



# Universal Smart Energy Framework (USEF)

## One international common standard for a unified smart energy system with consumers at its heart

Putting customers at the heart of our future energy system is essential for its success. Enabling them to play an active role, and rewarding decisions they take that improve efficiency or reduce system stress, are recognised as the best route to a smart energy future. The scope of the new smart energy market has been well publicised and there are already large and small innovators vying for position. With technology ahead of policy, the biggest challenge lies in making sure that all technologies, projects and markets can be integrated, at least cost, and that the end result is a system that optimises efficiency and benefits all stakeholders. The Universal Smart Energy Framework (USEF) aims to achieve this by providing one common international standard for an integrated smart energy future.

### More renewables, more system complexity, higher costs

The drive for clean, sustainable and secure energy has led to more of it being produced by renewables of all sizes, from domestic solar panels to large offshore wind farms. As a result, there are more people uploading and downloading variable amounts of electricity, in more diverse locations, than ever before. This has further impacted grid systems that were originally designed to move centrally-produced electricity one way and that are already stretched as demand for, and reliance on, electricity have grown. The increasing complexity of shoring up and managing the energy system in the face of these changes is driving up system costs and making interruption of supply more likely.

There are three key components that make up energy bills and they are intrinsically linked - the cost of the energy used, the transportation of that energy and the costs for operating and maintaining the system. These prices can fluctuate and stress on the system can influence this as it results in congestion, imbalance of supply and demand and, ultimately, volatility of the commodity price of electricity. One way or another, energy consumers pay for all of this and they therefore have a vested interest in solutions which alleviate overall system pain to limit costs in all three areas.

### A decentralised model and risk of defection

The advent of smaller, affordable renewables technologies has offered both domestic and commercial consumers the opportunity to become prosumers, generating their own energy to raise income or offset energy bills. In most cases they have been incentivised by governments to do so but the market stimulants in many countries are now in regression. As a result, there is a growing risk of prosumer defection from the energy system. New storage technologies complement their own renewable energy generation. Intuitive, easily accessible apps and smart appliances offer them improved energy optimisation. Combined, these technologies could drive them off-grid since it will be easier for them to control costs this way than remaining connected to, and exposed to the rising costs of, the system - and every defection will effectively increase those costs to other prosumers, potentially perpetuating the problem.

### The need to enable and incentivise prosumers

It is clear from both a societal and system perspective that it is better to keep as many prosumers connected to the system as possible. However, while current market designs still offer varying degrees of reward for prosumer renewable energy production, they do not involve the prosumer in market mechanisms. Instead, prosumers remain exposed to contractually fixed retail prices regardless of the situation and so there is little incentive for them to act according to system pressure or market price volatility. Unsurprisingly, this means that the majority continue to produce and use energy however they like because, as far as they are concerned, these things have no perceivable impact on them.

With the energy revolution already underway, ensuring that we arrive at a clean, efficient and affordable shared energy future requires that the power grid and energy markets are made more accessible. Prosumers already have access to energy related information but there is an opportunity to enable and incentivise their active participation in the system. Allowing consumers to make decisions about their energy generation and use would contribute to increasing energy efficiency and reducing overall system pain. Key to putting prosumers at the heart of the market in this way is the need to unlock the value of their flexible energy use.

### Commoditising flexible energy use will benefit everyone

By choosing to be flexible about whether to use or when to use energy, prosumers can collectively maximise the efficiency and lower the costs of energy generation, delivery, management and use. Their flexibility has financial value and, with a market for buying and selling it, it could become a new commodity. Prosumers would benefit by selling it for use by grid operators and balance responsible parties who, in turn, would benefit by using it to reduce or change the pattern of overall electricity demand to:

- Reduce grid congestion
- Avoid expensive grid upgrades
- Limit any penalties for failing to balance supply and demand
- Avoid buying energy when prices are high

Using flexibility this way would reduce overall system costs, making energy cheaper for prosumers, who would benefit further financially by selling their flexibility. Unlocking this value would revolutionise our energy system by incentivising all parties to play an active role in delivering a more sustainable and cost-effective energy future. Fundamental to achieving this is the need for a specific aggregation function within the market. In fact, the role is considered so important that it has already been part of in-depth discussions at EU level, including within the European Commission's Smart Grid task Force, and is reflected as a necessary requirement within European Commission regulatory initiatives.

