020). At the same time, new technologies -Science, Technology, Innovation-, although can mitigate several risks and foster resilience, can also become new sources of risk (UN, 2021, p.169). Furthermore, utilities offering Energy Services that do not manage to effectively adapt to digital and distributed energy resources nor to ameliorate the mode they relate with the end-consumers, may spoil the benefits they offer as fresh players appear in the market (Deloitte, 2019).

The concluding cluster of threats is that of **Legislative** barriers. It seems that there are still considerable uncertainties in the legislative framework (COM (2021) 558, final) and unstable and uncalculated legislation is a foremost threat (Bertoldi et al., 2014). Nonetheless, aggressive objectives are integrated in a kind of complicated regulatory environment and it will need time and persistence for their accomplishment (Deloitte, 2016). It is true that although there has been an ample spectrum of substantial developments in the EU legislation for the ESCO market during the last decade, the level of maturity and materialization still differs largely among Member States (Glicker and Roschini, 2020).

4.7. Results from the SWOT Analysis

The pursued SWOT analysis and the identification of the prime eight clusters of intrinsic strengths and weaknesses and the seven clusters of extrinsic opportunities and threats, as emerging from the literature review, highlight that, in overall, the perspectives of the EU Energy Service market are promising and ready to be further exploited.

It is vital to be noticed that while mentions associated with weaknesses and strengths represent 19% each of the total number of mentions, mentions related to opportunities account for the 36%, beating weaknesses that represent the 26% of all mentions respectively.

Looking in more detail, from the 43 unique registered strengths of Energy Services, the Product related ones at 26%, followed by the Services' Technological competencies at 16% and their Sustainability & Climate Change related attributes at 14%, constitute their top three strengths clusters.

With reference to the Energy Services' weaknesses, the Economic factors, representing the 21% of all 42 unique mentions, the Product related aspects at 17% and the Technological ones at 14%, set-up the three most crucial clusters.

The detailed results of the SWOT analysis, also including the number of mentions per each individual force cluster along with the corresponding weight each time, are depicted in Table 2.

Table 2: The EU Energy Service Market - SWOT Analysis Aggregated Results

CLUSTER		STRENGTHS	WEAKNESSES		OPPORTUNITIES	THREATS
	TOTAL Unique	**43**	**42**		**81**	**57**
	Over Total (%)	**19**	**19**		**36**	**26**
Product	No. of unique mentions	11	7	**Broader market-related**	19	6
	Over Total Unique - Weight (%)	26	17		23	11
Technological	No. of unique mentions	7	6	**Legislative**	16	5
	Over Total Unique - Weight (%)	16	14		20	9
Sustainability & Climate Change	No. of unique mentions	6	4	**Social & Energy Transition**	11	12
	Over Total Unique - Weight (%)	14	10		14	21
Esco-model related	No. of unique mentions	5	5	**Technological**	11	5
	Over Total Unique - Weight (%)	12	12		14	9
Standardization & Certification	No. of unique mentions	5	2	**Technical & Administrative**	11	12
	Over Total Unique - Weight (%)	12	5		14	21
Economic	No. of unique mentions	5	9	**Financial**	10	8
	Over Total Unique - Weight (%)	12	21		12	14
Regulatory	No. of unique mentions	3	3	**Awareness & Understanding**	3	9
	Over Total Unique - Weight (%)	7	7		4	16
Communication & Awareness	No. of unique mentions	1	6			
	Over Total Unique - Weight (%)	2	14			

(source: self-developed, 2022)

As it has been already observed, in regards to the external forces impacting on the EU Energy Service market, the identified opportunities over-exceed the traced threats. The Broader Market-related drivers, representing the 23% of all uniquely registered opportunities, followed by the Legislative ones at 20% and the Social & Energy Transition parameters at 14%, constitute the top three opportunities clusters.

On the other hand, from the 57 unique mentions in connection with threats, the highest percentage, of 21%, is associated with the Social & Energy Transition cluster, equaling the Technical & Administrative one at 21% too, both followed by the Awareness & Communication cluster at 16%.

4.8. Discussion of the Results: The potential of and for Energy Services

The SWOT analysis results have revealed the fundamental forces, whether positive or negative, that Energy Services have to take advantage from or try to diminish in the EU respective market. Precisely, the analysis has demonstrated that Energy Services possess certain characteristics, thanks to their energy efficient nature, that equip them with a large potential that is still untapped. Furthermore, the technologies and innovations on which they are based, their contribution to sustainable development and the fight towards the climate change along with the quality and transparency resulting from the recent standardization protocols and certifications represent their core strengths.

Their shortcomings mainly deal with the economic and investments criteria that Energy Services are requested to serve and comply with, the relatively complex business model they are based upon, the high cost of new technologies, research and development laying behind them and the seemingly limited so far communication and promotion of the multiple benefits they provide.

In parallel, the external environment generates considerable opportunities and threats, with the former to evidently outperform the latter, as it results from the actual literature review. The broader market-related opportunities, emanating from respective undertakings at EU-level and from efforts to leverage Energy Services to drive the energy transition and address crucial social challenges, seem to create solid potential for the respective market. Furthermore, legislative incentives and regulatory policies seem to energize the interest in Energy Services with the EED being the main driver for both public and private users. Technology and innovations broad up perspectives and generate considerable opportunities.

On the other hand, several threats apply. The most critical deal with a level of uncertainty on whether Energy Services are set as a priority by Organizations and Governments for the path towards energy and cost savings, the green transition and the lack of adequate streamlining of the related technical and administrative challenges. Furthermore, the limited financing and the insufficient awareness of the services nature, which leads to certain mistrust for the resulting benefits, also constitute crucial threats. To the extent that these threats are timely and competently addressed, the market opportunities will allow Energy Services to further develop and unravel their true potential.

4.9. Recommendations

There are improvement possibilities for the Energy Service markets across the different EU Member States, independently from each market's development level.

Creating awareness and fostering customers' understanding seems to be of paramount importance given that their lack has been revealed as a serious threat through the SWOT analysis. To mobilize both business and retail consumers, potential benefits should be presented in a straight forward and transparent way and feasible targets should be announced and next monitored. Also, customized energy service propositions, with tailor-made advice regarding potential measures and associated benefits, proper smart metering and monitoring systems offered by qualified energy service providers, could reduce the impact of the limited knowledge regarding Energy Services and help the respective market to flourish.

Especially for residential customers, national authorities should provide easily accessible financial incentives to help the undertaking of Energy Services projects and measures (Deloitte, 2016). Insights from behavioral science could be also exploited, to contribute to the design of smarter and more triggering policies (IEA, 2020b).

Building trust is a "universal area" that is essential to be managed by several stakeholders (Boza-kiss et al, 2019, p.44). The introduction of the ESCO and EPC notions in several EU countries, mainly thanks to the EED, should further expand, in order to foster clarity and reinforce understanding for Energy Services. Also, the set-up of more self-convincing reference projects could help towards the rise of Energy Services reliability while the standardization of documents and guidelines, for example for site audits, could further augment the level of quality, and, thus, heighten trust by the side of end-users.

Model contracts and EU-level accreditation systems could also establish trust. In any case, the EED demands Member States to prop up the development of a quality assurance system and quality labels and publicize a list of certified energy service providers (Boza-kiss, Bertoldi and Economidou, 2017). A voluntary EU-wide building assessment scheme could overcome the obstacle of low technical knowledge in the EU Member States with low building certification standards and, at the same time, safe-guard the EU global acceptance (Szomolányiová and Keegan, 2018). Also, the European EPC Code of Conduct could be further utilized to institutionalize specific rules and, thus, foster reliability and trust while with EU global energy savings, measurement and verification methods, energy service projects would not be questioned (Boza-kiss et al., 2019).

