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Energy Services: A Proposed Framework to Improve Results

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Abstract: Energy services markets are actively developing around the world, but their growth rates need to be accelerated in order to help the world meet energy policy goals. One barrier to energy services markets is confusion created from different terminology used in different parts of the world. In this context, various definitions of the term “energy services” have been analyzed in this paper and it has been recommended to distinguish between “energy services” and “energy-related services”. The structural and functional features of the energy services market conceptual design and its implementation models, as well as the use of energy service companies (ESCOs) concept has been also investigated. We hope that this standardization will clarify business activity as well as improve the ability for investors and stakeholders to further expand the market.

Keywords: Energy services; ESCOs market; energy efficiency; models

1 Introduction

Over past few decades, the global economy is increasingly transforming from a manufacturing (product) economy to a service economy [1–3]. Employment services dominate in the USA economy since 1960, accounting for about 80% of US value added. Services markets in the European Union (EU) brought 71% of EU-28 value added and 68% of EU employment in 2017. Nevertheless, the pace of development of services markets around the world is considered unsatisfactory, primarily due to low competitive pressures that drive innovation and performance, slow productivity growth, a shortage of cross-border investments, and low labor mobility [4,5].

Up-to-date energy services consist of professional business (commercial) activities, including scientific and technical, as well as management and consulting services. The specifics of energy services are defined in EU legislation as “the physical benefit, utility or good derived from a combination of energy with energy efficient technology and/or with action, which may include the operations, maintenance and control necessary to deliver the service, which is delivered on the basis of a contract, and in normal circumstances has proven to lead to verifiable and measurable or estimable energy efficiency improvement and/or primary energy savings” [6,7]. Here, as well as in economic theory, the term “good” refers to objects, devices, or things, whereas the term “service”—to actions, efforts, or performances.

The field of energy services covers all major branches of the global economy, where fuel and energy resources are used intensively. Primarily, these are energy, industry, transport, housing and communal sectors, agriculture etc. Since the beginning of the third millennium, global energy services markets are rapidly developing in two priority fields. These are energy efficiency and renewable energy, where energy efficiency is considered as "a special type of fuel". According to the International Renewable Energy Agency, the cumulative investment in energy efficiency and renewable energy in the world for 2016–2050 under different scenarios will be $(29.0–37.0) trillion and $(13.0–27.0) trillion, respectively [8].

What is also important for our further consideration, the EU Directive [9] that amends the Directive [7] on energy efficiency services, that establishes new, more strict requirements to the EU countries as follows: "…to promote energy efficiency within the Union in order to ensure that the Union's 2020 headline targets on energy efficiency of 20% and its 2030 headline targets on energy efficiency of at least 32.5% are met and paves the way for further energy efficiency improvements beyond those dates".

This paper presents the results of a synergy analysis of literature sources as well as the authors' findings, which allow answering the conceptual questions: "what are the energy services", "what are the fields of energy services implementation", and "what are the structural-functional components of energy services market's formation and functioning?" The answers to these questions are important for the energy services market development as they allow clarifying the object of business activity and possibilities that open to investors and stakeholders.

2 Literature Review

2.1 Energy Services

The most complete modern review of literary sources that covers 185 articles devoted to the definition of "energy services" has given in article [10], and first reference to this term, according to the Scopus database, was in the 1955 [11]. As a result of the review [10], the following definition was suggested: "Energy services are those functions performed using energy which are means to obtain or facilitate desired end services or states". In our opinion, this definition is too general and does not allow highlighting the objects of energy services and outlining the opportunities that they open to investors, entrepreneurs and end-users. The author of [10] agrees with us saying, "…this definition will not be suitable in all contexts".

To fix this, we added the definition of the term "energy services" given in [12] that reveals their internal content for engineering as a "set of organization, processes, activities, means and resources necessary for production, transmission, distribution and supply of energy and for providing a physical benefit, utility or goods, which are derived from a combination of energy with energy-efficient technology or with action, that can include the operations, maintenance and control necessary to deliver the service". The practical aspects of using this definition are detailed in [13].

