



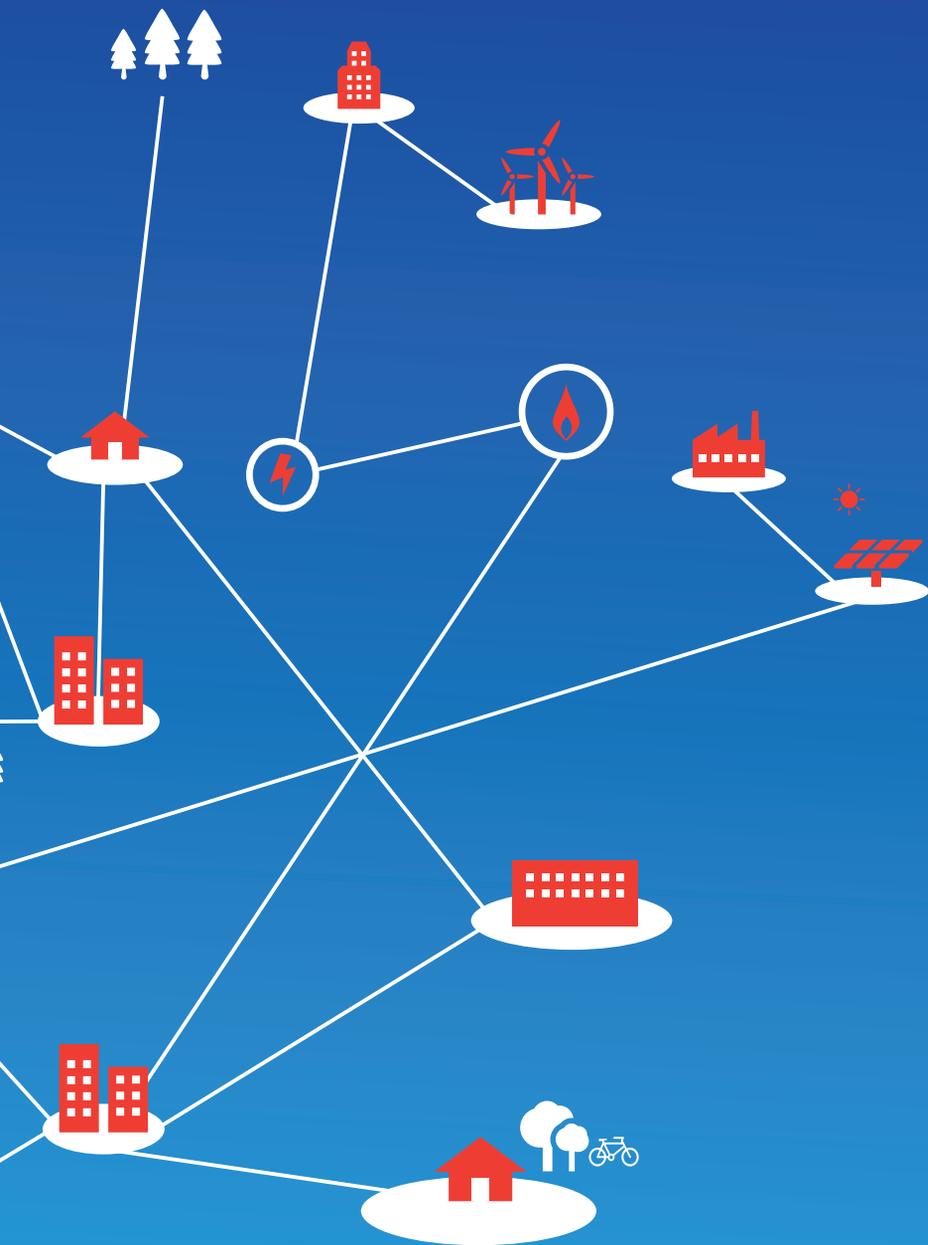
# SMART GRIDS FOR SMART MARKETS





# TABLE OF CONTENTS

<b>1</b>	<b>INTRODUCTION</b>	<b>10</b>
	1.1. What are Smart Grids?	12
	1.2. Why Smart Grids?	12
<hr/>		
<b>2.</b>	<b>INCREASING SYSTEM FLEXIBILITY</b>	<b>14</b>
	<b>Balancing supply and demand by integrating distributed energy resources</b>	
	2.1. Integration of renewable energy sources	16
	2.2. Storage	17
	2.3. Power to Gas	18
	2.4. Electric vehicles	18
	2.5. Smart meters	19
	2.6. Demand response: new services	20
<hr/>		
<b>3.</b>	<b>LIFTING BARRIERS</b>	<b>21</b>
	<b>To the deployment of smart grids</b>	
	3.1. Regulatory frameworks	22
	3.2. Financial barriers: from research to deployment	24
	3.3. Consumer acceptance	25
	3.4. Technical standards	25
	3.5. Market structures	26
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<b>4.</b>	<b>FACILITATING THE MARKET</b>	<b>27</b>
	<b>How active DSOs will operate the smart grid</b>	
	4.1. System management	29
	4.2. Data management	29
	4.3. Metering	30
	4.4. Electric vehicles charging infrastructure	30



# EXECUTIVE SUMMARY

This paper outlines the changing energy landscape and the manifold advantages smart grids entail for consumers, network operators, suppliers, renewable energy generators, new services providers, the environment and the economy. Smart grids, especially on distribution level, will have a significant impact on the energy landscape. They facilitate the integration of distributed energy resources (DER) such as renewable energy sources and the adaptation of demand patterns, forming a central part of a **sustainable, decentralised, participatory, secure and safe energy system of the future**, which helps to empower the consumer and corresponds to local needs. As important tools for regional development, smart grids will have positive impacts on local jobs, economic activities and infrastructures.

Consumers, in industry and small -to medium-size enterprises (SMEs), but also at a household level will play an increasingly active role in energy supply and consumption. Former consumers (-only) may become suppliers, service-providers and even business partners (e.g. in citizen projects) which leads to **changes in the traditional business models** of energy companies. A general shift from volume-based to service-based business models can be observed already today, but needs to be supported through stimulating legislation and clear political agendas.