Quantification standards would be also important, to safe-guard realistic energy saving calculations and harmonize existing schemes (Deloitte, 2016), that would set the basis for a broader and more efficient market. This, in turn, would reinforce reliability but also trust.

Leveraging large-scale upgrade and renovation programs, facilitating investments in distributed generation projects and enabling electrification could actively promote not only energy savings but also clean infrastructure, sustainable development and green transition. As IEA (2020a, p.23) observes in its Energy Policy Review, "scaling up energy actions towards climate neutrality while ensuring competitiveness, security of supply, sustainability and affordability" is fundamental for the achievement of the targets set for 2030.

Under this framework, the 'energy efficiency first principle' would be operationalized and fostered across different end uses while Energy Services and underpinning technologies would be entirely utilized. In all cases, the prioritization of energy efficiency should unlock several social, environmental and economic benefits while increasing interest for and usage of efficient products and solutions, allowing for increased levels of market activity (IEA, 2020b). Such activity could occur at all levels, in businesses, cities, local communities.

In order to address Economic weaknesses and Financial threats, the EU Member States could exploit InvestEU funds, that targets to trigger more than 372 billion euro in incremental investment over the period 2021-27, bringing together the European Fund for Strategic Investments as well as thirteen other EU financial vehicles (EU, no date) to provide guarantees for ESCOs. Likewise, projects are de-risked while leveraging private finance, hence fostering building renovations. Also, with the proper support, local authorities could finance public building refurbishments using EPCs along with household renovations exploiting energy savings solutions that can be compensated over long-term energy performance contracts. (Glicker and Roschini, 2020). Such renovations become even more important following the pandemic, which have spotlighted the need for higher health standards and energy efficiency measures, including an augmented indoor comfort and upgraded heat, ventilation and air-conditioning systems. Furthermore, disruptive financing mechanisms should be established both by EU and individual Member States, in order to mobilize the considerable Energy Services and energy efficiency potential (Deloitte, 2016). It will be opportune for such financial policies though to constitute part of a broader, consistent approach to drive larger market volumes (IEA, 2020b).

Digital innovation needs to be further exploited to enhance smart control, foster energy management and optimize Energy Services along with the broader energy system (IEA, 2020b). However, the impact of innovation can be sometimes complicated, since some solutions may augment the resilience of some people while increase the vulnerability of others (UN, 2021, p.169). A way to mitigate the risks of innovation's unforeseen repercussions is to take into account in the whole process different opinions and aspects, for example through the inclusion of diverse researchers or of end-users (UN, 2021).

4.10. Chapter Conclusions

If EU, at both region and country level, faces effectively the eight commonly shared clusters of forces for strengths and weaknesses, emanating from the SWOT analysis, along with the seven such clusters for opportunities and threats, the substantial but still untapped Energy Services potential will be unraveled. To that end, large reference projects, trust, awareness, proper financing, regulation and digitalization are vital.

5. CONSIDERATIONS IN REGARD TO EU's ENERGY TRANSFORMATION

5.1. Introduction

Having traced the forces driving or hindering the further growth of Energy Services in the EU and the potential ways to move forward, it is opportune to gather together and address distinct considerations related to the EU's energy transformation, including unintended consequences of innovation, and the way Energy Services are and will be further impacting on this new energy system paradigm.

5.2. The EU towards the Green Transition

Unquestionably, EU constitutes a universal leader in the energy transition, accounting for 10% of the yearly emissions worldwide, as of 2019. Decarbonisation objectives for 2030 have been strengthened in 2018, thanks to the Energy Efficiency Directive, and a debate regarding longer term options envisaging year 2050 has commenced in 2019, with an increasing agreement for climate neutrality by 2050 (Eyl-Mazzega and Mathieu, 2020). As already highlighted, the proposal on the EED in July 2021 recasts the whole directive, striving to finally set a higher binding target for decreasing both primary and final consumption. For all Member States, it launches a benchmarking system for their respective national plans while promoting the need for doubling annual energy savings obligations for end-users, with stronger emphasis on sectors with significant energy-savings potential, like Energy Services (EC, 2021).

Recently, the Fit-for-55 package, addressing EU's objective of lowering net greenhouse gas emissions by at least 55% by 2030, targets to align EU legislation with the 2030 goal. It fosters existing legislation and introduces new focus areas, such as transport and buildings that are intrinsically linked with Energy Services. It also comprises a proposal for altering the renewable energy directive with the increase of the current EU-wide target of at least 32% of RES in the total energy mix to at least 40% by 2030, thus promoting distributed generation related services (European Council, 2021). In essence, the Fit-for-55 establishes EU's exemplary leadership universally for the battle against climate change (COM (2021) 550, final), driving the way towards EU's green transition.

The way towards the decarbonisation objective is long and "climate and biodiversity preservation call for unprecedented, massive, and urgent action" (Eyl-

Mazzega and Mathieu, 2020, p.28). Although EU has already established considerable policies, tools to stimulate investments, targets and plans, it also needs to face important challenges, a good number of which are intertwined with and dependent on Energy Services and energy efficiency.

5.3. The overall impact of Energy Services on the EU's Energy Transformation

As it is pinpointed in Delphi Forum's introductory note (2022), humankind has been steadily going through "a new reality over the last decade: a severe climate emergency (that) is endangering the planet". However, the recent energy crisis has showcased that the green transition will prove to be a "monumental economic challenge for societies around the world" (Delphi Forum, 2022). The critical question is how to identify a mutually beneficial solution and how geopolitical developments may impact this global effort.

The IEA (2014, cited in Deloitte, 2016) states that, by 2035, investments in energy efficiency and in related services should represent almost half of all the global energy investments that are needed in order to stay under the two degree limit. This need is further accentuated if it is considered that the target globally has become to stay below the 1.5 degrees. This places Energy Services at the forefront of the EU's efforts to lead the way towards its energy system transformation.

Starting from broader communities, it has been calculated that cities generate 72% of the global GHG emissions and that they will host approximately 70% of the population globally by 2050 and 85% in the EU. This estimation stresses out the need to transform cities into climate-neutral smart hubs, through the active involvement and cooperation of citizens and technology (EERA, no date), which is hugely provided through Energy Services. Member States could also evaluate energy technology investments to vulnerable households, this way speeding-up the overall energy transformation. In accordance with the Renovation Wave Strategy, the EU braces energy efficiency and Energy Services along with investments on building upgrades, which becomes apparent in several new and already active schemes, such as the Multiannual Financial Framework and Next Generation EU (COM (2021) 558, final). Social and territorial solidarity are pre-conditions for a sustained low-carbon transition and energy transformation (Eyl-Mazzega and Mathieu, 2020).

However, unintended consequences of innovation should be also considered, since they may become new causes of risk. The externalities of new technologies on the environment constitute a broadly acknowledged issue. For instance, as Ethan Rogers (2019) observes, blockchain technology in the Energy Services industry can significantly foster resilience. Precisely, its use among several parties such as customers, ESCOs, utilities and banking institutions can strengthen transparency and trust through a shared ledger. ESCOs can exploit smart contract features that combine the guidelines for determining energy savings and the conditions for payments approval and penalties application (Kirli et al., 2022). Such an automated process can decrease transaction costs, hence providing the possibility to also serve smaller businesses thanks to the savings that this way could suffice to cover the costs. (Ethan Rogers, 2019). Apparently, by increasing the projects that ESCOs assume, the energy savings also increase. However, the problem is that such technology is estimated to consume larger volumes of energy than Argentina, therefore generating a considerable amount of CO_2 emissions (UN, 2021, p.169).