In light of the above, the literature review [10] should also be supplemented with background notes made by the Secretariat of World Trade Organization (WTO) [14,15]: "In liberalized markets, core energy services such as transport, transmission and distribution are increasingly supplied by independent operators under conditions of competition. Other services include consulting (in various fields including energy efficiency, conservation and renewable energy), construction, maintenance of the network, and services related to distribution such as metering and billing. A major difficulty in identifying energy services is represented by the fact that the industry has traditionally not distinguished between energy goods and services". Thus: "Other services intervene in the energy value added chain (from production to resale to consumers), including construction, engineering, and consulting services … are better defined as energy-related services rather than energy services".

We propose to use in engineering the WTO's differentiation between core energy services and energy-related services, since it is largely based on the widely used in world practice concept, theoretical basis of which has been developed by famous economists F. Bastiat, P. Kotler, K. Marx, P. Samuelson, A. Smith and others. Sic, Karl Marx in his classic work "Theories of Surplus-Value" talking about services underlines their feature to "increase the value of the commodities against which it is exchanged, that it creates surplus-value —and in doing so, it disregards the specific relationship through which money and commodities are transformed into capital" [16]. In other words, the terms "energy services" and "energy-related services", used in commercial sense, should mean different types of services that are provided in exchange for income.

2.2 Energy Services Markets

Markets have always played a leading role in the economy, but their definitions remain blurred and uncertain. Nevertheless, in general they are all associated with the monetary exchanges of goods, services and information [17,18].

In line with a definition of Business Dictionary, market is "an actual or nominal place where forces of demand and supply operate, and where buyers and sellers interact (directly or through intermediaries) to trade goods, services, or contracts or instruments, for money or barter". To succeed in the energy services market, it is important to have a clear understanding of the following market mechanisms and tools for: (1) determining price of each transaction, (2) communicating the price information, (3) facilitating deals and transactions, and (4) effecting distribution. Thus, market should (5) facilitate the efficient exchange, coordination and allocation of resources, goods and services, as well as (6) support competition and lower the costs of doing business, (7) provide incentives for trade and investment, and therefore stimulate the business growth. So, the market should be (8) customer-oriented by delivering the right goods and services to customers at the right time.

On the whole, the market is a mixture of agents who perform market roles, organizational and regulation structures, mechanisms, procedures, social relations, contracts and infrastructures whereby parties engage in exchange of goods, services and information. Agents of the markets as a rule are natural or legal entities.

Given the above, when implementing the energy service market, it is necessary to take into account the features of the organization and functioning of various types of markets (see, for example, [19]), among which we identified the following that most fully cover the specifics of energy services:

1. Price discrimination market that is characterized by significant differences between clients in terms of their solvency, ownership form, availability of suppliers of different types of energy et al. Service providers in this market should be prepared to set (to take into account) different price-value margins for different groups of their clients, including suppliers of energy and equipment;
2. Aftermarket, where the efficient use of main (primary) equipment is possible only in combination with other (secondary) products. This is typical of energy services, where their providers are directly involved in the acquisition of various primary and secondary products, which should complement each other by forming an efficiently functioning system;
3. Cluster market, which is characterized by transaction complementarities between the various components of a bundle of products and services. Transaction complementarities arise when a consumer incurs lower transaction costs if he buys several products (services) from one firm, instead of buying each product (service) from a different firm. Thus, transaction complementarities may be interpreted as economies of scope on the demand side that benefit consumers. Energy service providers on such type of market should be interested in organizing a kind of union, for example, in the form of a public association or cooperative;
4. Bidding market, where firms compete by submitting bids in response to tenders by buyers. This type of market is one of the most common when choosing an energy service provider. In its purest form, they exhibit four characteristics. First, competition is of the "winner takes all" type meaning that there is no smooth demand function, i.e., no relationship between price and quantity. Second, competition is

lumpy as contests are large with respect to the total sales of any particular firm. Third, competition begins afresh for each contract and customer and fourth, market entry is easy;

