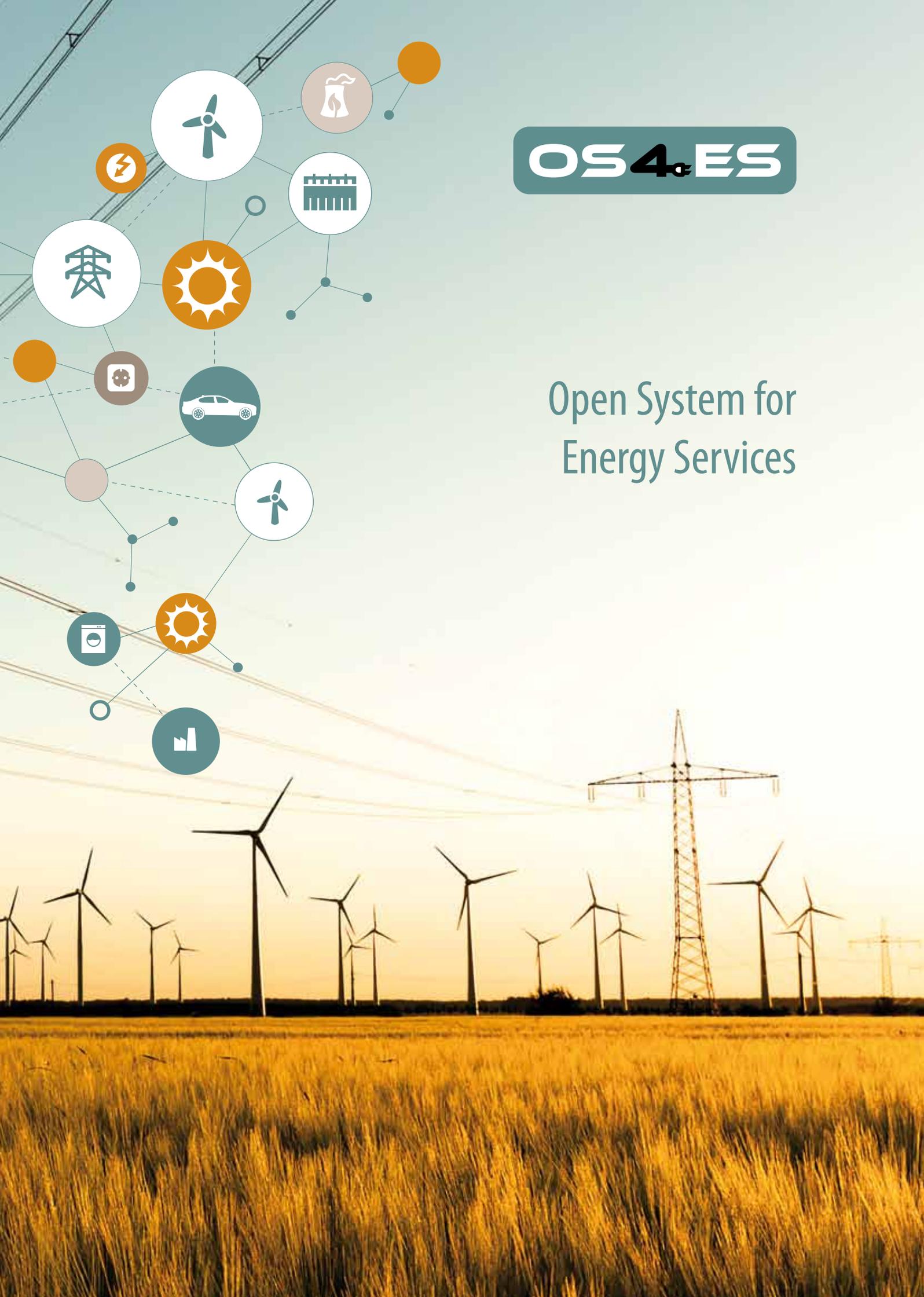


The logo for OS4ES, featuring the letters 'OS4ES' in a bold, white, sans-serif font. The '4' is stylized with a small 'e' inside it. The logo is set against a dark teal rectangular background.