It is opportune to try to reduce the risks of such unintended consequences by taking into account different perspectives and aspects in the innovation process. This could be potentially managed by amplifying the heterogeneousness among researchers, by including end users in the technology under evaluation and by involving adequate bodies that can interpret requirements and values between producers and users (UN, 2021).

5.4. Energy Efficiency objectives driving collaboration at Global and EU-level

The EU has proved that as one of the biggest historically CO_2 emitters globally, it recognizes its critical task in assuming higher costs and targets to pursue a global leadership role. (Eyl-Mazzega and Mathieu, 2020). It is evident that the EU multi-faceted action on emissions reduction and increase of energy efficiency does not suffice for the achievement of 2050 targets. Carbon neutralization is a feat that every country must attain, in order to ensure sustainable global development (Elavarasan et al., 2020). That is why it calls countries around the globe to work together on the climate objectives set. It works with inter-governmental forums, such as G7 and G20, as well as with other international partners, to prove that augmented climate targets, economic robustness and sustainable development can move across together (COM (2021) 550, final). The critical 26th COP in 2021, has set an agenda for EU to collaborate with the rest of the universe in view of a green transition that generates new opportunities for all (COM (2021) 550, final).

If EU manages to successfully play its leading role worldwide, its global influence will further increase. It is true that when countries collaborate and share best practices, they can learn from each other, gain knowledge fast and get aligned with regard to standards, where needed. However, the Member States should become more aggressive in respect of their short but also long-term efficiency targets as well as policies and undertakings (IEA, 2020b).

Undisputedly, the ambitious environmental targets of the Green Deal "which aims to leave no one behind and to deliver a sustainable economy" (EC, 2021c), will not be accomplished by Europe alone. The reasons for the testimonied climate change and biodiversity loss are not individual nor attributed to particular regions only. The EU is already striving to mobilize its neighboring countries and partners intercontinentally, to embark with it on its trip towards sustainability, leveraging its expertise and financial resources (COM (2019) 640, final). This can fuel new alliances and geopolitical changes, increasing the appetite of states and regions to experiment and prop up new modes of underpinning investment in low-carbon technologies and Energy Services while striving for cooperation in the industrial and regulatory fields (Eyl-Mazzega and Mathieu, 2020).

However, attention should be placed for EU and its economies not to lose their competitiveness due to a potential deindustrialization given that imports gradually substitute carbon-intensive production – 'carbon leakage' - and that non-EU players emulate EU's advancements. EU should devise properly structured, targeted mechanisms, such as Trade Agreements with binding climate obligations for the imports of concrete goods (Eyl-Mazzega and Mathieu, 2020).

At EU-level, the results from the implementation of the EED so far have demonstrated that a common Union context is socially just, decreases costs while allowing policy-makers of the Member States to learn from each other (COM (2021) 558, final). The EED effectively adds on other national and Union measures. Policies adopted at Union level showcase the extent to which the territories of climate change, security of supply, sustainability, environment, social and economic evolution are intertwined (COM (2021) 558, final). On the other hand, considering the current vulnerabilities in critical metals, it becomes evident that the EU needs to initiate new responsible mining projects and associate their growth to the introduction of environmental and social standards in the mining sector (Eyl-Mazzega and Mathieu, 2020).

Aspiring climate neutrality by 2050 commands robust and cost-competent technologies, adequate scale to decrease costs and effectual coordination of policies and investments (COM (2019) 640, final). It implies providing to businesses the proper mechanisms, incentives and context to pursue this transformation while maintaining their competitiveness and potential to leverage the energy transition in order to generate quality jobs and true added value on the EU market. At the same time, the transition has to be just and inclusive, placing humans first and giving emphasis on the EU regions. “A new pact is needed” (COM (2019) 640, final) to align individuals with domestic and local authorities, the society and the industry, driving them to work closely with the EU’s institutions.

The coordination at European level enhances environmental and climate benefits. Lower energy savings than the targeted ones are present everywhere throughout the Member States, with the resulting external costs of high energy consumption, such as greenhouse gas emissions, apparent in all countries. Action within EU is mandatory, to safeguard that Member States contribute adequately to the binding EU energy efficiency target and that it is collectedly met in the most cost competent manner (COM (2021) 558, final). Member States can define their own trajectories that reflect their national conditions and context, following the principle of subsidiarity. However, considering the higher climate target and the fact that energy is a policy area requiring high investments, it is well expected that EU will be called to strengthen national undertakings in energy efficiency through the Commission, as it is in any case implied by the Governance Regulation (COM (2021) 558, final).

Such approach at EU-level can establish trust and reliability, augmenting the likelihood of different players investing and becoming active in Energy Services. Moreover, impediments to public and private investments can be overcome, facing the lack of coordination among several authorities at national level and triggering the implementation of cross-border projects and support schemes (Boza-kiss et al., 2019). It is noteworthy that the respective EU policies can set-up a fairer transition for Member States with economies that may be considerably affected due to the energy transition (COM (2021) 550, final).

5.5. Looking towards the future

The new energy economy is expected to become highly electrified, considerably more efficient, evidently interconnected and clean (United Nations, 2021). Several developments may sound somewhat distant but they are indeed already happening.

Green hydrogen is expected to decarbonize the industrial segment and, potentially, to some extent, the maritime and freight transport. It is still questionable though whether it will also impact on the passenger car segment, residential heating and electricity storage (Eyl-Mazzega and Mathieu, 2020).

Smart buildings are constructed with the contribution of Energy Services, formulating smart places that manage energy supply and demand automatically, through an autonomous interconnected system among them. Over the years, they will gradually develop to smart cities, where the energy infrastructure will significantly differ from that of today with new entrants, transformed customer preferences and, most importantly, with highly evolved Energy Services (Deloitte, 2019).

EaaS providers will aggregate big volumes of data on energy supply, demand and prices, and combine them with other type of information, such as weather and traffic conditions, to manage smart places as a dynamic whole of products and services (Deloitte, 2019).

What is being gradually rolled-out it may be “more than just an energy transformation” (Tagliapietra, 2020), it may constitute a kind of industrial rebellion that will impact the different aspects of the everyday life and of the economic playfield as well as the way humans relate with the environment. It has all to do with a paramount challenge that can finally render EU but, also, the world, to a better place for everyone (Tagliapietra, 2020).

5.6. Chapter Conclusions

The EU, being the third largest emitter, has assumed the role of a global leader in the fight against climate change, driving the way towards the green transition. The global target for staying below the 1.5 degrees by 2050, renders Energy Services investments essential, expected to account for half of all the energy investments by 2035. In this challenging transformation route, utmost attention is required for the EU economies not to lose their competitiveness due to a potential deindustrialization.

6. CONCLUSIONS

6.1. Overall Conclusions

It is evident that energy can become a game-changer for the way towards the green transition. The EU, being accountable for 10% of the global yearly emissions, have a foundational role to play in the endeavors for the energy transformation. Even more, its target to safeguard that all Europeans have access to modern and safe energy heightens its role for the new energy system. The critical decade has already started. The EU necessitates a well-structured toolbox to comply with and satisfy the provisions of the Fit-for-55 program, in order to accomplish the objectives set for 2030 and become the first climate-neutral continent by mid-century. The vast majority of the EU Member States have introduced energy savings, energy efficiency and CO_2 emissions reduction objectives in their national plans, particularly in the industry, the transport, the private and public building segments.

The literature review has shown that the Energy Efficiency Directive is an essential pillar of the progress towards decarbonisation, under which "energy efficiency is to be treated as an energy source in its own right" (COM (2021) 558, final, p.29). Energy efficiency is recognized as a pivotal notion of the EU's energy policy and should be taken in consideration throughout all sectors and at all levels.