The network operators, both Distribution System Operators (DSOs) and Transmission System Operators (TSOs) will invest in smart grids to adapt the grid to the diverse generation landscape and **ensure reliable and secure grid functioning at all times**. Simultaneously, other (new) market parties will build their business model on the functionalities of smart grids and will benefit from the deployment, which endorses the role of the market-facilitating network operators. In the end, **consumers are the real beneficiaries of the smart grid** due to a reliable, affordable network and the possibility of profiting from manifold energy products and services from different market parties.

However, **technological, financial and regulatory challenges** persist for the deployment of smart grids. Regulatory frameworks for DSOs currently do not always reflect the immense **need for investment in grid development and upgrades**. They hence need to be adapted and shift from prioritizing cost-reductions to innovation-friendliness, making sure that investments are reflected in regulated tariffs without time delay. Moreover, DSOs rely on public support in the demonstration phase of smart grid projects. Some regulators have therefore created funds to support progressive DSOs in their innovation. These examples are crucial good practices for other regulators to trigger the deployment of smart grids.

Missing **technical standards for smart grid components** constitute another barrier, which should be resolved as soon as possible in order to ensure interoperability and a real European internal market for components used in the smart grid. Moreover, market structures need to be developed that align with system developments of increasing flexibility.

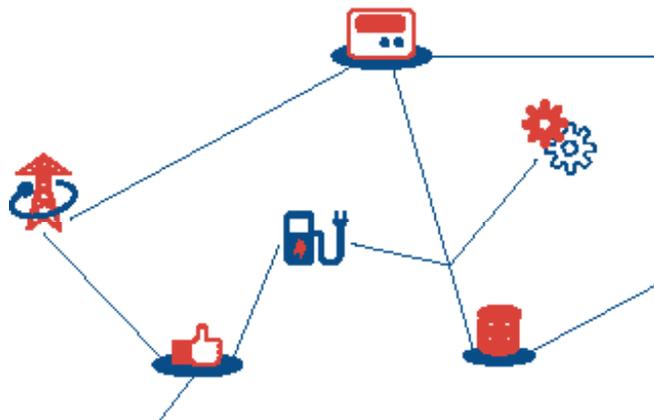
Finally, the most important barrier to overcome is the **acceptance of the consumer**. Traditionally, consumers have not been active in the energy markets. In order to change this pattern and reap the benefits of smart grids, consumers rely on sufficient, simple and transparent information; attractive, reliable and secure products and services, as well as incentives to make use of them. DSOs play a significant role in this regard, as they are the only parties structurally having a long-term relationship with all consumers in their area as neutral market facilitators.