5. Dynamic and innovative markets with rapid technological progress. The participation of energy service providers in such markets is attractive, but difficult, since the payback period of their performance contracts is usually several years;
6. Differentiated market-as-network [20,21] in the following terms: (a) exchange exists not only as discrete transactions, but also as ongoing relationships; (b) buyers and sellers are interconnected, and know each other, and market agents are not anonymous; (c) the supplier and the buyer are both active in the business relationship; (d) organizations, particularly in industrial settings, interact with a limited set of identifiable actors with considerable influence where agents are seldom atomized, (e) organizational boundaries are blurred and relationships extend outside the contractual boundaries of firms; and (f) bargaining power results from a relative position within a network, rational egalitarian interactions play a part but only to a limited extent. This type of market is quite new and most progressive due to the sustainable transition of the global economy from a manufacturing to a service economy. The role of energy service providers in this market is currently understudied. One possible framework for solving this non-simple task is a service-dominant concept.

The Service-Dominant Logic (SDL) concept of market formation, proposed in [22], is radically different from the conventional manufacturing (product) concepts of markets discussed above. In contrast to the "product" concept, which is based primarily on the core importance of value added created during the manufacturing process and where a customer service considered as a cost that plays a secondary, supporting role, in the SDL concept the product is cost, and the customer service is the core value added. In other words, within the framework of the SDL concept, the products are considered not only objects for sale but also a means to provide services, and the customers act as co-producers (prosumers) with product manufacturers and service providers. The details of SDL concept can also be found in [23,24].

A classification of business instruments (models) to provide services that divides them into two main categories was proposed in [25,26]: (a) ownership models, which focus on financing and risk mitigation, and (b) service models, which focus on providing specified services and highlight the different methods of operation and maintenance. Among the various types of ownership business models are considered: Public-Private Partnership (PPP) model in the forms of build-own-operate-transfer (BOOT), build-own-operate (BOO) and build-own-transfer (BOT); Multiparty Ownership Model; Lease or Hire Purchase Model; and Dealer Credit Business Model. The concept of "meta-service" and the role of intermediaries in catalyzing the energy services market are described in [27,28]. Meta-services define as "more-than-energy services and are shaped not only through energy consumption, provision and governance but also by a range of other non-energy providers and organizations". Various types of models for risk management, suitable for the specifics of energy services, you can find, for example, in [29].

2.3 Energy Services Companies

Energy service companies (ESCOs) are among the most efficient and most frequently used type of firms specializing in the provision of energy services, whose effectiveness has been proven in practice world-wide [30–32]. The first effort in ESCO market development came from Scallop Thermal, a division of Royal Dutch Shell. S. Hansen is considered a pioneer in analyzing and systematizing most of the conceptual provisions of the modern ESCO business concept, and the ideologist of its dissemination in EU is P. Bertoldi, who are the authors of more than ten published monographs on this topic, including [33,34].

ESCO is defined in [6] as "a natural or legal person that delivers energy services and/or other energy efficiency improvement measures in a user's facility or premises, and accepts some degree of financial risk in so doing. The payment for the services delivered is based (either wholly or in part) on the achievement of energy efficiency improvements and on the meeting of the other agreed performance criteria".

ESCO is a commercial type of organization, acting based on the energy-service contract and providing a wide range of energy services that cover technical, economic, financial and legal aspects of design, engineering, installation, commissioning, monitoring and verification of the results achieved from the implementation of innovative projects in the area of energy savings and energy infrastructure development [3,33–35].

ESCOs, depending on their composition and form of ownership, can be divided into the following types: ESCOs, which are private independent companies; ESCOs that belong to manufacturers of equipment or control systems; ESCOs that belong to regulated or state-owned utilities; ESCOs that belong to unregulated energy suppliers or engineering and construction firms; ESCOs that belong to state or municipal authorities. In more simple words, manufacturers of energy-efficient equipment, energy supply companies (utilities), energy engineering and energy maintenance companies can operate as effective ESCOs. However, the energy services of different types of ESCOs are fundamentally different, depending on the forms (models) of their energy services projects contracting and financing [33–36].

