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DE-RISK Project

D3.3: Analysis report on relevant smart LFMs energy services

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DE-RISK

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Abbreviations and Acronyms

BRP	Balance Responsible Party
BSP	Balancing Service Provider
CSC	Collective self-consumption
D	Deliverable
DLT	Distributed Ledger Technology
DoA	Description of the Action
DSO	Distribution System Operator
DR	Demand Response
EC	European Commission
EE	Energy Efficiency
EED	Energy Efficiency Directive
EMS	Energy Management System
EPC	Energy Performance Contracting
ESC	Energy Supply Contracting
ESCO	Energy Service Company
ESM	Energy Saving Measure
EU	European Union
EV	Electric Vehicle
GA	Grant Agreement
HVAC	Heating, Ventilation, and Air Conditioning
IEMD	Internal Electricity Market Directive
IoT	Internet of Things
LFM	Local Flexibility Market
M	Month
M&V	Measurement and Verification
PPA	Power Purchase Agreement
PV	Photovoltaics
P2P	Peer-to-peer
P4P	Pay for Performance
REDII	Renewable Energy Directive
RES	Renewable Energy Source
T	Task
TSO	Transmission System Operator
WP	Work Package

EXECUTIVE SUMMARY

This report contains the deliverable ***D3.3: Analysis report on relevant smart LFMs energy services*** of the Horizon Europe project DE-RISK — *DE-RISK the adoption of Local Flexibility Markets to unlock the safe and reliable mass deployment of Renewable Energy Systems* (funded under Grant Agreement No. 101075515), showing the results obtained from the task *T3.3: Analysis of Innovative Energy Services in the EU and participating countries, and mapping into relevant services for LFMs* (M3-M18), led by R2M. All the Consortium partners have participated in this task.

The aim of this deliverable is to provide a detailed analysis of both existing and innovative energy services available in the EU and specifically in DE-RISK's participating countries (i.e., Spain, Greece, Portugal, Ireland, Bulgaria, France and Turkey), and their potential to match services that can be provided within LFMs, or by LFMs to the grid. Relevant information has been obtained throughout a questionnaire sent out to the project's partners to gather data from their respective countries, as well as various interviews and meetings. The responses of the partners have highlighted how some energy services are more rooted than others within the regulatory framework of each country, and how the most advanced services are not yet fully deployed in some of the countries, due to a lack of enabling regulations.

1. INTRODUCTION

1.1. Overview of the DE-RISK project

DE-RISK, whose acronym stands for *"DE-RISK the adoption of Local Flexibility Markets to unlock the safe and reliable mass deployment of Renewable Energy Systems"* is a project funded by the EU's Horizon Europe programme under the Grant Agreement nº 101075515.

DE-RISK aims to support the market uptake of Renewable Energy Systems (RES) by fostering the adoption of Local Flexibility Markets (LFMs) and unlocking up to 100 GW of flexibility in 2030 which will allow a safe and reliable integration of RES in the grid. DE-RISK will achieve this ambitious objective by minimising the investments and implementation risk through an innovative consumer behaviour change journey that will increase end-users' trust and willingness to participate in the LFMs.

1.2. Description of the deliverable content, objectives and purpose

The objective of this deliverable is to deepen the knowledge on both existing traditional and innovative energy services across different EU and non-EU countries participating in DE-RISK, and their mapping into relevant smart energy services for LFMs, which can both be provided to the LFMs' participants (e.g., peer-to-peer trading, collective self-consumption, etc.) or by the LFMs to the grid (e.g., congestion management, frequency control, voltage control, etc.), and customised to different end-user types and different social and legislative frameworks.

The analysis aims to understand how the services should be customised to maximise the sustainability of LFMs under different business models. This therefore report presents:

➔ an analysis of existing types of local flexibility services and the benefits they can provide (energy and non-energy related);

➔ an investigation of the requirements to provide innovative local flexibility energy services under the different regulations of the EU Member States (and associated countries);

➔ an analysis of the potential barriers that limit the profitability, sustainability and impact of specific services under different legislative frameworks.

1.3. Relation to other activities

The information gathered during the analysis presented in this report (D3.3) complements the outcomes of the PESTLE analysis (T3.1) and the Regulatory Impact Analysis (T3.2), and it will be used to provide the full range of possibilities to the DE-RISK project's case studies under the engagement activities (T4.3), to feed the development of policy recommendations (T3.5) in order to enable policy-makers to create better boundary conditions for LFMs. The analysis of relevant smart energy services for LFMs, together with the market & stakeholder analysis performed in T5.1, will help understand how these services should be customised to to maximise the sustainability of LFMs under different business models (T5.3).

2. METHODOLOGY

This section details the methodology used by R2M (task leader) for carrying out the analysis of the energy services available in DE-RISK's participating countries, and their relevance to be provided within the frame of LFMs.

A **questionnaire** was prepared by R2M and shared with all the project's partners in order to collect country-specific information and subsequently assess the effective application and penetration of different energy services within various EU and non-EU countries (i.e., Spain, Greece, Portugal, Ireland, Bulgaria, France and Turkey).

The DE-RISK's partners were required to fill in the questionnaire with information respective to their own countries. Clarification meetings/interviews with the partners were conducted, when needed, to solve any doubts about the gathered data. The information collected in the questionnaire concerned the following categories:

- ➔ State-of-the-art of energy services: description of the application of the services in their respective countries.
- ➔ Investigation of the different requirements to provide energy services under the national regulations: list and description of regulatory, technical, social or other requirements.
- ➔ Main barriers to the provision of energy services: list and description of the technical, social, economic or other obstacles that make the application of the services complex in their specific national context.
- ➔ Best practices of energy services related to LFMs: description of any virtuous applications of the services (success stories) that support the successful operation of LFMs.

3. ENERGY SERVICES

What are 'energy services'?

'Energy service' is defined in the Energy Efficiency Directive[1] as "the physical benefit, utility or good derived from a combination of energy with energy-efficient technology or with action, which may include the operations, maintenance and control necessary to deliver the service, which is delivered on the basis of a contract and in normal circumstances has proven to result in verifiable and measurable or estimable energy efficiency improvement or primary energy savings."

An **'energy service provider'** or Energy Service Company (ESCO) is "a natural or legal person who delivers energy services or other energy efficiency improvement measures in a final customer's facility or premises."

The energy services' market across Europe has had several key developments, in terms of EU-level legislation, in the past 10 years.[2] However, implementation and maturity of energy services still vary greatly from country to country.

In the questionnaire, the DE-RISK's partners were asked to indicate if the energy services presented in the following sections are available in their countries and, in that case, describe how these services are provided and which actors are involved. The partners were also able to include information about any additional services (not listed hereinafter) available in their respective countries.

3.1. Energy Supply Contracting

Energy Supply Contracting (ESC) is a business model based on the provision of useful energy (e.g., electricity, heating, cooling, etc.) to a customer (e.g., industrial/commercial/residential building owners, managers and/or users) under a short-term or usually a long-term contract (e.g., 10-15 years). This service – as its name implies – focuses on supplying efficient energy (from either renewable or non-renewable sources) to new and existing buildings. The ESCO is responsible for the entire energy supply system, including planning, financing, installation, operation, maintenance and upgrading of the necessary equipment, as well as the purchase of energy from the producer(s) and its delivery to the consumer(s). The advantages of this form of contracting are optimised operation costs and security of energy supply, in addition

[1] Directive 2012/27/EU on energy efficiency. http://data.europa.eu/eli/dir/2012/27/oj
[2] BPIE. (2020). Energy Services and the Renovation Wave: Opportunities for a Green Economic Recovery in Europe. www.bpie.eu/publication/energy-services-and-the-renovation-wave/

to energy savings on the supply side. The ESC model encourages ESCOs to enhance energy conversion efficiency and reduce primary energy demand (e.g., promoting the uptake of RES technologies if cost-effective), as their remuneration is based on the useful energy output delivered. Each European country has different ways of regulating energy supply contracts. For example, there is the possibility of differentiating the price of energy according to the time of consumption (e.g., tariff range) or according to the origin of the energy (e.g., fossil fuels vs RES).

3.2. Energy Performance Contracting

The Energy Efficiency Directive 2012/27/EU defines Energy Performance Contracting (EPC) as a contractual arrangement between a beneficiary (e.g., building owner) and a provider of an energy efficiency (EE) improvement measure (e.g., ESCO or technology provider), verified and monitored during the whole term of the contract, where investments (i.e., work, supply or service) in that measure are paid for in relation to the agreed level of EE improvement or other agreed energy performance criterion, such as financial savings. EPC is one of the main mechanisms to deliver energy savings with third-party financing, addressing the barrier of high upfront investment costs for building renovations.[3] Under an EPC, the ESCO implements an EE project to deliver energy savings, or a renewable energy project, and uses the stream of income from the energy cost reduction, or the renewable energy produced, to repay the whole or part of the costs of the project, including the initial investment. If the project does not achieve the agreed savings, the ESCO will not get paid. This transfers the technical and operational risks from the end-user to the ESCO, as the ESCO is held accountable for its initially determined performance guarantee. Thus, while the ESC model focuses on energy supply costs reduction, the EPC model focuses on achieving verifiable energy savings (on the demand-side) over the contract term.

An active EPC model, which incorporates demand-side response (DR) into the contracting process, adds transparency to the risk sharing of EPC projects. Active-EPCs enable adjusting the use or operation of certain building assets (e.g., running appliances at off-peak hours) or onsite renewable energy production in order to achieve further energy and cost savings. This DR process can be manual or automatic, aided by smart meters and Energy Management Systems (EMS). Therefore, active-EPCs can provide benefits such as reduced investment in peak generation, reduced emissions, and improved transparency in energy usage figures.[4]

[3] Joint Research Centre.(JRC). 2019. Energy Service Market in the EU. https://dx.doi.org/10.2760/768
[4] BPIE. (2020). Energy Services and the Renovation Wave: Opportunities for a Green Economic Recovery in Europe. www.bpie.eu/publication/energy-services-and-the-renovation-wave/

3.3. Power Purchase Agreement

A Power Purchase Agreement (PPA) is a long-term contract (i.e., 10-15 years) between two parties: a (green) electricity producer and an offtaker (a.k.a. buyer) of this electricity, such as an electricity consumer or trader. A PPA should include all the terms of the agreement, such as the amount of electricity to be supplied, the negotiated price, who bears what risks, the required accounting, and the penalties if the contract is not honoured. PPAs are usually aimed at financing the deployment of RES while providing the buyer with a stable electricity supply at a predictable price. Therefore, PPAs partially remove the risk of fluctuations in the electricity price due to market volatility, which is desirable for large, debt-financed projects. PPAs can significantly contribute to the deployment of RES projects, aiding in energy security and emission reduction goals within the EU. As a bilateral agreement, a PPA can be adapted to the wishes of both parties involved, so the contractual arrangement can take many forms (e.g., corporate, municipal, community, retail, utility or financing PPAs), catering to different needs and scenarios. Also, PPAs can be based on the physical (i.e., direct supply) or virtual (i.e., though financial settlements) delivery of electricity, and allow for various configurations like on-site PPAs, which involve the direct physical supply of electricity from a generation plant (i.e., PV installation) located behind the consumer's metering point, or off-site PPAs, in which the generated electricity is delivered via the public grid. The guarantees of origin are usually transferred to the customer.[5,6]

PPAs allow ESCOs to make an investment decision using the criteria of profitability versus risk, and achieve the funding necessary to execute RES projects. By reducing the risk of price fluctuations, RES projects (especially those with high investment costs and low operational costs, such as PV installations) can get off the ground earlier and become profitable thanks to the constant payment for delivered electricity established in the PPA contract, ensuring the recovery of the investment costs. The main benefit for the consumer(s) is a clean supply of energy, which can be traced from a specific asset, at a stable and predictable price. Also, the openness of the PPA contract design creates a lot of flexibility to take into account the individual preferences of both the power plant operators and the consumers, but this can make PPAs complex contracts which often require a lot of time to agree on the terms.

In recent years, there has been an evident growth in the number of PPAs in most European countries, with variations depending on market maturity.

[5] Eurelectric. What are Power Purchasing Agreements (PPAs)? www.eurelectric.org/in-detail/ppas
[6] Next Kraftwerke. What is a Power Purchase Agreement (PPA)? www.next-kraftwerke.be/knowledge-hub/ppa-power-purchase-agreement

3.4. Pay for Performance (P4P) scheme

Pay for Performance (P4P) schemes represent an innovative approach to financing energy efficiency projects within the EU. These schemes operate on the principle that payments for EE improvements should directly relate to the performance of those measures. Advanced measurement methods and tools are used to quantify the actual energy savings achieved by the implemented EE measures. The organisational framework of P4P schemes is comparable to that of EPC models, which are prominent in the public sector (i.e., hospitals, universities, etc.) and to a lesser degree in the private sector (i.e., industrial and commercial buildings) but have had limited testing in residential structures. Using an aggregator approach, P4P schemes are being tested in real-world small and medium businesses and residential homes, and extensive property portfolios.[7]

P4P models facilitate investments in building retrofits by improving existing EE programmes, enabling the aggregation of buildings into larger portfolios for financing, and leveraging demand-side resources as a service to the power grid. P4P schemes aim to shift the risk of underperformance to the private sector, ensuring quality work and real energy savings. They offer periodic payments proportional to metered energy savings, therefore providing a more accurate, performance-based financial flow for building retrofits. Moreover, these schemes are recognized as a transformative enabler for the energy market, offering a path to include energy efficiency as a demand-side energy resource. This helps in quantifying and rewarding energy demand reductions which could be utilised as non-wires alternatives to extending capacity to meet demand.[8]

P4P models have yet to be implemented in the EU, despite the potential advantages they would provide. The EC has highlighted the potential of P4P schemes, encouraging Member States to explore such performance-based programmes to enable new business models that make energy efficiency initiatives marketable investments. This has the potential to leverage private finance, which would increase the pace of building renovations across the EU. The aim is to create novel transaction models that allow EE improvements to provide value via: i) financial incentives that encourage building owners to use energy-saving solutions that also benefit the electrical grid; ii) positively impacting peak capacity needs and ramping reserves as capacity methods that compensate EE to decrease power consumption indefinitely; iii) eliminating the risk of paying for potential energy savings that never materialise.

[7] Santini, M. et al. (2022). Pioneering a performance-based future for energy efficiency: Lessons learnt from a comparative review analysis of pay-for-performance programmes. Renewable and Sustainable Energy Reviews, vol. 158, p. 112162. https://doi.org/10.1016/j.rser.2022.112162

[8] SENSEI H2020 project. Final Conference (2024). Pay-for-performance to drive energy efficiency financing in Europe – how innovative business models can support achieving the EU climate and energy goals.

3.5. Energy consultation (e.g., energy audit)

Energy consultation, particularly through energy audits, is a critical service available across EU countries aimed at enhancing energy efficiency within organisations. In fact, the Energy Efficiency Directive[9] mandates that energy audits must be performed (every four years) by all large companies in the EU (with more than 250 employees or with turnover exceeding 50M€ or balance sheets over 43M€), underscoring the importance of identifying and implementing Energy Saving Measures (ESMs) to achieve the EU Green Deal targets.

An energy audit is a thorough examination, usually conducted by a certified energy auditor, of energy use and energy flows within a building, process or system in order to identify ways to reduce the amount of energy input without negatively affecting the output. An audit aims to identify energy-saving opportunities, evaluate energy usage, and recommend measures to enhance energy efficiency. The ultimate goal is to understand how energy is used and to find ways to make energy consumption more efficient, ultimately leading to cost savings and reduced environmental impact (e.g., carbon footprint).

Energy audits are pivotal for the systematic review of energy consumption profiles, enabling building managers to better understand their energy use, identify energy (cost) savings potentials, and assess these from a commercial perspective.

3.6. Energy Management System

An Energy Management System (EMS) is defined in the ISO 50001 standard[10] as a framework that establishes procedures for systematically monitoring, analysing and improving energy performance within a building. An EMS encompasses defining and implementing an energy strategy, establishing energy consumption targets that are attainable, designing action plans to achieve them, and tracking progress toward achieving the targets. In order to cut down on energy costs, some potential solutions include introducing innovative equipment that is more energy-efficient, cutting down on energy waste, or improving existing operations.

The term Energy Management System is also used to refer to computer-based systems that measure energy consumption and look for areas where it might be able to improve energy efficiency. Such an EMS can be used to centrally monitor device-level equipment (e.g., HVAC unit, lighting system, etc.) within a building or several buildings, providing building managers with an overall picture and hence allowing them to make more informed decisions about

[9] Directive 2012/27/EU on energy efficiency. http://data.europa.eu/eli/dir/2012/27/oj
[10] ISO 50001 - Energy management. https://www.iso.org/iso-50001-energy-management.html

their energy usage in order to reduce their (energy) costs and environmental impact. The EC aims to support the roll-out of EMSs in large buildings, especially those still being supplied by fossil fuels, in order to enable better control of their energy flows. This will save energy in the short term, while facilitating the switch to RES as soon as possible. ESCOs can provide EMSs as a service to real estate portfolio owners and managers.

3.7. Project design, implementation and maintenance

Project design, implementation, and maintenance, in the context of energy services, involve developing, executing, and upkeeping energy-efficiency projects tailored to optimise energy use within buildings. This service typically includes an initial energy audit, conceptualising potential energy-saving measures, deploying these measures, and ongoing management to ensure sustained energy performance improvements. Service providers (ESCOs) should work closely with the building manager(s) in order to identify energy-saving opportunities, design systems or processes to capitalise on these opportunities, and then maintain these systems to ensure they continue delivering benefits over time.

A correct project design can allow stakeholders to predict the future energy performance of buildings (both at individual and neighbourhood level) and make better informed decisions for optimal energy performance throughout the whole life cycle of the building(s), including operation and maintenance. It can also help determine the necessary services to maintain good conditions of occupants' comfort, health and satisfaction in buildings, in compliance with the applicable laws on the rational use of energy, safety and environmental protection, while providing energy & cost reductions.

3.8. Metering & monitoring services

Energy metering and monitoring services involve the installation and use of smart tools and technologies to track and analyse energy consumption and performance within a building. A combination of both hardware and software components allow to gather data and turn it into useful and actionable information about the overall facility and its equipment/devices. On the one hand, the hardware component is installed in the field and is represented by the energy meters, which can be more or less advanced, depending on their communication protocol, the measurements taken, the presence of internal memory, and the continuity of operation. On the other hand, the software component collects data and makes it usable by users, through the development of graphs or reports that can be standard or use advanced analytical algorithms. New generation residential smart meters allow every user to read in real time their energy consumption on the internet or on smartphone apps, enabling them to gain insights into their energy use patterns, identify inefficiencies and make data-driven decisions to enhance energy efficiency and reduce costs.

By implementing advanced (sub-)metering infrastructure and monitoring systems, ESCOs can help their customers to continuously measure their energy consumption and performance, leading to verifiable and measurable improvements in energy efficiency and primary energy savings across different EU countries. Also, for instance, energy monitoring is fundamental to implement an Energy Management System or to evaluate the benefit of an energy efficiency investment.

3.9. Smart contracts

Smart contracts are self-executable contracts in which the terms of the agreement between the involved parties (e.g., the buyer and the seller) are being directly, automatically written into lines of code via Distributed Ledger Technology (DLT), like blockchain. DLT underpins smart contracts by providing a secure, transparent and tamper-proof platform that is able to monitor and change the ledger according to user-defined rules. They can be triggered when certain pre-set conditions are met and can automatically execute and control transactions, utilising computer hardware to process data, verify conditions, deal with negotiations and validate a contract. These transactions' records are traceable, irreversible and transparent, hence eliminating the need for an intermediary. Thus, DLT holds the potential to automate and accelerate automated negotiations and contracting between parties.[11]

In the context of the transition to decentralised energy systems, the potential of DLT-enabled smart contracts for the energy sector is being increasingly recognised.[12] Energy systems are undergoing major changes to accommodate the increasing amount of RES, as well as new types of decentralised loads (e.g., EVs). The higher volume of small-scale RES (i.e., due to the increasing number of prosumers actively engaging in energy trading or initiatives for energy autonomy and self-sufficiency) is affecting the operation of national and local electric grids, as it increases the risk of imbalances and local voltage excursions. Furthermore, small-scale decentralised generation assets (which could offer the grid the flexibility it needs) are often too small to participate in energy or ancillary services markets, unless aggregated. Therefore, there is a need for innovative solutions that enable reliable and tamper-proof data exchange in order to support the deployment of new local-level management and distributed control

[11] IEEE Blockchain. Smart Contracts and Energy: How Blockchain Smart Contracts Can Improve the Energy Sector.
[12] Kirli, D, et al. (2022). Smart contracts in energy systems: A systematic review of fundamental approaches and implementations. Ren. & Sust. Energy Reviews, Vol. 158, 112013. https://doi.org/10.1016/j.rser.2021.112013.

techniques. Smart contracts, along with DLT, offer a solution to these challenges. Thanks to their self-executing and customisable nature, they are seen as a key technology for enabling the transition to a more efficient, transparent and transactive energy market that is able to coordinate and take advantage of the vast amount of small decentralised energy assets.

Applications of smart contracting in the energy sector can be categorised into two streams: i) energy and flexibility trading, including coordination of smart EV charging, peak shaving, load shifting, automated demand-side response, peer-to-peer energy trading, etc.; and ii) allocation of the control duties amongst the distribution network operators. Smart contracts facilitate the buying, selling, and distribution of locally produced renewable energy and the management of grid flexibility, enabling decentralised and automated transactions between energy producers, service providers (ESCOs), consumers/prosumers and grid operators. By automatically enforcing and executing the terms of an agreement based on data inputs (e.g., energy production, energy consumption, energy savings achieved, etc.), smart contracts enable participants to transact without intermediaries; saving time, reducing costs and risks of human errors; enhancing efficiency, transparency and trust in local energy markets and associated services; and optimising energy distribution based on real-time data.

Nevertheless, despite its significant potential, smart contracting (enabled by blockchain or distributed ledgers) is still a developing technology and its use in the energy sector is still in its early stages as there are several open challenges associated with its implementation and scale-up, such as security vulnerabilities and threats, privacy concerns, as well as financial and environmental costs of deploying smart contracts (whether they concern money, energy or flexibility commitments).

3.10. Energy optimisation (at household, building and/or community level)

Energy optimisation services focus on ensuring an energy-efficient operation of a household, a building or even a community, thereby increasing energy savings, while maintaining certain requirements (e.g., users' comfort and satisfaction). These services involve analysing energy usage patterns (i..e., through energy modelling), identifying inefficiencies, and implementing solutions like upgrading to energy-efficient appliances, improving insulation, and integrating RES and storage. The goal is to enhance the overall energy performance, lower energy costs, and reduce carbon footprint. At the household level, these services involve energy audits, EE retrofitting, and smart home systems for monitoring & managing energy use. For buildings, they include upgrading HVAC systems, optimising lighting, and installing EMSs to monitor & control energy flows. Community-level services focus on integrating RES, district heating and cooling systems, and developing smart grids to manage energy distribution efficiently. In the particular context of LFMs, optimisation services involve managing & optimising local energy production (leveraging collective energy resources, often RES), storage, and consumption to match demand with supply more effectively, achieve greater energy self-sufficiency, reduce costs, and contribute to the overall stability of the broader electricity grid.

For the provision of energy modelling and optimisation services, ESCOs usually make use of software tools to simulate and analyse the energy performance of households, buildings or communities under various conditions, taking into account different factors (e.g., climate, building materials, energy systems) to predict energy consumption and identify potential improvements. Optimisation algorithms can evaluate multiple scenarios in order to find the most effective strategies for reducing energy use and costs, while complying with the users' requirements (e.g., maintaining or improving their comfort levels). This helps, for instance, in planning retrofit projects, designing new buildings, or managing community energy systems for better sustainability and resilience. Optimisation algorithms can also analyse parameters such as variable energy prices and forecasted usage of flexible/dispatchable energy assets to depict the best way to manage local energy production, consumption and storage in order to optimise not only the energy performance (within the household, building or community) but also the provision of flexibility to the grid.

3.11. Time-of-Use tariffs and peak shaving

Time-of-Use (ToU) tariffs and peak shaving strategies are services aimed at optimising energy consumption patterns to lessen the strain on the electric grid during peak demand periods, by reducing energy consumption during those times and potentially lowering energy costs. Both strategies require energy metering, monitoring and management systems in order to adjust energy usage effectively, but they employ different mechanisms and incentives.

A ToU tariff is a time-based billing structure under which the rate charged per unit of electric energy consumed can vary depending on the time of the day in which it is being consumed. Through differential pricing, ToU incentivises end-users to adjust their energy behaviour by shifting their energy usage from peak (expensive) periods to off-peak (cheaper) periods. ToU tariffs are already prevalent in several EU countries, typically by different day/night rates or seasonal rates, and also varying according to specific hours of the day. The different rates are set in advance and the higher rate is intended to coincide with the period of higher pressure on the grid, with the aim of mitigating congestion problems. ToU tariffs need to be properly designed, as they can unintendedly create new peaks when the lower rate applies.

While ToU tariffs aim to redistribute energy demand from peak to off-peak times (a.k.a. load shifting), peak shaving strategies aim to “cut off” the top of the demand peaks (a.k.a. load shedding). Peak shaving hence reduces overall energy demand during peak periods (without necessarily shifting it to another time) and, thus, also reduces associated energy costs. Peak shaving lessens the demand from the electric grid during traditionally high-use periods, usually through energy storage or on-site generation, to alleviate grid pressure and reduce the need for additional peak capacity.

ESCOs can provide different services to their customers in order to help them benefit from existing incentives. For instance, ESCOs can implement Energy Management Systems as well as smart technologies to automatically adjust the end-users’ energy consumption patterns in response to ToU tariffs, effectively managing their energy demand and costs; or advise on the adoption of energy efficiency measures and RES & storage technologies to contribute to peak shaving.

3.12. Predictive building management

Predictive building management leverages the latest advancements in technology and data analytics to improve building operations. Two types of services can be delivered in buildings: i) predictive maintenance, focused on preventing potential failures; and ii) optimal operation management, enabling buildings to not only consume energy more efficiently, reduce energy costs and minimise associated GHG emissions but also interact intelligently with the grid.