Open System for  
Energy Services



## OS4ES in a nutshell

OS4ES is a European research project running from July 2014 to October 2017. It receives funding from the European Union's Seventh Framework Programme which co-finances research, technological development and demonstration projects.

The project was motivated by the fact that today's mass presence of distributed energy resources (DERs) connected to the grid is seen as complicating network management and having adverse effects on grid reliability and robustness. In order to improve this situation it is necessary to close the current information, communication and cooperation gap between DERs, DSOs/TSOs, BRPs and aggregators by

- enabling resource providers of DERs such as electric vehicles, photovoltaic systems, wind power plants and combined heat and power plants to make their resources visible in the energy market and to register their DER capabilities on a transparent and discriminatory-free data hub
- giving aggregators access to registered DERs in order to be able to spontaneously aggregate them for energy services such as the provision of flexibility in order to relieve stress on the grid
- providing an interface between aggregators on the one hand and TSOs, DSOs and BRPs on the other hand by implementing a market-based control mechanism that defines the rules required to optimise the whole system ensuring that energy is produced, delivered and managed at lowest cost.

This is where OS4ES comes in as it develops an Open System for Energy Services (OS4ES) that provides Smart Grid actors such as aggregators with an ideal means of monitoring and controlling an enormously high number of DERs on the fly. One central component of OS4ES is its distributed registry where DER systems register after commissioning both their static and dynamic data including measurement data and their available energy services. Once registered, DERs are visible to authorised aggregators who can browse the registry for DERs matching a requested energy service from a DSO. After having reserved and contracted the aggregated flexibility of suitable DERs, an aggregator can activate the DERs within its portfolio when grid support is needed. With the help of the registry, for example, dynamic Virtual Power Plants can be set up.

To demonstrate the feasibility and usability of this innovative system applications for crucial energy services such as provision of flexibility, frequency control, active and reactive power support as well as dynamic VPPs have been developed and will be applied in lab and field tests for different grid scenarios such as congestion management, imbalance risk reduction and Volt/VAr optimisation.

In order to make OS4ES future-proof its interfaces are based on international standards allowing for interoperability. The registry is based on a coming version of the IEC 61850-7-420 standard and the communication stack implements the brand-new IEC 61850-8-2 standard that is planned to be released soon. In order to allow communication to non-IEC 61850 DERs gateways have been developed. Besides, for the communication between aggregator and DSO/TSO/BRP the Universal Smart Energy Framework (USEF) is used, which constitutes a base software reference implementation providing a standardised way of exchanging information by means of flexibility-oriented messages.