With the inherent changes in the energy landscape, the **role and responsibilities of the DSOs will need to be extended** in order to be fit for altering framework conditions, as they will need to be defined for all market participants. Playing the most central role in the deployment of smart grids due to their single main task of ensuring secure and reliable network operations, DSOs as neutral market facilitators appear ideally placed to be allocated new key tasks. Nonetheless, there is no one-size-fits-it all model, due to the very different market structures in Europe.

DSOs are becoming managers of more dynamic and complex systems, as well as agents in a local smart market. For that, DSOs need access to commercial market places to purchase e.g. ancillary services from DER for effective grid management. Due to the responsibility for system management, stability and integrity at all times, it appears inevitable that DSOs need to be in charge of the data management in a smart grid environment. As regulated, non-commercial parties, DSOs also are well placed to ensure a **level-playing field for all market parties** relying on the data for their business while being a **safeguard of consumer data privacy and security**.

Already today, installing and managing (smart) metering systems is a key task of DSOs in almost all (26) Member States. The inherent need for the information obtained by the meter to securely operate the network and the economies of scale to be created, are two reasons for the distribution system operators to **remain in charge of metering, collecting and validating the data** before it is delivered to the consumers and the market (with consumers' approval).

Finally, DSOs already have and can continue to make a significant contribution to the uptake of electro mobility by **providing the necessary charging infrastructure for electric vehicles (EVs)**. While there is currently no business case for deploying charging infrastructure that sufficiently covers larger geographical areas, DSOs shall be allowed, to promote the uptake of e-mobility, by rolling out the infrastructure as part of their regulated asset base. Managing the grids to which the charging points are connected, this will also give them the opportunity to closely monitor the effects EV charging will have on the networks and counteract any negative consequences.



# POLICY RECOMMENDATIONS



## REGULATORY FRAMEWORKS

- A clear and stable policy framework for Europe's future energy system needs to be created to provide confidence for investment in smart grids: ambitious and binding 2030 targets for RES and GHG emission reductions should be set.
- Promote the completion of the European internal energy market by accurate implementation of the provisions of the Third Energy Package.
- National regulatory frameworks need to be adapted to be coherent, transparent, stable and cost-reflective in order to allow for sufficient remuneration for DSOs and to support the development of smart grids at distribution level.
- Incentive regulation should allow for time-differentiated prices, which will give price signals to consumers to shift their consumption from peak to off-peak times.



## MARKET STRUCTURES

- The roles and responsibilities for DSOs and commercial actors need to be clearly defined, monitored and enforced.
- Allow DSOs to actively purchase system services from distributed resources to manage their flexibility needs.
- Promote DSOs responsibility to be in charge of data handling in smart grids.

- DSOs shall remain in charge of metering, due to their dependence on the data for secure and reliable grid operation.
- If DSOs choose, they should be allowed to deploy the charging infrastructure for electric vehicles due to their inherent expertise and the unknown effects of EV charging on the distribution networks. The charging infrastructure must facilitate the mass market for EVs.