Energy efficiency solutions provided by Energy Services should be evaluated as a prioritized option in planning and investment decisions, given their potential to decrease energy consumption cost and increase energy savings, for both households and businesses. This role is becoming increasingly critical, considering the constantly soaring energy prices globally but also in Europe.

Energy Services can also become a cardinal weapon within EU's arsenal for reducing energy consumption, increasing energy efficiency while in parallel reducing CO_2 emissions, materializing EU's aspiration for net-zero emissions by 2050.

In all cases, for Energy Services to be successfully deployed and further penetrate the EU market, EU should set up an adequate and well-structured framework that will facilitate the undertaking of energy efficiency measures and the uptake of advanced and innovative Energy Services. For such a framework to be established, efficacious implementation, robust governance and appropriate design are mandatory.

Europe's energy efficiency services market, estimated to account for 50 billion euro by 2025, is considerably driven by new technologies and innovations in the area of sites upgrades, smart metering and monitoring, electro-mobility, automations, AI and digitalization. Energy Services in broad, also including distributed generation, micro-grids and demand management, are expected to showcase their potential in the years to come, leveraging their internal strengths and market's opportunities while overcoming their weaknesses and external threats.

The extensive literature review conducted has provided the basis for the materialization of a genuine SWOT analysis at EU-level, which constitutes this thesis' primary contribution, since not such analysis and at this level has been traced in the reviewed literature at the time. The scope of the analysis has been to bring in the limelight the main intrinsic and external forces that drive or impede the further growth and penetration of Energy Services in the EU.

Eight main clusters have been identified for the categorization of strengths and weaknesses, namely the Product, ESCO-model related, Standardization & Certification, Regulatory, Technological, Economic, Sustainability & Climate Change and Communication & Awareness clusters. While the top three clusters of the 43 unique identified strengths deal with the Product proposition itself (21%), Technological characteristics (16%) and Sustainability and Climate Change related attributes (14%), the top three clusters of the 42 unique identified weaknesses are attributed to Economic parameters (21%), Product related aspects (17%) and the Technological characteristics of the Energy Services (14%).

The external forces affecting the EU Energy Service market, namely the opportunities and threats, can be categorized in seven clusters, precisely the Broader-market related, Legislative, Social & Energy Transition, Financial, Technological, Technical & Administrative and Awareness & Understanding. The top three external drivers' clusters for the 81 unique identified Opportunities are those related to the Broader Market (23%), Legislation issues (20%) and Social & Energy Transition factors (14%). Likewise, the chief three clusters of the 57 unique threats that emerged from the literature review are associated with Social & Energy Transition barriers (21%), Technical & Administrative deficiencies (21%) and Awareness & Communication limitations (16%).

Evidently, the literature review has revealed a trend of paramount importance. Precisely, it has showcased that opportunities outplay all other SWOT forces, demonstrating the grand potential that Energy Services still have. Furthermore, the chief opportunity clusters that have been identified during the SWOT analysis imply the paths that the EU should strive to pursue, in order to allow the Energy Services' potential to be released.

Practically, fostering the end users' understanding on how the Energy Services operate through adequate training, strengthening their promotion and awareness of the benefits they provide and building trust through appropriate accreditation and quantification standards are the vehicles that the EU should utilize in its planning. Incrementally, leveraging large-scale upgrade and renovation projects and programs, ensuring the proper utilization of the respective funds and exploit digital innovation for a constructive energy management are routes that should act complementarily.

It is now a question whether the EU Member States, having already introduced Energy Services and measures in their respective markets, will further capitalize on the adequate technologies, in order to increase their usage and take advantage of their multiple benefits. The expanded penetration of Energy Services in the EU will unravel their potential, contributing to a more cost-effective, sustainable and energy efficient future.

6.2. Recommendations for Future Research

The performed SWOT analysis provides researchers with a foundational understanding of the broad context of the EU Energy Service market while future research could also assess the respective SWOT forces in individual EU Member States' corresponding markets or in specific EU regions. For example, the results emerging from the SWOT could be significantly different in the EU Member States of Northern Europe versus those of States adhering to Southern Europe, creating different trends for Energy Services and, hence, dissimilar growth perspectives.

Furthermore, taking into consideration the way the identified barriers and challenges are intertwined, an area for future research could be the mapping of the pertinent interconnections, to identify the emerging relational aspects among them.

Moreover, it is recognized that Energy Services are very much dependent on technology and innovations that are rapidly evolving and, hence, can, radically impact on the Energy Service market evolution. As the assumed research and the subsequent SWOT analysis is mainly grounded on recent publications made in the past 5 years, a future study could be taken on, leveraging both updated and new literature at the time.

Last but not least, the identification of the weights of the different clusters per SWOT pillar based on a quantitative rather than a qualitative study, could shed more light on the areas where the EU should primarily focus its efforts for the Energy Services to further grow, exploiting their true potential.

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APPENDIX – SWOT Tables

Table A1: Strengths

STRENGTHS		
A/N	**STRENGTH CLUSTER**	**SOURCE**
	PRODUCT	
S1	The most common EPC contract length is 5 to 10 years which ties in customers	Szomolanyiova & Keegan, 2018
S2	Financial Institutions testimony that energy service contracts are firm when they are properly set-up, with step-in rights, penalties and bankruptcy terms	Szomolanyiova & Keegan, 2018
S3	The business case of an Energy Efficiency project can be highly profitable	Szomolanyiova & Keegan, 2018
S4	Most often, short project durations and payback are well-accepted	Guarantee, 2016
S5	The implementation of technical measures needs strong quality standards	Szomolanyiova & Keegan, 2018
S6	The EaaS market builds on ESCO services but embraces a broader range of energy supply options, managing them across multiple sites through digital technologies	Deloitte, 2019
S7	Energy services use smart meters to accurately measure what end-users consume and quantify what they could realistically save	Deloitte, 2016
S8	Tailor-made solutions provided by closer public-private collaboration can trigger broader investments in energy efficiency	Deloitte, 2016
S9	EES are in the process of becoming a key market in the European industrial landscape	Müller et al., 2019
S10	The EED treats Energy efficiency as an energy source in its own	COM (2021) 558, final
S11	Well-defined procurement specifications augment the energy services quality level	Szomolanyiova & Keegan, 2018
	ESCO MODEL-RELATED	
S12	The introductory energy site-audit with the emanating techo-economic study is well-accepted as the key quality determinant for EPC projects	Szomolanyiova & Keegan, 2018
S13	The measurement and verification (M&V) phase plays a substantial role in the projects' success	Boza-kiss et al., 2017
S14	It is critical to deliver an integrated customer service, including a thorough audit, monitoring, understanding of customer behaviours and energy use over time and adequate pricing	Deloitte, 2019
S15	According to Roland Berger, energy services specialists are the most willing to invest (38% of the total), followed by utilities(16%) and investment funds (11%)	Consultancy.eu, 2019
S16	With an EaaS contract, customers can avoid investing themselves in technology and innovation by selecting vendors that provide design, installation, maintenance & performance services	Deloitte, 2019
	STANDARDIZATION & CERTIFICATION	
S17	Service standards can ameliorate the quality of the energy service markets	Bertoldi et al., 2014
S18	Energy standards and labels allow for improved communication and transparency for clients and investors while fostering competition and innovation for companies	Deloitte, 2016
S19	Eco-design and energy labelling provide high potential	Deloitte, 2016
S20	White certificates are essential as a specific market instrument for energy efficiency	Deloitte, 2016
S21	The Top-down and Bottom-up Methods resulting from the EU standard EN 16212, establish a holistic approach for energy efficiency and energy savings calculations	Szomolanyiova & Keegan, 2018
	REGULATORY	
S22	Building renovation is a fundamental measure for Covid-19 recovery, triggering economic stimulus and positive climate impact	Glicker & Roschini, 2020
S23	While the EED sets specific requirements for EPCs, Member States with a more solid domestic legislation can boast more dynamic ESCO markets	Glicker & Roschini, 2020
S24	There is a range of support schemes for EPC in almost all partner countries including green loans, white certificates, funds and subsidies	Guarantee, 2016