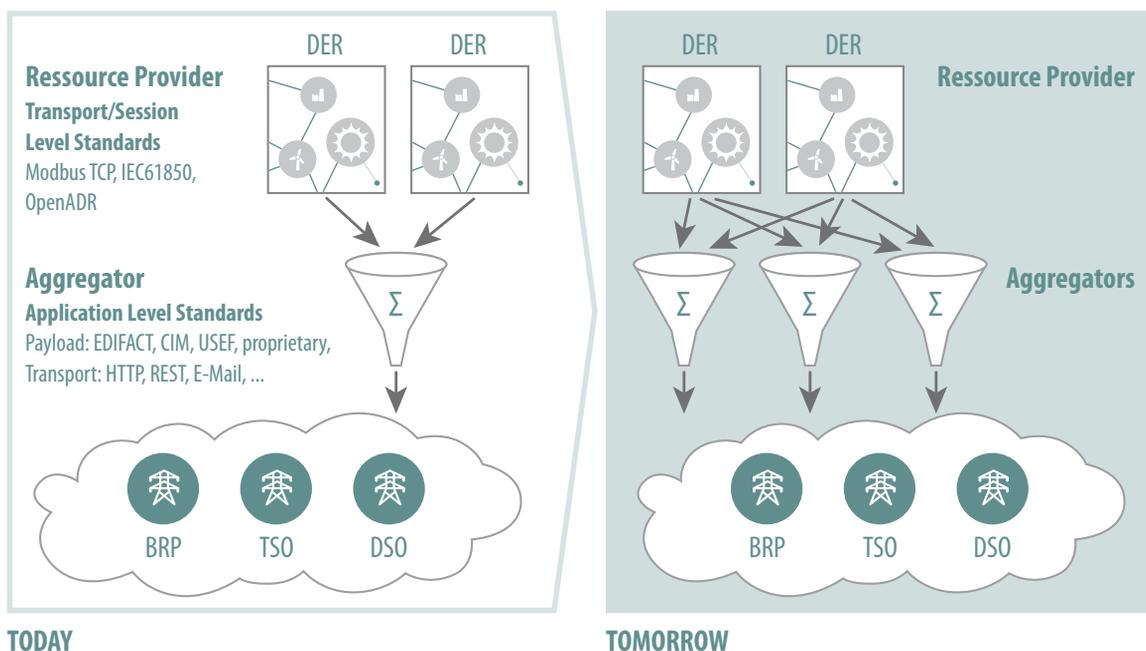
OS4ES is designed as an open-source solution, so that users of OS4ES can at any time develop their own applications on top of the provided system from scratch or by reusing one of the existing OS4ES applications. Of course, also the code for other OS4ES components such as registry, communication stack and middleware can be adapted as needed. For example, aggregators may utilise it to participate in energy markets with aggregated DER clusters, DSOs may integrate common features into their Distribution Management System.

## OS4ES achievements

With the open system architecture for energy services based on international standards a powerful tool for aggregators, system operators, BRPs and further stakeholders trading flexibility and ancillary services in the energy market has been developed and is currently tested in lab and field tests.

It offers the following components:

- **Semantic middleware:** This is the central communication platform of the OS4ES system which handles the interaction between the different components connected to it such as DER Systems, Registry and Aggregator applications. It uses the web-based communication stack based on the latest IEC 61850-8-2 standard to be released soon and provides e.g. messaging services such as concurrency and transaction management, threading, messaging and message conversion.
- **API for energy applications:** This interface assists aggregators and other Smart Grid actors in managing balancing and flexibility requests in the grid.
- **Distributed registry:** The distributed registry based on an IEC 61850 conform data model for energy services is the key component for DER systems to register their services and for aggregators to find matching energy services. The figure below shows that this innovative approach allows DER systems not to be booked by one aggregator only. The OS4ES registry enables DER system services to be booked by different aggregators. Even one energy service might be split into parts offered to various aggregators. This permits DER systems to play a much more active role in the energy market and achieve the best possible price for their services. Also aggregators profit from this approach: They can book a service partially if they do not need the full service which makes balancing easier and might be economically beneficial.
- **DER system gateways:** Gateways offer a mapping from the IEC 61850 based data model and communication to DER systems that implement proprietary protocols.





# What is OS4ES?



## Resource Provider

A Resource Provider is a legal entity that produces and/or consumes electrical energy. Accordingly, it can either be a producer, prosumer or consumer.

In general, a Resource Provider operates one or more DERs, forming a so called DER system. Its main interest consists in capitalising the energy provided by this DER system. It should be noted that DER systems can consist of any mix of generation, load and storage including both thermal and electric storage.

By using the OS4ES platform the Resource Provider benefits from the possibility to offer and sell its flexibility to Aggregators in such a way that the DER system can be booked either partially or fully by an Aggregator. Once booked, the Aggregator can control the DER system according to grid requirements, provided that its control actions comply with the contractual details agreed with the Resource Provider.