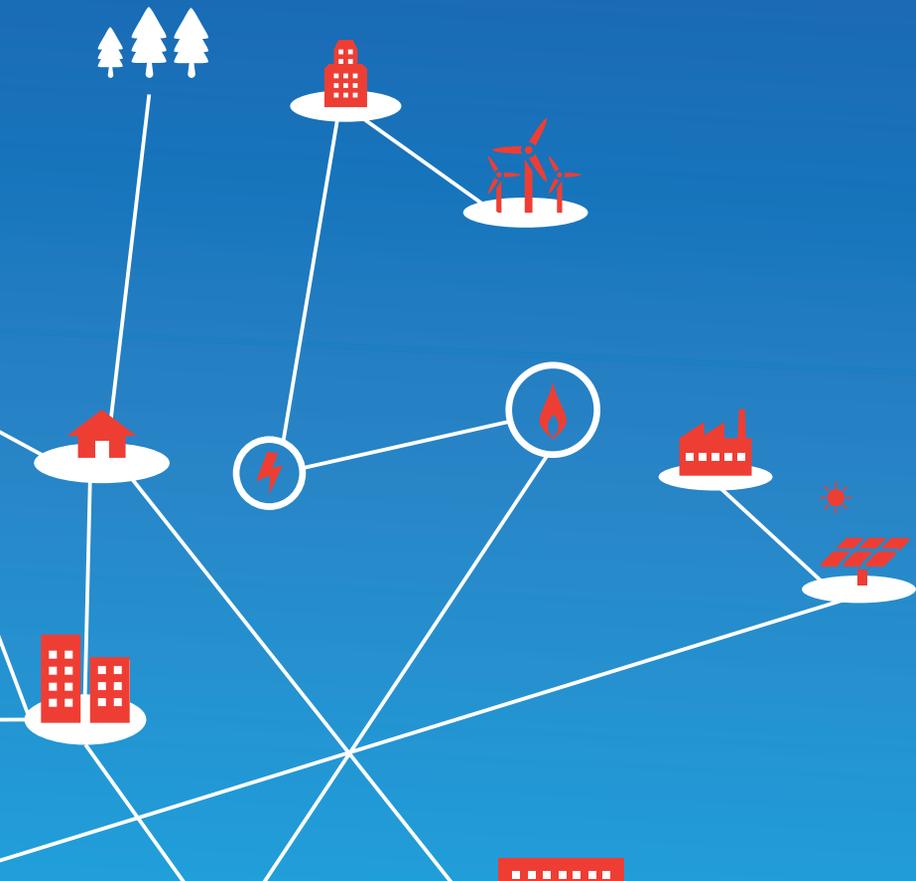
## RESEARCH AND DEVELOPMENT

- Support for smart distribution networks should be mainstreamed in all public funding programmes (EU, national and regional level) and access must be facilitated especially for smaller actors.
- Incentive regulation needs to be innovation-friendly and to stimulate expenditures for R&D activities.



## TECHNICAL STANDARDS

- European standards for smart grid components and demand response must be finalised as soon as possible in order to achieve interoperability and a European market for smart grid components.



# 01

## INTRODUCTION

01

### **ADVANTAGES OF SMART GRIDS:**

- Contribute to energy and climate targets
- Facilitate system management
- Enhance security of supply
- Entail economic benefits
- Connect electricity, gas and heat networks
- Link the power and transport sectors
- Empower consumers to play an active role
- Enable energy savings for consumers
- Create new markets, jobs and growth



## 1.1. WHAT ARE SMART GRIDS?

Networks that can efficiently integrate the behavior and actions of all users connected to it – generators, consumers and those that do both – in order to ensure an economically efficient, sustainable power system with low losses and high quality and security of supply and safety.

European Commission [1]



## 1.2. WHY SMART GRIDS?

Smart energy grids – for electricity, gas and heat [2] - will constitute the backbone of the future energy supply, based to a large degree on renewable energy sources.

With growing shares of (variable) renewable energy, growing demand of electricity due to the increasing electrification of transport and heating, as well as continuously growing shares of energy produced by consumers (“prosumers”), the traditional requirements for energy networks are drastically changing, especially for electricity. Moreover, a paradigm shift is taking place: **demand for energy can become less inelastic when it follows changing supply patterns**. Therefore, increased flexibility in the system will need to be created in order to respond optimally and cost-effectively to the increasing variability of supply and demand.

Enabling system flexibility by partially “smartening” the grid through adding information and communication technologies (ICT) layers, constitutes the socio-economically less expensive alternative to traditional reinforcement of solely adding “copper” in the grids. [3] While traditional grid expansion and reinforcement will continuously be needed, an intelligent usage of the existing grid through **ICT solutions** can decrease or delay the need for new infrastructure, leading to overall benefits for the consumer, the economy, the environment and the energy system.[4] Despite all, the integrity of the network remains the primary concern, especially for network operators.

The majority of renewable energy installations in Europe are connected at the low-and medium voltage level.[5] On the one hand, this considerably increases investment needs on distribution level. The International Energy Agency estimates that the investments in distribution grids will amount to two thirds of all transmission and distribution investments in 2020, growing to three quarters in 2035 and four fifth in 2050. [6]

On the other hand, this development entails new dynamics and technical challenges for the distribution grid operators (DSOs). The traditional one-way delivery of energy will evolve to a two-way management of energy and data flows with implications on the larger system, including high-voltage transmission lines. Consequently, **the roles and responsibilities of the European DSOs will evolve**, as they have to fulfill an increasing number of ever-more complex tasks. The challenges and barriers DSOs face under the current regulatory frameworks and market designs will be addressed in section IV.