	TECHNOLOGICAL	
S25	The growth of smart technology, utilised in the buildings' energy management is predicted to drive several ESCO markets along	Bertoldi et al., 2014
S26	Systems associated with electric vehicles are expanding fast	Eyl-Mazzega & Mathieu, 2020
S27	In several countries, the current evolution of lithium batteries for electric vehicles is leading to a substantial cost decrease, resulting in sound solutions	Hafner & Noussan, 2020
S28	The growing role of distributed generation with the implementation of smart grids leads to the shift from consumers to prosumers' paradigm	Hafner & Noussan, 2020
S29	Hydrogen-powered vehicles seem to offer longer ranges, shorter charging times	Hafner & Noussan, 2020
S30	Moving away from centralised energy generation & delivery, distributed generation platforms ease distributed energy resources integration in the grid	Deloitte, 2019
S31	Innovative technologies can support recovery from the different crises and foster future preparedness	United Nations, 2021
	SUSTAINABILITY & CLIMATE CHANGE	
S32	Energy efficiency offers some of the fastest and most cost-competent measures to abate CO2 emissions	International Energy Agency, 2021a
S33	Energy services constitute today a primary axis ofenergy saving measures implementation in the majority of the EU Member States	Boza-kiss et al., 2019
S34	Energy efficiency is a fundamental concept for fighting climate change	European Commission, 2021
S35	The road to net-zero includes more than 40 energy efficiency milestones	International Energy Agency, 2021a
S36	Reduced energy consumption permits the reduction of both emissions and energy costs for the consumers and the industry	COM (2021) 550, final
S37	Energy efficiency provides a significant job creation potential	Inernational Energy Agency, 2020b
	ECONOMIC	
S38	The energy savings guarantee is considered a major driver by the businesses	Szomolanyiova & Keegan, 2018
S39	Saving energy also leads to the energy bill's reduction, make all customers benefit	European Commission, 2021
S40	The key reason for EPC is the guaranteed energy cost savings	Guarantee, 2016
S41	EPCs are one of the main vehicles for generating energy savings given the third-party financing	Glicker & Roschini, 2020
S42	Financial savings and maintenance costs decrease are the most critical reasons for implementing energy services	Guarantee, 2016
	COMMUNICATION & AWARENESS	
S43	Experienced customers or promotion of successful customer cases persuade peers, primarily so in the public sector	Boza-kiss et al., 2019

(source: self-processed, 2022)

Note: The registered strengths are briefed excerpts from the depicted source each time and the table has been extracted from the thesis dedicated SWOT database.

Table A2: Weaknesses

WEAKNESSES		
A/N	**WEAKNESS CLUSTER**	**SOURCE**
	PRODUCT	
W1	The complexity of the EPC concept	Szomolanyiova & Keegan, 2018
W2	Energy Efficiency does not constitute the driving force for the implementation of an Energy Management System	Szomolanyiova & Keegan, 2018
W3	Often, the relatively small size of energy service projects does not attract the interest of the larger financial institutions, which creates a perceived small market size perception and rather low interest	Bertoldi & Rezessy, 2005
W4	The decrease of CO2 or increase of building value through 'green buildings' cannot become the driving force for modernisation measures	Guarantee, 2016
W5	The collaboration between the customer and the provider is rather resource-consuming, while the commitment is demanding due to the long contractual terms and the low flexibility of service contracts	Marino et al., 2011
W6	In the transport sector, the potential decrease of energy demand by a heightening efficiency is counteracted by a continuously increasing demand for private car transport and larger vehicles	Brugger et al., 2021
W7	Efficiency gains do not result by default in energy demand reduction	Brugger et al., 2021
	TECHNOLOGICAL	
W8	Although electrification is expected to grow significantly due to the new 2030 targets set, thermal engines will not be removed	Eyl-Mazzega & Mathieu, 2020
W9	The limitations of EVs roll-out are primarily associated with the limited available range attributed to the high charging duration and the current limited availability of charging points	Hafner & Noussan, 2020
W10	Without a considerable amelioration of the energy density of EV batteries, the search for greater autonomy will end up with technical-economic limits	Eyl-Mazzega & Mathieu, 2020
W11	Cooling technologies are rather limited today although the role of cooling is progressively augmenting and it is expected to continue growing due to the increasing per-capita income in developing countries	Hafner & Noussan, 2020
W12	Cooling is supplied by distributed electricity-powered chillers, with some exceptions only incl. district cooling networks or solar cooling	Hafner & Noussan, 2020
W13	For the carbon footprint of EVs to become lower than that for conventional vehicles, they must be charged with low-carbon electricity	Eyl-Mazzega & Mathieu, 2020
	ECONOMIC	
W14	The public sector is rather hesitant to systematically include energy efficiency requirements in their procurement due to the energy services purchase price	European Commission, 2021c
W15	The accounting treatment of EPC impacts on the ability of the public sector to treat EPC projects as off-balance sheet investments	Bertoldi et al., 2017
W16	Small scale projects do not easily comply with EPC as they generally imply high transaction costs	Bertoldi et al., 2017
W17	High cost and complexity of microgrids and distributed energy management tools	Deloitte, 2019
W18	The consideration and administration of ESCO projects contracted by the public sector as part of the public debt is probably the primary largest and most encountered obstacle in recent years	Bertoldi et al., 2017
W19	Energy contracting implies high transaction costs associated with compiling historical information and identifying technically, financially and contractually sound solutions	Bertoldi et al., 2017
W20	Equity financing is the predominant form of financing selected which may limit the undertaking of energy-saving measures	Guarantee, 2016
W21	Hidden costs, such as unexpected maintenance or training needs, may also arise, demoting the savings from efficiency measures	Bertoldi et al., 2017
W22	Apart from long-term contracts with guaranteed prices for renewables projects, there are no price incentives for long-term investments related to low-carbon electricity generation capacity	Eyl-Mazzega & Mathieu, 2020
	ESCO-MODEL RELATED	
W23	The lack of technical knowledge and the know-how for addressing technical risks	Boza-kiss et al., 2019
W24	Measurement and verification protocols for assuring performance guarantees are not understood	Bertoldi & Rezessy, 2005
W25	EPCs have not yet reached their full potential mainly due to low-quality implementation, lack of enforcement and a limited number of methods	Deloitte, 2016
W26	There is a complex procurement process along with long time frames	Guarantee, 2016
W27	Small scale projects are not compatible with energy performance contracting	Boza-kiss et al., 2019