Among the business models (instruments) for financing ESCO projects can be used such as private and state sources (funds, subsidies, tax rebates, loans, third-party financing), as well as energy savings via performance contracting, energy outsourcing and other related financing that allows ESCOs to partially or fully cover the projects cost [6].

As for energy services contracting, the service-based business models, considered in [25,26,37], distinguish three common forms: Energy Performance Contracting (EPC), Energy Supply Contracting (ESC) and “Chauffage”. However, in practice, most real service-based business models are a combination of various forms and types or even a simplification of them.

Energy performance contracting in European legislation “means a contractual arrangement between the beneficiary and the provider of an energy efficiency improvement measure, verified and monitored during the whole term of the contract, where investments (work, supply or service) in that measure are paid for in relation to a contractually agreed level of energy efficiency improvement or other agreed energy performance criterion, such as financial savings” [7]. In general, energy performance contracting is focused on the benefits derived from the efficient use of energy, and not on the procedures for the purchase/sale of energy. ESC is aimed at efficient supply of useful energy, usually limited to the energy supply side and purchase of fuels. “Chauffage” generally refer to a greater value-added approach, where ESCO manages all supply and demand efficiencies.

Regarding the specifics of ESCO contracting in relation to the cost of their energy services projects, the key role of transaction costs is noted first [3,28,36]. The latter incur both inside the companies and outside it, as a result of their interactions in the energy services market and include any necessary costs that are not connected directly to the production of goods and services (production costs), but provide their successful implementation.

Transboundary (cross-border) cooperation of ESCOs creates fundamentally new challenges in the field of energy services provision, aimed at carrying out upgrade and innovative technical and technological development of each company and national economies of the countries, which cooperate. Such international cooperation is realized through the interaction of manufacturers and financial institutions, ESCOs and state and local authorities in the market environment. It should be noted that the efficiency and effectiveness of ESCOs transboundary cooperation depends largely on the ability to account for the absolute and comparative advantages of ESCOs located in different countries and economic zones [3,38].

3 Study Area

3.1 Energy Services Classification

Based on the literature review, a proposed block diagram of the energy services classification is shown in Fig. 1.