### Key resources

- DER system(s) with smart meter which allow to measure the amount of flexibility that can be sold and is actually sold to the Aggregator,
- OS4ES platform and electricity grid

### Key activities

- DER system(s): set up, connect to the grid, operate and register at the OS4ES platform
- determine price limits for offered flexibility
- set up a business model for its resources

### A Resource Provider can be an operator of

- a huge solar power plant or a residential PV system with or without storage unit
- a combined heat and power plant (including thermal storage)
- a wind farm or a Virtual Power Plant



## Aggregator

The Aggregator is an entity which accumulates energy services of Resource Providers' DER systems in order to offer those aggregated services to the energy market.

An Aggregator acts as intermediary between a DSO/TSO/BRP and the DER systems of Resource Providers: A DSO/TSO/BRP expecting a grid problem or having an acute problem in its grid asks an Aggregator to provide a certain amount of flexibility to cope with this problem (e.g. congestion or imbalance). The approached Aggregator registered at the OS4ES platform searches the registry for DER systems matching the DSO/TSO/BRP request and offers them to the requesting party. Upon reception of the requesting party's approval the Aggregator contracts the DER systems and can then start to control them as contractually agreed.

Hence, the Aggregator is the one who manages the provision of flexibility offered by the Resource Providers.

### Key resources

- forecasting algorithms in order to determine the energy demand
- contracted DER systems
- OS4ES platform

### Key activities

- searching and contracting DER systems for a given grid request
- fixing price limits for the flexibility provided by the Resource Provider and offered to the TSO/DSO/BRP
- controlling of the DER system(s) in its portfolio according to the contract with the Resource Provider