	COMMUNICATION & AWARENESS	
W28	Limited knowledge of the advantages of the building certification schemes represents a core reason for the relatively low growth pace	Szomolanyiova & Keegan, 2018
W29	The lack of positive examples and success stories is often a hinder in markets with limited experience and know-how	Boza-kiss et al., 2017
W30	The lack of transparency in the Energy Efficiency Services market is a limitation	Müller et al., 2019
W31	Partly due to the lack of trusted information, the energy efficiency benefits are often considered less secured, and energy efficiency is undervalued compared to other investment options	Boza-kiss et al., 2017
W32	The multi-faceted benefits of energy efficiency improvements, such as the increased asset value, comfort and productivity, even health improvements, are mostly unknown and non-considered when evaluating a related investment	Boza-kiss et al., 2017
W33	Lack of credible and apparent use cases with a straight-forward customer focus	COM (2021) 558, final
	SUSTAINABILITY & CLIMATE CHANGE	
W34	The socio-economic impact of innovation can become complex, given that some solutions may increase the resilience of some people while also accentuating the vulnerability of others	United Nations, 2021
W35	Big data and AI can accentuate new forms of social exclusion, for example, through intransparent algorithms and biased historical data	United Nations, 2021
W36	In transport, the potential reduction of energy demand by an increased efficiency is countervailed by an inreasing demand for private cars and larger vehicles	Brugger et al., 2021
W37	Without an improved energy density of EV batteries, the need for bigger autonomy will impede the contribution of electro-mobility to sustainability	Eyl-Mazzega & Mathieu, 2020
	REGULATORY	
W38	EPC is a risk-taking business for energy suppliers and service providers and demands a crystalline framework and specific user behaviour	Boza-kiss et al., 2017
W39	Efforts to finance adaptation undertakings still need to be considerably reinforced	European Commission, 2019
W40	Domestic regulatory barriers hinder energy efficiency investments in rented buildings and buildings with multiple owners	European Commission, 2019
	STANDARDIZATION & CERTIFICATION	
W41	Lack of experience, consistentcy and clear standards impact reliability	Guarantee, 2016
W42	The six primary voluntary building certification schemes, the BREEAM-the EU market leader, DGNB, HQE, LEED, Minergie and PassivHau, differ among them in the covered environmental and energy aspects, making benchmarking difficult	Szomolanyiova & Keegan, 2018

(source: self-processed, 2022)

Note: The registered weaknesses are briefed excerpts from the depicted source each time and the table has been extracted from the thesis dedicated SWOT database.

TABLE A3: Opportunities

OPPORTUNITIES		
A/N	**OPPORTUNITY CLUSTER**	**SOURCE**
	BROADER MARKET-RELATED	
O1	The 53& of the interviewees reported growth for their national EPC market for the last 12 month period (2015, 2017)	Szomolanyiova & Keegan, 2018
O2	The majority of the EU Countries have an EPC model contract	Szomolanyiova & Keegan, 2018
O3	International undertakings offer guidelines for the design, implementation and management of EPC projects	Szomolanyiova & Keegan, 2018
O4	For actors focusing already on EES, market fragmentation is a key opportunity	Müller et al., 2019
O5	The EED contributed fundamentally to the evolution of Energy Services markets and EPC	COM (2021) 558, final
O6	The intensive proliferation of ESCO associations targets to build an increased capacity for the ESCO markets support	Bertoldi et al., 2014
O7	Energy is at the core of the European Economy	Deloitte, 2016
O8	The untapped economic potential behind energy efficiency in broad is considered of paramount importance	Deloitte, 2016
O9	Growing energy prices and import fees are triggering companies to foster their energy efficiency	Müller et al., 2019
O10	IEA estimations foresee that two-thirds of the economically profitable investments for energy efficiency will remain untapped up to 2035	Deloitte, 2016
O11	In both the developed and the emerging EPC markets, the public sector still represents the most important EPC customer group	Guarantee, 2016
O12	The green image of buildings and businesses and the potential interest of individuals, e.g. tenants, in anergy efficiency is a driver for EPC in all segments	Guarantee, 2016
O13	The European Battery Alliance mobilises private players and synergies among industrial European players	Eyl-Mazzega & Mathieu, 2020
O14	Extending the EPC market across the Member States helps the decarbonisation of the building stock and the economic recovery post Covid-19	Glicker & Roschini, 2020
O15	Given the growing electricity demand, a primary challenge is to decarbonise the power sectors globally, while stressing on the heating and cooling, industry and transport sectors and on GHG other than CO2, such as methane	Eyl-Mazzega & Mathieu, 2020
O16	Efforts in energy efficiency have diminished and while quick-wins have been achieved, the challenge is to push forward on the residential/transport sectors	Eyl-Mazzega & Mathieu, 2020
O17	Although several measures have already been undertaken, particularly so in developed countries, there is still considerable perspectives for energy savings and optimized energy use in the building segment	Hafner & Noussan, 2020
O18	At a country level, energy pricing evolution also drives the market for energy efficiency consulting	Müller et al., 2019
O19	Several intl programmes stimulate cooperation, technical support and financial assistance for energy efficiency and conservation projects	Marino et al., 2011
	LEGISLATIVE	
O20	The EED imposes obligations on MS to support the energy services market (Article 18), to promote it and trigger SMEs to enter it via specific incentives	Szomolanyiova & Keegan, 2018
O21	The EED requires MS to ensure that energy distributors, distribution system operators and retail energy companies refrain from any activities that may hinder the demand for and supply of energy services	Szomolanyiova & Keegan, 2018
O22	The EED (Article 8) implies obligatory energy audits for large companies, which heightens demand for energy consultancy	Szomolanyiova & Keegan, 2018
O23	The revision of the EPBD aims to define specific measures to accelerate buildings renovations, assisting energy efficiency, renewable targets and CO2 abatement	COM (2021) 550, final
O24	The EED (Article 19) asks MS to remove regulatory and non-regulatory barriers to energy efficiency, also for public purchasing, annual budgeting and accounting	Szomolanyiova & Keegan, 2018
O25	The EED (Article 20) refers to the National Energy Efficiency Fund, which embraces dedicated financing to speed-up the uptake of energy services projects	Szomolanyiova & Keegan, 2018
O26	The revised provisions to the EPBD by Directive (2018/844/EU) objects to speed-up the cost-effective renovation of existing buildings, for a decarbonised building stock by 2050 and the triggering of investments, also addressing smart technologies, automations and building technical systems	Szomolanyiova & Keegan, 2018
O27	The power of the European legislation on its contribution to the growth of the ESCO industry has been gradually augmenting	Boza-kiss et al., 2017
O28	Well-structured regulations can stimulate transparency of new digital tools and innovations	United Nations, 2021