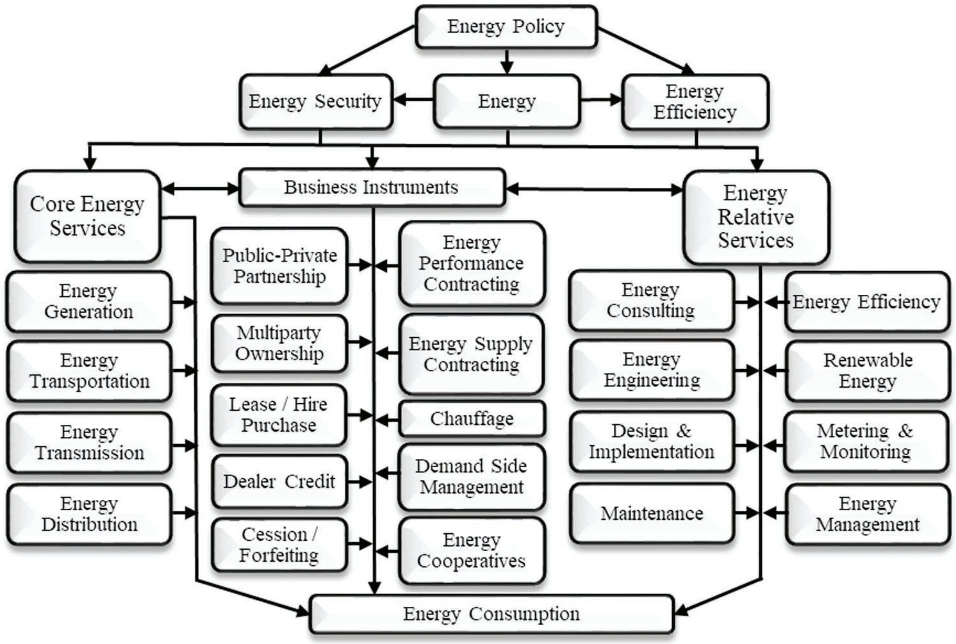

Figure 1: The business environment of energy and energy-related services

As you can see, we recommend considering the differences between Core Energy and Energy-Related Services that are consistent with worldwide industry and commerce policy. The proposed classification also enfolds the contractual business instruments for the implementation of energy services activity. Important elements of the block diagram are the components of Energy Policy, Energy Security and Energy Efficiency, located at the top of the scheme. These components determine the directions and content of energy services and energy services market development that will be discussed in more detail below.

3.2 Particulars of Providing Energy Services

3.2.1 Features of the Interaction of Participants in Energy Services Projects

To achieve the desired result through the providing energy services, we have to consider first their components as a causal process, whose links are connected by chains of causes and effects. At the same time, we must consider the behavioral strategies of service providers and their clients (customers), very often do not coincide and require a holistic approach. A generalized diagram of the causal processes of interaction between the participants of energy services (ESs) projects is shown in Fig. 2.

As can be seen from Fig. 2, besides the main energy services provider, energy services supporting activities are carried out by other participants (actors), such as: manufacturers of energy-efficient equipment and materials, energy-and-fuel resources providers, utility companies, financial intermediaries (investors, etc.), participants of trading platforms (exchanges, auctions), state and local authorities, regulators of business activities, etc. In such a multipurpose cooperation, the knowledge of energy services providers and their contribution to financing and implementation of services, measuring and verification of results, as well as ability to maintain high level of service standards becomes the stable source of customer's development.

3.2.2 The Process of Providing Energy Services

The ESs projects energy management cycle is shown in Fig. 3, where you can see all the main stages of such projects implementation. The presented cycle is a rather complicated cause-and-effect process, which requires professional training of energy services project executors in the technical, financial and legal fields.