Predictive maintenance is a proactive equipment maintenance strategy that involves the use of advanced data models, analytics, artificial intelligence and machine learning algorithms to analyse data collected from building systems and reliably predict when and where failures are most likely to occur. Predictive maintenance relies on continuous real-time monitoring of equipment conditions during normal operation to identify potential issues and address them before they result in failure, therefore enabling facility managers to take preventive actions and perform maintenance tasks at the optimal time. Implementing predictive maintenance has numerous benefits, such as reducing downtime and maintenance costs, extending the lifespan of building systems and machinery, minimising disruptions to facility operations, and also improving building performance and energy efficiency. By proactively addressing issues based on data-driven predictions, building managers can optimise the efficiency, reliability, and safety of their facilities, ultimately enhancing the occupants’ overall experience.[13,14]

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[13] Buildings IoT. What is predictive maintenance in buildings?
[14] Neuroject. Predictive Maintenance in Buildings; Ultimate Guide 2024.

In the context of smart buildings, characterised by their ability to integrate and analyse data from various sources, including IoT devices; predictive maintenance can leverage historical and real-time data from different building systems and components (i.e., HVAC, lighting, RES, storage, EVs, etc.) to gain insights into their condition and energy performance, and identify opportunities for optimisation and energy savings. Smart buildings utilise innovative smart technologies that enable interactions between the building, its occupants, and the energy grid with the goal of optimising local energy production and consumption, while enhancing the occupants' comfort and contributing to the grid security and stability.[15] Model Predictive Control (MPC) technology has significantly propelled the efficiency of smart buildings, using the computational power of building automation systems and monitored data to optimise energy management.[16] The deployment of advanced IoT sensors in buildings plays a pivotal role, providing a comprehensive monitoring and predictive analysis framework, essential for the effective management of smart buildings.

3.13. Peer-to-peer (P2P) trading

Peer-to-peer (P2P) energy trading is a business model based on an interconnected platform, serving as an online marketplace, where producers and consumers can trade energy directly, without the need for an intermediary. P2P trading allows local distributed energy generators to sell their electricity at the desired price to consumers willing to pay that price. The P2P model aims to make RES more accessible, empowering prosumers and consumers to take an active role in the energy market, thus leading to increased flexibility in the grid. P2P trading platforms help grid operators in balancing and congestion management by lowering reserve requirements, providing ancillary services and reducing peak demand, while saving citizens' money on their electric bills.[17,18,19]

The P2P trading model emerged as a result of the ever-increasing deployment of distributed energy resources connected to distribution networks, and the intention to provide more incentives to promote further deployment of these resources. This model allows prosumers to switch their roles to either purchase or sell electricity. This electricity is transacted (like an open market economy) between users of the P2P platform (buyers and sellers), who become members of the platform by, for example, paying a monthly subscription fee.

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[15] https://build-up.ec.europa.eu/en/resources-and-tools/articles/overview-smart-buildings-and-smart-grids

[16] Zabala, L., et al. (2023). Model predictive control with self-learning capability for automated demand response in buildings. Proceedings of ECOS 2023. https://doi.org/10.52202/069564-0293.

[17] IRENA. (2020). Innovation landscape brief: Peer-to-peer electricity trading.

[18] BABLE Smart cities. Peer to Peer Energy Trading.

[19] CORDIS. (2020). SHAR-Q project: New platform facilitates peer-to-peer energy trading and sharing.

In contrast to traditional power supply, in which consumers purchase electricity from utilities or retailers through fixed tariffs or ToU tariffs, prosumers (who produce as well as consume) sell excessive electricity back to the grid at a “buy-back rate”. Electricity consumption tariffs are generally higher than the buy-back rates that prosumers can obtain. Through P2P trading platforms, prosumers are able to directly trade electricity with other consumers to achieve a win-win. Trading power locally eliminates most transmission costs and allows prosumers to sell electricity at a greater profit than if it were sold back to the grid. Also, by limiting the involvement of intermediaries (i.e., utilities or retailers) in transactions, P2P models enable buyers to save costs and sellers to make a greater profit. They also empower customers to choose where their electricity is sourced from.

A P2P electricity trading model can be established, for instance, among neighbours within a local community, as well as on a larger scale, among various communities. This is enabled by interconnected networks owned by DSOs. The size and number of participants involved are important, as P2P platforms are only viable when there are enough participants willing to trade electricity with each other. If the participants are part of the main distribution system, the ESCO acting as the P2P platform (market) operator will need to interact both with the DSOs and the electricity market in order to provide its service (organising trading among the members of the platform). This is because power flow between the participants will affect the local distribution network, which needs to be operated, maintained and remunerated accordingly; and it will need to buy/sell excess demand/generation upstream. On the other hand, if the P2P platform operates based on an isolated mini-grid, then the ESCO managing the P2P platform will need to ensure that supply and demand are balanced at all times to maintain grid stability (thus fulfilling the system operator role).

Therefore, P2P energy trading represents an innovative approach to energy production and distribution at the local level, allowing for a more decentralised, efficient and sustainable energy system that empowers prosumers to generate their own renewable energy and share or sell excess energy directly to other peers within a local network or community, bypassing traditional centralised energy providers. Market participants can directly negotiate with each other to buy and sell electricity, potentially using smart contracts to facilitate trading. There are various models for implementing P2P trading, including fully decentralised markets, community-based markets and hybrid markets, each with different levels of independence from the grid. Despite its potential, the market for P2P energy trading is still developing and faces challenges, particularly regarding regulatory hurdles. Nevertheless, some EU countries have begun to establish more supportive regulations to facilitate P2P electricity exchanges. Significant R&D efforts to develop reliable platforms and the emergence of start-ups in the last decade indicate growing interest and potential for scalability.

3.14. Collective self-consumption

According to the EU Directives 2019/944 on the internal market for electricity (IEMD)[20] and 2018/2001 on the promotion of the use of energy from RES (REDII),[21] citizens are allowed to produce renewable electricity for own consumption, store and sell the excess of production, empowering them to play an active role in the electricity market either by acting individually as single self-consumer or prosumer (who feeds the self-produced surplus of electricity into the public grid) or, conversely, by organising production and consumption with other users, through innovative collective schemes, with the purpose of distributing (in a given manner) the economic benefits gained from feeding the energy surplus in the public grid. The IEMD and REDII define "collective self-consumption schemes" (CSC), which are innovative market configurations that allow a group of citizens to cooperate in local electricity production for their own consumption by using the public distribution grid, since they are connected via the same voltage electric substation, thus being located into a restricted area of the public grid (in the same building, multi-apartment block or, where permitted by the national regulatory framework, within other premises). This phenomenon reflects what is assumed to happen when supply meets demand within the public network on a virtual metering dimension, as it is not possible to actually track, on a real basis, electricity flows and exchanges among users. Generally, no charges or fees should be applied to self-produced electricity remaining within the premises of the self-consumers. Also, no double charge (incl. network charges) should be applied to electricity storage. For electricity fed into the grid, self-consumers should receive remuneration, which reflects the market value of that electricity and may take into account its long-term value to the grid, the environment and society.[22,23]

CSC schemes allow members within the same area, such as a building or neighbourhood, to collectively consume the renewable energy they produce locally, rather than relying solely on the traditional, central grid. This approach not only fosters local energy independence but also promotes the deployment of decentralised RES and enhances community cohesion. CSC schemes help to lower the cost of investing in RES (e.g., PV panels), as the investment costs (as well as the benefits) are shared among several users, thus enabling access to affordable RES for all consumer categories, especially for low-income households. Another advantage is the possibility of locating the RES installations in shared spaces.

[20] Directive 2019/944 on common rules for the internal market for electricity. data.europa.eu/eli/dir/2019/944/oj.
[21] Directive 2018/2001 on the promotion of the use of energy from RES. data.europa.eu/eli/dir/2018/2001/oj.
[22] Giarmanà, E. (2023). Managing renewable electricity within collective self-consumption schemes: A systematic private law approach. Ren. & Sust. Energy Reviews, Vol. 188, 113896. https://doi.org/10.1016/j.rser.2023.113896.
[23] Frieden, D., et al. (2020). Collective self-consumption and energy communities: Trends and challenges in the transposition of the EU framework. http://dx.doi.org/10.13140/RG.2.2.25685.04321.

Collective self-consumption plays a pivotal role in and is one of the most frequent business models for Energy Communities, which are legal entities involving citizens, small businesses and local authorities that are entitled and empowered to jointly produce, manage, store and consume their own energy. The model of an energy community can vary significantly based on its type (i.e., Renewable or Citizen Energy Communities), its location (i.e., high influence of national regulations), the actors involved, and the specific energy services provided.[24]

The CSC model is especially relevant for rooftop solar PV systems, which traditionally aim to consume most of the generated electricity onsite and then export any surplus to the grid at a relatively low price. With CSC, this surplus electricity can be sold to neighbouring buildings, offering financial benefits to both the PV system owner and the neighbours. The CSC model allows for the installation of larger PV systems, using more roof space, which in turn reduces costs through economies of scale and increases revenue by generating more electricity.[25]

The EU has been proactive in establishing a supportive regulatory framework for CSC and energy communities through the Clean Energy for All Europeans package, including both the IEMD and the REDII. While specifics vary by country, national regulations across the EU have generally further facilitated the adoption of CSC schemes. Some EU countries (e.g., Spain, France, etc.) have introduced financial incentives, such as subsidies and reduced taxes, for the participation in collective self-consumption of RES.

3.15. Congestion management

Congestion occurs when a particular area of the grid is overloaded due to excessive power flow, which overwhelms the available transmission or distribution capacity. Congestion can lead to various problems, such as inflated operational costs, heightened GHG emissions due to inefficiency and the threat of widespread blackouts. Consequently, considering the rapidly evolving energy landscape, preventing the risks and costs of congestion is critical.[26]

Congestion management is aimed at ensuring the stability and reliability of the electric grid amid rising demand and fluctuating RES production, without the need of reinforcing the grid with more transformers and higher-capacity cables to solve the bottlenecks. It is a strategic approach designed to steer either the supply or the demand during peak periods, when the grid's capacity reaches its limit.

[24] European Commission. DG-ENER. (2022). In focus: Energy communities to transform the EU's energy system.
[25] Syzygy Consulting. (2024). Collective Self-Consumption: The Key to Unlocking Rooftop Solar's Full Potential.
[26] WithTheGrid. (2021). What is congestion management?

The Capacity Allocation and Congestion Management (CACM) regulation[27] defines detailed guidelines on cross-zonal capacity allocation and congestion management in day-ahead and intraday markets. This is crucial for establishing harmonised rules for capacity calculation, trading of electricity, and ensuring efficient utilisation of the grid across the EU.

Grid operators can employ diverse strategies to efficiently manage congestion and maintain the smooth flow of electricity within the grid, notably: i) Redispatching power generation or consumption to alleviate the strain on the grid. In this case, Congestion Management Service Providers (e.g., generators or large consumers) adjust their electricity feed-in or take-off to ease the grid overload, in communication and coordination with the TSO and/or the DSO to manage the flexibility transactions, and receive compensation accordingly. ii) A more recent approach involves capacity limitation agreements with parties connected to the grid to limit their energy use in exchange for financial compensation. This helps in managing congestion by ensuring that energy consumption does not exceed certain thresholds during peak times. In this case, it is worth mentioning the role of aggregators which accumulate flexibility from multiple customers and their flexible assets and sell it to the TSO and/or the DSO.[28,29]

ESCOs provide energy services to consumers and prosumers, including energy management, cost savings, maintenance and operation of flexible assets, energy-efficiency evaluation, and energy optimisation; unlocking the large demand-side flexibility potential and empowering end-users to actively participate in energy and flexibility markets, hence also supporting the management of grid congestion issues.

3.16. Imbalances management

Imbalances management services are designed to ensure the stability of the electric grid by balancing power supply and demand in real-time. The primary goal is to maintain the grid at a constant frequency of 50 Hertz (standard in Europe), which relies on a delicate equilibrium between power generation and consumption. When there is an excess of power generation, the frequency goes up. Conversely, if there is not enough power supply to meet demand, the frequency goes down. This disparity is referred to as “imbalance”. Any imbalance (+/- 0.2 Hz) can lead to blackouts and other disruptions. Thus, maintaining the equilibrium (continuously matching electricity supply and demand in real-time) is crucial for grid stability.[30]

[27] Commission Regulation EU 2015/1222 establishing a guideline on capacity allocation and congestion management. http://data.europa.eu/eli/reg/2015/1222/oj.
[28] USEF. (2021). White Paper: Flexibility Deployment in Europe.
[29] Hive Power. (2023). Energy Players and Their Roles in the Balance of Power.
[30] WithTheGrid. (2023). Understanding grid balancing & congestion management: Differences and potential conflicts.

Every supplier or buyer connected to the grid must be associated with a Balance Responsible Party (BRP), which is then responsible for balancing supply and demand within its specific portfolio. BRPs are obligated to inform about their planned production, consumption and trades for the following day. Deviations might happen, in which case the BRPs must rectify them before the end of the corresponding imbalance settlement period. This period, lasting 15 minutes, is when imbalances are calculated and settled. In case of a remaining imbalance, BRPs face financial consequences. BRPs have the possibility to trade energy surplus or deficit with other BRPs. However, if the BRPs (and the market) fail to maintain the balance, the TSO must intervene. If the summed imbalances of the BRPs cause a general change in the grid's frequency, the TSO can address the issue using "balancing resources" facilitated by Balancing Service Providers (BSPs), who steer their production/consumption to help stabilise the grid's frequency.[30]

The EU's Electricity Balancing Guideline (EBGL)[31] establishes a framework to harmonise these balancing services across EU countries, and outlines the roles of TSOs, BRPs and BSPs. This framework seeks to ensure effective competition, non-discrimination and transparency in the balancing markets, which are crucial for the integration of the EU electricity markets.[32] The EBGL stipulates that imbalance pricing (i.e., the cost applied to parties whose electricity supply and demand are not in balance) should reflect the real-time costs of grid balancing, encouraging the adoption of a single pricing model across the EU. This model aims to price imbalances based on the cost of activated energy for frequency restoration and replacement reserves, promoting efficiency and the integration of RES into the grid.

The successful implementation of the EBGL and other related guidelines, mechanisms and grid codes requires a strong collaboration among TSOs, BRPs, BSPs, and national regulatory authorities within the EU in order to enhance operational reliability, market efficiency, and the inclusion of demand-side management and RES in the electricity markets.

[31] Regulation EU 2017/2195 establishing a guideline on electricity balancing. data.europa.eu/eli/reg/2017/2195/oj.
[32] NextKraftwerke. What is the Electricity Balancing Guideline (EBGL)?

4. RESULTS FROM THE QUESTIONNAIRE

In this section, the results obtained from the questionnaire filled in by the project's partners are presented. The tables in the following sub-sections collect country-specific information about the application and penetration of different energy services, and their relevance for LFMs, in the 7 countries that are part of the DE-RISK's Consortium: Spain, Greece, Portugal, Ireland, Bulgaria, France and Turkey.

4.1 Spain

Table 1: Questionnaire results for Spain.

Energy Service: Energy Supply Contracting	
Description of the service	The ESC business model is a proven model to implement efficient supply (from fossil and/or renewable sources) in new and existing buildings of the public, industrial, commercial and large residential sectors.
Requirements to provide the service	In accordance with law 24/2013, it is not necessary to be an accredited company for the commercialization of electricity. An ESCO can provide this service simply by owning power generation assets such as a PV installation on the customer's premises.
Laws / Legislation of reference	Royal decree 56/2016 regulating Energy Services Companies release.
Main barriers that limit the profitability and impact of the service	Like all long-term contracts for energy services or supplies, it is affected by three major risks: • It is based for the supplier on a significant initial investment that is recouped over time, so its profitability is greatly affected by inflation or the updating of the value of money. • It depends on long-term contracts (10 to 20 years) whose profitability for the customer depends on the evolution of electricity prices in the markets, which at a time of low prices can lead to many simultaneous defaults or contract breakages. • The ESCO's capital or credit needs are very large to maintain operations, which reduces the value of the company according to classic valuation rules, discouraging investment in it.
Relevant aspects for LFMs	ESC is a form of peer-to-peer (P2P) supply that opens up many opportunities for distributed producer-consumers to sell their excess production to nearby consumers.
Best practices related to LFMs	Many energy communities can be self-financing by becoming ESCOs to their own members and third parties, with a multitude of

	possible business models.
Energy Service: Energy Performance Contracting	
Description of the service	It is similar to the ESC. However, the energy is not supplied by the provider but by a third party (energy retailer). In this case, the income comes from the savings that the supplier offers to the customer thanks to its efficiency services.
Requirements to provide the service	To be an energy service company (ESCO).
Laws / Legislation of reference	Royal decree 56/2016 regulating energy service companies (ESCO) release.
Main barriers that limit the profitability and impact of the service	On many occasions, the contracts link the remuneration with the customer's economic savings (the supplier also manages the supply contracts with the electricity supplier), not with energy savings. At times of rising prices, the supplier company (ESCO) reduces or completely cancels its incomes. Furthermore, if the initial investment in assets for energy efficiency is large, it suffers from the same drawbacks as the ESC model.
Relevant aspects for LFMs	N/A
Best practices related to LFMs	N/A
Energy Service: Power Purchase Agreement	
Description of the service	A PPA, or electricity power agreement, is a long-term contract between an electricity generator and a customer, usually a utility, government or company. PPAs may last anywhere between 5 and 20 years, during which time the power purchaser buys energy at a pre-negotiated price. Such agreements play a key role in the financing of independently owned (i.e. not owned by a utility) electricity generators, especially producers of renewable energy like solar or wind farms. It can be divided between on-site PPAs, where the generation is near the consumption, so it can be considered self-consumption and off-site, where they are mere financial instruments.
Requirements to provide the service	N/A
Laws / Legislation of reference	• Royal Decree 24/2020 of social measures to reactivate employment and protect self-employment and the competitiveness of the industrial sector. • Royal Decree 244/2019 which regulates the administrative, technical and economic conditions for the self-consumption of electricity.

Main barriers that limit the profitability and impact of the service	Extremely unstable prices (as in 2021 and part of 2022 in Europe) discourage the existence of PPAs. On the other hand, the existence of low and constant prices year after year, as has traditionally been the case in Europe, does not encourage the signing of PPAs because they are more of a financial coverage instrument than a savings measure (especially off-site PPAs). Situations with variable prices and large differences in the hours of the day, but not as volatile as in the 2021/2022 crisis, are a good context for the proliferation of PPAs.
Relevant aspects for LFMs	PPAs contribute to the creation of markets, tools and regulations for energy exchange (and consequently flexibility) in decentralised models: local markets, P2P, etc.
Best practices related to LFMs	N/A
Energy Service: Pay for Performance (P4P) scheme	
Description of the service	P4P services are based on the same models as ESCs or EPCs, but are usually more complex in terms of size, scope and actors involved. In usual cases, an aggregator participates to gather many users in a situation of energy inefficiency. An installation company makes the necessary improvements. A financial entity finances the overall operation. Energy improvements produce a lower cost, and are more secure due to the aggregation of cases. They are also more financially supported by the aggregation of users. Optionally, an energy retailer is part of the chain, distributing the value generated by the lower aggregate consumption among the participating parties.
Requirements to provide the service	The requirements are those of the regulation of energy services, as well as those that exist at the level of financial entities.
Laws / Legislation of reference	N/A
Main barriers that limit the profitability and impact of the service	The main barriers are not technical or regulatory, but social and cultural. Raising awareness about the advantages for a family, home or building of undertaking an energy renovation, even without investment costs, is not easy. The aggregation of clients up to a critical mass of economy of scale constitutes the main barrier.
Relevant aspects for LFMs	P4P models, both for energy efficiency renovation and for the financing of assets and devices related to flexibility, are a great value driving LFM.
Best practices related to LFMs	N/A
Energy Service: Energy consultation (e.g., energy audit)	
Description of the service	This service encompasses all the activities related to the

	improvement of energy efficiency within an organisation, the energy savings and the reduction of GHG emissions.
Requirements to provide the service	To count on technical qualification (capacity and or experience), adequate resources, insurance and administrative permissions.
Laws / Legislation of reference	[Royal Decree 56/2016]
Main barriers that limit the profitability and impact of the service	The same as EPC, when the energy consultancy model is linked to energy savings, and these savings are measured in €, instead of in energy.
Relevant aspects for LFMs	Any agent wishing to be part of an LFM must have optimised their consumption as a prior step, as well as knowledge of use, timing, and quantities of each energy use in their facility. A prior consultancy is considered a prerequisite for participation in an LFM.
Best practices related to LFMs	To count on an optimised, flexible and versatile energy system based on energy consultancy recommendations.
Energy Service: Energy Management System	
Description of the service	An EMS is a framework for energy consumers, including industrial, commercial and public sector organisations, to manage their energy use. It helps companies identify opportunities to adopt and improve energy-saving technologies, including those that do not necessarily require high capital investment. In most cases, the successful implementation of an EMS requires specialised expertise and staff training.
Requirements to provide the service	N/A
Laws / Legislation of reference	Affected by collateral regulations, such as Data Protection Directive 2016/680 and Royal Decree 12/2018 of security of data networks and systems.
Main barriers that limit the profitability and impact of the service	A barrier to the deployment of EMSs is the proliferation of excessively closed architectures or those with difficult interoperability, both at the software and deployed device levels
Relevant aspects for LFMs	Flexibility implies the existence of fast-acting systems, as well as appropriate control logic. Having a prior EMS that coordinates the signals from the FMS (Facility Management Systems) with other system operational needs, prioritising those needs, is a significant advantage for automating the necessary responses of each specific installation to FMS requirements in a timely manner
Best practices related to LFMs	Open and interoperable systems.

Energy Service: Project design, implementation and maintenance	
Description of the service	ESCOs deliver energy efficiency projects, offer a range of services from initial audits through to the implementation of energy-saving measures, including financing arrangements. Their remuneration is often tied directly to the energy savings achieved, thus bearing some degree of risk for the energy performance improvements at a user's facility. The typical ESCO project encompasses stages like site survey, energy audit, identification of energy-saving actions, project financing, engineering and design, and ongoing maintenance, all aimed at improving energy efficiency with guaranteed results.
Requirements to provide the service	Being an ESCO. and complying with regulations.
Laws / Legislation of reference	• National Integrated Energy and Climate Plan (NIECP) 2021–2030, aimed at fostering the efficient use of clean energy. • Royal Decree 390/2021 on the basic procedure for the certification of the energy efficiency of buildings.
Main barriers that limit the profitability and impact of the service	The development of energy projects/services face several barriers, including technical, economic, policy, regulatory, and socio-political barriers that hinder the development of RES. Also, the global crisis posed by the COVID-19 pandemic showed how vulnerable these services are to disrupted manufacturing, supply chains, and installations, which impacted the solar sector, among others.
Relevant aspects for LFMs	N/A
Best practices related to LFMs	N/A
Energy Service: Metering & monitoring services	
Description of the service	A smart meter is a measurement device whose main function is to record actual electricity consumption readings automatically and remotely. Smart meters enable users to have full control over their energy expenditure, and also minimise all possible annoyances and errors that may occur when making a traditional measurement. They make it easier to optimise the supply for each home depending on the particular consumption needs and habits, and enable faster changes to power capacity and rates, which can mean savings for the customer. In Spain, smart meters began to be installed in 2010. Now, Spain is among the 6 EU Member States that have reached almost 100% smart meter rollout (JRC, CET Observatory, 2023)
Requirements to provide the service	N/A

Laws / Legislation of reference	• Royal Decree 1110/2007, which approves the technical conditions and guarantees in the electricity metering, setting the framework for metering systems and their functionalities. • Order ITC/3860/2007, which established the initial framework for the replacement of traditional meters with smart meters for consumers with contracted power not exceeding 15 kW.
Main barriers that limit the profitability and impact of the service	No barriers.
Relevant aspects for LFMs	• Smart meters provide real-time or near-real-time data on electricity consumption and generation at consumer level. • With smart meters, consumers can participate in DR programs more effectively, allowing for adjustments in electricity consumption in response to supply conditions. • Smart meters facilitate the integration of DERs, such as solar PV and battery storage, by providing the necessary data and control capabilities to align local production with local consumption. • Smart meters empower consumers by providing them with detailed information about their energy usage, which can encourage more energy-efficient behaviours. • The data from smart meters allow utilities and energy service companies to develop innovative pricing models, such as ToU.
Best practices related to LFMs	Spain's nearly complete smart meter rollout can serve as a benchmark for other EU countries. The lessons learned and the infrastructure developed can be replicated in other countries.
Energy Service: Smart contracts	
Description of the service	The smart contract is written in a virtual language and has the ability to execute and enforce itself autonomously and automatically based on a series of programmed parameters. Hand in hand with blockchain technology, its main value lies in reinforcing security, transparency, and trust among the signatories, avoiding misunderstandings, forgeries, or alterations, and dispensing with intermediaries.
Requirements to provide the service	To develop a smart contract on the blockchain, one requires a development platform capable of facilitating the creation and deployment of such contracts. Among the available options are Ethereum, Binance Smart Chain, Polkadot, and Cardano.
Laws / Legislation of reference	N/A
Main barriers that limit the profitability and impact of the service	There are barriers at various levels. At the regulatory level, the energy market and sector are heavily regulated and centralised, with regulatory authority conferred to third parties designated by

	the public administration. The scope for peer-to-peer (P2P) services based on smart contracts would be limited to the unregulated portion or would imply the existence of more areas without a regulatory body. At a social level, it entails the acceptance of blockchain technology as a reliable record.
Relevant aspects for LFMs	Smart contracts are highly relevant for the existence of local flexibility markets, as both are based on P2P systems where peers conduct transfers of information, money, etc., in an agile and decentralised manner.
Best practices related to LFMs	N/A
Energy Service: Energy optimisation (at household, building and/or community level)	
Description of the service	In Spain, energy optimisation services are part of a broader strategy to enhance energy efficiency, reduce costs, and contribute to the country's energy transition and climate goals.
Requirements to provide the service	N/A
Laws / Legislation of reference	• The Electricity Sector Act (Electricity Industry Law 24/2013) is the main regulation governing the TSO's activities. • Royal Decree 1955/2000 which includes provisions relevant to energy optimisation (Installations Authorisation Procedures). • Royal Decree 413/2014 and Royal Decree 244/2019 regulate the activity of electricity production from RES and the conditions for self-consumption of electric energy, respectively, which are crucial for community-level energy optimisation.
Main barriers that limit the profitability and impact of the service	• The lengthy and complex administrative process for project approvals can deter investment and slow down the implementation of energy optimisation projects. • Regulatory changes and the retroactive application of some amendments have introduced legal uncertainty, affecting the confidence of investors and stakeholders in the energy sector. • While there are financial incentives and financing options available for energy optimisation projects, accessing these funds/subsidies can be challenging due to bureaucratic delays.
Relevant aspects for LFMs	Energy optimisation services can help manage and balance local energy supply and demand within LFMs more effectively.
Best practices related to LFMs	N/A
Energy Service: Time-of-Use (ToU), Peak shaving	
Description of the service	Peak shaving service is the reduction of consumption during peak demand hours. Peak consumption determines the overall energy

	costs (usually calculated on the basis of marginal costs) and establishes the capacity and size of the network. Peak shaving can be classified into two types: pure peak shaving, which is to implement energy efficiency measures specially oriented to those moments or situations of maximum consumption, producing a reduction in overall energy consumption. In the second type, peak shaving is based on load shifting, so there is no energy saving, but a service to the system and the grid at a time when they need flexibility to go down.
Requirements to provide the service	There are no special requirements except if it is intended to be done through an incentive system (auctions), at the request of the grid or system operator or through aggregation. In this case, the requirements are the general requirements for each energy flexibility service.
Laws / Legislation of reference	• Royal Decree-Law 18/2022, of October 2018, approving measures to reinforce the protection of energy consumers and to contribute to the reduction of natural gas consumption in application of the "Plan + seguridad para tu energía (+SE)", as well as measures regarding the remuneration of public sector personnel and the protection of temporary agricultural workers affected by the drought. • Royal Decree-Law 17/2022, of September 2020, adopting urgent measures in the energy field, in the application of the retributive regime to cogeneration facilities and temporarily reducing the rate of certain fuels.
Main barriers that limit the profitability and impact of the service	When the peak shaving is intended to respond to an external signal, it presents limitations. If peak shaving is executed individually by a consumer to reduce its maximum power demand, for example, there are no relevant external barriers. However, when it comes to explicit demand response, numerous technological (real-time information, automated control, aggregation) and regulatory (minimum capacity, aggregation) barriers arise.
Relevant aspects for LFMs	The greatest economic value of the LFM will be precisely in the trimming of the peaks, since they are the events that have the highest cost for the system and thus, where there is the most monetisation potential for the LFM.
Best practices related to LFMs	N/A
Energy Service: Predictive building management	
Description of the service	Model Predictive Control (MPC) is an optimal control strategy that can be integrated in buildings to improve thermal comfort while achieving energy-related objectives such as minimization of the

	energy consumption, the energy cost or the associated emissions, or to shift power consumption and perform DR actions. MPC uses a predictive model of the building to calculate the optimal setpoints of the energy assets to achieve the desired objectives in the following hours, taking advantage of the building thermal inertia. The MPC also uses additional inputs such as weather forecast and occupancy information, uses the latest building measurements to work in closed-loop and can include operation restrictions defined by the building manager or the users.
Requirements to provide the service	Monitoring of the building is required to calibrate the model embedded in the MPC and control the indoor conditions. The MPC deployment requires a server or platform with computational capacity.
Laws / Legislation of reference	N/A
Main barriers that limit the profitability and impact of the service	The MPC is still in an early market stage. The scalability and adaptability of the solutions for new buildings is one of the main challenges to face. Monitoring is also required.
Relevant aspects for LFMs	Even if the most common MPC is applied to reduce energy consumption (so called economic MPC), the MPC solution can also be applied to shift energy consumption and exploit the building's thermal flexibility.
Best practices related to LFMs	N/A
Energy Service: Peer-to-peer (P2P) trading	
Description of the service	Participants in a P2P energy trading platform can transact with one another, and the aggregated transactions are then managed by a balance responsible party (BRP).
Requirements to provide the service	In a local system (within Spain, up to 2 kilometers of distance between generation and consumption), there are no regulatory requirements. Therefore, distance is a prerequisite. Additionally, having a suitable measurement system for settlement is necessary, and ideally, the possibility of having dynamic distribution coefficients in collective self-consumption installations, allowing for the creation of a real peer-to-peer (P2P) market within the community.
Laws / Legislation of reference	Royal Decree 244/2019
Main barriers that limit the profitability and impact of the service	-The limit for distance in collective self-consumption. -The need for dynamic sharing coefficients (currently can be changed up to every 4 months, but with a great delay of processing in most DSOs in Spain).