### The aggregator – a central role

Aggregating flexibility is not new. Many large industrial organisations with high energy requirements already benefit from offering flexibility, for example, by offering to reduce power to cooling systems at certain times, and aggregators sell this on the wholesale market. In order to really deliver smart energy at lowest cost though, the role needs to be extended to aggregate the flexibility that all energy users and all suitable grid-connected devices can offer. Most of this activity needs to happen in the lower levels of the distribution grid in order to deliver local solutions to local problems. To bring everyone together at this level and, ultimately, connect them to the whole requires robust technologies, systems based on common standards and agreed rules of operation. Above all, the final solution must be cost-effective.



The aggregator role is positioned centrally, between its end customers, who are all motivated to buy or sell flexible energy use because they receive benefits for doing so. The inter-related nature of all parties means that an aggregator's decisions related to one of its customer groups will impact others. For example, if an end-user chooses to offer flexibility to an aggregator and the aggregator acts on that, both that end-user's supplier and the person responsible for balancing supply and demand in that end-user's area will be impacted. They will have planned for that usage, at a specific time and place and so there could be financial implications for them. Addressing this will require multi-way contracts, transparency of information, and clear rules and processes for communication so that all stakeholders are aware of when

they will be impacted, and can receive compensation when they are impacted.

### A role for energy experts or retail experts?

Given the complexity and requirement for understanding the energy industry, it is natural to assume that existing energy market players will be the people most likely to offer independent aggregation services. Certainly, they will be interested since it offers a significant commercial opportunity. Functionally, though, it must be a standalone role, unbundled from the sale of electricity so that end-users can make informed decisions to buy energy from, and sell flexibility to, different service providers based on the perceived merits of their offering. Creating a focus on the end-users' willingness and ability to sell the value of their flexibility this way will create the competition necessary to drive investment in, and demand for, energy flexibility services. It will also make the role appealing to organisations that already have strong existing retail relationships and expertise and so it is not hard to imagine a future where we have a choice to sell our flexibility to all kinds of aggregators, from supermarkets to insurance companies.

There may also be opportunities for niche aggregators. For example, a company that currently sells uninterruptible power supply systems to large industrial organisations as back-up in the event of power failure could offer the collective power in its customer units to grid operators. The agreement with its customers to do so could be written into maintenance agreements. It just requires that they are remotely accessible. Likewise, an organisation that leases electric vehicles could offer their collective battery power as storage, or to be drawn on when needed. The opportunities are endless, providing scope for both new and old market participants to create new services.

### Pioneers without standards risk reinventing the wheel

With everyone vying for a slice of the smart energy future, there are a multitude of pilot projects underway in multiple locations. There are even organisations that have already started to adopt the aggregator role at some level. The problem is that existing local and national energy markets have different drivers, market structures, roles and legislation. As a result, those already active in the smart energy market are all paving their own way to the future depending on where they are located. This might produce successful individual projects but, while they are not based on a common standard, integrating them all in future will, at best, be costly and, at worst, be impossible. Both scenarios could seriously impact our chances of achieving a truly smart energy future. They would also reduce competition for the aggregators role because of the high costs attached to managing the different contracts, systems and rules in each location and the lack of a guaranteed future opportunity for pan-European or international trading of flexibility.



## The Universal Smart Energy Framework (USEF)

### A solid foundation for smart energy futures

The Universal Smart Energy Framework (USEF) has been developed to provide a solution to these challenges by delivering one common standard to drive the fastest, most cost-effective route to an integrated smart energy future. It aims to unlock the value of flexible energy use by making it a tradeable commodity and delivering the market structure and associated rules and tools required to make it work effectively. USEF fits on top of most energy market models, extending existing processes to offer the integration of both new and existing energy markets. It is designed to offer fair market access and benefits to all stakeholders and is accessible to anyone internationally.