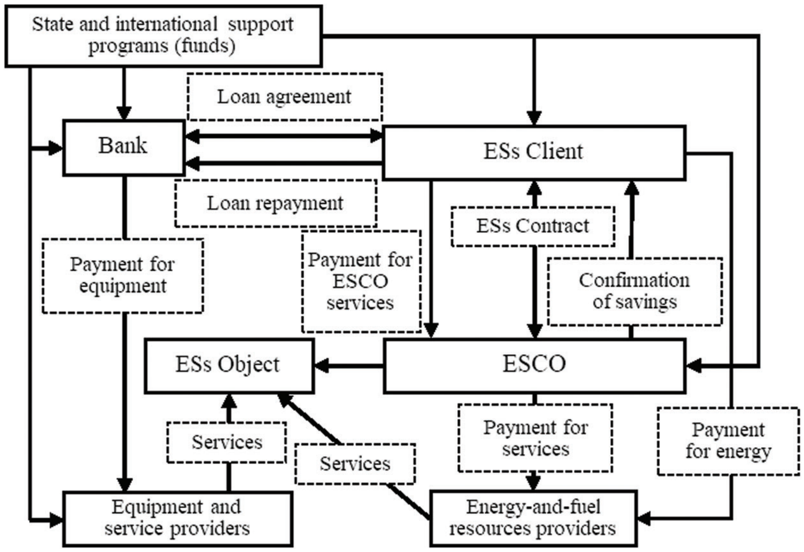

Figure 2: Structure and forms of business relations in energy services projects

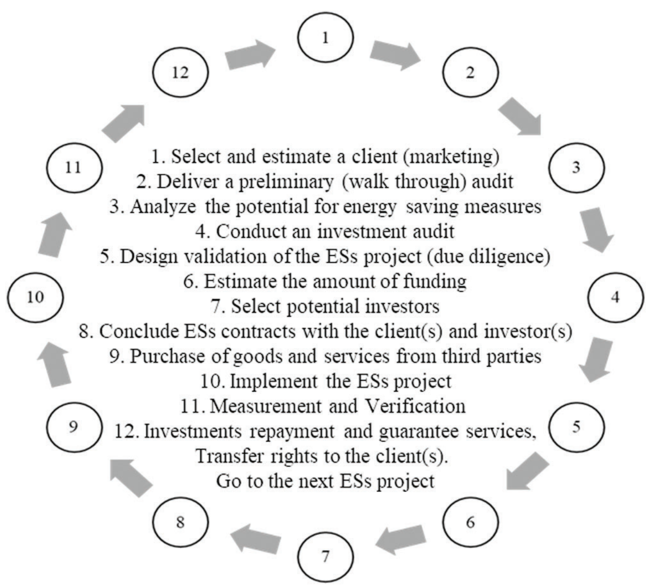

Figure 3: Flowchart of energy services (ESs) projects management cycle

3.2.3 The Specifics of Energy Performance Contracting

Energy performance contracting is the most attractive for customers and the most difficult form of energy services for ESCO. The specifics of providing the energy performance contracting are as follows:

1. An energy performance contracting provider must guarantee that the energy savings achieved through the implementation of an energy services project will exceed payments to cover total project costs during the project payback period;
2. An energy performance contracting provider invests its own funds (in whole or in part) in the implementation of energy services projects. If the guaranteed savings do not materialize, the provider compensates the difference. It should be noted here that in many mature markets, it is more profitable

to involve third parties (bank or financier) in financing, since energy performance contracting provider usually requires a greater return on its capital than a bank;

3. An energy performance contracting provider has to aim at a comprehensive smart restructuring of the organizational and management structures of production and distribution processes of their business clients in order to increase their energy efficiency, competitiveness and financial sustainability.

3.3 Basic Features of Energy Services Markets

3.3.1 Structure-Functional Approach to Energy services Market Conceptual Design

The literature review results clearly show that the conceptual design of energy services markets requires study from the very beginning to clarify the structure-functional components of the market's formation and functioning.

Among the Energy services market's basic features, we will distinguish such as:

- Improving the quality of services as well as resource utilization to reduce waste and cost;
- Setting alternative and renewable energy resources;
- Using high-efficiency cogeneration, heat pumps, energy storage, district heating and cooling etc.;
- Shifting the client's load from peak to off-peak times, as well as using distributed generation and distributed consumers (aggregators, prosumers, energy cooperatives etc.);
- Choosing non-discriminatory pricing and tariffs that reflect real economic costs;
- Establishing fair competition between market participants, and independent selection of business partners.

To make the functioning of energy services market more productive, we propose to form a system of complementary markets configuration, where the energy services market is an integral part of multilevel organizational structure that ensures the efficient operation of the cause-and-effect chain of energy use from its production to end consumption. The proposed configuration of such a system of markets is shown in Fig. 4.

At the top level of the proposed configuration are markets of energy resources supplying consumers with natural gas, coal, renewable energy (RE), electricity (El), heating & cooling. To improve the results of interaction between suppliers of energy resources and consumers, we recommend that ESCOs take the lead in using a combination of core energy and energy-related services. For this, ESCOs need to organize mutually beneficial cooperation with all market participants, among which priority are consumers, energy suppliers and providers of EE/RE equipment. The latter are indicated in Fig. 4 as MT providers of energy efficient (EE) and renewable energy (RE) equipment. However, the primary task of each market participant is ensuring the effective interaction with energy consumers from public, private, municipal and other sectors of the economy, and the leading role in this belongs to energy-related services.

To formalize the interactions in such system of the markets, we propose using the mathematical sign ($\cap$) of intersection of sets in families, which allows us to correctly reflect the scale and complexity of such interactions, as well as using 'U' forms with indices denoting direct and feedback links between markets. For example, $U_{E/R}$ denotes link between core energy services market and energy-related services market.