Relevant aspects for LFMs	Energy & flexibility trading among LFM participants.
Best practices related to LFMs	N/A
Energy Service: Collective self-consumption	
Description of the service	Model that applies to housing blocks, industrial estates or energy communities through which a photovoltaic installation generates electricity for the use of several connected consumers.
Requirements to provide the service	Be connected to the internal network of associated consumers: • Be connected to any of the low voltage networks of the same transformation centre. • Maximum distance of 2,000 meters between the installation and the consumers. • The installation and consumers are collected in the same cadastre (according to its first 14 digits).
Laws / Legislation of reference	Royal Decree 244/2019, of April 5, regulating the administrative, technical and economic conditions of the self-consumption of electric energy.
Main barriers that limit the profitability and impact of the service	The main barrier is the delay of DSO companies to register collective self-consumption, especially when they belong to different retailers. This is an impediment that delays the use of self-consumption by around 8 months. Users are therefore paying installation fees months before receiving benefits. Another barrier is that there are no energy sharing coefficients among users that can be modified in real time based on consumption. The distribution coefficients can only be changed every 4 months. This reduces the energy that is self-consumed, and increases the energy that is fed into the grid as surplus. It is also important to know all the legal aspects of access to the collective self-consumption of the owners of the building where it is located.
Relevant aspects for LFMs	This is a very relevant service for local flexibility markets. Flexibility implies the dynamic sharing of energy among collective self-consumption. LFMs need DERs to exist and, in most European cities' urban planning, roof sharing implies sharing PV installations. The maximum allowed distance between generation and consumption (currently 2 km) is also very relevant, as it marks the distance where a highly efficient flexibility market can be made.
Best practices related to LFMs	Solar communities financed by the installation company (or where the installation company manages access to financing for consumers) are a very attractive model for the citizen. As there is no initial investment, if the payback period is adequate and the installation is efficiently sized, the energy savings can fully cover the amortisation.

Energy Service: Congestion management	
Description of the service	Congestion management services are crucial for maintaining the stability and efficiency of the national electricity grid, particularly given the rapid expansion of RES. In Spain, the congestion management process is primarily overseen by Red Eléctrica de España (REE), Spain's TSO. REE's responsibilities mirror those of TSOs in other EU countries, managing grid constraints through the Technical Restrictions market and coordinating with BSPs and BRPs to ensure grid stability, allowing generators to bid to increase or decrease their output based on system needs to manage voltage levels and local capacity constraints.
Requirements to provide the service	N/A
Laws / Legislation of reference	BOE-A-2022-4969 Resolution 17/03/2022. CNMC (Spanish National Markets and Competition Commission).
Main barriers that limit the profitability and impact of the service	• Lag in expanding transmission capacity to match the growth of RES generation, leading to increased congestion and curtailment. • The current market design, being a pay-as-bid market, can limit competition and result in high costs for consumers due to the lack of cap on bids for congestion management services. Thus, congestion management costs are disproportionately borne by consumers, reflecting on household energy bills. • Concentration of benefits among a few power plants, while also posing risks of revenue loss for generators asked to curtail production without compensation.
Relevant aspects for LFMs	The market design and regulatory framework in Spain highlight the importance of ensuring fair competition and efficient cost distribution in developing LFMs
Best practices related to LFMs	N/A
Energy Service: Imbalances management	
Description of the service	All actions and processes, in all time horizons, through which the managers of the transportation and distribution network ensure, uninterruptedly, the maintenance of the system frequency within a predefined stability range that appears in article 127 of Regulation (EU) 2017/1485.
Requirements to provide the service	• All: Technical requirements of production assessment, real -time information exchange with the system operator and others. • Secondary regulation (aFFR): 1 MW of flexible power. From 20 seconds to 15 minutes. • Tertiary regulation (mFFR): 1 MW of flexible power. From 15

	minutes to 45 minutes. • Replacement Reserve (RR): 1 MW of flexible power. Up to 30 mins to get into operation.
Laws / Legislation of reference	BOE-A-2021-9231 Resolution 20/05/2021.
Main barriers that limit the profitability and impact of the service	The need to have a minimum of 1 MW of flexible energy in each generation, storage or demand scheduling unit is the main barrier to entry.
Relevant aspects for LFMs	Local flexibility markets are called to replicate balance markets on a smaller scale (power, geographic, etc.) with the proliferation of DER, so the mechanisms and processes of accreditation, baseline calculation, entry into operation, etc. can be inspired by balance services. Similarly, local flexibility providers could be Balance Service Providers through the aggregator role.
Best practices related to LFMs	N/A

4.2. Greece

Table 2: Questionnaire results for Greece.

Energy Service: Energy Supply Contracting	
Description of the service	The ESC business model is a proven model to implement efficient supply (from fossil and/or renewable sources) in new and existing buildings of the public, industrial, commercial and large residential sectors.
Requirements to provide the service	"Electricity Supply and Trading License" by Regulatory Authority for Energy (RAE).
Laws / Legislation of reference	• The issuance of electricity supply licenses follows the regulatory framework of Law 4001/2011 (Government Gazette 179 A '/ 22.08.2011) and the First Part of the Licensing Regulation that refers to the "Electricity Supply and Trading License" pursuant to article 135 of the Law 4001/2011 (Government Gazette B '2940 / 05.11.2012). • Article 134 (2) (4) of Law 4001/2011 differentiates the criteria that must be met for the issuance of the "Supply and Trading License" and introduces new provisions that replace the corresponding provisions of Law 2773/1999. • According to the current institutional framework (Law 4001/2011), RAE decides on the issuance, the modification, and the revocation of the licences.
Main barriers that limit the profitability and impact of the service	Energy market in Greece is regulated by the Regulatory Authority for Energy (RAE). Due to the energy crisis RAE estimated that ESCOs had superprofits from high energy prices from October 2021 to June 2022 and they will be taxed 90% on those superprofits.
Relevant aspects for LFMs	Greece implemented EU's directive 2019/944 in Law 4986/2022 in October 2022. LFMs implementation is at a very early stage.
Best practices related to LFMs	N/A
Energy Service: Energy Performance Contracting	
Description of the service	EPC is offered as a business to business (B2B) service. An ESCO provides an agreed service package, including technical improvements (investments) on the basis of an EPC contract, in order to be more energy efficient. In this case, the income comes from the savings that the user offers to the ESCOs thanks to the implementation of their measures.
Requirements to provide the service	To be registered as an Energy Service Company (ESCO).

Laws / Legislation of reference	Greek Law 3855/2010 on measures to improve energy efficiency in end use, energy services and other provisions
Main barriers that limit the profitability and impact of the service	ESCOs have to provide end users competitive prices and be paid from energy savings accomplished, upon completion.
Relevant aspects for LFMs	N/A
Best practices related to LFMs	N/A
Energy Service: Power Purchase Agreement	
Description of the service	PPA is a long-term contract between two parties. Either ESCO - end user or RES producer/ Energy community - ESCO, during which the power purchaser buys energy at a pre-negotiated price. Note that in Greece there are ongoing negotiations for PPA between RES producers and industrial players.
Requirements to provide the service	To be an energy company or a RES producer/energy community.
Laws / Legislation of reference	Law 3468/2006 on Generation of Electricity using RES and High-Efficiency Cogeneration of Electricity and Heat and Miscellaneous Provisions vaguely defines PPAs. PPAs in Greece need further regulations and definition.
Main barriers that limit the profitability and impact of the service	Barriers that limit the profitability and impact of PPAs are: • The small size of the market. • Buyers do not want to take long term risks. • High non-compliance penalties. • Low liquidity.
Relevant aspects for LFMs	N/A
Best practices related to LFMs	N/A
Energy Service: Pay for Performance (P4P) scheme	
Description of the service	P4P schemes in Greece at at very early stages and as of now not a commercial service. The Greek Ministry of Environment & energy has initiated the action " SAVE AND OPERATE ", which is financed by the National Recovery and Resilience Plan. This act is not an energy service, but a fund for businesses to upgrade their energy category based on PEA, at least by two (2) energy categories in relation to the existing classification (or mandatory B+ class when it comes to a radical renovation). This act can pave the way for P4P services.
Requirements to provide the	N/A

service	
Laws / Legislation of reference	"SAVE AND OPERATE", financed by the National Recovery and Resilience Plan.
Main barriers that limit the profitability and impact of the service	No barriers have been identified yet as the "SAVE AND OPERATE" action is at very early stages. (Official Gazette 1650/B/11-3-2024)
Relevant aspects for LFMs	N/A
Best practices related to LFMs	N/A
Energy Service: Energy consultation (e.g., energy audit)	
Description of the service	The aim of the energy audit is to create a performance evaluation list of energy saving actions (based on the actual operation and energy consumption of the company's facilities) as a tool for the managers to make relevant investment decisions. The main objective of the energy audit process is to record the energy flows of a company in a transparent and operational manner to clearly identify the potential for energy savings in the most cost-effective way. Energy audits are part of the procedure during an Energy Performance Contract. For large commercial companies, an energy audit is mandatory every 10 years. For residential and small commercial buildings, it is mandated for a number of legal uses.
Requirements to provide the service	To be registered as an Energy Service Company (ESCO).
Laws / Legislation of reference	Law 3855/2010 "Measures for the improvement of energy efficiency during the final crisis, energy services and other provisions" established the basic policies, regulations and measures for the development of the energy services market in Greece and laid the foundations for the significant development of Energy Service Companies.
Main barriers that limit the profitability and impact of the service	Under Greek law, Companies that: 1. employ more than 250 employees; or 2. employing fewer than 250 employees, but with an annual turnover exceeding EUR 50 million and an annual balance sheet total exceeding EUR 43 million; are legally required to to be audited. As a result, smaller companies, which are not obligated to be audited tend to avoid this energy service.
Relevant aspects for LFMs	N/A
Best practices related to LFMs	N/A

Energy Service: Energy Management System	
Description of the service	The EMS model in Greece is mainly a B2B market, in which businesses try to reduce energy consumption, minimise a company's environmental footprint and reduce costs by promoting and adopting sustainable energy use.
Requirements to provide the service	To be registered as an Energy Service Company (ESCO). Some of the ESCOs comply with ISO 50001.
Laws / Legislation of reference	Law 3855/2010 "Measures for the improvement of energy efficiency during the final crisis, energy services and other provisions" established the basic policies, regulations and measures for the development of the energy services market in Greece and laid the foundations for the significant development of Energy Service Companies.
Main barriers that limit the profitability and impact of the service	Small market reach, mainly B2B.
Relevant aspects for LFMs	N/A
Best practices related to LFMs	N/A
Energy Service: Project design, implementation and maintenance	
Description of the service	The projects undertaken by ESCOs are financed by third parties in a B2B market. Financing may come either from the ESCOs existing funds or financial institutions - from public or private sector- or both. Therefore, some of the benefits for service users are the low investment cost because of the abovementioned funding and the assumption of the major risk by the ESCOs, as well as the procurement of the necessary equipment at better prices.
Requirements to provide the service	To be registered as an Energy Service Company (ESCO).
Laws / Legislation of reference	Law 3855/2010 "Measures for the improvement of energy efficiency during the final crisis, energy services and other provisions" established the basic policies, regulations and measures for the development of the energy services market in Greece..
Main barriers that limit the profitability and impact of the service	N/A
Relevant aspects for LFMs	N/A
Best practices related to LFMs	N/A

Energy Service: Metering & monitoring services	
Description of the service	Energy Monitoring & Management service, is currently a B2B service, which offers remote data collection of electricity consumption in real time, either for a whole facility or for specific production sections, as well as access to useful information via a web interface or automated notifications: alarms, alerts along with intelligent reporting and data analytics.
Requirements to provide the service	To be registered as an Energy Service Company (ESCO).
Laws / Legislation of reference	Law 3855/2010 "Measures for the improvement of energy efficiency during the final crisis, energy services and other provisions" established the basic policies, regulations and measures for the development of the energy services market in Greece.
Main barriers that limit the profitability and impact of the service	Small market reach.
Relevant aspects for LFMs	N/A
Best practices related to LFMs	N/A
Energy Service: Smart contracts	
Description of the service	N/A
Requirements to provide the service	Smart contracts are acceptable by Greek law, as long as the code is presented along with the contract and it is validated by an experts report.
Laws / Legislation of reference	Greek law 4961/2022.
Main barriers that limit the profitability and impact of the service	Smart contracts as new technology orbits around cryptocoin transactions.
Relevant aspects for LFMs	N/A
Best practices related to LFMs	N/A
Energy Service: Energy optimisation (at household, building and/or community level)	
Description of the service	• Capture and evaluation of existing energy consumption • Planning a strategy with solutions that maximise savings and ensure a rapid return on investment • Implementation of energy saving interventions by combining them with renewable energy sources, where possible • Measurement of results and evaluation of the effectiveness of

	proposed solutions
Requirements to provide the service	To be an ESCO.
Laws / Legislation of reference	Greek Law 3855/2010: "Measures for the improvement of energy efficiency during the final crisis, energy services and other provisions" established the basic policies, regulations and measures for the development of the energy services market in Greece and laid the foundations for the significant development of Energy Service Companies.
Main barriers that limit the profitability and impact of the service	Small market reach, mainly B2B.
Relevant aspects for LFMs	N/A
Best practices related to LFMs	N/A
Energy Service: Time-of-Use (ToU), Peak shaving	
Description of the service	Starting in January 2024, consumers can select between 3 different contracts, distinguished by colour. • Blue: Long term contract with fixed price • Yellow: Correlated with the market prices. At the start of each month, the energy provider offers a price and at the end of the month a clear-out by the energy provider charges consumers based on the market price of the energy consumed. • Orange: A contract available for consumers and prosumers with smart meters installed. The end users can adjust their consumption and get charged based on the spot market price. • Green: Monthly contract with fixed price.
Requirements to provide the service	To be an energy provider.
Laws / Legislation of reference	Greek law 4951/2022.
Main barriers that limit the profitability and impact of the service	It is a recent endeavour and the majority of consumers/ prosumers are uneducated about the differences between the contracts.
Relevant aspects for LFMs	N/A
Best practices related to LFMs	N/A
Energy Service: Predictive building management	
Description of the service	N/A
Requirements to provide the	N/A

service	
Laws / Legislation of reference	N/A
Main barriers that limit the profitability and impact of the service	IoT (Internet of Things) equipment has not gained significant penetration in the Greek market yet.
Relevant aspects for LFMs	N/A
Best practices related to LFMs	N/A
Energy Service: Peer-to-peer (P2P) trading	
Description of the service	N/A
Requirements to provide the service	N/A
Laws / Legislation of reference	N/A
Main barriers that limit the profitability and impact of the service	IoT (Internet of Things) equipment has not gained significant penetration in the Greek market yet.
Relevant aspects for LFMs	N/A
Best practices related to LFMs	N/A
Energy Service: Collective self-consumption	
Description of the service	Collective self-consumption can be adopted by two or more self-consumers (residential or commercial), as long as they are in the same building. Self-consumers under collective self-consumption schemes must appoint a representative and enter into an agreement, the provisions of which regulate specific activities such as entry and exit requirements, required majority and financial issues. Collective self-consumption schemes can include the consumption needs of common parts of a building.
Requirements to provide the service	Limitation to the same building.
Laws / Legislation of reference	Law 5037/2023, recently published in the Government's Gazette A' 78/28-03-2023.
Main barriers that limit the profitability and impact of the service	Collective Self-Consumption can be adopted by two or more self-consumers as long as they are in the same building.
Relevant aspects for LFMs	Broadening the residency criteria from the same building to the

	same vicinity and then locally, could pave the way for LFM.
Best practices related to LFMs	N/A
Energy Service: Congestion management	
Description of the service	The Greek TSO assigns to the interested parties the ability to transfer electricity through interconnections for up to one year. Capacity allocation in the interconnections, which is completed up to the previous day of the Allocation Day, is conducted through visible capacity tenders ("explicit auctions") on an annual, weekly and daily basis. By the 1st of November each year, the Greek TSO submits to RAE a draft of terms and rules governing the auctions that are conducted for the allocation of capacity in the interconnections for the following calendar year. These terms and conditions are approved by RAE. The available transmission capacity at interconnections, which is allocated through the above auctions on a long-term basis, i.e. from one month to one year before the delivery day, is determined by a RAE decision upon a proposal of the Greek TSO. By that decision, RAE may determine the maximum allowed percentage of commitment of the transfer capacity available in the auction by any participant. The Greek TSO manages the congestion income as provided by Regulation 714/2009 (Article 16 of the Regulation and Article 6 of the Annex to Regulation 714/2009): 1. To ensure the availability of distributed capacity or/and; 2. To maintain or increase interconnection capacity through network investments, in particular with new interconnection lines. If this revenue cannot be used for the above purposes, it can be used up to a maximum amount determined by a RAE decision, to reduce the network tariffs. The Greek Transmission System includes interconnections with Albania (AL), North Macedonia (NMK), Bulgaria (BG), Turkey (TR) and Italy (IT).
Requirements to provide the service	N/A
Laws / Legislation of reference	The congestion management on the interconnections and the assignment of their capacity, is governed by the principles enshrined in Regulation (EC) 714/2009.
Main barriers that limit the profitability and impact of the service	Greek TSO has a monopoly on this market.

Relevant aspects for LFMs	N/A
Best practices related to LFMs	N/A
Energy Service: Imbalances management	
Description of the service	The Balancing Market consists of the Balancing Capacity Market, the Balancing Energy Market and the Imbalance Settlement. The Imbalance Settlement is the energy volume calculated for a Balance Responsible Party and representing the difference between the allocated volume and the final position (Market Schedule) of that Balance Responsible Party, including any imbalance adjustment within a given period.
Requirements to provide the service	Natural or legal persons, in one or more of the following capacities, shall be entitled to register in the Balancing Service Providers Registry kept by the Hellenic Electricity Transmission System (HETS) Operator, as long as they are able to provide Balancing Services: 1. Producer; 2. RES producer; 3. Auto-producer; 4. RES Aggregator; 5. Demand Response Aggregator; 6. Consumer, including self-supplied customers, providing demand response services, as long as they are not represented by a Demand Response Aggregator.
Laws / Legislation of reference	For registration in the Balancing Service Providers Registry, the terms and conditions described in the “Terms and Conditions for Balancing Service Providers” must be fulfilled, as approved by decision of RAE following a recommendation by the Operator, as set out in article 18, par. 4 of Law 4425/2016. Imbalance: It shall have the meaning of Article 2(8) of Regulation (EU) 2017/2195.
Main barriers that limit the profitability and impact of the service	• Consumer lack of awareness, willingness and competence. • Lack of provider willingness and experience to make the risk manageable for consumers.
Relevant aspects for LFMs	An imbalance Settlement mechanism could be implemented in the case of LFMs.
Best practices related to LFMs	N/A

4.3. Portugal

Table 3: Questionnaire results for Portugal.

Energy Service: Energy Supply Contracting	
Description of the service	ESC in Portugal involves contracting energy supply with licensed electricity or gas suppliers. Consumers can choose from a variety of suppliers offering different energy pricing and contractual terms.
Requirements to provide the service	• Compliance with licensing and regulatory requirements for energy supply activities. • Connection to the national electricity or gas grid and adherence to grid codes. • Financial capacity to meet contractual obligations and ensure a reliable energy supply.
Laws / Legislation of reference	The primary legislation governing energy supply contracting in Portugal is Law No. 12/2008. It establishes the legal framework for the organisation and functioning of the electricity and natural gas sectors.
Main barriers that limit the profitability and impact of the service	• Intense competition in the energy supply market, limiting profit margins. • Regulatory requirements and administrative burdens for licensing and market entry. • Challenges in managing fluctuating energy prices and supply risks.
Relevant aspects for LFMs	• Integration of ESC within the LFM framework to enable participation of flexible energy suppliers. • Clear rules and procedures for contracting and settlement in the LFM context.
Best practices related to LFMs	• Promote long-term contracts with flexible terms to enable participation in LFMs. • Implement transparent and efficient contract negotiation and settlement processes. • Foster collaboration between ESC providers and flexibility aggregators to optimise value for both parties.
Energy Service: Energy Performance Contracting	
Description of the service	EPC in Portugal entails a contractual agreement between an energy service provider and a consumer to achieve energy efficiency improvements. The provider guarantees certain energy savings, and the consumer pays based on the achieved savings.
Requirements to provide the service	• Possession of relevant certifications, such as ESCO (Energy Service Company) certification.

	• Demonstration of expertise and experience in energy efficiency measures and project implementation. • Contractual agreements specifying energy savings targets, measurement, and verification protocols.
Laws / Legislation of reference	Energy performance contracting in Portugal is regulated by Decree-Law No. 68-A/2015. It establishes the legal framework for energy efficiency contracting and outlines the rights and obligations of the parties involved.
Main barriers that limit the profitability and impact of the service	• Limited awareness and understanding of EPC among potential clients. • Difficulty in accessing financing for energy efficiency projects. • Lengthy decision-making processes and procurement procedures.
Relevant aspects for LFMs	• Incentives and mechanisms to promote energy efficiency projects and EPCs within LFMs. • Standardised measurement and verification protocols for energy savings within the LFM framework.
Best practices related to LFMs	• Incentives and mechanisms to promote energy efficiency projects and EPCs within LFMs. • Standardised measurement and verification protocols for energy savings within the LFM framework.
Energy Service: Power Purchase Agreement	
Description of the service	PPAs in Portugal are commonly used for renewable energy projects. They involve long-term agreements between renewable energy generators and consumers, specifying the terms, pricing, and duration of electricity purchases.
Requirements to provide the service	• Contractual agreements specifying energy savings targets, measurement, and verification protocols. • Agreement on terms, pricing, duration, and energy delivery obligations. • Agreement on terms, pricing, duration, and energy delivery obligations.
Laws / Legislation of reference	PPAs in Portugal are subject to the general provisions of Law No. 12/2008, which regulates the electricity sector. The specific terms and conditions of PPAs are negotiated between the parties involved.
Main barriers that limit the profitability and impact of the service	• Complex negotiations and contractual arrangements between parties. • Uncertainty regarding future electricity market prices and policy support for renewable energy.