In current debates about smart grids confusion often occurs between the network and the market dimension. While smart grids first and foremost will be a technical necessity for network operators to ensure **network stability and system integrity**, they also open business opportunities for new and old market players, through demand-response services. Despite these two spheres being interlinked, a conscious distinction between smart grids and smart markets should be made, as introduced by the German regulator. [7]

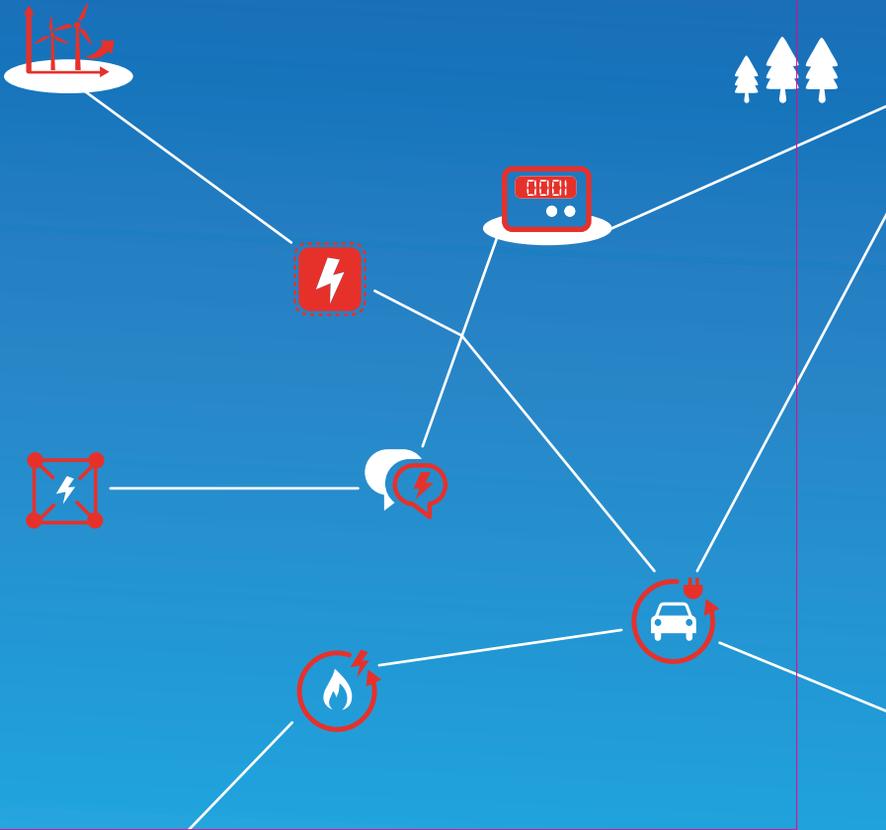


# 02

## INCREASING SYSTEM FLEXIBILITY

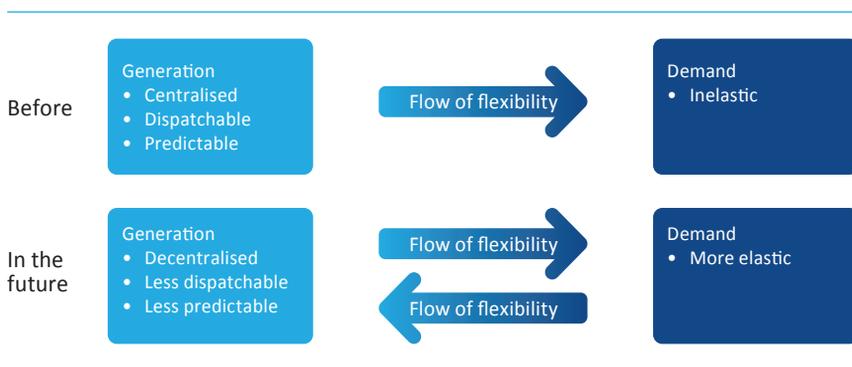
BALANCING SUPPLY AND DEMAND BY INTEGRATING DISTRIBUTED ENERGY RESOURCES

02



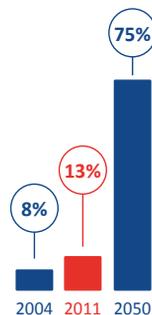
Traditional energy networks need to be made fit to integrate the distributed energy resources (DER), such as renewable generation, storage and electric vehicles, and balance supply and demand at all times. Bottlenecks can be avoided by extending the network to the (new) peak demand or by managing the (peak) demand through the utilisation of ICT to manage the flexibility in the system. For every (local) part of the network this choice must be made by the DSO. By adding innovative ICT to parts of the networks, the general management of the system will be facilitated.