3.3.2 Conceptual Model of Organizational Structure of Energy-Related Services Market

The organizational structure of the energy-related services market has its own specific features that distinguish it from other types of markets. The main thing is the matrix form of the structure, the proposed conceptual design of which is shown in Fig. 5, where: ESR–Energy-related Services Regulator; ESC–Energy-related Services Client; ESP–Energy-related Services Provider; ESO–Energy-related Services Object; VF–Vertical Flows and HF–Horizontal Flows of structural interactions of market participants.

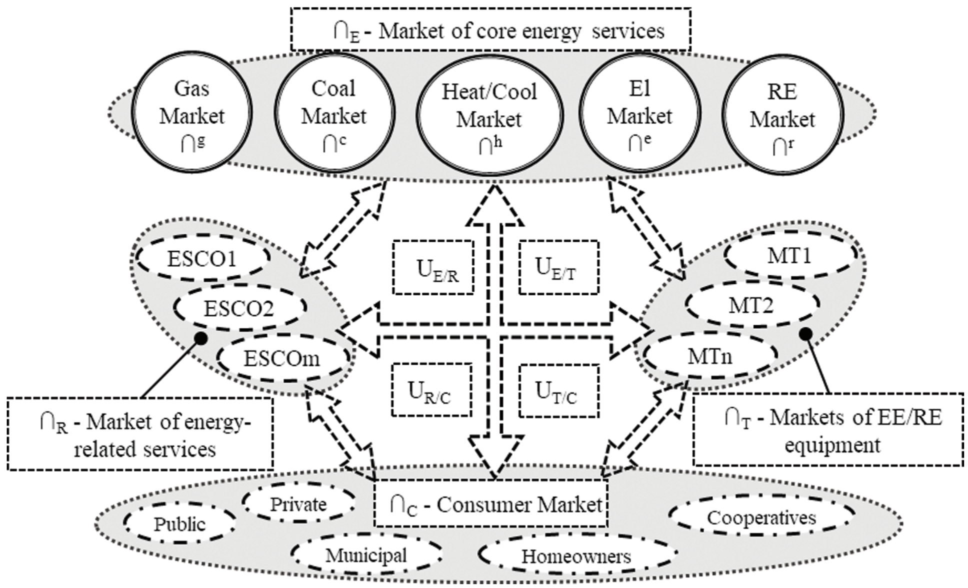

Figure 4: Configuration of the structure-functional interaction of energy services market participants

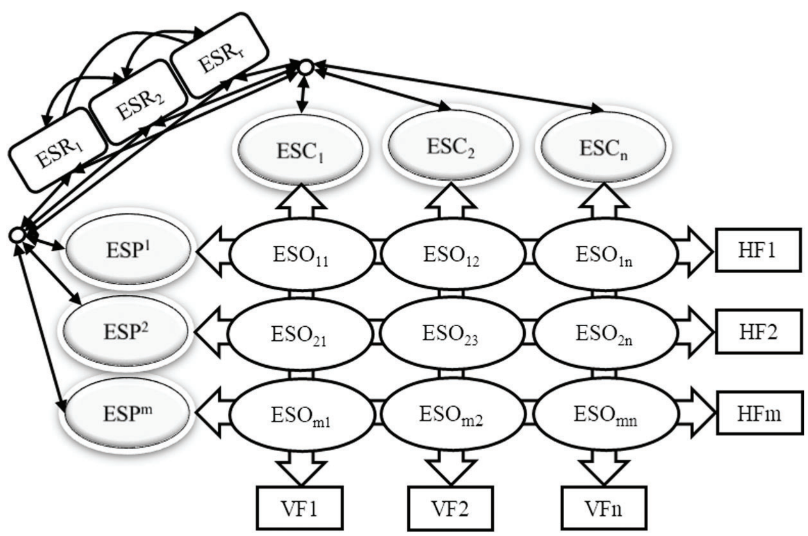

Figure 5: The matrix form of the organizational structure of the energy-related services market

It should also be noted that in the case of matrix structure, a basic organizational-and-technological module of the operational flows in the energy-related services market has a triangular structure if the ESR impacts are not considered, or a diamond-shaped structure, if these impacts are taken into account (see details in Fig. 6).