	• Limited availability of long-term PPAs for small-scale renewable energy projects.
Relevant aspects for LFMs	• Integration of renewable energy PPAs into LFMs to enable flexibility services from renewable generators. • Clear guidelines for the participation of PPAs in the LFM market and grid integration.
Best practices related to LFMs	• Facilitate streamlined procedures for PPA implementation within LFMs. • Incorporate flexibility services and grid interaction provisions in PPAs. • Promote the integration of RES through PPAs within LFMs.
Energy Service: Pay for Performance (P4P) scheme	
Description of the service	The P4P scheme in Portugal incentivises energy efficiency improvements by offering financial rewards to energy service providers based on the verified energy savings achieved through their projects.
Requirements to provide the service	• Expertise in energy efficiency measures and technologies. • Ability to accurately measure and verify energy savings achieved.
Laws / Legislation of reference	Pay for Performance schemes in Portugal may be governed by a combination of regulatory measures, guidelines, and policies introduced by the Portuguese energy regulatory authority (ERSE) and other relevant entities.
Main barriers that limit the profitability and impact of the service	• Challenges in accurately measuring and verifying energy savings. • Lack of standardised protocols for energy savings measurement and verification. • Limited financial incentives or subsidies for participating in P4P schemes.
Relevant aspects for LFMs	• Incorporation of P4P schemes within LFMs to incentivize energy efficiency and demand response actions. • Transparent and reliable measurement and verification mechanisms to support P4P schemes within the LFM context.
Best practices related to LFMs	• Establish robust measurement and verification mechanisms to accurately assess performance. • Implement transparent and reliable payment structures for successful performance outcomes. • Encourage market-based incentives and rewards to drive participation and engagement in P4P schemes.
Energy Service: Energy consultation (e.g., energy audit)	
Description of the service	Energy consultation services in Portugal involve conducting energy

	audits and providing professional advice to consumers on energy-saving measures, efficiency upgrades, and available incentives or subsidies.
Requirements to provide the service	• Qualifications and certifications as an energy auditor or consultant. • Knowledge of energy auditing methodologies and tools. • Ability to conduct energy audits, analyse data, and provide recommendations for energy savings.
Laws / Legislation of reference	Energy consultation, including energy audits, can be guided by various regulations and standards, such as the European Directive on Energy Efficiency (2012/27/EU) and national legislation transposing the directive.
Main barriers that limit the profitability and impact of the service	• Limited awareness among consumers about the benefits of energy audits. • Lack of mandatory requirements or incentives for conducting energy audits. • Insufficient availability of qualified energy auditors and consultants.
Relevant aspects for LFMs	• Recognition of the value of energy consultations and energy audits in the LFM framework. • Provision of support and resources for energy consultants to participate in the LFM market.
Best practices related to LFMs	• Develop standardised energy audit protocols and guidelines. • Promote the use of qualified energy auditors and certified audit processes. • Foster knowledge-sharing and collaboration among energy consultants through industry networks and platforms.
Energy Service: Energy Management System	
Description of the service	EMS solutions in Portugal help monitor, control, and optimise energy consumption within buildings or facilities. These systems provide real-time data, analysis, and automation features to improve energy efficiency.
Requirements to provide the service	• Access to suitable EMS software or platform. • Integration with relevant building or facility energy systems and devices. • Expertise in EMS implementation, configuration, and optimisation.
Laws / Legislation of reference	Energy consultation, including energy audits, can be guided by various regulations and standards, such as the European Directive on Energy Efficiency (2012/27/EU) and national legislation transposing the directive.

Main barriers that limit the profitability and impact of the service	• High upfront costs of implementing EMS and integrating with existing systems. • Limited interoperability and compatibility between different EMS platforms. • Resistance to change and lack of awareness about the potential benefits of EMS.
Relevant aspects for LFMs	• Integration of EMS solutions into the LFM infrastructure to enable real-time flexibility management. • Interoperability and data exchange standards to facilitate EMS integration within LFMs.
Best practices related to LFMs	• Implement advanced EMS technologies to enable real-time monitoring and control of flexibility assets. • Ensure interoperability and compatibility of EMS solutions within the LFM infrastructure. • Promote data privacy and security measures to protect EMS systems and user information.
Energy Service: Project design, implementation and maintenance	
Description of the service	This service in Portugal encompasses the end-to-end process of designing, implementing, and maintaining energy-related projects, such as renewable energy installations, energy efficiency retrofits, or other initiatives.
Requirements to provide the service	• Technical expertise in designing energy projects, such as renewable energy installations or energy efficiency retrofits. - Compliance with building codes, regulations, and environmental standards. • Capacity to execute and maintain energy projects effectively and safely.
Laws / Legislation of reference	The legal framework for project design, implementation, and maintenance in Portugal depends on the specific sector and nature of the project. It may involve compliance with construction regulations, environmental impact assessment requirements, and sector-specific legislation.
Main barriers that limit the profitability and impact of the service	• Complexity and time-consuming nature of permitting and regulatory processes. • Lack of access to financing and investment for energy projects. • Challenges in finding skilled professionals and contractors for project implementation.
Relevant aspects for LFMs	• Streamlined processes and supportive regulations for project development and implementation within LFMs. • Clear guidelines for maintenance and operation of flexibility assets participating in LFMs.

Best practices related to LFMs	• Adopt a holistic and integrated approach to project design, considering both technical and market requirements. • Promote collaboration among project stakeholders, including developers, technology providers, and grid operators. • Implement robust maintenance and operation protocols to ensure ongoing performance and reliability of flexibility assets.
Energy Service: Metering & monitoring services	
Description of the service	Metering and monitoring services in Portugal involve the installation and management of energy meters, data collection systems, and monitoring tools to track energy consumption patterns and enable informed decision-making.
Requirements to provide the service	• Access to appropriate metering and monitoring equipment. • Compliance with metrological standards and accuracy requirements. • Expertise in data collection, analysis, and reporting for energy monitoring and management.
Laws / Legislation of reference	The legal framework for project design, implementation, and maintenance in Portugal depends on the specific sector and nature of the project. It may involve compliance with construction regulations, environmental impact assessment requirements, and sector-specific legislation.
Main barriers that limit the profitability and impact of the service	• Limited availability of advanced metering infrastructure for accurate data collection. • Challenges in ensuring data privacy and security. • Insufficient integration and interoperability of metering systems with energy management systems.
Relevant aspects for LFMs	• Advanced metering infrastructure and smart metering technologies to enable accurate measurement and monitoring of flexibility assets in LFMs. • Standardisation of metering and monitoring protocols to facilitate participation in LFMs.
Best practices related to LFMs	• Deploy advanced metering infrastructure and smart metering technologies for accurate and real-time data collection. • Ensure compliance with relevant metering and monitoring standards and regulations. • Implement data analytics and visualisation tools to effectively utilise metering data for decision-making and optimisation.
Energy Service: Smart contracts	
Description of the service	In Portugal, smart contracts utilising blockchain technology can streamline and automate energy transactions, such as peer-to-peer trading or energy data exchange, ensuring

	transparency, security, and efficiency.
Requirements to provide the service	• Familiarity with blockchain technology and smart contract development. • Compliance with legal and regulatory frameworks governing smart contracts. • Compliance with legal and regulatory frameworks governing smart contracts.
Laws / Legislation of reference	The use of smart contracts in Portugal is governed by general contract law principles and relevant regulations, including those related to electronic transactions and data protection. There is no specific legislation solely dedicated to smart contracts.
Main barriers that limit the profitability and impact of the service	• Legal and regulatory uncertainties surrounding the enforceability of smart contracts. • Limited awareness and understanding of smart contract technology and its benefits. • Technical challenges in implementing and maintaining smart contract systems.
Relevant aspects for LFMs	• Legal recognition and support for smart contracts within LFMs. • Development of secure and reliable smart contract platforms for energy transactions and flexibility services.
Best practices related to LFMs	• Establish legal frameworks and standards to support the use of smart contracts within LFMs. • Ensure transparency, security, and enforceability of smart contracts. • Foster collaboration between energy market participants and technology providers to develop reliable smart contract platforms.
Energy Service: Energy optimisation (at household, building and/or community level)	
Description of the service	Energy optimisation services in Portugal focus on maximising energy efficiency and minimising waste at different scales, including households, buildings, and communities, through tailored solutions and behaviour change initiatives.
Requirements to provide the service	• Compliance with applicable legal and regulatory frameworks. • Understanding of energy optimisation strategies for different scales. • Ability to assess, plan, and implement energy optimisation initiatives.
Laws / Legislation of reference	Energy optimisation measures in Portugal may be subject to various regulations and guidelines related to energy efficiency, renewable energy, and building codes, including those aimed at promoting energy-efficient behaviour and technologies.

Main barriers that limit the profitability and impact of the service	• Lack of financial incentives or subsidies for energy optimisation measures. • Limited access to information and resources for implementing energy optimisation initiatives. • Resistance to change and lack of awareness about energy-efficient practices.
Relevant aspects for LFMs	• Incentives and support mechanisms for energy optimisation initiatives within LFMs. • Integration of energy optimisation measures into the LFM framework to enhance grid flexibility.
Best practices related to LFMs	• Promote the adoption of energy-efficient technologies and practices at various levels (household, building, community). - Encourage the use of energy management systems and demand response programmes for optimisation. • Provide incentives and educational campaigns to raise awareness and encourage energy optimisation behaviours.
Energy Service: Time-of-Use (ToU), Peak shaving	
Description of the service	Portugal's electricity market offers Time-of-Use pricing options, where electricity prices vary based on time periods, encouraging consumers to shift their consumption to off-peak hours. Peak shaving practices help reduce energy demand during periods of high electricity consumption, contributing to grid stability.
Requirements to provide the service	• Ability to assess, plan, and implement energy optimisation initiatives. • Ability to offer pricing plans and billing systems based on ToU rates. • Knowledge and capability to implement load management strategies for peak shaving.
Laws / Legislation of reference	Time-of-Use pricing and peak shaving initiatives can be established by electricity suppliers within the framework set by ERSE and the regulatory provisions governing the electricity sector in Portugal.
Main barriers that limit the profitability and impact of the service	• Limited availability and adoption of ToU pricing schemes. • Lack of flexible electricity tariffs that incentivise peak shaving. • Insufficient consumer awareness and understanding of peak shaving strategies.
Relevant aspects for LFMs	• Implementation of ToU pricing schemes and peak shaving mechanisms within LFMs. • Clear communication and education campaigns to raise consumer awareness and promote participation in ToU programmes.
Best practices related to LFMs	• Implement clear and flexible tariff structures to incentivize

	time-of-use consumption patterns. • Enable demand response programmes that incentivize peak shaving actions. • Provide consumer education and engagement programmes to promote active participation in ToU and peak shaving initiatives.
Energy Service: Predictive building management	
Description of the service	This service in Portugal utilises data analytics and predictive models to optimise building performance, energy consumption, and maintenance. It enables proactive measures to improve energy efficiency and reduce operational costs.
Requirements to provide the service	• Access to data analytics tools and software for predictive modelling. • Integration with building automation and control systems. • Expertise in analysing data and predicting energy consumption patterns.
Laws / Legislation of reference	Framework set by ERSE and the regulatory provisions governing the electricity sector in Portugal.
Main barriers that limit the profitability and impact of the service	• Limited availability and quality of data for predictive modelling. • Challenges in integrating predictive building management systems with existing building infrastructure. • High upfront costs and complexity of implementing predictive building management technologies.
Relevant aspects for LFMs	• Integration of predictive building management systems within LFMs to enhance flexibility and energy efficiency. • Collaboration between building owners, technology providers, and grid operators to facilitate predictive building management in LFMs.
Best practices related to LFMs	• Deploy advanced building management systems that utilise predictive analytics and machine learning algorithms. - Integrate building management systems with LFM platforms to optimise flexibility and energy efficiency. • Foster collaboration between building owners, technology providers, and grid operators to share best practices and data.
Energy Service: Peer-to-peer (P2P) trading	
Description of the service	P2P trading platforms are emerging in Portugal, enabling direct energy transactions between consumers or prosumers, facilitating the exchange of locally produced renewable energy and promoting local energy communities.
Requirements to provide the service	• Participation in a P2P trading platform or agreement. • Compliance with regulatory requirements for energy trading.

	• Technical capabilities to facilitate energy transactions, metering, and settlement.
Laws / Legislation of reference	P2P energy trading in Portugal is currently being explored and developed within the framework of European Union legislation and regulatory initiatives. Specific legislation or guidelines for P2P trading may be introduced in the future.
Main barriers that limit the profitability and impact of the service	• Regulatory barriers and lack of specific rules for P2P trading in the energy market. • Technical challenges in establishing secure and efficient P2P trading platforms. • Limited consumer awareness and participation in P2P trading.
Relevant aspects for LFMs	• Development of regulatory frameworks and market rules to enable P2P trading within LFMs. • Creation of secure and transparent P2P trading platforms integrated into the LFM infrastructure.
Best practices related to LFMs	• Establish regulatory frameworks that support and facilitate P2P trading within LFMs. • Develop secure and transparent P2P trading platforms integrated with LFM infrastructure. • Implement clear rules and mechanisms for settlement, balancing, and grid interaction in P2P transactions.
Energy Service: Collective self-consumption	
Description of the service	Collective self-consumption initiatives in Portugal allow a group of consumers to collectively benefit from a shared renewable energy system. Excess energy generated is distributed among the participants, promoting renewable energy usage and cost-sharing.
Requirements to provide the service	• Formation of a legal entity or community framework for collective self-consumption. • Compliance with regulations governing self-consumption and sharing of renewable energy. • Agreements among participants on energy sharing, billing, and excess energy distribution.
Laws / Legislation of reference	The legal framework for collective self-consumption in Portugal is defined in Decree-Law No. 162/2019. It establishes the conditions, rights, and obligations for collective self-consumption of renewable energy.
Main barriers that limit the profitability and impact of the service	• Complex administrative procedures and legal requirements for establishing collective self-consumption projects. • Challenges in balancing energy generation and consumption within the collective self-consumption community. • Limited availability of financial incentives or support for

	collective self-consumption initiatives.
Relevant aspects for LFMs	• Supportive regulations and administrative processes for collective self-consumption projects within LFMs. • Clear guidelines for the participation of collective self-consumption communities in LFMs and grid interactions.
Best practices related to LFMs	• Simplify administrative procedures and regulations for collective self-consumption projects. • Encourage community engagement and collaboration in collective self-consumption initiatives. • Provide financial incentives and support mechanisms for the implementation of collective self-consumption projects.
Energy Service: Congestion management	
Description of the service	In Portugal, congestion management involves the efficient management and control of electricity flows within the grid to alleviate congestion issues and ensure grid stability, particularly in areas with high renewable energy penetration or capacity constraints.
Requirements to provide the service	• Access to grid data and real-time monitoring capabilities. • Compliance with grid codes and regulations for congestion.
Laws / Legislation of reference	Congestion management in Portugal is governed by the regulatory framework established by ERSE, the transmission system operator (REN), and distribution system operators (DSOs). This includes rules and procedures for congestion management and grid operation.
Main barriers that limit the profitability and impact of the service	• Insufficient grid infrastructure and capacity to handle increasing renewable energy generation. • Limited coordination and cooperation between grid operators and energy market stakeholders. • Regulatory and administrative barriers to grid expansion and grid reinforcement projects.
Relevant aspects for LFMs	• Effective grid planning and investment strategies to address congestion challenges within LFMs. • Coordination mechanisms between grid operators, flexibility providers, and market stakeholders to manage congestion in LFMs.
Best practices related to LFMs	• Develop effective congestion management mechanisms that consider both supply and demand flexibility. • Implement advanced grid monitoring and control systems to detect and address congestion issues. • Encourage coordination and cooperation among market

	participants, grid operators, and regulators to manage congestion effectively.
Energy Service: Imbalances management	
Description of the service	Imbalances management in Portugal refers to the process of addressing energy imbalances between contracted energy and actual consumption. It involves monitoring, reporting, and settling imbalances to maintain grid stability and ensure compliance with regulatory requirements.
Requirements to provide the service	• Registration as a Balance Responsible Party (BRP) with the Portuguese TSO or DSO. • Compliance with the rules and procedures set by the TSO or DSO for imbalance settlement. • Accurate measurement and reporting of energy imbalances between contracted energy and actual consumption. • Timely settlement of any financial obligations resulting from imbalances. • Adherence to regulatory requirements and obligations related to imbalance management.
Laws / Legislation of reference	Imbalances management in Portugal is regulated by ERSE, REN, and DSOs. The specific rules and procedures for imbalance settlement, metering, and reporting are defined in accordance with national and European regulations.
Main barriers that limit the profitability and impact of the service	• Challenges in accurately forecasting and balancing electricity supply and demand. • Penalties and financial risks associated with imbalances. • Lack of flexibility and options for managing imbalances in real-time.
Relevant aspects for LFMs	• Efficient imbalance settlement processes and mechanisms within the LFM framework. • Flexibility services and markets to manage imbalances and minimise penalties.
Best practices related to LFMs	• Establish clear rules and guidelines for the settlement of imbalances within LFMs. • Develop accurate forecasting tools and methodologies to minimise imbalances. • Encourage flexibility providers to actively participate in balancing markets and offer their services to balance supply and demand.

4.4. Ireland

Table 4: Questionnaire results for Ireland.

Energy Service: Energy Supply Contracting	
Description of the service	The Energy Supply Contracting (ESC) business model is a proven model to implement efficient supply (from fossil and/or renewable sources) in new and existing buildings of the public, industrial, commercial and large residential sectors.
Requirements to provide the service	The Energy Contracting Support Scheme provides financial assistance to help businesses and public sector organisations to deliver energy efficiency and decarbonise projects through Energy Performance Contracts (EPCs), Local Energy Supply Contracts (LESCs) and Energy Performance Guarantees (EPGs). The support is not limited to any specific project type or technology, but they must incorporate a pay-for-performance element. Project proposals with the following criteria are particularly encouraged: • Deep energy retrofit and / or decarbonisation actions. • Work packages comprising multiple project elements and / or technologies. • Project aggregation or comprising multiple facilities. • Projects that set organisations on a trajectory to net zero. • Projects that contribute positively to the energy contracting knowledge base and support the development of the energy contracting supply chain.
Laws / Legislation of reference	SI 20 of 2022
Main barriers that limit the profitability and impact of the service	Regulatory: Compliance with energy market regulations and government policies can be complex. Navigating and adhering to regulatory requirements can be costly and time-consuming. Financial: • ESC projects often require significant initial investments in energy-efficient equipment and technologies, which constitutes a barrier for organisations with limited capital. • The return on investment for ESC projects may take several years, which can discourage potential clients looking for quicker financial returns. • The level of competition can also affect the pricing and quality of ESC services, which in turn influences both profitability and the actual impact achieved through these energy-saving initiatives. Balancing market size and competition is crucial for ESC providers to thrive and for the market to make a meaningful contribution to energy efficiency and sustainability goals in

	Ireland.
Relevant aspects for LFMs	Ireland's climate, energy needs, and sustainability goals may influence the types of ESC projects and services that are in demand, including LFMs.
Best practices related to LFMs	N/A
Energy Service: Energy Performance Contracting	
Description of the service	EPC allows funding energy upgrades from cost reductions. Under an EPC arrangement, an external organisation (ESCO) implements a project to deliver energy efficiency or deploy renewable energy, and uses the stream of income from the cost savings or the energy produced, to repay the costs of the project, including the initial investment. A contractor implements these measures and through the contract, guarantees savings. The client pays the contractor from these savings over a number of years. If savings fall short, the contractor covers the difference.
Requirements to provide the service	• A contractual arrangement between the beneficiary and the provider of the aforementioned measures. • Verification and monitoring 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.
Laws / Legislation of reference	Energy performance contracting is supported through SI 426 of 2014, and defined by the Energy Efficiency Directive 2012/27/EU.
Main barriers that limit the profitability and impact of the service	• Public sector organisations often face complex and lengthy procurement processes. These processes can be a barrier to implementing EPC projects, particularly in the public sector. • In cases where the building owner is different from the energy user, a split incentive problem can occur. Building owners may be hesitant to invest in energy efficiency improvements when the tenants benefit from reduced energy costs. • The transaction costs associated with EPC projects, including legal and administrative fees, can be substantial. These costs may discourage organisations from pursuing EPC agreements, especially if the potential energy savings are not significant.
Relevant aspects for LFMs	• Providing incentives or mechanisms for building owners, tenants, and energy users to collaborate and share the benefits of participating in LFMs can facilitate broader engagement and address the split incentive problem.

	• To make participation in both EPC projects and LFMs financially feasible, it is essential to reduce transaction costs. Standardising contracts, procedures, and legal requirements can help minimise the administrative and legal fees, making participation in LFMs and EPC projects more attractive. • Common procurement standards and simplified procedures can be implemented to encourage participation in energy efficiency and flexibility initiatives.
Best practices related to LFMs	N/A
Energy Service: Power Purchase Agreement	
Description of the service	Corporate PPAs are a way for businesses to purchase electricity directly from generators. This differs from the standard approach, in which businesses buy power from a licensed electricity supplier and generators sell their output to those suppliers at the market price, which varies. However, cPPAs are often struck at some sort of fixed price, usually over a long time period.
Requirements to provide the service	• Supply: a pool of projects seeking cPPAs as a route-to-market. • Value: projects with the right combination of price, additionality, traceability, and price certainty to meet corporate criteria. • Risk: appropriate allocation of risk between the counterparties. • Execution: Simplified contractual terms, greater liquidity and more transparent price discovery.
Laws / Legislation of reference	SI 119 of 2023
Main barriers that limit the profitability and impact of the service	• While Ireland has abundant wind resources, renewable energy generation is intermittent. This intermittency can affect the reliability of power supply under a PPA, potentially increasing costs for the off-taker. • Connecting renewable energy projects to the grid can be challenging in certain locations. Delays or additional costs associated with grid connection can impact the feasibility of PPA projects. • Off-takers may be concerned about the creditworthiness and financial stability of renewable energy providers. The perception of risks associated with PPA projects can be a barrier to entry.
Relevant aspects for LFMs	The mentioned barriers would apply also to LFMs.
Best practices related to LFMs	N/A
Energy Service: Pay for Performance (P4P) scheme	
Description of the service	In the P4P scheme, the chosen option when installing and operating energy technologies in a business, influences the level of energy and cost savings guaranteed. There are two different types

	of P4P schemes: • Simple: Contractual guarantee making a portion of payment conditional on performance. • Complex: Third parties take full performance and finance risk of the energy project but on the basis of having future savings as a revenue stream.
Requirements to provide the service	• Regulatory: Compliance with Irish energy regulations and guidelines, as well as adherence to relevant laws and standards governing energy services. • Licensing: Depending on the nature of the services provided, licensing or authorization from regulatory authorities may be required. This ensures that service providers meet certain qualifications and standards. • Collaboration with ESCOs: Collaboration with Energy Service Companies (ESCOs) or other entities that specialise in energy efficiency to facilitate the successful execution of energy-saving projects. • Financial Resources: Sufficient financial resources to invest in energy efficiency projects and cover initial costs, as P4P models typically require upfront investments in energy-saving measures. • Stakeholder Engagement: The ability to engage with various stakeholders, including energy consumers, regulatory bodies, and other market participants.
Laws / Legislation of reference	As EPC, it is supported through SI 426 of 2014, and defined by the Energy Efficiency Directive 2012/27/EU.
Main barriers that limit the profitability and impact of the service	• Costs: The P4P scheme often requires building owners or energy efficiency project initiators to make upfront investments in energy-saving measures. The financial burden of these costs can be a significant barrier, especially for smaller organisations or homeowners. • Return on Investment (ROI) uncertainty: Some energy efficiency projects may have uncertain or long payback periods. This can prevent potential participants from investing in P4P projects, as they are unsure about when they will recover their initial costs. • Contracting and Legal Challenges: Developing and implementing performance-based contracts can be legally complex. Legal and contracting challenges can deter participants from engaging in P4P schemes. • Weather: In Ireland's variable weather, energy consumption is highly susceptible to weather fluctuations, posing challenges for predicting energy savings. • Split incentive issue: Encouraging behavioural change can be challenging, and the success of P4P projects may depend on the willingness of occupants to embrace energy-efficient practices.