O29	Manifested, credible and of long-term commitment by the government and the public sector to sustainable energy, energy efficiency and the ESCO paradigm is a critical success factor	Bertoldi et al., 2014
O30	A policy framework that supports the set-up and growth of the ESCO market cannot be avoided	Bertoldi et al., 2014
O31	The Fit-for-55 proposal (14-07-21) ephasizes on segments with high energy-savings potential, mainly heating and cooling, industry and energy services and an incremental focus on the public sector	European Commission, 2021
O32	Renovation can become the driving force for economic recovery post Covid-19 together with the EU's Recovery and Resilience Facility focus on buildings and the Fit-for-55 that addresses changes that could drive energy efficiency investments	European Commission, 2021
O33	The impacts of the EED, especially so of the articles 5, 18, 19, 20 and their transposition into domestic law in the MS are expected to be fundamental	Guarantee, 2016
O34	The EU regulation must strengthen both demand and competitive supply of low-carbon solutions, to respond to policies and actions from emerging and established powers, namely USA & China ('Made in China 2025 strategy')	Eyl-Mazzega & Mathieu, 2020
O35	The Eco-Design Directive (2009/125/EC) and the related measures strongly affect the energy efficiency of equipment such as street and indoor lighting	Gynther & Eichammer, 2016
	SOCIAL & ENERGY TRANSITION	
O36	The EED has the potential to more effectively address socio-economic issues such as the protection and empowerment of vulnerable clients, to alleviate energy poverty and empower consumers	COM (2021) 558, final
O37	Businesses are reinforcing their internal procedures for climate protection and adopting higher sustainability goals aligned with governments' expectations	Müller et al., 2019
O38	The EC urged MS to address energy efficiency as an own energy source	Deloitte, 2016
O39	The Fit-for-55 being a set of interconnected proposals leads towards the target of safeguarding a fair, competitive and green transition by 2030 onwards	COM (2021) 550, final
O40	The challenges of climate change demand a global response, and the EU will continue getting actively involved with its partner countries	COM (2021) 550, final
O41	Environmental awareness and climate change policies have had a spin-off effect with the establishment of constructive legislation and implementation measures	Marino et al., 2011
O42	Climate change awareness along with technology evolution has pushed the energy efficiency market in Europe to €25 billion	Consultancy.eu, 2019
O43	Urban mobility has the highest energy efficiency potential, but road freight and aviation are more difficult to decarbonise	International Transport Forum, 2021b
O44	Governments architecting the future energy transition along the principles of strong governance, market effectiveness and public engagement will reap the rewards in the long term	World Economic Forum, 2015
O45	The EU being responsible for the 10% of the global yearly emissions, has been now transformed to a world leader in energy transition	Eyl-Mazzega & Mathieu, 2020
O46	It is important to safeguard that energy efficiency investments are also implemented among the most vulnerable societal groups	COM (2021) 558, final
	FINANCIAL	
O47	EU and national grants, financial incentives, preferential loans generate a dynamic for the market	Bertoldi et al., 2014
O48	Public finance may trigger private finance for EES	Deloitte, 2016
O49	Increased carbon prices would render energy efficiency measures more attractive	Deloitte, 2016
O50	Financing programmes on the consumers' bill is a tool for utilities to motivate end-users to pursue energy efficiency actions, such as air conditioning, improved lighting and insulation	Deloitte, 2016
O51	The recent EC economic recovery package, with the Multiannual Financial Framework and Next Generation EU, admits that building upgrades are substantial green investments for the EU economic recovery	Glicker & Roschini, 2020
O52	InvestEU is perfectly placed to offer guarantees for ESCOs and hence stimulate building renovations, exploiting the EPC model	Glicker & Roschini, 2020
O53	Companies have sought to improve their energy efficiency as to reduce long-terms costs and cover their own objectives in terms of their carbon footprint	Consultancy.eu, 2019
O54	A price set on carbon that discourages high emission transport can render greener alternatives more attractive	International Transport Forum, 2021b
O55	The Cohesion Policy funds will keep on dedicating an critical share of the EU budget to energy efficiency and buildings retrofits	COM (2021) 558, final
O56	Green Deal supports urban projects to create climate-neutral cities. With the 'Next Generation EU', it provides a financing line of €750 billion for the pandemic recovery. Coupled with the EU's long-term budget Next Generation EU, it constitutes the largest incentives package ever financed in EU, of €2.018 trillion	European Commission, no date

	TECHNOLOGICAL	
O57	The development of new technology such as the Internet of Things (IoT), blockchain and artificial intelligence (AI) allows EES providers to improve their solutions and offer customers tailored services	Müller et al., 2019
O58	New Digital Platforms should allow the energy and transaction management, operations and maintenance along with the optimisation of all equipment	Deloitte, 2019
O59	The most value-added opportunities will reside in innovative services, whether single or combined, that reinforce customer loyalty and allow high margins	Deloitte, 2019
O60	The development of new energy-saving technology results in the "reinvention" of production processes – for instance, electric steel production	Müller et al., 2019
O61	Overall system costs will further heighten to cater for the development of electricity storage technologies and demand-side management solutions	Eyl-Mazzega & Mathieu, 2020
O62	If biofuels and hydrogen are the only realistic paths for the partly decarbonisation of the aviation sector, then considerable funds should be allocated in this area	Eyl-Mazzega & Mathieu, 2020
O63	It is well expected to be seen whether decarbonised hydrogen will assist the passenger car segment, households' heating and electricity storage to meet seasonal demand fluctuations	Eyl-Mazzega & Mathieu, 2020
O64	Acturally, there are no pure technological obstacles hindering major decarbonisation routes across any industrial sector	Hafner & Noussan, 2020
O65	Countries competent in innovating in renewables, batteries and electric cars will be better positioned to take advantage of the industrial and economic benefits from the energy transition	Hafner & Tagliapietra, 2020
O66	Innovation and technology are fundamental drivers for the energy services market, including the development of new energy-saving technologies and the reinventing of production processes	Müller et al., 2019
O67	Innovation provides the most optimistic path to decarbonising non-urban passenger transport	International Transport Forum, 2021b
	TECHNICAL & ADMINISTRATIVE	
O68	During the last ten years, growth in legislative, standardisation, certification and other initiatives has been observed, as regards energy efficiency and energy management	Szomolanyiova & Keegan, 2018
O69	The Investor Project Confidence Europe conveys standardised protocols for the documentation of building and single technology energy efficiency projects	Szomolanyiova & Keegan, 2018
O70	Obtaining quality assurance is expected to give providers a competitive advantage in the market	Szomolanyiova & Keegan, 2018
O71	The majority of clients interviewed across all countries consented that the quality assurance scheme would foster project quality (73%) and that the projects would be improved from a technical and process aspect (71%)	Szomolanyiova & Keegan, 2018
O72	The integration of highly innovative and successful start-ups demands specific skills, should be regarded more 'as an art rather than a science'	Müller et al., 2019
O73	Energy efficiency investments are often triggered by common refurbishment	Bertoldi et al., 2014
O74	Adaptation of the energy services procurement to the industry's regular procurement process can better open the market	Guarantee, 2016
O75	The mandatory energy audits and energy performance certificates for buildings and the growing number of energy management systems (e.g. ISO 50001) drive energy services	Guarantee, 2016
O76	If a good solution for the 'split incentives dilemma' is pursued, the energy service market in the rented facilities segment, the tertiary sector and household buildings can open up	Guarantee, 2016
O77	In the Residential Building sector, mandatory energy performance certificates concentrate the attention to energy consumption, creating value for efficiently performing venues	Guarantee, 2016
O78	Focus to be given on schools and hospitals' renovation as the money saved through building efficiency could be next invested in better education and public health support	COM (2019) 640, final
	AWARENESS & UNDERSTANDING	
O79	A financing guide would create a framework of shared understanding for clients, EES providers and financial institutions	Szomolanyiova & Keegan, 2018
O80	A number of EPC providers are not aware of all opportunities related to the financing of their projects via sale of claims	Szomolanyiova & Keegan, 2018
O81	The EU proposal for the EED recast on July 14, 2021 requires each MS to define their tentative domestic contributions based on a formula of impartial criteria and benchmarks, reflecting national market conditions	European Commission, 2021

(source: self-processed, 2022)

Note: The registered opportunities are briefed excerpts from the depicted source each time and the table has been extracted from the thesis dedicated SWOT database.