Implementation of matrix-structural interactions in the energy-related services market requires using specialized mechanisms of organizational-and-financial support aimed at strengthening and stable functioning of the market [39,40]. The proposed sequence of stages for the implementation of such a support mechanism is shown in Fig. 7.

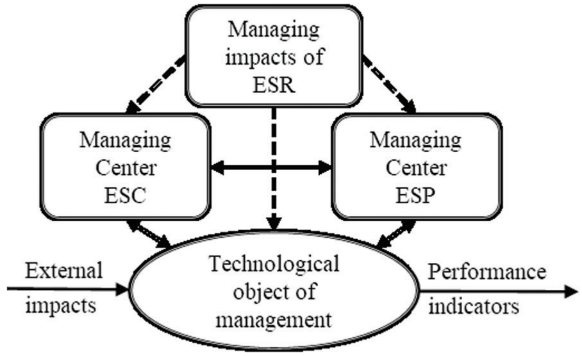

Figure 6: The basic module of the matrix structure of energy-related services market

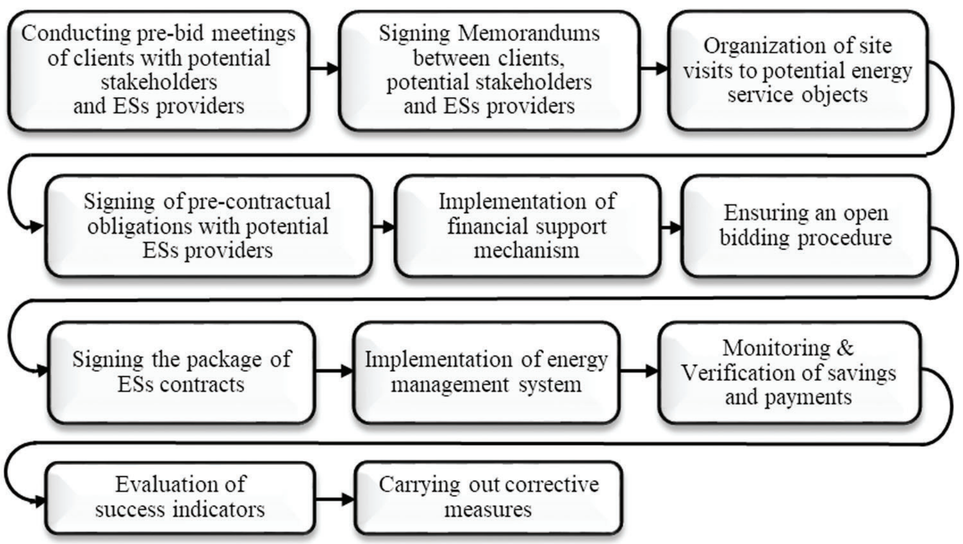

Figure 7: Flowchart of support mechanism

In a generalized form, this sequence represents a system of three main cause-and-effect units: a market of pre-contractual obligations, trading platform (auction) and a market of post-contractual obligations that form the modern energy services market.

4 Conclusions and Recommendations

1. Energy service is a fundamental instrument for putting energy efficiency and renewable energy technologies into practice. In this sense, a clear, unambiguous and transparent definition of the basic terms of the energy service is of paramount importance. Based on the results of the literature review, we recommend using the definition “energy services” given in ISO 50007:2017. In addition to this, we propose to distinguish “core energy services” from “energy-related services”, as recommended by the World Trade Organization.
2. The same requirements should apply to different types of energy-related service markets, whose definitions are now in their infancy and require fundamentally new approaches for the development of methodological, organizational, financial and technological solutions to ensure the profitability of energy efficiency and renewable energy projects in these markets.

3. Proposed structure-functional approach to energy-related services market design and the conceptual model of the market organizational structure are important initial steps in putting energy services markets into practice, where the next step in the study should be the processing and formalization of each component of the model presented in this paper.

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