Relevant aspects for LFMs	P4P incentivises energy-saving practices. LFMs can use the same principles to motivate local energy consumers to conserve energy when required, helping to balance local energy supply and demand. P4P often involves collaboration among various stakeholders, including building owners, contractors, and ESCOs. LFMs can engage with local stakeholders, including distributed energy resources (DER) owners and local utilities, to enhance grid flexibility and energy efficiency. Both P4P and LFMs should consider weather-related challenges. LFMs can use weather forecasts to anticipate grid demands and potential stress points, just as P4P projects may consider weather variations in their energy-saving calculations.
Best practices related to LFMs	N/A
Energy Service: Energy consultation (e.g., energy audit)	
Description of the service	The Sustainable Energy Authority of Ireland (SEAI) offers the Support Scheme for Energy Audits (SSEA) to look at electricity, gas, oil, diesel, and any other energy sources that are used in a facility. The energy audit will include transport fuel for the company fleet, if applicable, but will not look at processes and activities that occur offsite. It will consist of 3 main steps: 1. Collection & review of facility's energy data. 2. Site visit by Auditor. 3. Production of Energy Audit Report (called the SSEA Report). Apart from the energy audit, Building Energy Rating (BER) certificates rate homes' energy performance on a scale between A and G (from the most to the least energy efficient).
Requirements to provide the service	SEAI's Support Scheme for Energy Audits (SSEA) will offer SMEs a €2,000 voucher towards the cost of a high quality energy audit. In most cases, this will cover the total cost of the audit. Application to the scheme is easy, with automatic approval for eligible businesses, which must meet the following requirements: • Non-obligated entities (SMEs or public sector bodies with a useful floor area less than 500m2 and spending less than €35,000 per year on energy consumption). • Tax compliant. • Registered in the Republic of Ireland. • At least €10,000 spent on energy (exclusive of transport energy costs) per year at the site being audited. A BER certificate is compulsory for all homes available for rent or sale.
Laws / Legislation of reference	SI 243 of 2012

Main barriers that limit the profitability and impact of the service	• Split Incentive issue. Cases where property owners are different from the energy users can create challenges. • Concerns about the return on investment. • Energy audits and BER assessments may yield recommendations that require significant technical expertise to implement. Property owners may find it difficult to understand and act upon complex energy-saving recommendations.
Relevant aspects for LFMs	The mentioned barriers would apply also to LFMs.
Best practices related to LFMs	N/A
Energy Service: Energy Management System	
Description of the service	An EMS is a process for continually improving energy performance. Suitable for all organisations, whatever the size or sector, it is particularly beneficial for operating energy intensive processes.
Requirements to provide the service	N/A
Laws / Legislation of reference	The international standard ISO 50001 specifies requirements for establishing, implementing, maintaining and improving an energy management system. Before its introduction, the standard EN 16001 was best practice for energy management.
Main barriers that limit the profitability and impact of the service	N/A
Relevant aspects for LFMs	N/A
Best practices related to LFMs	N/A
Energy Service: Project design, implementation and maintenance	
Description of the service	According to the Energy Performance Contracting Handbook, there are 5 steps recommended when deploying any energy saving project: 1. Get organised 2. Initial appraisal and feasibility study 3. Detailed appraisal and final business case 4. Procurement 5. Contract implementation and operation
Requirements to provide the service	N/A
Laws / Legislation of reference	SI 20 of 2022
Main barriers that limit the	• Complex and time-consuming regulatory and permitting

profitability and impact of the service	processes can delay project implementation and increase costs, becoming a significant barrier. • The scarcity of skilled labour in renewable energy system installation or building retrofitting can lead to increased project costs and longer completion times. • Projects that are particularly large or complex may face difficulties in design and implementation, as well as ongoing maintenance. • In some sectors, such as residential solar installations, the market may become saturated, making it challenging for new entrants to find profitable opportunities. • Challenges related to grid connection and infrastructure limitations can affect projects, particularly in the renewable energy sector. Delays or additional costs related to grid integration can be barriers.
Relevant aspects for LFMs	Ensuring reliable grid connection and addressing infrastructure limitations is vital for LFMs. Investments in grid upgrades and smart grid technologies can enhance the integration of flexibility services.
Best practices related to LFMs	N/A
Energy Service: Metering & monitoring services	
Description of the service	Energy monitoring can be defined as the establishment of the energy consumption pattern for a building or plant. Energy targeting uses the identified consumption levels to find new ways to reduce energy usage and improve efficiency.
Requirements to provide the service	Public bodies should report annual consumption subtotals for electricity, thermal and transport. All the necessary data must be gathered before starting the process.
Laws / Legislation of reference	SI 37 of 2022
Main barriers that limit the profitability and impact of the service	• Metering and monitoring systems require upfront investments in equipment and technology. • With the increasing focus on data privacy and security regulations (e.g. GDPR), ensuring that metering and monitoring systems comply with these regulations can be complex. Data breaches or non-compliance can result in significant legal and financial penalties. • Rapid advancements in technology can lead to the obsolescence of metering and monitoring systems. Organisations may be hesitant to invest in systems that could become outdated quickly. • Inefficiencies can result from metering and monitoring systems that do not integrate well with other energy management or

	building automation systems.
Relevant aspects for LFMs	The mentioned barriers would apply also to LFMs.
Best practices related to LFMs	N/A
Energy Service: Smart contracts	
Description of the service	A smart contract is a legally valid contract that executes automatically using a computer program.
Requirements to provide the service	Smart contracts need a DLF platform implementing blockchain technologies, and digital currencies.
Laws / Legislation of reference	In Ireland no review of smart contracts has been formally carried out, and there is no specific law dealing with smart contracts. Legal professionals in Ireland have been echoing different UK regulatory efforts (Law Commission 'Call for Evidence'). In Irish law, a contract is not necessarily written down to be legally enforceable. Blockchain Ireland[33] is a stakeholders group that supports advancing in the strategic direction of the digital market and DLT technologies to support regulatory roadmaps to the public, the Bank of Ireland, and the Irish department of Finance. The following are the applicable law instruments: • Directive 2011/83/EU of the European Parliament and of the Council of 25 October 2011 on consumer rights (the 'Consumer Rights Directive). • Section 12(1) of the Electronic Commerce Act 2000 in Ireland. • The Lugano convention. • Regulation (EU) 1215/2012 of the European Parliament and of the Council on jurisdiction and the recognition and enforcement of judgments in civil and commercial matters (Brussels Recast).
Main barriers that limit the profitability and impact of the service	Smart contracts are still at a very early development stage in Ireland. The following barriers have been identified: • Confirmation of agreement in code-only contracts is difficult to prove. Use of electronic signatures and digitally signed contracts could be a way of solving this as digital signatures have been allowed in Irish law since 2000. • Code-only contracts may need the use of a mediation of specialist code experts to decipher code. • Computer code and natural language code could conflict and be difficult to judge. • Difficulty to identify the parties and its jurisdiction. • Difficulty to identify when the contract was accepted. • Cost of infrastructure.

[33] https://www.blockchainireland.ie/about/consultation-papers-research/

Relevant aspects for LFMs	• Smart contracts interpretations are unambiguous as contracts that use natural language. • Reduced risk of fraud. • Lower enforcement costs
Best practices related to LFMs	There are no energy related smart contracts examples in Ireland. Other relevant examples are (1) we.trade platform that is using smart contracts to launch and administer agreements between banks and clients. The platform is a blockchain based initiative based in Dublin which has been developed by a consortium of nine major European banks. (2) ConsenSys, a global blockchain company operating in Ireland, has also established a blockchain studio in Dublin where developers are actively working on a range of smart contract projects on the Ethereum blockchain.
Energy Service: Energy optimisation (at household, building and/or community level)	
Description of the service	Energy communities, BER, Energy labelling and ecodesign, Home upgrades: • The SEAI Sustainable Energy Community (SEC) Programme engages and enables energy citizens who are working together to achieve their energy goals. Being a member of the SEC Network enables SECs to engage and learn from existing SECs, energy project site visits, capacity building workshops, local and regional SEC events, and case studies. • SEAI is also supporting schools and teachers across Ireland to help teach students about saving energy at school and at home, sustainability and climate change.
Requirements to provide the service	The SEC Programme is designed to enable communities to manage and save energy across all sectors. It requires the following: • All domestic buildings completed must deliver a minimum BER uplift of 100 kWh/m²/yr. • 10 pre BER's are required at the application stage. • A pre BER and post BER should be published for all homes, this will be supported under the Better Energy Community (BEC) Scheme. • It should be noted that if a Pre BER is older than five years, a new Pre BER will be necessary for publication. The published BER Certificate, Advisory Report, and Dwelling Report associated with the Pre BER publication should be retained.
Laws / Legislation of reference	SI 76 of 2022 under "Renewable energy communities"
Main barriers that limit the profitability and impact of the service	• Uncertainty for building and homeowners about the time it takes to get a return on their investments in energy optimisation, hindering them from making energy-efficient upgrades.

	• Consumer behaviours and attitudes towards energy conservation. Resistance to change or a lack of motivation to reduce energy consumption can prevent the adoption of energy optimisation measures. Doing this at the community level may require coordinated efforts among residents, which can be challenging to achieve.
Relevant aspects for LFMs	LFMs must be adaptable and flexible to accommodate the varying needs and objectives of different energy communities. Providing a framework that can cater to diverse design projects is essential.
Best practices related to LFMs	N/A
Energy Service: Time-of-Use (ToU), Peak shaving	
Description of the service	• Time-of-Use (ToU) tariffs are a new way for homes with smart meters to pay for electricity. Different rates are paid at different times of the day. This differs from a traditional 'flat' tariff, which charges the same rate at all times of day. ToU tariffs reflect the amount of electricity used at different times. Usage is low at night and highest in the late afternoon, according to demand variations. • Peak-shaving: reduction of customer's import from grid during peak network times by storing sufficient capacity within a battery. It is essential to ensure that the energy stored in the battery is enough to satisfy the demand.
Requirements to provide the service	N/A
Laws / Legislation of reference	S.I. No. 542 of 2009 Metering and Billing for Non-Regulated Energy Sector
Main barriers that limit the profitability and impact of the service	• A smart meter is required. Even if there are over 1.4 million smart meters installed in Ireland, the roll-out is still taking place. • Many consumers may be unaware of ToU pricing and peak shaving opportunities, hindering their ability to take advantage of cost-saving strategies. • Collecting and sharing consumer energy usage data for peak shaving purposes may raise privacy concerns. • The availability of demand response programmes, which are essential for effective peak shaving, may be limited.
Relevant aspects for LFMs	Privacy concerns are relevant to LFMs. Limited availability of DR programs can be a barrier to effective local flexibility.
Best practices related to LFMs	N/A

Energy Service: Predictive building management	
Description of the service	Predictive building maintenance uses model based cutting-edge technology and data analytics to enhance the efficiency of building operations. It offers two key services: (1) Predictive maintenance, which aims to prevent potential failures and, (2) Optimal operation management, allowing buildings to enhance energy efficiency, decrease energy expenses, minimise greenhouse gas emissions, and intelligently engage with the power grid.
Requirements to provide the service	• Buildings with a Building Management System; • Vendor platform that can connect to existing legacy assets such as BMS, legacy PLCs. etc. • Connected building to API powered databases. • Contractual arrangements between energy services companies and facility owners/operators.
Laws / Legislation of reference	No explicit regulatory framework exists regarding provision of predictive maintenance services. However, legal arrangements need to be in place to regulate the privacy and ownership of data.
Main barriers that limit the profitability and impact of the service	In Ireland, the state of Model Predictive Control (MPC) for building management is not extensively documented. Potential barriers to its adoption may include regulatory frameworks, economic factors, technical expertise, infrastructure compatibility, and awareness among stakeholders. These factors collectively influence the implementation of MPC systems in buildings within Ireland.
Relevant aspects for LFMs	Model supported energy management in buildings can provide a better insight and forecasting capabilities for demand management.
Best practices related to LFMs	Examples of MPC and predictive maintenance targeting buildings are scarce, although there are numerous academic papers targeting renewables and smart grid monitoring applications. Examples related to industrial infrastructure (motors, wind farms, etc.), are more common.
Energy Service: Peer-to-peer (P2P) trading	
Description of the service	P2P trading is defined as the sale of renewable energy between market participants by means of a contract with pre-determined conditions governing the automated execution and settlement of the transaction directly between participants or indirectly through a certified third party market participant, such as an aggregator. The right to conduct peer-to-peer trading shall be without prejudice to the rights and obligations of the parties involved as final customers, generators, suppliers or aggregators.

Requirements to provide the service	• Licensing: Obtain the necessary licenses or registration as required by the regulatory authority. • Compliance: Adhere to energy market regulations and rules governing electricity and gas trading. • Data Privacy: Ensure compliance with data protection and privacy regulations, such as GDPR. • Market Rules: Follow specific market rules and guidelines for trading, pricing, and settlements. • Grid Integration: Ensure compatibility with the existing grid infrastructure. • Consumer Protection: Implement measures for consumer protection and dispute resolution. • Environmental Compliance: Comply with renewable energy support schemes and environmental regulations, if applicable. • Market Reporting: Provide transparency and reporting to regulatory authorities.
Laws / Legislation of reference	SI 76 of 2022 under "Renewables self-consumers"
Main barriers that limit the profitability and impact of the service	• Ensuring interoperability with existing systems and market participants is necessary for a seamless P2P trading experience. • Overcoming technical obstacles related to metering, settlement, and grid management is essential for P2P trading success. • High entry costs for new P2P trading providers and the need for significant capital investments can limit market competition. • Managing transaction costs, such as platform fees, blockchain or digital infrastructure costs, and settlement expenses, is vital to ensure the economic feasibility of P2P trading.
Relevant aspects for LFMs	The mentioned barriers would apply also to LFMs.
Best practices related to LFMs	Solo Energy has produced a way for citizens to make use of renewable energy throughout the day by pairing it with battery storage. Storing renewable energy can be done via solar panels on the roof or by topping up the batteries when renewable energy is being used by the grid. This stored energy can then be used to help the grid when demand is high. Solo gives electricity consumers the opportunity to get involved in the energy system so they can buy, sell and trade energy within the community while supporting the wider grid network and local renewable energy generators. Their Unique Selling Proposition is FlexiGridTM - a cloud-based aggregation platform that turns intermittent renewable generation into a smart, stable energy system by controlling distributed flexible energy storage assets such as batteries to balance local supply and demand while simultaneously executing peer-to-peer

	energy trades. The idea is that the consumer will benefit from lower prices, use as much renewable energy as possible and the grid gets access to renewable generation 24 hours a day.
Energy Service: Collective self-consumption	
Description of the service	Collective Self-consumption (CSC) is a system that helps shift towards cleaner energy in the electricity sector by letting people in a community share renewable energy sources. This community usually includes neighbours, a local area, or a group of businesses. Unlike small power grids, CSC projects stay connected to the main power network and don't aim to let users disconnect from it (islanding). They allow several users to benefit from shared renewable energy installations, which is different from setups that serve only one user. Also, unlike Virtual Power Plants (VPP), CSC relies on having both energy use and generation happening in the same area.
Requirements to provide the service	Requirements for CSC are in discussion. A CRU led consultation process regarding different matters affecting RE communities and CSC. CRU finally decided regarding "proximity requirements" as follow for renewable energy communities[34]: • Proximity requirements for a REC are to be set by those in the community. • *Requirements should be established when formalising the REC as a legal entity through a written constitution.* • *It should be clear from the REC's constitution how it assesses the proximity criteria.* • *The RECs constitution should be accessible such that members/shareholders (or potential members / shareholders) can see who can be involved in the control of the REC.* • *Membership of the REC is limited to those served by the Irish distribution network.* • *The REC must satisfy itself that its constitution is in line with the intentions of the Renewables Directive and must state this in its constitution.* • *Effective control must remain within the proximity of the renewable asset.*
Laws / Legislation of reference	No framework for collective self-consumption in multi-tenant buildings exists yet in Ireland. The Multi-units development Act 2011 provides the regulatory framework for the shared areas and facilities of a residential block, which are managed by a "Owners Management Company (OMC)". However, various interconnected

[34] https://www.cru.ie/publications/27626/

	ideas have emerged, including the promotion of local renewable energy generation. Renewable Energy Communities (RECs) are among these concepts. The Commission for Regulation of Utilities was called to review the regulation framework and produced a key document Consultation on Energy Communities and Active Consumers (2021). A new Renewable Electricity Support Scheme (RESS) was implemented in 2020 by the Irish Government. This scheme introduces community-led projects that receive special incentives for renewable energy generation. These projects must adhere to certain criteria, as outlined by the Sustainable Energy Investment Association (SEIA) in 2020: • They must be affiliated with a "Sustainable Energy Community" (SEC), which has been a concept in Ireland for several years. SECs are broader, regional initiatives, whereas community-led projects are more localised. • The community-led project's declaration must specify its connection to the relevant SEC and the relationship between the applicant and the SEC. • The majority ownership (at least 51%) must belong to a Renewable Energy Community whose primary goal is community benefits rather than financial profit. • A minimum of 51% of all profits, dividends, and surpluses must be reinvested into the REC. • The energy generation capacity of the project is limited to 5MW. In addition to the RESS, Ireland also implemented a new grid connection policy (ECP) in 2020 to facilitate connections for community-led renewable energy projects. This policy, established by the Commission for Regulation of Utilities, aims to reduce implementation barriers by offering preferred connection opportunities to eligible projects (ECP projects). Shareholders or members of a REC must reside in close proximity to an ECP project, whether they are small to medium-sized enterprises (SMEs), local authorities, or individual residents
Main barriers that limit the profitability and impact of the service	• Lack of community interests as 97% of residential buildings in Ireland are single dwellings. • Lack of culture regarding collective management of shared facilities. • Perceived high cost of multi-tenant developments and costs of management mediated by the OMC. • Limited network capacity. • Lack of financial incentives. • Monetization is difficult due to increased costs and complexity of participation in PPAs or Auctions. • Barriers regarding Planning application, NIMBYsm, and public

	opposition. • Current models geared towards other-than-monetary impact.
Relevant aspects for LFMs	It is widely accepted that the implementation of CSC is a valid example that can help unlock the potential of the local flexibility market.
Best practices related to LFMs	Examples that focus on CSC were not found currently in Ireland.
Energy Service: Congestion management	
Description of the service	Price-incentivised contracts for local energy markets to modify their production and consumption patterns in response to congestion signals.
Requirements to provide the service	Congestion management is currently provided by EirGrid which is the TSO in the Republic of Ireland and SONI in Northern Ireland in accordance with the Transmission System Operator Licence obligations.
Laws / Legislation of reference	A breadth of legislation applied to congestion management can be consulted in the EirGrid and SONI Balancing Market Principles Statement[35]. Legislation covers (1) general EU and National legislative regulations of the TSO and energy market, (2) Operational Security (3) Priority Dispatch Obligations (4) Efficient Operation of the SEM Obligations and (5) Transparency obligations.
Main barriers that limit the profitability and impact of the service	• Demand inelasticity of the residential market; • Lack of monetary incentives for demand side flexibility targeting industry and business. • Standards and Services workstreams to support 70% RES-E and 95% SNSP by 2030 are still under development. • Market size and market liquidity. • Responsibility allocation between DSO-TSO is unclear; • High transaction costs between TSO-DSO-Aggregators due high information exchange and computational costs.
Relevant aspects for LFMs	Flexibility is a key instrument to enhance congestion management.
Best practices related to LFMs	An ongoing multi-annual 2022-2026 TSO-DSO [36] joint system operator program is in place. The program includes “Enabling the provision of system services from new technology introduced on the transmission and distribution network”. A dedicated Pilot (Pilot 1 – Load Congestion) is currently under development including the following candidate areas: • Dublin – Watling Street 38kV Zone

[35] https:/cms-prd.eirgrid.dept.ie/sites/default/files/publications/EirGrid-and-SONI-Balancing-Market-Principles-Statement-V7.0.pdf
[36] https://www.eirgrid.ie/site-files/library/EirGrid/Multi-year_DSO-TSO_WorkPlanCovering2023-2027.pdf

	• Dublin – Corduff Zone (Corduff, Macetown and College Park) • Dublin – Dublin North Zone (McDermott, Pelletstown, Cabra, Wolfe Tone St. and Artane) • Wexford – Clonroche Zone • Wexford – Wexford East Zone (Mulgannon, Clonard and Carriglawn) • Meath – Trim Zone • Kildare – Blake and Edenderry Zone • Wicklow/Carlow – Wicklow-Carlow Zone (Shillelagh, Tullow and Baltinglass)
Energy Service: Imbalances management	
Description of the service	Price-incentivised contracts for local energy markets to modify their production and consumption patterns in response to grid imbalance signals.
Requirements to provide the service	Imbalances management is currently provided by EirGrid which is the TSO in the Republic of Ireland and SONI in Northern Ireland in accordance with the Transmission System Operator Licence obligations.
Laws / Legislation of reference	A breadth of legislation applied to imbalances management can be consulted in the EirGrid and SONI Balancing Market Principles Statement document (BMPS). Legislation covers (1) general EU and National legislative regulations of the TSO and energy market, (2) Operational Security (3) Priority Dispatch Obligations (4) Efficient Operation of the SEM Obligations and (5) Transparency obligations.
Main barriers that limit the profitability and impact of the service	• Demand inelasticity of the residential market; • Lack of monetary incentives for demand side flexibility targeting industry and business. • Market size and market liquidity. • High transaction costs between TSO-DSO-Aggregators due to information exchange and computational costs.
Relevant aspects for LFMs	Flexibility is a key instrument to enhance imbalance management
Best practices related to LFMs	An ongoing multi-annual 2022-2026 TSO-DSO joint system operator program is in place. The program includes "Enabling the provision of system services from new technology introduced on the transmission and distribution network". Two pilot projects are looking at balancing products. Pilot 2 "DSO Pilot 2 - 2023 I&C DSR TSO Market (DSU InstructionSets)" is currently under development and looking for participants as well as Pilot 3 "DSO Pilot 3 2023 flexibility pilot of scale"

4.5. Bulgaria

Table 5: Questionnaire results for Bulgaria.

Energy Service: Energy Supply Contracting	
Description of the service	Business model based on the provision of useful energy, such as electricity, heat or steam to a building owner or user, through a long-term contract (e.g. 10 to 15 years).
Requirements to provide the service	From 1st of July 2020, domestic consumers with equal and more than 50 kW connected to electric power can enter the free electricity market. From 1 October 2020, all non-household consumers have an obligation to enter the free market by choosing an electricity supplier and signing a contract. The trader makes the transfer and enters into all necessary contracts on behalf of the client. Through the contract concluded with the trader, the consumer gives them the right to submit an application for initial registration on the free market, as well as to conclude contracts with the relevant network operator and with the provider of last resort. The contract will often include the purchase and sale of electricity, participation in a standard balancing group and payment for network services. Through this combined contract, the consumer agrees that the trader will supply him with electricity, perform balancing services and have the right to collect network and other charges that are a normal part of the final electricity bill.
Laws / Legislation of reference	Amendment to the Energy Act of 26.06.2020
Main barriers that limit the profitability and impact of the service	• Since 2018 the electricity generated for the free market is traded exclusively via the Independent Bulgarian Energy Exchange (IBEX) segments. • Even though the stability and transparency of the organised free electricity market increased with the integration of RES and all types of business customers, households have no incentive to enter the free electricity market because regulated prices are lower. • Uncertainty regarding the regulation of new technologies. For example, there is a lack of legislation to regulate smart energy networks and services. • Lack of new technologies hinders the development of flexible tariffs by traders that accurately cover individual consumption.
Relevant aspects for LFMs	Local flexibility market design is largely still in the conceptual stage in Bulgaria. Many regulatory changes and adaptation schemes would be necessary to enable Bulgaria's electricity market to develop as a LFM. Nonetheless, in compliance with the liberalisation process, the internal electricity market in Bulgaria has been established as a market for bilateral contracts and balancing market. Customers sign contracts with traders for electricity supply and traders purchase the required electricity from the generators to satisfy the needs of their customers. On a daily basis generators, traders and coordinators of balancing groups notify the Electricity System

	Operator (ESO) of their hourly schedules for generation and consumption for the next day. When there is a mismatch between the declared volumes and the actual consumption or generation, the balancing market steps in. ESO, as an operator of the balancing market, compensates the difference between the declared and the consumed/generated electricity. The resulting costs are charged to the market participants in the form of prices for balancing energy.
Best practices related to LFMs	FlexiGrid is an H2020 EU-funded innovation project that aims to create an enabling architecture for small and medium Distribution System Operators (DSOs) to unlock flexibility resources. As part of the project, the Bulgarian DSO Energo-Pro aims to test and validate the concept of smart grid flexibility by procuring flexibility services to consumers and producers while managing the grid stability through a market platform.
Energy Service: Energy Performance Contracting	
Description of the service	An EPC is a contractual arrangement between the beneficiary and the provider of an EE improvement measure, verified and monitored during the whole term of the contract, where investments in that measure are paid for in relation to an agreed level of energy performance criterion (Directive 2012/27/EU).
Requirements to provide the service	EPC contracts shall contain at least: • The normalised energy consumption established by an energy efficiency audit. • A list of the efficiency measures to be implemented and their associated costs. • Guaranteed energy savings, as well as provisions for measuring and confirming the achieved energy savings. • Description of the financial consequences of the project and the distribution of the shares of both parties in the achieved financial savings. • Method of financing. • Method of payment of remuneration. • Other clauses, encompassing inclusion of equivalent requirements for each subcontract with third parties, as well as detailed information on the obligations of each of the contracting parties and the sanctions for their violation. • Methodology for estimating the saved energy.
Laws / Legislation of reference	Article 72 of the Energy Efficiency Act (last amended 2018) regulates the ESC contracting.
Main barriers that limit the profitability and impact of the service	End-users are not interested in EPC. This is intensified in the conditions of possibilities of grant financing: • Some energy traders have ESCOs, but negotiation is difficult, even for very effective measures. • There is not enough interest in ESCOs.