While new dynamics on the supply-side of the energy system are visible and steadily growing, developments on the demand-side have not kept up. CEDEC therefore welcomes the conclusions of the European Heads of States of 22 May 2013, in which they subscribe to: “more determined action on the demand side as well as the development of related technologies, including the drawing up of national plans for the swift deployment of smart grids and smart meters in line with existing legislation”.



## 2.1. INTEGRATION OF RENEWABLE ENERGY SOURCES

In recent years, the shares of renewable energy sources in the EU’s final energy demand have increased considerably from 8% in 2004 to 13% in 2011.[9] In its Energy Roadmap 2050, the European Commission projects the share of renewable sources to reach up to 75% of final energy consumption in 2050.[10]



Besides the large centralised plants, such as offshore wind, the majority of renewable installations are small-scale, decentralised plants such as small wind parks and biogas plants. Microgeneration at household level, from micro combined heat and power systems or PV panels, has great potential and represents a good way for consumers to gain control over their energy supply and to actively participate in energy markets, while possibly reducing their costs.

With onshore wind and solar PV, the two fastest growing technologies generate variable output, depending on weather conditions. While forecasting of outputs is steadily improving, smart grids create the opportunity for short-term reactions, through real-time information about supply, demand and network functioning: modern ICT applications enable more dynamic and flexible network management. Advanced management and responsiveness of the system allows for the integration of variable sources through an optimal matching with supply from non-variable (renewable) sources or corresponding actions on the demand side. Thus, grid stability and security of supply are increased while disruptions of supply, having significant macro-economic implications, can be avoided.[11] Intelligent grids therefore are an important facilitator for a transition of the European energy system based on renewables.



## 2.2. STORAGE

As a potential enabling technology for intelligent networks, storage of electricity, gas and heat can play a central role in facilitating the matching of supply and demand of energy, especially against the background of growing shares of variable RES in electricity supply. The possibility of storing energy at distribution level at times of high supply, and to release it during times of high demand can play a crucial role for the security and stability of the grids, especially as the majority of distributed generation is connected to the LV and MV networks. In this context, dispatching at the local level will become increasingly important and DSOs will need to play a central role in terms of managing storage systems.

While pumped hydro storage has been a commonly-used technology for many years, new forms of longer-term storage, such as electrical, thermal and chemical storage display considerable potential in the future, but are still in research and development phase and currently lack a tangible market model.

In principle, storage systems are technologies to be used from both a smart grid and the smart market perspective. Functioning in the network dimension, storage would take up energy at times of high supply threatening grid stability and inject it back into the grid at times of low supply. Strategically placed next to plants with variable output, they can then make a significant contribution to perpetuate their supply and secure the grid management. In this case, the development of storage could be seen as a complementary technology to load management. If not, it might have adverse impacts on network optimisation strategies in the context of the European internal energy market and lead to economic inefficiencies.[12] For this reason, the deployment of storage should be primarily addressed to ensure stability to the system, as a part of smart grid management.



### 2.3. POWER TO GAS

Another possibility for electricity storage, which is currently explored by some public local utilities, is power-to-gas (P2G). With this technology, electricity from renewable sources is transformed into hydrogen, which can be directly injected into the gas grid, or be transformed into storable gas through methanisation. In case of high demand, this gas can be converted back to electricity, or be used for heating and transport. Simultaneously, the methanisation process is generating usable heat, which can be used for district heating. Currently in the research and development phase, P2G is a promising enabling technology for smart grids, as the distribution infrastructure for gas is well developed in Europe and is often operated by multi-utility DSOs, creating efficient links between gas and electricity infrastructures.[13]



### 2.4. ELECTRIC VEHICLES

Electric vehicles through the vehicle-to-grid (V2G) approach constitute another promising factor for increasing the flexibility of distribution grids, with the pre-condition of consumer agreement. By using the battery for storage of electricity at times of high supply and injecting it back into the grid when demand is high, the (aggregation of) electric vehicles complement variable energy supply and can make a significant contribution to balancing demand and supply.