USEF is developed, maintained and audited by the USEF Foundation, a non-profit partnership of seven organisations, active in all areas of the smart energy industry: ABB, Alliander, DNV GL, Essent, IBM, ICT Automation and Stedin.

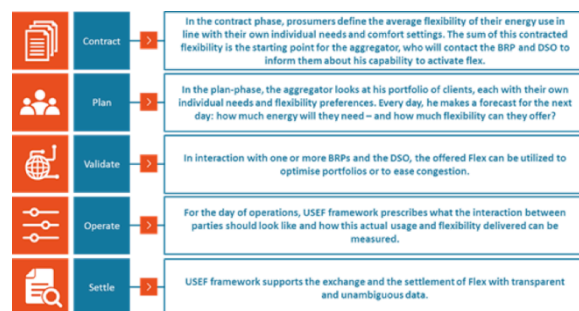
### USEF at a glance

<p><b>The market structure</b> comprises specifications, which define the <b>roles and responsibilities</b> of each stakeholder, how they interact and how they can benefit from doing so.</p>	<p><b>A market-based control mechanism</b> ensures the system is optimised based on least cost and maximum efficiency. The processes related to achieving this are also defined.</p>
<p><b>The tools</b> include descriptions of basic service requirements, exemplary coding and a <b>reference implementation</b> as a standard to build on.</p>	<p><b>Privacy &amp; security</b> are defined to balance consumer confidence with security of supply. USEF complies with the new European General Data Protection Regulation.</p>

### Unlocks flexibility throughout the energy value chain

USEF unlocks prosumer flexibility by ensuring that all stakeholders in the energy system can benefit from its commoditisation. To achieve this, it specifies all stakeholder roles, how they interact and how they can benefit by doing so.

Trading of flexibility is aligned with existing wholesale market models, by extending key processes to include usage prognoses for individual consumers. USEF fits on top of, and can integrate, most market models, therefore building on what exists rather than requiring a whole new market design.



### Connects smart energy products and projects

USEF's open ICT architecture provides the freedom to create unique and commercially competitive smart energy products and services without vendor lock-in. It delivers a common standard on which to build them, ensuring that all technologies and projects will be compatible and connectable to the future smart energy system.

### Delivers smart energy market opportunities

The smart energy market will see existing roles adapted and new roles created, some of which will be appealing to all types of organisation, from supermarkets to insurance companies. By defining the individual roles, responsibilities and interactions required, USEF enables interested parties to both understand and realise smart energy opportunities.

### Accelerates smart energy transition

By adopting USEF and building on a common standard, projects are more rapidly connectable. Learning is shared, creating a faster route to best practice. USEF's exemplary coding and reference implementation provide the groundwork to accelerate innovation and, ultimately, the whole can be integrated and scaled-up much efficiently.

### Reduces costs

By delivering a common standard to build on, USEF reduces the cost to connect different technologies and projects to the energy system. Its market-based control mechanism then defines the rules required to optimise that whole system, ensuring that energy is produced, delivered and managed at lowest cost.

### USEF in practice

Pending legislative guidance, the standardisation of market organisation and technologies could facilitate controlled development of the market without hindering innovation. With existing detailed specifications and existing real-life pilots in the market, USEF is perhaps the most comprehensive, advanced initiative of its kind. Two of the USEF-based pilot projects can be found below:



#### Hoog Dalem

A collaborative project in a newly built, all-electric neighborhood in the Netherlands. It demonstrates the financial feasibility of smart energy applications and services to reduce the peak load on the grid. This is done by offering residents a choice of technologies to produce, store and manage energy.



#### Heerhugowaard

A collaborative project in an existing residential community of 200 houses. It aims to optimise energy use by bringing gas and electricity applications into competition with each other and providing residents with the technology to make choices about their flexible usage. Is already being used as a basis for other pilot projects and examples of these can be found below.

### USEF - Togetherness as an ingredient for success

The USEF Foundation believes that working to one common standard is the most effective route to an integrated smart energy future and that collaboration across organisations, roles and borders is vital to deliver it. USEF was developed, and is being refined, this way and its founding partners work regularly with specialists across Europe to evaluate the framework and deliver a shared goal, for the good of everyone.

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