	• There is a significant risk if the customer goes bankrupt. • There are no incentives for household consumers, who are the main customers for traders.
Relevant aspects for LFMs	N/A
Best practices related to LFMs	N/A
Energy Service: Power Purchase Agreement	
Description of the service	PPAs are long-term contracts between large industrial energy consumers and new RES project investors. These contracts are usually signed for periods from 5 to 20 years. Through them, the energy consumer commits to buying clean energy and will receive guarantees of origin without having to invest in their own equipment, such as wind/water turbines or solar panels.
Requirements to provide the service	The popular solution in Bulgaria currently is for companies to procure electricity through short-term supply contracts, usually from 6 months to 2 years. This exposes them entirely to the high price risk of the energy exchange. But there are already other opportunities on the market. Newly developed RES projects can ensure predictability of energy costs over a longer period of time, on top of clean energy supply.
Laws / Legislation of reference	RES Act
Main barriers that limit the profitability and impact of the service	However, because PPAs are contracts signed over a long period of time, they carry significant risks and costs for smaller market participants. Therefore, their availability is currently limited to a few large end customers (e.g. energy-intensive enterprises), creating a risk that access to decarbonized production is limited to a specific subset of users.
Relevant aspects for LFMs	PPAs provide a competitive advantage for companies hedging the energy prices. Such agreements ensure better planning of energy expenses and protect businesses from the price shocks of energy exchanges. In addition, they make it possible for companies to demonstrate a strong commitment to environmental protection and sustainable development to customers and investors, to meet regulatory requirements, to improve the ESG (Environmental, Social and Governance) rating of the company or to generate additional financial and marketing advantages.
Best practices related to LFMs	N/A
Energy Service: Pay for Performance (P4P) scheme	
Description of	Pay-for-Performance (P4P) is an innovative scheme to finance energy efficiency

the service	where payments are linked to the measured performance. However, P4P is not offered in Bulgaria.
Requirements to provide the service	• High level commitments to implement energy efficiency programmes based on Pay-For-Performance and metered savings. • A competent managing authority to support the scheme and develop a methodology for metered savings using measurement and verification methods.
Laws / Legislation of reference	N/A
Main barriers that limit the profitability and impact of the service	Lack of interest and initiative on behalf of the responsible parties, DSOs, etc. Lack of information and smart meters installed.
Relevant aspects for LFMs	N/A
Best practices related to LFMs	N/A
Energy Service: Energy consultation (e.g. energy audit)	
Description of the service	An energy audit is an inspection survey and an analysis of energy flows for energy conservation in a building. It may include a process or system to reduce the amount of energy input into the system without negatively affecting the output. In commercial and industrial real estate, an energy audit is the first step in identifying opportunities to reduce energy expense and carbon footprint. The energy audit is a process of analysis and evaluation of consumption.
Requirements to provide the service	Energy audits are performed by legal entities that meet the requirements of the Energy Efficiency Act and are certified for this activity by the Energy Efficiency Agency, being included in its public register. In Bulgaria, according to the Energy Efficiency Act, energy audits are a key element in conducting energy certification of buildings.
Laws / Legislation of reference	Article 31 of the Energy Efficiency Act (last amended 2018) regulates the energy audits and building certification
Main barriers that limit the profitability and impact of the	There is an obligation to conduct an energy audit before implementing EE measures in buildings to complete the assessment of energy savings. The main barriers are the formal audit completion and the wrong estimation of energy savings. Sometimes energy saving measures are too uniform and do not

service	provide clear information on the scope and content of the equipment offered. There is a need for more qualified energy auditors and consultants, especially as the energy audits are a prerequisite for the programs for building renovations.
Relevant aspects for LFMs	Support to the energy consultants and auditors for their participation in the LFM.
Best practices related to LFMs	N/A
Energy Service: Energy Management System	
Description of the service	An EMS is a collection of good practices, processes and activities necessary to improve energy performance of any type of organisation. Successful implementation depends on commitment from all levels and functions of the organisation, and especially from top management. The methodology is based on the deming cycle, or plan-do-check-act and is part of a philosophy of continuous improvement. The methodology is reported in ISO 50001 standard. This standard specifies requirements applicable to energy use and consumption, including measurement, documentation and reporting, design and procurement practices for equipment, systems, processes and personnel that contribute to energy performance.
Requirements to provide the service	Energy management is the planning and control of the operation of energy consuming facilities. It is carried out on the basis of complex automated systems for analysis, monitoring and implementation of measures aimed at increasing energy efficiency. Energy management systems can be built on the basis of existing metering and communication devices and cover all energy consumers in the site (or part of them). It is necessary to provide accurate analysis about the actual consumption of all capacities in the site. There is a need to build a monitoring system for control of the energy consumption at all critical points. After the corresponding analysis, the measures to be taken have to be defined on the basis of RoI. It is important to define a precise and clear goal for energy saving.
Laws / Legislation of reference	Energy Efficiency Act Requirements of ISO 50001
Main barriers that limit the profitability and impact of the service	• The standard ISO 50001 is not mandatory and its application depends on the knowledge and expertise of the interested parties. • There is a need for more information and training.
Relevant aspects for LFMs	The integration of the Intelligent Energy Management Systems with local flexibility services will further contribute to the development of the LFMs.
Best practices	Examples can be found in schools, hospitals, buildings etc.

related to LFMs	
Energy Service: Project design, implementation and maintenance	
Description of the service	Correct project design can allow the stakeholders to predict the current and future EE of buildings (both at individual and neighbourhood level) and make better informed decisions in optimising the energy performance with regard to the building life cycle, including operation and maintenance. This can help the supply of goods and services necessary to maintain the conditions of comfort in buildings in compliance with the laws on the rational use of energy, safety and environmental protection, while improving the transformation process and use of energy. To centralise these operations it is possible to rely on an energy service. In an energy service contract, it is the supplier's task to purchase the fuel, provide for the maintenance of the system and take care of the heat production process if needed. Supplier's profit derives from the difference between the revenues from the sale of thermal energy to the condominium and the costs incurred for the production of heat. It will therefore be in the supplier's interest to produce heat at the lowest possible cost, optimising the upstream process.
Requirements to provide the service	An energy service contract should consider both energy efficiency and user comfort. The supplier should identify any possible energy efficiency investment to constantly improve the energy performance. The company must provide before the start of the period of validity of the contract for the energy certification of the building. In addition, objective parameters "independent of current consumption" of primary energy must be established and shared, on the basis of which the periodic fee due to the company can be calculated.
Laws / Legislation of reference	EE Act, RES Act, Energy Law.
Main barriers that limit the profitability and impact of the service	• Specifically in cities with central heating, because of old infrastructure and regulated prices, the companies go into debt. New project implementation and restructuring of the companies need high investment costs and sufficient funding. • Lack of qualified workers with technical expertise in energy efficiency measures also has a negative impact on the design and implementation of the energy projects.
Relevant aspects for LFMs	Information and training for the flexibility services and their application in the processes of implementation of the energy projects.
Best practices related to LFMs	N/A
Energy Service: Metering & monitoring services	
Description of	Electricity metering and monitoring is a management tool that uses a combination of hardware and software to gather data and turn it into useful

the service	and actionable information about a facility and/or an equipment. The hardware component is installed in the field and is represented by the energy meters, which can be more or less advanced, depending on their communication protocol, the measurements taken, the presence of internal memory or the continuity of operation. The software component collects data and makes it usable by users, through the development of energy graphs or reports that can be standard or use advanced analysis algorithms. New generation residential smart meters allow every user to read in real time their energy consumption on the internet or smartphone applications. Energy monitoring is fundamental to implement an energy management system or to evaluate the benefit of an energy efficiency investment. Real energy measures are also mandatory to perform an energy audit or to obtain some incentives, such as white certificates (TEE).
Requirements to provide the service	DSO can provide information for hourly measurements by sites for the past period: • on monthly basis; • for 6 month period; • on a yearly basis; • for clients with 50 sites and more according to an individual offer. The service is only applicable to customers with installed hourly commercial metering devices.
Laws / Legislation of reference	Energy Law
Main barriers that limit the profitability and impact of the service	At present there are no mass smart meters installed in Bulgaria, which hinders the EMS and the FS application.
Relevant aspects for LFMs	There are some good examples of intelligent EMS in private industrial and touristic buildings that serve as best practices for the people.
Best practices related to LFMs	N/A
Energy Service: Smart contracts	
Description of the service	A smart contract is a self-executing contract with the terms of the agreement between buyer and seller being directly written into lines of code. The code and the agreements contained therein exist across a distributed, decentralised blockchain network. The code controls the execution, and transactions are trackable and irreversible. Within a smart contract, the user is no longer just a consumer, but producing energy at the same time, being defined as a "prosumer". The prosumer

	transparently shares energy excess with other consumers, thus becoming a node of a smart grid. The main benefit for the prosumer will be a reduction in costs. The blockchain platform can constitute a support structure to allow P2P energy exchanges between distributed energy producers.
Requirements to provide the service	Net metering is not allowed by the regulation in Bulgaria, while blockchain technology is on an experimental level.
Laws / Legislation of reference	In connection with the plans for the liberalisation of the energy market until 2026 for the households, new proposals are under development for changes in the Energy Law concerning the mass replacement of the current individual electricity meters with smart ones, construction of "smart" networks and application of a new tariff policy to manage consumption schedules.
Main barriers that limit the profitability and impact of the service	The mass replacement of the current individual electricity meters with smart ones has high investment costs that have to be paid by the citizens.
Relevant aspects for LFMs	The smart electric meters will contribute to the use of the FS and the development of the LFMs.
Best practices related to LFMs	N/A
Energy Service: Energy optimisation (at household, building and/or community level)	
Description of the service	In order to achieve next-generation energy efficiency and sustainability, a novel smart grid ICT architecture based on smart houses interacting with smart grids is needed. This architecture enables the aggregation of houses as intelligent networked collaborations, instead of seeing them as isolated passive units in the energy grid. This architecture includes: in-house energy management based on user feedback, real-time tariffs, intelligent control of appliances and provision of (technical and commercial) services to grid operators and energy suppliers. Furthermore, it can also encompass aggregation software architecture based on agent technology for service delivery by clusters of smart houses to wholesale market parties and grid operators, usage of Service Oriented Architecture (SOA) and strong bidirectional coupling with the enterprise systems for system-level coordination goals, as well as handling of real-time tariff metering data.
Requirements to provide the service	SmartHouse/SmartGrid concepts will exploit the potential that is created when homes, offices and commercial buildings are treated as intelligently networked collaborations. The SmartHouses will be able to communicate, interact and negotiate with both customers and energy devices in the local grid. The technical requirements are: end user feedback, automated decentralised control of distributed generation and demand response, control for grid

	stability and islanding operation.
Laws / Legislation of reference	Energy Efficiency Act and RES Act.
Main barriers that limit the profitability and impact of the service	Solid ICT structure and load management logics required.
Relevant aspects for LFMs	Variable-tariff-based load and generation shifting, energy usage monitoring and feedback, distribution system congestion management, distribution grid cell islanding (in case of higher system instability) and support from smart houses.
Best practices related to LFMs	N/A
Energy Service: Time-of-Use (ToU), Peak shaving	
Description of the service	Prices of energy depend on time of usage. To reduce energy costs and interruptibility, the methodology of peak shaving can be implemented thanks to in-house production of energy and storage systems. For each MW of interruptible power made available, Terna remunerates the assignee of the service on the basis of the monthly consumption of the interruptible loads, paying an amount consisting of a fixed portion (for availability to the service) and a variable (for each interruption with success). Usually, the prices of the energy component can be divided into: • 3 tariff bands: F1, F2 and F3 • 2 tariff bands, one called "peak" and one called "off peak" • a single tariff band (single-hour rate)
Requirements to provide the service	There are 2 tariffs for the households: day and night tariff. All enterprises have contracts with energy traders and pay according to the individual conditions (either fixed price for a given period or market price plus surplus for the service).
Laws / Legislation of reference	Energy Law.
Main barriers that limit the profitability and impact of the service	Need for development of further regulatory steps - detailed instructions and guides for the application and set up of energy communities. Need for information and communication of the possibilities and benefits of the service.
Relevant aspects for LFMs	Yes

Best practices related to LFMs	N/A
Energy Service: Predictive building management	
Description of the service	Not offered in Bulgaria. This energy service is based on the technology for a building management system that collects and uses historical and real-time data to provide reliable predictions of energy consumption and accurate recommendations for efficient energy management.
Requirements to provide the service	Integrative building management system with a predictive algorithm for managing building energy supply and demand,that analyses building data from internal and external systems to perform their prediction.
Laws / Legislation of reference	Data Protection Law, Energy Law, EE Act.
Main barriers that limit the profitability and impact of the service	• Lack of smart meters to build intelligent BMS generally. • Lack of information and interest. • Regulated energy prices for households.
Relevant aspects for LFMs	Prerequisite for the development of the LFMs.
Best practices related to LFMs	N/A
Energy Service: Peer-to-peer (P2P) trading	
Description of the service	Not offered and regulated service in Bulgaria. The energy service P2P electricity trading is based on a business model, constituting an interconnected platform that serves as an online marketplace where consumers and producers can trade electricity directly, without the need for an intermediary.
Requirements to provide the service	• High level of digitalisation. • Distributed renewable energy resources. • Favourable regulatory framework.
Laws / Legislation of reference	Guidelines on energy trading.
Main barriers that limit the	Lack of high level of digitalisation and underdeveloped regulatory framework.

profitability and impact of the service	
Relevant aspects for LFMs	N/A
Best practices related to LFMs	N/A
Energy Service: Collective self-consumption	
Description of the service	"Self-consumers of electric energy from RES located in the same building, incl. residential building, have the right to participate as JOINTLY ACTING SELF-CONSUMERS OF RENEWABLE ENERGY in specified activities and may share with each other electric energy from RE produced in installations for producing electric energy in the building, respecting the rights and obligations of each self- consumers of RE, without affecting payments for use of the network and the corresponding taxes and fees applicable to each self-consumers of RE." - defined in the amendment to the RES Act (SG no. 86/2023).
Requirements to provide the service	N/A
Laws / Legislation of reference	Amendments to the Law on Energy from Renewable Sources (SG no. 86/2023, in force from 13.10.2023).
Main barriers that limit the profitability and impact of the service	Net metering is not allowed by the regulation in Bulgaria.
Relevant aspects for LFMs	N/A
Best practices related to LFMs	N/A
Energy Service: Congestion management	
Description of the service	Congestion management is an ancillary service connected with the increasing share of RES that impacts line loadings going beyond the limits, and slower realisation of new investments into transmission paths.
Requirements to provide the	Managed by the Electric System Operator (TSOs, DSOs). Small-scale (residential, commercial and small industrial) electricity consumers with on-site generation like rooftop PV panels and battery storage, including

service	electric-drive vehicles and virtual power plants can also provide congestion relief on critical transmission lines.
Laws / Legislation of reference	Energy Law, RES Act.
Main barriers that limit the profitability and impact of the service	Underdeveloped regulatory framework for EC.
Relevant aspects for LFMs	Ancillary service in the LFM
Best practices related to LFMs	N/A
Energy Service: Imbalances management	
Description of the service	Imbalance management services are part of the broader electricity market mechanism that maintains the stability of the power grid by ensuring a balance between electricity supply and demand in real-time.
Requirements to provide the service	Managed by the Electric System Operator (TSOs, DSOs).
Laws / Legislation of reference	Energy Law.
Main barriers that limit the profitability and impact of the service	To facilitate the grid's stability amidst the rising share of RES, the Electric System Operator is investing in the digitalization and modernization of the grid. Despite these efforts, there are significant barriers to fully leveraging imbalance management services in Bulgaria. These include regulatory inconsistencies, delays in repair projects for large and small hydro power plants, and challenges in fully utilising the potential of existing market mechanisms for the integration of RES and storage solutions. The Bulgarian government's energy policies, especially concerning the coal sector, also reflect the tension between environmental goals and economic considerations.
Relevant aspects for LFMs	N/A
Best practices related to LFMs	N/A

4.6. France

Table 6: Questionnaire results for France.

Energy Service: Energy Supply Contracting	
Description of the service	The goal of the ESC is to bring a reduction of final energy demand. The ESCO is only remunerated for the useful energy output which is measured and verified in MWh delivered. ESC models run under long-term contracts of typically ten to fifteen years, depending on the technical lifetime of the equipment deployed.
Requirements to provide the service	Energy suppliers are vetted by the CRE (Commission Régulation de l'Énergie), and are subjected to regulated tariffs decided by the Ministry of Energy.
Laws / Legislation of reference	The French electricity sector (generation, transmission, distribution, supply and trading) has been fully open to competition since 2007. However, the French electricity market is still dominated by Electricité de France (EDF), both in generation and supply. The Nouvelle Organisation du Marché de l'Electricité (Law No. 2010-1488, now codified in the Energy Code) required EDF to sell electricity to other suppliers at a regulated price. Although the French generation sector is entirely open to competition, only three companies generate almost all non-imported electricity.
Main barriers that limit the profitability and impact of the service	Administrative burden of registering with the CRE.
Relevant aspects for LFMs	N/A
Best practices related to LFMs	N/A
Energy Service: Energy Performance Contracting	
Description of the service	EPC is 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.
Requirements to provide the service	EPC providers are required to hold specific certifications or accreditations to demonstrate their expertise and compliance with quality standards. For example, the French certification scheme "Garantie d'origine de l'efficacité énergétique" (GOEE) recognises companies that meet certain criteria in delivering energy efficiency

	projects. EPC projects typically require robust measurement and verification (M&V) protocols to assess and validate the achieved energy savings. M&V procedures should adhere to recognised standards and methodologies to ensure accuracy and transparency in quantifying energy performance improvements.
Laws / Legislation of reference	EPCs are covered by the “Loi Grenelle”, in a tool designed to create lasting energy efficiency improvements in a building or collection of buildings. These contracts govern the relationship between a private- or public-sector project owner, and an operator.
Main barriers that limit the profitability and impact of the service	• Service dedicated to industrial users. • The "yet another contract" effect.
Relevant aspects for LFMs	Focusing on energy performance changes the way energy is sold and will most likely improve the overall efficiency of the energy supply chain.
Best practices related to LFMs	N/A
Energy Service: Power Purchase Agreement	
Description of the service	PPA is a long-term agreement between an offtaker and an asset owner that allows the offtaker to purchase power on a long-term basis for a price level agreed by the parties. Asset owners can be power developers or suppliers.
Requirements to provide the service	In general, these contracts are aimed at large accounts such as industry, local authorities and the service sector.
Laws / Legislation of reference	French standard PPAs “Les modèles indicatifs de contrats d'obligation d'achat d'électricité” for small installations / renewable energy sources, within the framework of the law of 2000 “Loi no. 2000-108 du 10 février 2000” and decrees of 2000 and 2001 “Décret no. 2000-877 du 7 septembre 2000” and “Décret no. 2001-410 du 10 mai 2001” setting out the terms on which the grid and power distributors are to purchase electricity from the small power producers and wind power “Arrêté du 8 juin 2001 fixant les conditions d'achat de l'électricité produite par les installations utilisant l'énergie mécanique du vent telles que visées à l'article 2 (2o) du décret no 2000-1196 du 6 décembre 2000”.
Main barriers that limit the profitability and impact of the service	PPAs are complex contracts, often requiring a great deal of time and consultation before they can be concluded. As PPAs are long-term contracts, both partners are bound for the long term.
Relevant aspects for LFMs	N/A

Best practices related to LFMs	N/A
Energy Service: Pay for Performance (P4P) scheme	
Description of the service	A P4P scheme is a mechanism used in energy markets to incentivise power generators to provide reliable and high-quality electricity supply. Under a P4P scheme, power generators are compensated based on their actual performance in meeting predefined targets or criteria, rather than receiving fixed payments.
Requirements to provide the service	N/A
Laws / Legislation of reference	N/A
Main barriers that limit the profitability and impact of the service	N/A
Relevant aspects for LFMs	N/A
Best practices related to LFMs	N/A
Energy Service: Energy consultation (e.g., energy audit)	
Description of the service	Process conducted by energy experts or professionals to assess the energy usage, efficiency, and performance of a building, facility, or organisation. The objective is to identify potential areas of energy waste, inefficiency and cost-saving opportunities, providing recommendations for improving energy efficiency and reducing energy consumption.
Requirements to provide the service	The energy audit shall be carried out by a qualified professional who has no link liable to impair his impartiality and independence vis-à-vis the owner or the authorised representative who calls on them. They have insurance that covers the consequences of liability.
Laws / Legislation of reference	In France, law no. 2013-619 of 16 July 2013 requires large companies to carry out an energy audit every 4 years. Moreover, since 2006, the sale of a dwelling must be accompanied by an energy performance diagnostic (EPR), which assesses its energy consumption and greenhouse gas (GHG) emissions. Depending on the result, this dwelling is classified from A to G. (Law L126-28-1).
Main barriers that limit the profitability and impact of the service	This law is seen as a major constraint that is slowing down property sales.

Relevant aspects for LFMs	Energy audits legal framework was reinforced in April 2023 to focus on energy inefficient dwellings called "energy strains". Improving efficiency lowers energy consumption.
Best practices related to LFMs	Energy audit shall be mandatory for being part of an LFM.
Energy Service: Energy Management System	
Description of the service	An EMS is a framework or set of practices designed to effectively manage and optimise energy consumption within an organisation. It involves the integration of people, processes, and technologies to monitor, control, and improve energy efficiency, reduce energy costs, and enhance sustainability.
Requirements to provide the service	Service provided by private companies. Most of them use commercial names and not "EMS" specifically.
Laws / Legislation of reference	ISO 50001 white certificate (CEE) programme.
Main barriers that limit the profitability and impact of the service	EMS offers are not widely known in the market.
Relevant aspects for LFMs	Subsidies exist to set up an EMS, which contributes to setting the needed framework for the deployment of LFMs.
Best practices related to LFMs	N/A
Energy Service: Project design, implementation and maintenance	
Description of the service	Project design is the initial phase where the goals, scope, and specifications of an energy project are defined. On the other hand, project implementation is the phase where the designed project is constructed, installed, and commissioned, whereas project maintenance refers to the ongoing activities and efforts required to ensure the smooth operation, performance, and longevity of the energy project.
Requirements to provide the service	Service provided by private companies.
Laws / Legislation of reference	Any installation (solar, wind, storage, etc.) must comply with the Energy Act "Le Code de l'Energie".
Main barriers that limit the profitability and impact of the service	Complexity level of projects may repel people.
Relevant aspects for LFMs	Many subsidies and tax benefits exist for solar and wind projects that could involve LFMs.
Best practices related to LFMs	N/A

Energy Service: Metering & monitoring services	
Description of the service	Metering and monitoring services is the collection, analysis, and reporting of data related to energy consumption, generation and performance. These services involve the use of specialised meters, sensors, and monitoring systems to measure and track energy usage, monitor equipment performance, and provide valuable insights for energy management and decision-making.
Requirements to provide the service	95% of the points of delivery are managed by ENEDIS, the DSO driven by the French State. ENEDIS has run a large-scale smart meter deployment. For now, 80% of energy sites are equipped with smart meters.
Laws / Legislation of reference	ENEDIS missions are defined by “Le code de l'énergie”(Energy Act). It is mandatory for energy providers to be able to display some specific consumption information from smart meters.
Main barriers that limit the profitability and impact of the service	The data chain is centralised on ENEDIS and can sometimes lack reliability. Moreover, a dedicated WiFi dongle must be plugged into the smart meter to collect data in real time.
Relevant aspects for LFMs	Smart meters collect very fine data in both production and consumption. With the real time feature plus the IOT piloting, LFM can be driven efficiently.
Best practices related to LFMs	Real time data is necessary to manage LFM.
Energy Service: Smart contracts	
Description of the service	Smart contracts in the energy market are self-executing. Contracts are built on blockchain or DLT platforms, which allow for decentralised, transparent, and automated execution and enforcement of contractual obligations. Smart contracts have the potential to transform and streamline various aspects of the energy market, including energy trading, grid management, and peer-to-peer energy transactions.
Requirements to provide the service	Blockchain type technology must be legally allowed by the country.
Laws / Legislation of reference	An experiment was driven by ADEME (the French Agency for Ecological Transition) in 2018, focusing on how smart contracts could help cities be more energy efficient, but there was not any large-scale implementation so far.
Main barriers that limit the profitability and impact of the service	Lack of legal framework in France.
Relevant aspects for LFMs	It might facilitate peer-to-peer trading.

Best practices related to LFMs	N/A
Energy Service: Energy optimisation (at household, building and/or community level)	
Description of the service	Energy optimisation is a process of improving energy efficiency, reducing energy waste, and maximising the use of available energy resources. It involves implementing strategies and technologies to optimise energy consumption, enhance energy performance, and achieve sustainable energy goals.
Requirements to provide the service	Such services can be provided by private companies. No specific/legal requirements are in place to provide these services.
Laws / Legislation of reference	No legal framework for these energy optimisation/improvement of building/households.
Main barriers that limit the profitability and impact of the service	Lack of clear certification. Any professional can propose anything aiming at optimising energy consumption.
Relevant aspects for LFMs	N/A
Best practices related to LFMs	A European certification of a technique (e.g. insulation, building materials) may be a good thing for LFMs.
Energy Service: Time-of-Use (ToU), Peak shaving	
Description of the service	ToU is a pricing structure used in electricity markets where the cost of electricity varies based on the time of day or day of the week. Under a ToU pricing plan, different rates are set for specific periods, typically divided into peak, off-peak, and sometimes intermediate periods. The goal of ToU pricing is to encourage electricity consumers to shift their energy usage to off-peak periods (peak shaving) when the demand and overall system costs are lower.
Requirements to provide the service	Peak/Off-peak option is available for any domestic contracts. The off-peak time slots are set by ENEDIS. Prices are lower during off-peak periods. For industrial HV contracts, up to 5 periods are defined in the year. A mobile peak period is defined with a very high rate to encourage professional users to shift their energy load.
Laws / Legislation of reference	"Arrêté du 26 juillet 2013 relatif aux tarifs réglementés de vente de l'électricité"
Main barriers that limit the profitability and impact of the service	• Lack of incentives and information to end users: they rarely shift their energy load to the night when rates are lower. • Lack of dynamic price rates in France.
Relevant aspects for LFMs	ToU price rates are a good option to encourage LFMs users to shift

	energy loads.
Best practices related to LFMs	N/A
Energy Service: Predictive building management	
Description of the service	Predictive building management involves the use of advanced data analysis techniques and predictive models to optimise the operation, maintenance, and energy efficiency of buildings. It leverages real-time and historical data from various building systems and sensors to anticipate and address potential issues before they occur, leading to improved building performance and cost savings.
Requirements to provide the service	Service offered by private companies, mostly relying on IOT devices measuring power consumption and temperature and providing a real-time monitoring of the building. Most of the time, prediction models are applied to forecast energy consumption and give advice.
Laws / Legislation of reference	Decree no. 2019-771 of July 23, 2019 on obligations to reduce final energy consumption in tertiary buildings.
Main barriers that limit the profitability and impact of the service	It only focuses on industrial buildings.
Relevant aspects for LFMs	Improving efficiency lowers energy consumption.
Best practices related to LFMs	N/A
Energy Service: Peer-to-peer (P2P) trading	
Description of the service	P2P energy trading or decentralised energy trading, refers to a direct exchange of electricity or energy between individual participants at a hyperlocal level. This enables consumers and producers to trade energy directly with each other, bypassing traditional utility companies or energy retailers.
Requirements to provide the service	N/A
Laws / Legislation of reference	N/A
Main barriers that limit the profitability and impact of the service	N/A
Relevant aspects for LFMs	N/A
Best practices related to LFMs	N/A

Energy Service: Collective self-consumption	
Description of the service	Collective self-consumption, also known as community self-consumption or shared solar, is a collaborative approach to energy generation and consumption within a local community or group of participants. It involves multiple energy consumers or households collectively sharing and benefiting from a shared renewable energy system, typically solar photovoltaic (PV) installations.
Requirements to provide the service	The maximum distance between producers and consumers is 20km. Producers and consumers must come together to form a legal entity (LE) in charge of managing the operation, and also of establishing a collective self-consumption agreement with the public distribution network operator.
Laws / Legislation of reference	Law number 2017-227.
Main barriers that limit the profitability and impact of the service	• Lack of information. • Long and complex administrative paperwork.
Relevant aspects for LFMs	Collective self-consumption offers an opportunity for communities to actively participate in the transition towards a more sustainable and decentralised energy system.
Best practices related to LFMs	N/A
Energy Service: Congestion management	
Description of the service	Congestion management refers to the strategies and measures implemented to address and mitigate congestion issues of electricity grids or transmission networks. Congestion occurs when there is limited capacity or bottlenecks in the transmission infrastructure, leading to challenges in the efficient and reliable transmission of electricity.
Requirements to provide the service	Managed by RTE (French TSO) under the name of flexibility tenders. These are intended to pay for the reservation, over a multi-year period, of a flexibility capacity that can be activated in real time by RTE to limit congestion on the transmission system, as a solution for delaying or avoiding network adaptation.
Laws / Legislation of reference	RTE is in charge of organising calls for tenders related to support schemes for the development of demand response with the purpose of contributing to achieve the objectives of the French Multiannual Energy Programme (Article L271.4 of the Energy Code).
Main barriers that limit the	Service dedicated to large industrial users: at least 1 MW of

profitability and impact of the service	flexibility is required.
Relevant aspects for LFMs	Large-scale connected smart appliances (boilers, EV chargers, AC systems…) accompanied with financial incentives might be an efficient tool for LFMs
Best practices related to LFMs	N/A
Energy Service: Imbalances management	
Description of the service	Imbalance management refers to the process of monitoring, measuring, and addressing discrepancies between scheduled or contracted electricity supply and actual electricity consumption or generation. Imbalances can occur due to various factors such as forecasting errors, operational constraints, changes in demand or supply, as well as unforeseen events.
Requirements to provide the service	Such balance monitoring is performed by RTE, the electricity network operator in France (TSO). They can delegate partial services to the balance responsible party (BRP) to monitor a sub-grid.
Laws / Legislation of reference	(EU) Regulation 2017/2195, reinforced by CRE Deliberation No. 2018-229, entitling RTE to manage BRP agreements.
Main barriers that limit the profitability and impact of the service	• Service dedicated to industrial users. • Difficulties dealing with TSO contracts.
Relevant aspects for LFMs	N/A
Best practices related to LFMs	N/A

4.7. Turkey

Table 7: Questionnaire results for Turkey.