A study by Pricewaterhouse Cooper for the Austrian market showed that based on average consumer behaviour, 82% of the battery capacity of an electric vehicle is guaranteed capacity which can be injected back into the grid at any time. For Austria,

this could amount to capacity of almost 16TWh in 2020 [14], representing ca. 18% of the country's final energy consumption. However, to tap into this potential, smart meters and smart distribution grids are indispensable. [15]



## 2.5. SMART METERS

Confusion between the term smart meters and smart grids often arises – or is even being created. While intelligent meters represent one of the central components of a smart grid, they only cover one part of the technologies needed to adding intelligence to the grid.

The Third Energy Package provided that 80% of consumers should be equipped with smart meters by 2020, under the prerequisite that a national cost/benefit analysis shows positive results. [16] For consumers (in combination with in-home displays), smart meters deliver more detailed information on energy consumption and production. For network operators, smart meters provide all kinds of quality information of the network (outage, voltage level etc). Additionally, smart meters are important tools for all kinds of commercial service providers, for example demand-response service providers, using the data to create incentives for consumers to adapt their consumption according to price signals.

The roll-out of smart meters therefore has to be seen in a differentiated manner, from a smart grid and a smart market perspective. From a mere grid perspective, smart meters are not needed in every household to maintain grid stability and security. For residential areas with small single family houses and similar consumption patterns, for example, some central metering points (on street level) suffice for secure and reliable grid operations. However, from a smart market perspective, a national or consumer-segmented roll-out of smart meters is indispensable. Only with close to real-time information about energy consumption and variable prices will interested consumers be able to react to real-time price-signals and demand-response services from Energy Service Companies (ESCOs). However, many smart meters installed are not yet fit for these purposes. Therefore it is advisable to identify in a first phase new demand-response/customer services and ancillary services provided by DER and, from these, derive the technical characteristics required from the new meters. This is equally applicable for smart appliances, which can deliver consumer benefits, for instance by shutting off devices at times of high price signals and therefore form a part of a smart market, rather than a smart grid.



## 2.6. DEMAND RESPONSE : NEW SERVICES

With increasing flexibility in energy supply, new demand-side services, i.e. demand-response-programmes are becoming more important. In its recently published Communication on optimising public intervention, the European Commission estimates the controllable load in Europe to amount to at least 60 GW. Shifting loads from peak to off-peak times could reduce the need for peak generation capacity by 10%. Demand-response therefore potentially entails further benefits such as avoided grid reinforcement, decreased consumer bills and higher overall system efficiency. [17] Industry and SMEs certainly display the largest potential for supplying flexibility by shifting loads; however, through aggregation, private households can also contribute to demand-response programmes.

Traditional energy suppliers will be among those to offer their consumers new products and services; but also new actors, such as aggregators and specialised ESCOs will make contracts with consumers for these energy services and benefit from the deployment of smart grids. As these services can also benefit DSOs in the operation of networks (e.g. by enabling them to purchase as ancillary services), a clear and transparent market design needs to be found and new roles and responsibilities of all actors need to be defined thoroughly. Having the ultimate responsibility for the reliability of the network, which is essential for all market players but especially consumers, it is a prerequisite that DSOs must at all times be informed about the actions of market actors and about the dynamics in the grid.