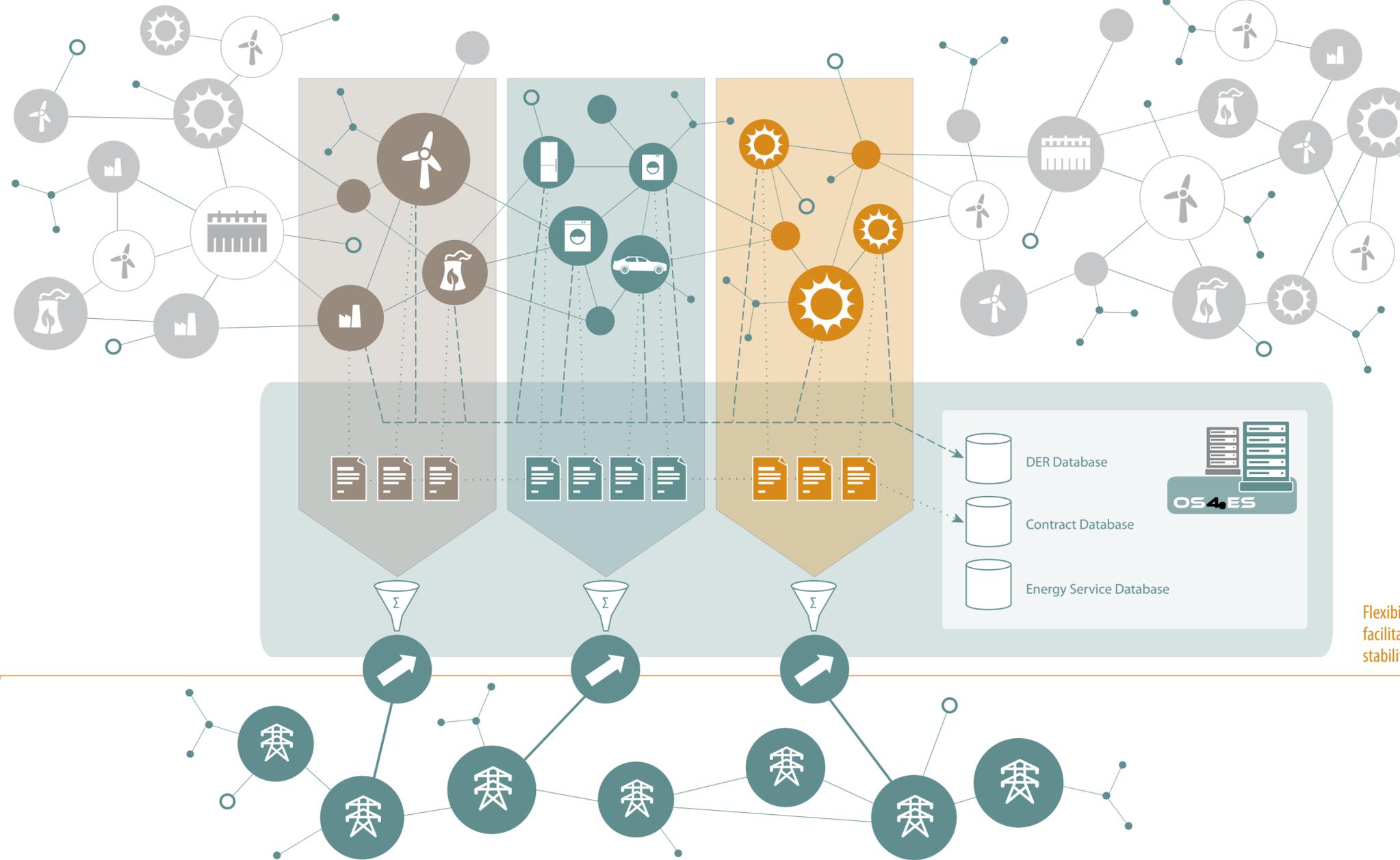
### Who could e.g. act as Aggregator

- operator of energy networks (DSO, TSO, BRP)
- telecommunications companies
- energy resellers

Controllability sells



Aggregation of controllability creates flexibility



Flexibility facilitates stability

Flexibility sells

## System Operator



The System Operator can be a legal entity or an operating consortium which operates, maintains and further develops the OS4ES platform. It monitors the whole system and contracts users by selling user licenses to its customers. These licenses authorise customers to access and use the services provided by the OS4ES platform according to their individual needs.

### Key resources

- know-how for operating the OS4ES software platform
- data center for data processing
- platform administrator who is in charge of the correct functioning and the supervision of the OS4ES platform
- information and communication technology (ICT) for deploying the OS4ES software
- ICT infrastructure in order to run the OS4ES software
- DER systems connected to the OS4ES software platform

### Key activities

- operating and maintaining the entire OS4ES platform
- eliminating system bugs
- contracting users of the OS4ES platform
- enhancing (in cooperation with a partner) the OS4ES software platform with added functionality
- monitoring changes in the regulation of energy related issues

### Who could e.g. act as System Operator?

- TSOs
- telecommunications companies

Further development increases benefits

## DSO, TSO, BRP



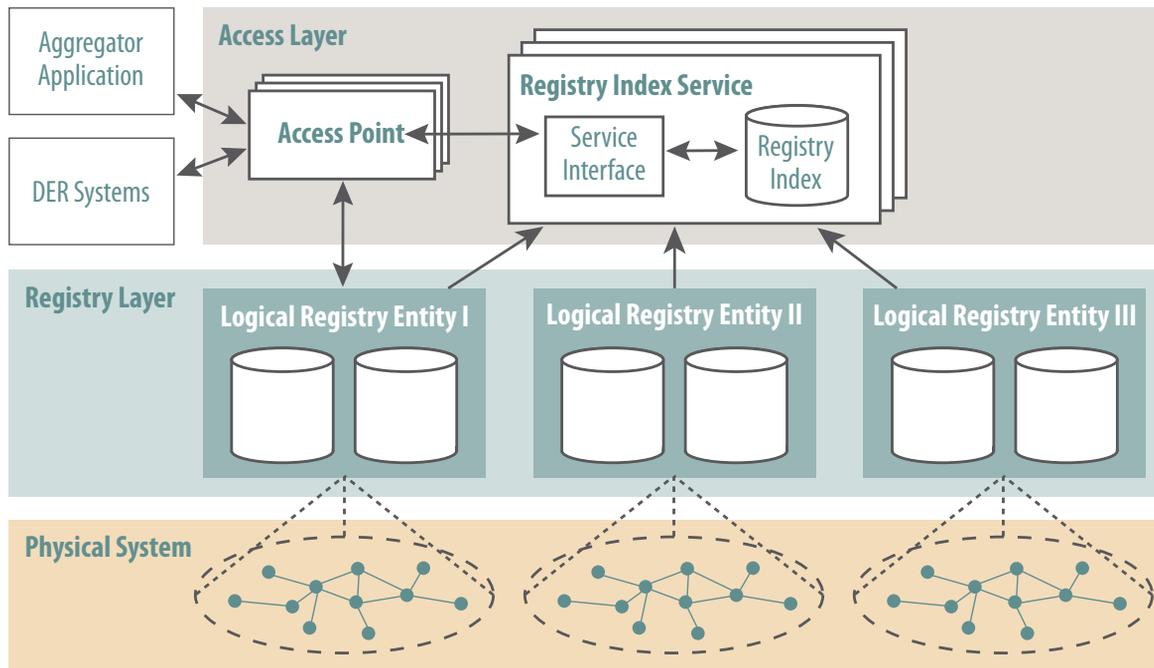
DSO, TSO and BRP are responsible of ensuring secure grid operation and stability within their network area.