Energy Service: Energy Supply Contracting	
Description of the service	The ESC model efficiently supplies energy (from fossil and/or renewable sources) to various sectors, aiming to reduce the final energy demand. In this model, an ESCO is compensated for delivering useful energy through long-term contracts, incentivising them to reduce energy demand. In an ESCO case, the ESCO finances the installation or renovation of the energy supply facility using their own or external funds and then generates revenue by selling energy at a specific price. Thus, the ESC focuses on the provision of energy supply, such as electricity, gas, or heat, to meet the consumer's energy needs.
Requirements to provide the service	• Licensing: Energy supply companies are typically required to obtain a license from the Energy Market Regulatory Authority (EPDK) or relevant authorities to operate legally. • Compliance with Regulations: Energy supply companies must comply with the regulations and guidelines set by the EPDK and other relevant authorities. • Market Participation: Energy supply companies may need to participate in the wholesale energy markets, such as the day-ahead market or the balancing market. • Infrastructure and Network Connection: Depending on the energy source, energy supply companies may need to establish or connect to the appropriate infrastructure, such as power transmission lines. • Insurance and Financial Requirements: Energy supply companies may be required to have certain types of insurance coverage. • Consumer Protection: Energy supply companies must comply with consumer protection regulations, including providing clear and transparent information to customers, etc.
Laws / Legislation of reference	• Electricity Market Law (No. 6446): This law sets the legal framework for the electricity market in Turkey, including the provisions related to energy supply contracts, licensing requirements, market operations, pricing, and consumer rights. • Natural Gas Market Law (No. 4646): This law regulates the natural gas market in Turkey and includes provisions related to energy supply contracts, licensing, market operations, pricing, and consumer rights in the natural gas sector. • Renewable Energy Law (No. 5346): This law promotes the use of renewable energy sources in Turkey and provides provisions related to energy supply contracts, feed-in tariffs, purchase obligations, and incentives for renewable energy projects.

	• Energy Efficiency Law (No. 5627): This law aims to promote energy efficiency in Turkey and includes provisions related to energy audits, energy management systems, energy efficiency measures, and financial incentives for energy-saving projects. • Consumer Protection Law (No. 6502): This law protects the rights and interests of consumers in various sectors, including energy. It includes provisions related to consumer rights, contracts, dispute resolution, and enforcement mechanisms.
Main barriers that limit the profitability and impact of the service	• Market Competition, Price Volatility and Regulatory Constraints: Energy supply contracts are subject to various regulatory requirements, which can impact profitability and the ability to offer competitive pricing. • Cost of Energy Procurement: Energy suppliers need to procure energy from the wholesale market or through long-term contracts with energy producers. The cost of energy procurement can significantly impact profitability, operational costs and efficiency. • Customer Retention and Churn, Technological Advances and Disruptions: technological advances in the energy sector, such as renewable energy generation can disrupt traditional energy supply models. • Environmental and Social Factors: Increasing emphasis on environmental sustainability and social responsibility can impact the profitability and impact of energy supply contracts.
Relevant aspects for LFMs	The mentioned barriers would apply also to LFMs.
Best practices related to LFMs	N/A
Energy Service: Energy Performance Contracting	
Description of the service	EPC is a financing mechanism based on the repayment of initial investment costs of energy efficiency or renewable energy projects through future savings. In this context, the service provider takes responsibility for financing energy efficiency measures using either their own funds or external sources. The client, who seeks to improve energy efficiency, pays the service provider a fee. This fee is typically covered by the client's energy bill reduction resulting from the implemented measures.
Requirements to provide the service	• ESCO Registration: ESCOs must register with the relevant ministry (MENR) to operate legally. • Qualified Personnel: ESCOs are typically required to have qualified personnel who possess the necessary technical expertise and certifications in energy efficiency and related fields. • Energy Audits: Energy audit of the building or facility is often

	required. • Measurement and Verification (M&V): ESCOs may need to establish a robust measurement and verification system to monitor and evaluate the energy savings achieved through the implemented measures. • Contractual Requirements: Energy performance contracts typically outline the scope of work, energy-saving targets, project duration, payment terms, and other contractual obligations. • Compliance with Energy Efficiency Standards, Reporting and Documentation: ESCOs may be required to submit periodic reports to the relevant authorities, providing details of the energy-saving measures implemented, energy savings achieved, and other relevant data.
Laws / Legislation of reference	• Energy Efficiency Law (No. 5627): This law sets the legal framework for promoting energy efficiency in Turkey. It includes provisions related to energy audits, energy management systems, energy efficiency measures, and the implementation of energy performance contracts. • Electricity Market Law (No. 6446): This law establishes the legal framework for the electricity market in Turkey. It includes provisions related to energy efficiency obligations, demand-side management, and the promotion of energy efficiency measures, which can include EPC projects. • Natural Gas Market Law (No. 4646): This law governs the natural gas market in Turkey. It may include provisions related to energy efficiency and the promotion of energy efficiency projects. • Renewable Energy Law (No. 5346): This law promotes the use of renewable energy sources in Turkey. Although primarily focused on renewable energy generation, it may indirectly impact EPC projects by creating opportunities for energy efficiency improvements in renewable energy installations. • Public Procurement Law (No. 4734): In cases where EPC projects involve public institutions or entities, the Public Procurement Law may apply. It establishes the regulations and procedures for public procurement, including the selection and contracting of ESCOs for energy efficiency projects.
Main barriers that limit the profitability and impact of the service	• Lack of Awareness and Understanding: Many potential customers may have limited awareness and understanding of the benefits and potential cost savings that can be achieved through EPCs. • High Initial Costs: Implementing energy efficiency measures or renewable energy systems through EPCs often requires significant upfront investment.

	• Financing Challenges: Securing financing for EPC projects can be difficult, particularly for small and medium-sized enterprises (SMEs) or organisations with limited access to capital. • Complex Contracting Process: EPCs involve complex contractual arrangements, including performance guarantees, measurement and verification protocols, and risk-sharing mechanisms. • Performance Risk and Measurement: accurately measuring and verifying energy savings can be challenging. • Lengthy Payback Periods: EPCs typically involve long payback periods.
Relevant aspects for LFMs	The mentioned barriers would apply also to LFMs.
Best practices related to LFMs	N/A
Energy Service: Power Purchase Agreement	
Description of the service	A PPA is a contractual arrangement between a buyer (offtaker) and the owner of an energy-generating asset, enabling the buyer to procure electricity over an extended period of time at an agreed-upon price. The asset owner can be a power developer or supplier.
Requirements to provide the service	• Project Development and Licensing: Obtain permits and licenses by submitting applications, providing technical specifications, conducting environmental impact assessments, and meeting criteria for feasibility, site suitability, and regulatory compliance. • Connection to the Grid: Coordinate with the grid operator to establish a connection point to the electrical grid. • Renewable Energy Support Mechanisms: Access support mechanisms like feed-in tariffs, YEKA tenders, or YEKDEM. • PPA Negotiation: Engage in discussions with the off-taker (buyer) - often a distribution company or wholesale electricity market company - to negotiate terms and conditions related to pricing, payment, project performance etc.. • Regulatory Compliance: Comply with regulations and guidelines from the EPDK and other authorities, covering technical specifications, grid connection, reporting obligations, metering, billing, and environmental and social considerations. • Financial and Insurance Requirements: Meet financial requirements and provide insurance coverage.
Laws / Legislation of reference	• Electricity Market Law (No. 6446): This law establishes the legal framework for the electricity market in Turkey. It includes provisions related to electricity generation, distribution, transmission, and supply. The law sets out the general principles and regulations governing PPAs. • Renewable Energy Law (No. 5346): This law promotes the use of

	renewable energy sources in Turkey. It includes provisions related to the purchase obligations, feed-in tariffs, support mechanisms, and procedures for renewable energy projects, which may involve specific regulations for PPAs. • Public Procurement Law (No. 4734): In cases where PPAs involve public institutions or entities, the Public Procurement Law may apply. It establishes the regulations and procedures for public procurement, including the selection and contracting of electricity suppliers. • General Contract Law: General contract principles and provisions under the Turkish Civil Code (No. 6098) and other related legislation are applicable to Power Purchase Agreements. These provisions govern the formation, validity, interpretation, performance, and termination of contracts, including PPAs.
Main barriers that limit the profitability and impact of the service	• Regulatory and Policy Environment: The regulatory and policy environment can significantly impact the profitability and impact of PPAs. • Market Structure and Competition: The competitive landscape and market structure can affect the profitability of PPAs. • Financing Challenges: PPAs often require significant upfront investment to develop and operate renewable energy projects. • Grid Connection and Infrastructure: Connecting renewable energy projects to the grid can pose challenges, particularly in areas with limited transmission capacity or inadequate grid infrastructure. • Counterparty Risks: Off-taker creditworthiness, payment default, or contract renegotiation, can impact the profitability and reliability of cash flows. • Project Development and Permitting: Developing renewable energy projects and obtaining the necessary permits and approvals can be time-consuming and costly.
Relevant aspects for LFMs	The mentioned barriers would apply also to LFMs.
Best practices related to LFMs	N/A
Energy Service: Pay for Performance (P4P) scheme	
Description of the service	P4P schemes are based on the principle that payments for energy efficiency should align with the actual performance of implemented measures. Advanced measurement and verification (M&V) methods are employed to accurately quantify the energy savings achieved through these measures. Essentially, these methods enable the use of an energy efficiency meter to measure and verify the accomplished energy savings.
Requirements to provide the	There is no specific nationwide P4P scheme in Turkey that applies

service	across all sectors.
Laws / Legislation of reference	There is no law regulating this scheme, but by expanding scope of Energy Efficiency Law (No. 5627) might be applicable.
Main barriers that limit the profitability and impact of the service	• Lack of Awareness and Understanding, Measurement and Verification Challenges, Financial Constraints: The financial burden of implementing performance improvements can be a significant barrier for participants. • Inadequate Financing Options: Limited access to financing options or high borrowing costs can hinder the implementation. • Scalability and Standardization: Scaling up the P4P scheme to reach a larger number of participants can be challenging. • Data Access and Privacy Concerns.
Relevant aspects for LFMs	• Regulatory and Policy Framework: The presence of clear and supportive regulations and policies is essential for the establishment and functioning of the LFM. • Technology and Infrastructure: The availability and accessibility of appropriate technologies and infrastructure are vital for the functioning of the Local Flexible Market. • Robust communication systems, smart meters, advanced control systems, and grid flexibility solutions are necessary to enable the effective participation and coordination of flexible resources.
Best practices related to LFMs	N/A
Energy Service: Energy consultation (e.g., energy audit)	
Description of the service	Process in which energy experts or professionals carry out an assessment to evaluate the energy utilisation, efficiency, and performance of a building, facility, or organisation. The purpose is to identify possible sources of energy waste, inefficiency, and opportunities for cost-saving. The assessment aims to provide recommendations for enhancing energy efficiency and reducing energy consumption.
Requirements to provide the service	• Expertise and Qualifications: Energy consultants are typically expected to have expertise in energy management, efficiency, and related fields. • Registration or Accreditation: Energy Manager Certificate, Energy Project Audit Certificate and authorisation for energy efficiency agencies and universities given by relevant ministry.
Laws / Legislation of reference	There is no specific law in Turkey that solely regulates energy consultation as a distinct field. In addition, laws such as the Turkish Commercial Code (No. 6102) and related regulations set general provisions for professional services, including consulting services, which may be applicable to energy consulting.

Main barriers that limit the profitability and impact of the service	• Lack of Awareness and Understanding: Many organisations and individuals may have limited awareness of the benefits of energy consultation services. • High Upfront Costs: Energy audits often require upfront investment to conduct detailed assessments of energy use and identify opportunities for improvement. • Lack of Incentives: The absence of financial or regulatory incentives can limit the uptake of energy consultation services. • Payback Period and Return on Investment: The perceived long payback period and uncertainty around the return on investment (ROI) can deter organisations from investing in energy consultation services • Lack of Performance Monitoring: Without a system to monitor and track energy performance over time, organisations may struggle to assess the effectiveness of energy consultancy.
Relevant aspects for LFMs	Lack of awareness and understanding about the benefits and opportunities of energy consultancy services can hinder participation in the LFM.
Best practices related to LFMs	N/A
Energy Service: Energy Management System	
Description of the service	An EMS is a structured approach or collection of methodologies aimed at efficiently managing and maximising energy usage within an organisation. It entails integrating individuals, procedures, and technologies to observe, regulate, and enhance energy efficiency, minimise energy expenses, and promote sustainability.
Requirements to provide the service	• Expertise and Qualifications: Energy management system providers are typically expected to have expertise in energy management, systems engineering, and related fields. • Compliance with Standards: Energy management systems should adhere to relevant standards, such as ISO 50001, which provides a framework for establishing, implementing, maintaining, and improving energy management systems.
Laws / Legislation of reference	The Energy Efficiency Law (No. 5627) provides the legal framework for energy efficiency practices, including the establishment and implementation of energy management systems. The law aims to promote energy efficiency and rational energy use across various sectors.
Main barriers that limit the profitability and impact of the service	• Cost and Return on Investment: Implementing an EMS often involves significant upfront costs. • Lack of Awareness and Understanding, Complex Implementation Process: Implementing an EMS can be a complex process that requires technical expertise and involvement from various

	stakeholders within an organisation. • Data Availability and Quality: An effective EMS relies on accurate and reliable data to monitor and analyse energy consumption patterns. • Organisational Barriers: Internal organisational barriers, such as resistance to change, lack of management commitment, and limited staff resources, can impede the successful implementation and utilisation of EMS services. • Integration with Existing Systems: Integrating an EMS with existing building management systems or other operational systems can be challenging.
Relevant aspects for LFMs	The mentioned barriers would apply also to LFMs.
Best practices related to LFMs	N/A
Energy Service: Project design, implementation and maintenance	
Description of the service	Project design enables stakeholders to optimise energy efficiency in buildings, making informed decisions about operation, maintenance, and compliance. An energy service contract can streamline processes by having the supplier handle fuel procurement, system maintenance, and heat production. Heat is measured by a meter and sold at an agreed tariff. Suppliers aim to minimise costs and improve efficiency by using better fuels, upgrading boilers, and enhancing insulation. The unit cost of heat depends on thermal plant efficiency, except for official fuel cost changes.
Requirements to provide the service	• Expertise and Qualifications. • Compliance with Regulations. • Design and Documentation. • Implementation and Construction. • Maintenance and Operation. • Insurance and Liability Coverage. • Quality Assurance and Control.
Laws / Legislation of reference	• Construction Law (No. 3194): This law sets out the general principles and regulations related to construction activities in Turkey. It includes provisions for design, construction, and maintenance requirements for all types of buildings, including energy-related projects. • Electricity Market Law (No. 6446): This law establishes the legal framework for the electricity market in Turkey. It includes provisions related to the design, installation, and operation of electricity generation, transmission, and distribution facilities. It also covers safety regulations and maintenance requirements for energy projects.

	• Renewable Energy Law (No. 5346): This law promotes the use of renewable energy sources in Turkey. It includes provisions related to the design, implementation, and operation of renewable energy projects. • Occupational Health and Safety Law (No. 6331): This law regulates occupational health and safety in Turkey. • Environmental Impact Assessment (EIA) Regulation: The EIA Regulation requires the assessment and approval of environmental impacts for certain energy projects. It sets out the procedures and criteria for conducting an environmental impact assessment, which includes design, implementation, and maintenance considerations.
Main barriers that limit the profitability and impact of the service	• Lack of Expertise and Resources. • Cost and Financing. • Regulatory and policy frameworks can create barriers to project design, implementation, and maintenance. • Technical and Infrastructure Challenges, Stakeholder Engagement and Cooperation. • Operational and Maintenance Costs. • Market and Demand Uncertainty can limit the profitability and impact of projects.
Relevant aspects for LFMs	• Lack of Expertise and Resources: LFMs require specialised expertise in optimising flexibility and integrating flexible resources into the energy system. • Regulatory and Policy Constraints: The regulatory and policy framework directly influences the flexibility options available in LFMs. • Technical and Infrastructure Challenges: LFMs rely on advanced technologies, such as energy storage systems, demand response mechanisms, and smart grid infrastructure, to enable flexibility. • Stakeholder Engagement and Cooperation: Flexibility projects often require the cooperation and active participation of various stakeholders, including energy consumers, distribution system operators, aggregators, and market operators.
Best practices related to LFMs	N/A
Energy Service: Metering & monitoring services	
Description of the service	Metering and monitoring services encompass the collecting, analysis, and reporting of data pertaining to energy consumption, generation, and effectiveness. These services utilise specialised meters, sensors, and monitoring systems to quantify and monitor energy usage, assess equipment performance, and offer valuable insights for energy management and decision-making.

Requirements to provide the service	• Licensing and Accreditation. • Compliance with Technical Standards. • Equipment and Technology. • Data Security and Privacy. • Calibration and Maintenance. • Data Management and Reporting: Service providers should have systems in place for collecting, managing, and analysing metering data. • Compliance with Regulations.
Laws / Legislation of reference	The Energy Market Regulatory Authority (EPDK) is the regulatory body responsible for overseeing the energy market in Turkey. The EPDK regulations cover aspects such as metering equipment standards, meter reading procedures, data validation and quality control, data reporting, and metering infrastructure management. They also define the roles and responsibilities of market participants involved in metering and monitoring activities, including energy suppliers, distribution companies and metering service providers.
Main barriers that limit the profitability and impact of the service	• <u>Cost and Investment:</u> Implementing metering and monitoring services can involve significant upfront costs, including the installation of meters, data acquisition systems, and data management infrastructure. • <u>Data Availability and Quality:</u> Metering and monitoring services rely on accurate and reliable data to provide meaningful insights and analysis. • <u>Technological Compatibility and Integration:</u> Integrating metering and monitoring systems with existing infrastructure and systems can be a challenge. • <u>Privacy and Security Concerns:</u> Metering and monitoring services involve the collection and storage of energy consumption data, which can raise privacy and security concerns. • <u>Lack of Awareness and Understanding:</u> Limited awareness and understanding of the benefits that can be achieved through metering and monitoring services can be a barrier. • <u>Regulatory and Policy Framework:</u> The regulatory and policy environment can influence the adoption and effectiveness of metering and monitoring services.
Relevant aspects for LFMs	The mentioned barriers would apply also to LFMs.
Best practices related to LFMs	N/A
Energy Service: Smart contracts	
Description of the service	Smart contracts within the energy market are automated contracts that operate on blockchain or DLT platforms. These contracts

	enable decentralised, transparent, and automated execution and enforcement of contractual obligations. By leveraging smart contracts, various facets of the energy market, such as energy trading, grid management, and peer-to-peer energy transactions, can be transformed and streamlined.
Requirements to provide the service	Since there is no live smart contract system in Turkey, there is no specific requirement.
Laws / Legislation of reference	There is no specific law in Turkey that explicitly regulates smart contracts as a distinct legal concept. However, it is important to note that the legal recognition and enforceability of smart contracts in Turkey can be derived from existing laws and regulations that govern traditional contracts and electronic transactions, such as the Turkish Code of Obligations (No. 6098), which provides the general framework for contract law in Turkey. It establishes the basic principles and requirements for contract formation, validity, interpretation, and performance. Furthermore, the Law on Electronic Signature (No. 5070) and the Regulation on the Implementation and Usage of the Electronic Signature provide the legal framework for electronic transactions and the use of electronic signatures in Turkey.
Main barriers that limit the profitability and impact of the service	• <u>Legal and Regulatory Challenges:</u> Smart contracts operate on blockchain or distributed ledger technology, which may not be fully recognised or regulated by existing legal frameworks. • <u>Technological Complexity:</u> Smart contracts require a solid understanding of blockchain technology and programming skills to develop and deploy them effectively. • <u>Interoperability and Integration:</u> Smart contracts need to seamlessly interact with various systems, databases, and applications to achieve their full potential. • <u>Security and Trust Concerns:</u> Smart contracts are built on the principles of immutability and transparency, but their security vulnerabilities can pose risks. • <u>Awareness and Education:</u> Limited awareness and understanding of smart contract technology among potential users and stakeholders can hinder its adoption and impact.
Relevant aspects for LFMs	The mentioned barriers would apply also to LFMs.
Best practices related to LFMs	N/A
Energy Service: Energy optimisation (at household, building and/or community level)	
Description of the service	Energy optimisation is the practice of enhancing energy efficiency, minimising energy loss, and maximising the utilisation of accessible energy resources. It encompasses the implementation of strategies

	and technologies aimed at optimising energy consumption, improving energy performance, and attaining sustainable energy objectives.
Requirements to provide the service	There is no specific nationwide energy optimisation scheme in Turkey that applies across all sectors.
Laws / Legislation of reference	There is no specific law in Turkey that solely regulates energy optimisation at the household, building, or community level as a distinct field.
Main barriers that limit the profitability and impact of the service	• Cost and Investment: Energy optimisation measures often require upfront investments in technologies, equipment, and infrastructure. • Lack of Awareness and Information: Limited awareness and understanding of energy optimisation practices and their potential benefits can be a significant barrier. • Split Incentives: In multi-tenant buildings or communities, a common barrier is the presence of split incentives, where the entity responsible for investing in energy optimisation measures may not directly benefit from the resulting cost savings. • Technical Complexity and Expertise: Implementing energy optimisation measures often requires technical expertise and knowledge. • Behavioural and Cultural Factors: Energy consumption patterns and behaviours can significantly impact the effectiveness of energy optimisation services.
Relevant aspects for LFMs	The mentioned barriers would apply also to LFMs.
Best practices related to LFMs	N/A
Energy Service: Time-of-Use (ToU), Peak shaving	
Description of the service	ToU is a pricing arrangement implemented in electricity markets, where the price of electricity fluctuates depending on the specific time of day or day of the week. This pricing structure establishes different rates for distinct time periods, typically categorised as peak, off-peak, and sometimes intermediate periods. The primary objective of ToU pricing is to incentivise electricity consumers to adjust their energy consumption to off-peak periods (peak shaving) when demand and overall system costs are lower.
Requirements to provide the service	There is no specific nationwide Time-of-Use (ToU) or Peak shaving scheme in Turkey that applies across all sectors.
Laws / Legislation of reference	There is no specific law in Turkey that solely regulates Time-of-Use (ToU) pricing or peak shaving as distinct legal concepts.

	The Energy Market Regulatory Authority (EPDK) in Turkey has the authority to regulate and set electricity tariffs. While there may not be specific laws governing ToU pricing, the EPDK has the power to establish tariff structures that incentivize time-based pricing, such as peak and off-peak rates.
Main barriers that limit the profitability and impact of the service	• Limited Customer Awareness: Many energy consumers may be unaware of the existence and benefits of ToU and peak shaving programs. • Inflexible Energy Consumption: Some customers may have limited flexibility in adjusting their energy consumption patterns to align with ToU rates or peak shaving requirements. • Infrastructure Limitations: The infrastructure required to support ToU and peak shaving programs, such as advanced metering infrastructure (AMI) and smart grid technologies, may not be widely implemented or available in certain areas. • Complexity of Rate Structures: ToU and peak shaving programs often involve complex rate structures, including different pricing tiers and time-specific rates. This might be challenging for customers. • Lack of Incentives: The absence of appropriate incentives can limit customer motivation to participate in ToU and peak shaving programs. • Regulatory and Market Barriers: Regulatory frameworks and market structures may not adequately support the implementation and profitability of ToU and peak shaving services.
Relevant aspects for LFMs	The mentioned barriers would apply also to LFMs.
Best practices related to LFMs	N/A
Energy Service: Predictive building management	
Description of the service	Predictive building management utilises advanced data analysis techniques and predictive models to enhance the operation, maintenance, and energy efficiency of buildings. By harnessing real-time and historical data from diverse building systems and sensors, it enables the anticipation and proactive resolution of potential issues, resulting in enhanced building performance and cost savings.
Requirements to provide the service	There is no specific nationwide predictive building management in Turkey that applies across all sectors.
Laws / Legislation of reference	There is no specific law regulating this issue. However, the Energy Efficiency Law (No. 5627), which promotes energy efficiency and in terms of data protection, the Personal Data Protection Law (No.