Table A4: Threats

THREATS		
A/N	**THREAT CLUSTER**	**SOURCE**
	AWARENESS & UNDERSTANDING	
T1	There is limited trust regarding the ESCO Industry and the ESCO providers	Szomolanyiova & Keegan, 2018
T2	The clients questioned across all countries most often report issues regarding EPC services quality for the technical measures (38%), transparency and completeness of contractual terms (38%), initial analysis including technical and economic feasibility (31%) and measurement & verification (31%)	Szomolanyiova & Keegan, 2018
T3	The narrow technical knowledge, lack of know-how for addressing technical risks and experience in procurement are challenges encountered by several countries, where the EPC and ESCO concepts are rather new, as in Estonia	Boza-kiss et al., 2017
T4	A characteristic behavioural factor of developing energy services markets is the limited confidence in ESCO services or preferences for in-house solutions	Boza-kiss et al., 2017
T5	For many financial institutions, the energy services model is new and not that straight forward	Boza-kiss et al., 2017
T6	Most companies do not have the expertise to identify the technical energy-saving opportunities and the resulting economic benefits	COM (2021) 558, final
T7	Lack of trust from the contractors' verge towards clients, attributed to an augmented risk of unreliable and defaulting customers	Bertoldi et al., 2014
T8	End-users still demonstrate low energy efficiency behaviours	Deloitte, 2016
T9	In the tertiary segment, there is resistance to outsource energy related services and operations to third parties	Guarantee, 2016
	SOCIAL & ENERGY TRANSITION	
T10	The energy transition process incubates new industrial risks and threats for the control of the low-carbon technologies value chain and of the systems' operation	Eyl-Mazzega & Mathieu, 2020
T11	Economic growth and security of supply and economic growth are lawful priorities of several emerging economies, placed higher than the CO2 emissions abatement	Eyl-Mazzega & Mathieu, 2020
T12	Margins on specific technologies, such as solar and storage, will seemingly decline, so building a sustainable energy services business in any particular sector will become difficult except for companies that will manage to operate at scale	Deloitte, 2019
T13	The supply of critical metals and rare earths used for the technologies behind energy services is aggregated in a few countries only, plenty of which are not OECD members	Eyl-Mazzega & Mathieu, 2020
T14	The EU should demand higher ESG standards for its imports of critical metals and connected materials	Eyl-Mazzega & Mathieu, 2020
T15	Although users' behavior in buildings impacts drastically energy demand, behaviour cannot easily change	Guarantee, 2016
T16	The EU necessitates to foster its European Battery Alliance and devise a mineral strategy to competently face the critical metals issue	Eyl-Mazzega & Mathieu, 2020
T17	Globally, most countries have not yet kickstarted a low-carbon transition process and, in the best case, renewables roll-out just avoids the set-up of incremental coal-fired power generation capacity	Eyl-Mazzega & Mathieu, 2020
T18	The global economic slowdown is definitely transforming the environment in which the transition is being rolled-out	World Economic Forum, 2015
T19	To ensure the transition to a high performing energy system, the business-as-usual scenario could not be supported	World Economic Forum, 2015
T20	Covid-19 brought a massive reduction to global investment in 2020, exacerbating the slowdown in overall productivity increase and raising the issue of a 'lost decade'	United Nations, 2021
T21	Past has shown that energy efficiency gains may be counteracted by societal trends that make corresponding activities to grow	Brugger et al., 2021
	TECHNICAL & ADMINISTRATIVE	
T22	The market for voluntary building certification schemes is still at its early stage	Szomolanyiova & Keegan, 2018
T23	In principle, businesses add energy costs under overhead and energy consumption is ergarded as secondary issue in tems of investment decisions	Boza-kiss et al., 2017
T24	Merger policies within municipalities have been pursued in several European countries for decades, which causes uncertainty into the decision making	Gynther & Eichammer, 2016
T25	Administrative obstacles persist, such as complex procurement processes	Bertoldi & Rezessy, 2005
T26	Ownership of the assets will be dispersed among customers, companies and communities, so service providers that will deploy and manage large-scale projects will be best-positioned to capitalize on this growing market	Deloitte, 2019
T27	A ctitical obstacle to energy efficiency in the building sector is the 'landlord-tenant problem'	Deloitte, 2016
T28	Non-pragmatic energy saving calculations demand quantification standards to be implemented and the balancing of existing schemes is mandatory for the establishment of a larger Energy Services market	Deloitte, 2016
T29	The public sector is highly dependent on political support	Guarantee, 2016
T30	In the households building segment, the vast majority of property owners are individuals, who may easily block decision	Guarantee, 2016

T31	Without adequate policy support, ESCOs, especially the ones at the early development stage, could stay well behind	Ashak and Jihyun, 2021
T32	The Eurostat rules on public debt and deficit faced investments in energy efficiency on their balance sheet and handled them as deficits in their internal accounts, even if organised under ESCOs	Glicker & Roschini, 2020
T33	Given the considerable market fragmentation, bigger growth may be achieved through acquisitions	Müller et al., 2019
	BROADER MARKET-RELATED	
T34	The reasons for ESCO market development diverges among MS, lacking consistency	Szomolanyiova & Keegan, 2018
T35	The schemes vary significantly among MS and few markets have schemes presenting little in common, as in the case of Germany, Spain and Austria	Szomolanyiova & Keegan, 2018
T36	Energy price evolutions may have a crucial impact on the deployment of energy efficiency measures	Boza-kiss et al., 2017
T37	Most Member States seem not to have defined a solid path for the renovation of their national building stock	Deloitte, 2016
T38	SMEs, representing 99% of all companies in the EU, need special focus, given that only 64% are undertaking energy-saving measures compared to 82% of larger companies	Deloitte, 2016
T39	Critical variances among MS priorities are observed and the recent submission of the national climate plans proves that the advancement towards the shared objectives is not consistent nor even	Eyl-Mazzega & Mathieu, 2020
	FINANCIAL	
T40	The general view of respondents (66%) including EPC providers and facilitators across all countries is that securing viable finance is "difficult"	Szomolanyiova & Keegan, 2018
T41	Energy-efficiency projects compete for scarce capital with more traditional investments such as small power plants, industrial expansion or other type of building improvements	Boza-kiss et al., 2017
T42	In almost all MS, financing ESCO projects remains difficult, even in cases where credit is available, since there are obstacles due to customer or ESCO limited liquidity, or unavailability of credit lines	Boza-kiss et al., 2019
T43	Various barriers demote the attractiveness of financing energy efficiency projects in the eyes of traditional investors, such as considerable payback periods, unstable energy prices, lack of related and understandable information	Deloitte, 2016
T44	In the industry segment, it seems that top management prefers income-generating projects over cost reduction ones	Guarantee, 2016
T45	In the residential building segment, ESCO financing is too risky and costs a lot	Guarantee, 2016
T46	Most Member States have delayed in submitting their long-term renovation strategies which hinders the direction of the related funds to the right priorities and objectives	Glicker & Roschini, 2020
T47	Grants or preferential loans do not favour nor disqualify ESCOs	Boza-kiss et al., 2019
	TECHNOLOGICAL	
T48	Vulnerabilities in the supply chain of critical metals and rare earths generate risks for the value chains of the technologies behind energy services	Eyl-Mazzega & Mathieu, 2020
T49	Unintended consequences of new Science, Technology, Innovation (STI) must not be ignored; specially new technologies although while having the potential to mitigate risks and strengthen resilience, can also become new sources of risk	United Nations, 2021
T50	The 2030 targets will push electrification forward but not remove the thermal engine	Eyl-Mazzega & Mathieu, 2020
T51	The e-vehicles value chain is dominated by Asian players China, Japan and Korea, enjoying subsidies and economies of scale, particularly in the battery cells production	Eyl-Mazzega & Mathieu, 2020
T52	Incompetency of Utilities offering service to effectively adapt to digital and distributed energy resources or to increase their ties with energy consumers, may deteriorate their advantages over time	Deloitte, 2019
	LEGISLATIVE	
T53	There are several ambiguities in the legislative framework	COM (2021) 558, final
T54	Unstable and uncalculated legislation is an important threat	Bertoldi et al., 2014
T55	A complex regulatory framework impedes the achievement of ambitious targets	Deloitte, 2016
T56	Stronger market surveillance is critical for the enforcement of ecodesign and labelling regulation	Deloitte, 2016
T57	Despite critical developments in EU legislation for the ESCO market during the ladt decade, maturity and implementation differs significantly among countries	Glicker & Roschini, 2020

(source: self-processed, 2022)

Note: The registered threats are briefed excerpts from the depicted source each time and the table has been extracted from the thesis dedicated SWOT database.