In order to accomplish this task, despite of fluctuating generation caused by intermittent energy resources, deviations between forecasted and actual demand, changing weather prognosis and unforeseen network scenarios such as the outages of big power plants they rely on flexibility in the grid.

Thus, they are the final beneficiaries of the flexibility provided by DER systems, traded by Aggregators and made accessible through the OS4ES platform via the Universal Smart Energy Framework (USEF).

You want to know whether one of these listed roles could be a suitable and lucrative business case for your company? Feel free to contact us! We can provide you with a generic template based on a business model canvas which might help you make a quick decision.

## OS4ES Architecture and Design



The development of OS4ES goes hand in hand with an open source strategy. The OS4ES software is developed, tested and fine-tuned as an OS4ES open-source semantic message oriented middleware which will comprise the interoperability gateway and the central interconnection part for all OS4ES components, allowing for the smooth communication and information exchange between them as well as between OS4ES and the involved smart grid actors and DERs.

The OS4ES Registry System has an open deployment strategy. With a strong focus on the different national legislative and energy market situations throughout Europe, the OS4ES has been developed to address different deployment and distribution strategies of the actual system. Logical Registry Entities can cover different aspects and geographical zones of the physical system. Through a resource-addressing scheme based on the established Domain Name System of the Internet, the OS4ES allows access to all resources across indexed Logical Registry Entities independent of the actual deployment situation.

Access Points serve as gateways to the OS4ES Registry System. They ensure scalability and performance of the Registry System and support multiple communication standards to allow for interoperability. The OS4ES prototype system is using IEC 61850 and REST services for demonstration purposes.

## OS4ES Consortium

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## User Group

The massive interest of various European companies shown in OS4ES even before project start resulted in the establishment of an OS4ES User Group. This group of industrial stakeholders has continuously being extended during project runtime and currently counts about 25 member companies from utilities, industry, device manufactures, telecommunication providers and research companies.

Being a member of this User Group has the advantage of:

- permanently being kept up with the latest project work and results in regular web meetings and physical meetings,
- having access to deliverables before their publication,
- being able to influence the project work by giving feedback to project documents, taking part in discussions and proposing pressing issues to be considered in future work.

Besides, as it is the aim of the project to enable both early implementation of future standards and broad market penetration of Smart Grid enabling components even before these standards are released in their final versions (e.g. IEC 61850-7-420 Ed. 2 and IEC 61850-8-2), User Group members can start creating company specific solutions which can be offered to the market directly after the respective standard has been released. Members and their companies would thereby obtain an advantage over competitors.

Interested parties willing to profit from OS4ES and participate in its User Group can register at [www.os4es.eu/Contact/](http://www.os4es.eu/Contact/).

## Imprint

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