	6698) can be considered in the scope of this issue.
Main barriers that limit the profitability and impact of the service	• Data Availability and Quality: Predictive building management relies on accurate and reliable data inputs from various sources, such as sensors, meters, and building management systems. • Technical Complexity: Implementing predictive building management systems involves complex technical requirements, including data collection, integration, analysis, and model development. • Organisational Resistance and Change Management: Introducing predictive building management systems may require organisational changes and adjustments in workflows and processes. • Data Privacy and Security: Predictive building management relies on the collection and analysis of sensitive data related to building operations and occupants. • Lack of Industry Standards and Best Practices: The absence of standardised methodologies, benchmarks, and best practices in predictive building management can hinder its widespread adoption and impact.
Relevant aspects for LFMs	The mentioned barriers would apply also to LFMs.
Best practices related to LFMs	N/A
Energy Service: Peer-to-peer (P2P) trading	
Description of the service	P2P energy trading involves the direct exchange of electricity or energy between individual participants within a localised energy system. P2P trading empowers energy consumers and producers to directly trade energy with one another, circumventing the need for traditional intermediaries like utility companies or energy retailers.
Requirements to provide the service	There is no specific nationwide P2P trading scheme for energy in Turkey that applies across all sectors.
Laws / Legislation of reference	There is no specific law in Turkey that solely regulates P2P trading. P2P trading activities may be influenced by various laws and regulations concerning the energy market and electricity trading.
Main barriers that limit the profitability and impact of the service	• Regulatory Challenges: P2P trading often operates within the existing energy market regulations, which may not be designed to accommodate this type of trading. • Market Access: P2P trading requires access to a diverse pool of energy producers and consumers who are willing to participate in the trading platform. • Technological Infrastructure: P2P trading relies on advanced

	digital platforms and technologies that facilitate secure and transparent energy transactions. • Trust and Transparency: Trust is essential in P2P trading, as participants need confidence in the reliability and integrity of the transactions. • Market Monopoly and Incumbent Interests: P2P trading disrupts the traditional energy market structure, which may face resistance from incumbent market players.
Relevant aspects for LFMs	The mentioned barriers would apply also to LFMs.
Best practices related to LFMs	N/A
Energy Service: Collective self-consumption	
Description of the service	Collective self-consumption is a collaborative model for energy generation and consumption in a localised community or a group of participants. It entails multiple energy consumers or households coming together to collectively utilise and derive benefits from a shared renewable energy system, commonly consisting of solar PV installations.
Requirements to provide the service	There is no specific nationwide collective self-consumption scheme for energy in Turkey that applies across all sectors.
Laws / Legislation of reference	Although there is no dedicated law in Turkey specifically regulating collective self-consumption as a distinct legal concept, various laws and regulations pertaining to the energy market, renewable energy, and electricity distribution can have an impact on collective self-consumption practices.
Main barriers that limit the profitability and impact of the service	• Regulatory Framework: The regulatory framework for collective self-consumption may not be well-defined or supportive, which can create uncertainties and barriers for market participants. • Administrative and Legal Barriers: Administrative and legal processes for establishing collective self-consumption projects can be complex and time-consuming. Obtaining the necessary permits, licenses, and agreements from relevant authorities can pose challenges. • Market Design and Access: Accessing and participating in energy markets as collective self-consumption entities may face barriers. • Awareness and Engagement: Limited awareness and understanding of collective self-consumption among potential participants, energy consumers, and stakeholders can hinder its adoption and impact.
Relevant aspects for LFMs	The mentioned barriers would apply also to LFMs.
Best practices related to LFMs	N/A

Energy Service: Congestion management	
Description of the service	Congestion management pertains to the deployment of strategies and actions aimed at tackling and alleviating congestion problems within electricity grids or transmission networks. Congestion arises when the transmission infrastructure encounters limited capacity or bottlenecks, which hinder the smooth and dependable transmission of electricity.
Requirements to provide the service	• Compliance with Regulatory Framework. • Licensing and Accreditation. • Technical Expertise. • Data Management and Analysis. • Market Participation and Collaboration. • Compliance with Imbalance Settlement Rules.
Laws / Legislation of reference	The Energy Market Regulatory Authority (EPDK) in Turkey establishes regulations that define the principles and mechanisms for managing congestion in the electricity transmission and distribution system. These regulations are designed to maintain the stability and reliability of the grid by effectively managing congestion. Congestion management practices in Turkey encompass various measures, including curtailing generation, implementing load shedding, and utilising market-based mechanisms such as redispatching and financial settlement. The EPDK's regulations provide market participants with clear guidelines and procedures to ensure the efficient and equitable management of congestion. The Turkish electricity system, managed by the Turkish Electricity Transmission Corporation (TEİAŞ), has been operating in synchronous parallel mode with the European Network of Transmission System Operators for Electricity (ENTSO-E).
Main barriers that limit the profitability and impact of the service	• Grid Infrastructure Limitations: Inadequate grid infrastructure, such as limited transmission capacity or outdated distribution networks, can hinder effective congestion management. • Communication and Coordination: Lack of efficient communication channels, information sharing platforms, and coordination mechanisms can create barriers to timely and coordinated congestion management actions. • Market Power and Strategic Behaviour: Concentration of market power among a few dominant players can hinder effective congestion management.
Relevant aspects for LFMs	The mentioned barriers would apply also to LFMs.
Best practices related to LFMs	N/A

Energy Service: Imbalances management	
Description of the service	Imbalances management involves the monitoring, measurement, and resolution of disparities between the scheduled or contracted electricity supply and the actual consumption or generation of electricity. Imbalances can arise from a variety of factors, including forecasting errors, operational limitations, fluctuations in demand or supply and unexpected occurrences.
Requirements to provide the service	• Compliance with Regulatory Framework. • Licensing and Accreditation. • Technical Expertise. • Data Management and Analysis. • Market Participation and Collaboration. • Compliance with Imbalance Settlement Rules.
Laws / Legislation of reference	In Turkey, imbalance management practices may include real-time balancing, the imposition of penalties for imbalances, and the implementation of settlement processes. The EPDK's regulations provide market participants with clear guidelines and procedures to effectively and fairly manage imbalances.
Main barriers that limit the profitability and impact of the service	• Forecasting Accuracy: Accurate forecasting of energy supply and demand is critical for effective imbalance management. • Balancing Costs and Settlement Mechanisms: Imbalance management may incur costs, including charges for deviations from scheduled energy deliveries. • Grid Infrastructure and Flexibility: The availability and flexibility of grid infrastructure play a crucial role in managing imbalances. • Regulatory and Market Barriers: Regulatory and market barriers, such as complex administrative processes, unclear rules, and barriers to market participation, can hinder the profitability and impact of imbalance management services.
Relevant aspects for LFMs	The mentioned barriers would apply also to LFMs.
Best practices related to LFMs	N/A

5. ANALYSIS AND CONCLUSIONS

This deliverable reports the application and level of implementation in different countries across Europe of existing and innovative energy & flexibility services considered relevant for the deployment of Local Flexibility Markets (LFMs).

An LFM can be defined as a platform or mechanism that allows participants to trade flexible energy at the local level, optimising the use of decentralised RES & storage assets, reducing the need for grid reinforcements, and enhancing grid stability. LFMs recognize the value of distributed energy resources and demand-side response capabilities, enabling consumers to to play a active role in the operation of the energy system by producing, storing, consuming and/or selling their own energy (thus, becoming prosumers) and by shifting or reducing their electricity usage in response to market signals or financial incentives (e.g., time-based rates). DR programs are currently being run by some electric system planners and operators, using mainly the flexibility provided by large industrial facilities connected to the high-voltage grid, as resource options for balancing supply and demand. Therefore, the challenge is to unlock the very high potential of LFMs in the distribution grid, where the main sources of flexibility are residential and tertiary buildings, representing 70% of the total DR flexibility potential[37] available in the EU. Therefore, the adoption of LFMs is crucial in the transition towards more sustainable and decentralised energy systems.

LFMs can operate under various business models, which will depend on the market design, the regulatory framework, and the technological capabilities of the country. Some possible models would be: i) Platform-based model: a digital marketplace where flexibility services are traded between prosumers (i.e., flexibility providers) and local utilities or grid operators. This model relies heavily on smart technologies and real-time data analytics. ii) Aggregator model: a third-party aggregator pools and manages the distributed flexible energy resources of multiple small-scale prosumers and consumers to sell flexibility services to grid operators or energy suppliers. iii) Cooperative model: local energy cooperatives/communities manage the production, consumption and storage of energy within a community. Their members can trade energy and flexibility services amongst themselves or with external parties. iv) Hybrid model: a combination of the previous models, tailored to the local conditions and regulatory environment, leveraging the strengths of each to maximise efficiency and participation.

All those energy services that can somehow have benefits or support the roll-out of LFMs were considered relevant and analysed in this report.

[37] Demand Response: A Study Potential In Europe, SIA Partners.
www.sia-partners.com/en/news-and-publications/from-our-experts/demand-response-study-its-potential-europe

The information was collected through a questionnaire prepared by R2M and sent out to the DE-RISK project's partners. For each energy service, the partners provided a brief description of the applicability of the service in their own country, as well as information relating to existing regulations, the main barriers and requirements, and other relevant aspects or best practices for LFMs.

The analysis of the answers of the partners to the questionnaire highlighted how there are currently several shortcomings in the regulation of certain innovative energy and flexibility services and, in general, there is currently a lack of clear regulations or legal frameworks that recognize and facilitate the operation of LFMs. Other identified barriers that can hinder the development and scaling of LFMs across Europe are technical and operational issues such as the integration of distributed flexible energy resources, data management and cybersecurity concerns; market barriers like the need of encouraging the participation of a diverse range of energy producers & consumers, especially residential actors; economic and financial barriers such as establishing pricing mechanisms for flexibility services and ensuring the economic viability for all participants, considering investments in necessary infrastructure; as well as cultural and social acceptance challenges, for instance, building trust of citizens in new smart technologies and market models, and ensuring equitable access to the benefits of LFMs.

The responses of the partners to the questionnaire also revealed how some energy services are more rooted than others within the regulatory structure of each country. In general, the directives of the European Union have been or are being implemented in all the countries, but further policy development is needed at the national level to remove certain regulatory and administrative barriers that hinder the integration of new players in the energy flexibility market (i.e., users' engagement and active participation in LFMs), as thoroughly described in DE-RISK's *Regulatory Impact Analysis for LFMs* (D3.2). Moreover, the bureaucratic difficulties and the difficulty in finding buildings' technical data or historical consumption data have also been found to contribute to reducing the possibilities of successfully applying advanced and innovative services (e.g., smart contracts, optimization through DR management logics, etc.) in some countries.

The tables presented hereinafter show a summarised analysis of the applicability of each of the energy services identified in the countries participating in the DE-RISK project.

Table 8: Energy Supply Contracting.

	Spain	Greece	Portugal	Ireland	Bulgaria	France	Turkey
Presence of the energy service	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Specific requirements	No need to be an accredited company.	Electricity supply and trading license.	Licensing & regulation compliance, grid connection; financial capacity.	N/A	Regulatory compliance.	To be a vetted energy supplier.	Licensing & regulation compliance, grid connection; financial capacity.
Main barriers	Large initial investment and ESCO's capital needs. Long-term contracts.	As a result of the high energy prices, ESCOs are highly taxed on their profits.	Admin. burdens, intense competition and fluctuating energy prices.	Regulatory barriers; long ROI; and the level of competition affects ESC pricing.	Lack of incentives to enter the free electr. market; uncertainty regarding regulation of new technology.	Admin. burden to get registered as an energy supplier.	Price volatility; regulatory constraints; energy supply costs; customer retention; etc.
Application within LFMs	Distributed prosumers selling their excess production to nearby consumers.	N/A (LFMs at very early stage)	Integrating ESC within LFMs would enable particip. of flexible energy suppliers.	N/A	The internal electricity market was established as a market for bilateral contracts & balancing market.	N/A	N/A

Table 9: Energy Performance Contracting.

	Spain	Greece	Portugal	Ireland	Bulgaria	France	Turkey
Presence of the energy service	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Specific requirements	To be an ESCO.	To be an ESCO.	Expertise, relevant certificate (ESCO).	M&V measures during the whole contract.	Specs. for EPC contracts	To be an accredited provider; to comply w. quality standards; robust M&V protocols.	To be registered as ESCO; qualified personnel, compliance with standards.
Main barriers	ESCO's incomes (linked to customer's economic savings) affected by energy prices volatility.	ESCOs are paid based on achieved energy savings, upon completion of the project.	Financial barriers; lack of awareness among potential clients, and long adm. procedures	Complex and long procurem. processes; high transaction costs; split incentive problem.	Lack of end-users' interest in EPC; lack of incentives; financial uncertainty and risks.	Service dedicated only to industrial users,; and the "yet another contract" effect.	Lack of awareness; high initial costs; financing challenges; complex contracting process; accurate M&V; long payback periods.
Application within LFMs	N/A	N/A	Standard M&V protocols for energy savings within the LFMs.	Including EPCs as services in LFMs may help mitigate barriers.	Similar barriers apply to LFMs.	EPCs improve the overall efficiency of energy supply chains.	Similar barriers apply to LFMs.

Table 10: Power Purchase Agreement.

	Spain	Greece	Portugal	Ireland	Bulgaria	France	Turkey
Presence of the energy service	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Specific requirements	No	To be an ESCO, RES producer or energy community	Contract specifying all the conditions & targets.	N/A	Regulatory compliance	No	Permits & licensing; connection to the grid; regulatory compliance and insurance.
Main barriers	Reliance on energy price variations.	Small-sized market; long-term risks; high non-compliance penalties; and low liquidity.	Complex contract negotiation and uncertain electricity prices.	Reliability of RES supply; grid connection issues; and perception of risks can be barriers to entry.	Long-term contracts carry risks and costs for smaller market participants so it is now limited for large consumers.	Complex, and long-term contracts.	Regulatory and policy; market structure; financing challenges; long permitting approval process.
Application within LFMs	Creation of markets, tools and regulations for energy & flexibility exchange at local level.	N/A	Integration of RES PPAs into LFMs to enable flexibility services.	Similar barriers apply to LFMs.	Ensure better planning of energy expenses and protect consumers from price shocks.	N/A	Similar barriers apply to LFMs.

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Table 11: Pay for Performance (P4P) scheme.

	Spain	Greece	Portugal	Ireland	Bulgaria	France	Turkey
Presence of the energy service	Yes	Not yet	Yes	Yes	No	No	No
Specific requirements	No	N/A (Decision 1650/B by the Energy Ministry was just launched in March 2024).	Expertise, M&V abilities.	Regulatory compliance; licensing; collaboration with ESCOs; sufficient financial resources.	N/A	N/A	N/A
Main barriers	Social & cultural: lack of awareness on the advantages of EE renovation.	No barriers identified yet as the action is still at very early stages.	Limited financial incentives; lack of standard M&V protocols.	High initial costs; ROI uncertainty; contracting and legal challenges; split incentive issue.	Lack of interest from responsible parties, DSOs, etc.; lack of smart meters installed.	N/A	Lack of regulatory framework; lack of awareness; data access & privacy concerns.
Application within LFMs	P4P models for financing flexibility assets.	N/A	P4P schemes within LFMs to incentivise EE and DR.	P4P motivate consumers to save energy, helping to balance local supply and demand.	N/A	N/A	Regulatory & policy framework and tech. infrastruct. are also needed for LFMs.

Table 12: Energy consultation (e.g., energy audit).

	Spain	Greece	Portugal	Ireland	Bulgaria	France	Turkey
Presence of the energy service	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Specific requirements	Technical certificate.	To be registered as an ESCO	To be certified as an energy auditor.	Rqmts. set by Support Scheme for Energy Audits.	To be certified by the EE Agency.	To be a qualified & impartial auditor; insurance	Expertise, qualification and accreditation
Main barriers	N/A	SMEs are not obligated to be audited and tend to avoid it.	Lack of incentives, limited awareness among consumers and lack of qualified personnel.	Concerns about ROI, split incentive issue; level of tech. expertise required.	Energy saving measures that do not provide clear info.; lack of qualified auditors.	Legislation in place slows down property sales.	Lack of awareness; high upfront costs; lack of incentives; long payback period and uncertain ROI; lack of accurate M&V.
Application within LFMs	Energy audit as requisite prior to joining an LFM.	N/A	Recognise the value of energy audits in LFMs.	N/A	Support the role of auditors in LFMs.	Energy audits shall be mandatory to be part of an LFM.	Lack of awareness can hinder participation in LFMs.

Table 13: Energy Management System.

	Spain	Greece	Portugal	Ireland	Bulgaria	France	Turkey
Presence of the energy service	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Specific requirements	ISO 50001 is not mandatory.	ISO 50001, and to be registered as an ESCO	Expertise and access to suitable software. ISO 50001.	ISO 50001	ISO 50001 is not mandatory.	ISO 50001 white certificate programme	Expertise, qualification and comply with standards.
Main barriers	Inter-operability at software and device levels.	Small market reach (mainly B2B).	Upfront costs; limited inter-operability; lack of awareness.	N/A	Lack of info. & training; application depends on knowledge/ expertise of interested parties.	Lack of awareness of EMS offers in the market.	Upfront cost and ROI; complex implementat. process; data quality & availability; integration and inter-operability.
Application within LFMs	EMS for automatic control of buildings within LFMs.	N/A	Integration of EMS into LFMs to manage flexibility in real-time.	N/A	Integration of EMS with flexibility services will foster LFMs	Subsidies for EMS contribute to setting the needed framework for LFMs.	Similar barriers apply to LFMs.

Table 14: Project design, implementation and maintenance.

	Spain	Greece	Portugal	Ireland	Bulgaria	France	Turkey
Presence of the energy service	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Specific requirements	To be an ESCO.	To be registered as an ESCO	Technical expertise; regulatory compliance	N/A	Energy certificatio n of building; objective parameters must be established and shared.	Regulatory compliance	Expertise; qualification; regulatory compliance; insurance; and quality assurance & control.
Main barriers	Economic or financial barriers. Regulatory and admin. burdens.	N/A	Financial barriers; long and complex processes; lack of skilled personnel.	Complex and long permitting processes; scarcity of skilled labour; technical difficulties; and grid connection issues.	High investment costs; lack of qualified workers.	Complexity level of projects.	Lack of qualified personnel; cost and financing; regulatory & policy constraints; technical challenges; stakeholder engagement; and market uncertainty.
Application within LFMs	N/A	N/A	Clear guidelines to install, maintain & operate flexibility assets in LFMs.	Investment RES & smart grid projects enhance integration of flex. ser. in LFMs.	Implement projects that support the application of flexibility services.	Subsidies and tax benefits for RES projects that could involve LFMs.	Similar barriers apply to LFMs.

Table 15: Metering & monitoring services.

	Spain	Greece	Portugal	Ireland	Bulgaria	France	Turkey
Presence of the energy service	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Specific requirements	Regulatory compliance	To be registered as an ESCO	Expertise, standards compliance & access to equipment	Reports of annual electricity usage are mandatory for public bodies.	No	Mandatory for energy providers to be able to display specific data.	Licensing & accreditation; compliance with technical standards & regulations; data management & reporting.
Main barriers	No	Small market reach.	Limited metering infrastruc.; privacy and security issues; insufficient integration and inter-operability.	Upfront investment in devices that could become outdated; data security; and inter-operability.	No mass roll-out of smart meters, hindering application of flexibility services.	Lack of reliability in the data chain; additional accessories required to get real time data.	Investment cost; data privacy and security concerns; , technological compatibility & integration; lack of awareness.
Application within LFMs	Availability of data in real-time.	N/A	Advanced metering to enable accurate & real-time monitoring of assets in LFMs.	Similar barriers apply to LFMs.	Smart meters needed to provide energy data in real-time.	Real-time monitoring data is necessary to manage LFMs	Similar barriers apply to LFMs.

Table 16: Smart contracts.

	Spain	Greece	Portugal	Ireland	Bulgaria	France	Turkey
Presence of the energy service	No	Yes	Yes	No	No	No	No
Specific requirements	N/A	Comply with legal framework in Law 4961/2022	Comply with legal and regulatory framework	N/A	N/A	Blockchain must be legally allowed.	N/A
Main barriers	Regulatory barriers & social acceptance	New technology orbits around cryptocoin transaction	Technical, legal and regulatory barriers; lack of awareness.	No specific law dealing with smart contracts in Ireland. Very early stage.	Net energy metering is not allowed; DLT only at R&D level.	Lack of regulatory & legal framework	Lack of legal and regulatory framework; technical complexity; security and trust concerns.
Application within LFMs	Enable P2P trading within LFMs.	N/A	Smart platforms for LFMs.	N/A	N/A	Enable P2P trading within LFMs.	Similar barriers apply to LFMs.

Table 17: Energy optimisation (at household, building and/or community level).

	Spain	Greece	Portugal	Ireland	Bulgaria	France	Turkey
Presence of the energy service	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Specific requirements	No	To be an ESCO.	Comply with legal and regulatory framework	Rqmts. of the SEC Programme	Regulatory compliance	No	No
Main barriers	Regulatory & admin. burdens delaying access to financial incentives.	Small market reach, mainly B2B.	Lack of financial incentives; Lack of awareness and info.; Resistance to change.	Uncertainty in ROI; consumers' resistance to change their energy behaviours.	Solid ICT structure and load mgmt. logics are required.	Lack of legal framework and clear certification	Lack of awareness; split incentives; technical complexity and lack of expertise.
Application within LFMs	Optimise operations within LFMs.	N/A	Energy optimisat. measures into LFMs to enhance flexibility.	Optimisat. within LFMs should be adaptable to varying needs and objectives.	Optimise operations of smart homes to provide flexibility.	Improving energy efficiency also within LFMs.	N/A

Table 18: Time-of-Use (ToU), Peak shaving.

	Spain	Greece	Portugal	Ireland	Bulgaria	France	Turkey
Presence of the energy service	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Specific requirements	Regulatory compliance	To be an energy provider.	Knowledge /capability to implem. load mgmt. strategies.	No	Regulatory compliance	Rqmts. set by DSO.	N/A
Main barriers	Technical & regulatory barriers for explicit DR. Social & cultural barriers for implicit DR.	Very recent endeavour (Jan 2024), so lack of awareness among consumers	Lack of consumer awareness; and limited availability of flexible tariffs.	Uncomplete smart-meter roll-out; lack of consumer awareness; data privacy concerns.	Need to develop further regulatory steps.	Lack of incentives for end-users & lack of dynamic rates.	Limited consumer awareness; inflexible energy use patterns; lack of metering infranstruc.; complex pricing structures.
Application within LFMs	Potential to monetise peaks trimming as a result of LFMs operations.	N/A	Implementation of ToU pricing and peak shaving schemes within LFMs.	Limited availability of DR programs can be a barrier to LFMs.	Yes	Incentive for LFMs users to shift energy loads.	Similar barriers apply to LFMs.

Table 19: Predictive building management.

	Spain	Greece	Portugal	Ireland	Bulgaria	France	Turkey
Presence of the energy service	Yes	No	Yes	No	No	Yes	No
Specific requirements	Monitoring & comput. capacity.	N/A	Expertise, access to specific tools and integration with BMS.	N/A	N/A	N/A	N/A
Main barriers	Scalability and adaptation of the solutions for new buildings.	IoT equipment has not yet penetrated the Greek market.	Limited availability & quality of data; technical challenges; upfront costs.	No explicit regulatory framework exists.	Lack of smart meters; lack of interest; regulated energy prices.	Currently it only focuses on industrial buildings.	Limited data quality & availability; technical complexity; lack of standards.
Application within LFMs	Better exploiting buildings' flexibility.	N/A	Enhanced flexibility and energy efficiency.	Better insight and forecasting capabilities for DR.	Pre-requisite for developing LFMs.	Improving energy efficiency also within LFMs.	N/A

Table 20: Peer-to-peer (P2P) trading.

	Spain	Greece	Portugal	Ireland	Bulgaria	France	Turkey
Presence of the energy service	No (only R&D pilots)	No	Yes	Yes	No	No	No
Specific requirements	2km distance limit.	N/A	Platform; compliance with regulations and tech. capabilities	Licensing; regulatory compliance and market rules; data privacy; and grid integration	N/A	N/A	N/A
Main barriers	Need for dynamic sharing coefficients (delay of processing by DSOs).	IoT equipment has not yet penetrated the Greek market.	Technical & regulatory challenges; lack of consumer awareness.	Inter-operability & technical obstacles, high entry & transaction costs.	Lack of digitalisation and under-developed regulatory framework.	N/A	Regulatory challenges; market access; lack of tech. infrastruc.; trust and transparency
Application within LFMs	Energy & flexibility trading among LFM members.	N/A	P2P trading platforms integrated into LFMs infrastruct.	Cloud-based platform to control distributed flexible energy.	N/A	N/A	Similar barriers apply to LFMs.

Table 21: Collective self-consumption.

	Spain	Greece	Portugal	Ireland	Bulgaria	France	Turkey
Presence of the energy service	Yes	Yes	Yes	No	No	Yes	No
Specific requirements	Connection to the same transform. centre. Maximum distance of 2km.	To be located in the same building.	Form legal entity/ community framework & comply with regulations	Rqmts. for CSC are in discussion: proximity, effective control, etc.	N/A	Maximum distance of 20km; form legal entity; and establish agreement with DSO.	N/A
Main barriers	Delays from DSOs registering CSC install. Energy sharing coefficients cannot be modified in real-time.	Distance constraint.	Long and complex paperwork; technical challenges; lack of financial incentives.	Lack of interest; perceived high costs; lack of financial incentives; limited network capacity.	Net energy metering is not allowed by regulations	Long and complex paperwork; lack of users' awareness	Regulatory, admin. & legal barriers; market design & access; consumers' awareness & engagement
Application within LFMs	LFMs need DERs, which in Spain usually implies a shared PV installation for CSC.	Broadened residency criteria to other buildings in vicinity could pave the way for LFMs.	Need for clear guidelines, supportive regulations and admin. processes for CSC projects.	CSC can help unlock the potential of LFMs.	N/A	CSC offers allow consumers to actively participate in LFMs.	Similar barriers apply to LFMs.

Table 22: Congestion management.

	Spain	Greece	Portugal	Ireland	Bulgaria	France	Turkey
Presence of the energy service	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Specific requirements	Managed by TSO. National regulatory framework	Managed by TSO. National regulatory framework	Managed by TSO. National regulatory framework	Managed by TSO. National regulatory framework	Managed by TSO. National regulatory framework	Managed by TSO. National regulatory framework	Managed by TSO. National regulatory framework
Main barriers	Pay-as-bid market that limits competit. and results in high costs for consumers	Greek TSO has the monopoly of the market.	Grid infras. limitations; regulatory and admin. Barriers; lack of coordin. among market players.	Demand inelasticity; lack of incentives for DR flexibility; unclear DSO-TSO responsib.; market size & liquidity.	Under-developed regulatory framework	Only focusing on industrial users, as at least 1 MW of flexibility is required.	Grid infrast. limitations; lack of efficient comm. & coor. among parties; market power by a few dominant players.
Application within LFMs	LFMs aim to alleviate congestion problems at DSO level.	N/A	Planning & coordinat. to address congestion within LFMs.	LFMs are a key instrument to enhance grid congestion mngmt.	Ancillary services in LFMs.	Large-scale connected smart appliances & financial incentives.	N/A

Table 23: Imbalances management.

	Spain	Greece	Portugal	Ireland	Bulgaria	France	Turkey
Presence of the energy service	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Specific requirements	Managed by TSO.	A (RES) producer, aggregator, consumer able to provide balancing services is entitled to register as a BSP.	Register as a BRP with TSO/DSO; complying with regulations	Managed by TSO.	Managed by TSO.	Managed by TSO.	Managed by TSO.
Main barriers	Entry barrier: min. 1MW of flexible energy in each generation, storage or demand scheduling unit.	Lack of consumers awareness; and lack of BSPs experience	Technical challenges; lack of flexibility options; financial risks and penalties.	Demand inelasticity; lack of incentives for DR flexibility; high transaction costs between TSO, DSO & aggreg.; market size & liquidity.	Regulatory inconsis., & challenges in utilising the full potential of RES and storage solutions	Focusing only on industrial users; and difficulties dealing with TSO contracts.	Forecasting accuracy; balancing costs and settlement mechanisms; grid infras.; regulatory and market barriers.
Application within LFMs	LFMs replicate the balancing market at a smaller scale.	Imbalance settlement in LFMs.	Flexibility services / markets to manage imbalances & minimise penalties.	LFMs are a key instrument to enhance grid balancing.	N/A	N/A	N/A

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