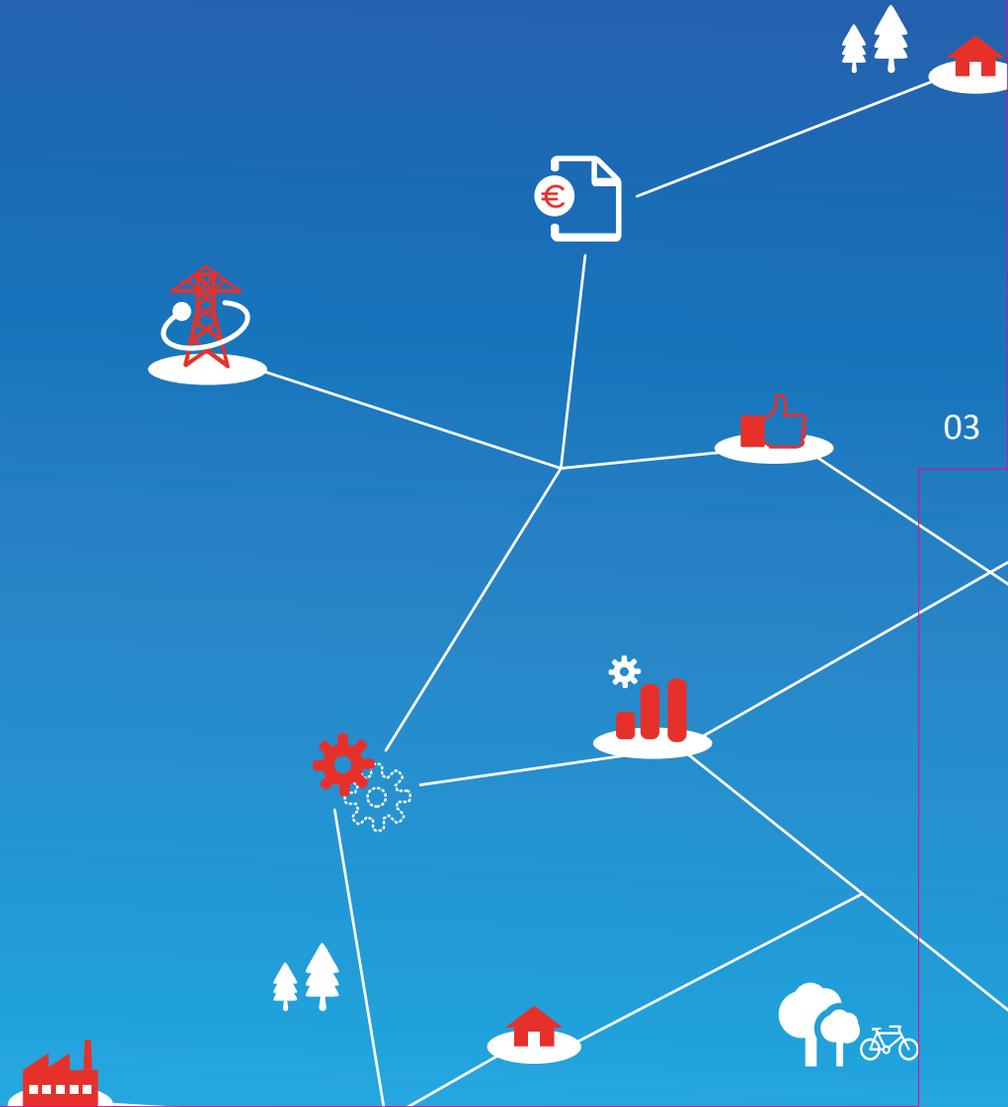
### ADVANTAGES OF SMART GRIDS

- Contribute to **energy and climate targets**
- Facilitate **system management**
- Enhance **security of supply**
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- Connect electricity, gas and heat networks
- Link the **power and transport** sectors
- **Empower consumers** to play an active role
- Enable **energy savings** for consumers
- Create **new markets, jobs and growth**

# 03

## LIFTING BARRIERS

TO THE DEPLOYMENT  
OF SMART GRIDS



Although the deployment of smart grids will lead to overall macro-economic benefits, it should not be forgotten they are only one part of the solution for making the energy networks future-proof. The majority of Europe's existing energy infrastructure is relatively old and needs replacement. In total, the International Energy Agency estimates that European DSOs will need to invest ca. 480 billion by 2030.[18] Besides this large amount of necessary investment, regulatory and market barriers, as well as technical limitations and consumer acceptance constitute non-negligible barriers to the deployment of smart grids.



### 3.1. REGULATORY FRAMEWORKS

#### INCENTIVE REGULATION

As distribution systems are natural monopolies, their operation is a regulated business. The costs of DSOs are remunerated through the network tariffs paid by consumers. National regulators determine the tariff level, and thus the allowed revenue for DSOs over a specific period of time. In most regulatory frameworks incentives for cost-reductions are given, placing the focus on efficiency and short-term cost-reductions, featuring sanctions in case of non-compliance.

Given the needed replacement of Europe's aging energy network infrastructure, a drastically changing generation landscape from centralized to decentralized, and investments shifting from reinforcement and extension to adding an ICT layer on the traditional copper lines, traditional regulatory frameworks increasingly appear to be inappropriate to cope with these realities. DSOs sometimes face returns on investments that are lower than their weighted average cost of capital (WACC). Often, the revenue caps of DSOs are only adapted with considerable time-delays (for example up to 7 years in Germany) and hence lead to very late return on investments made and consequently financial difficulties for DSOs.[19] Additionally, a general complexity of incentive schemes and benchmarking procedures make it very difficult for DSOs to develop new activities.

Another issue is the design of network tariffs. In many European countries, network tariffs are 100% volume-based, meaning network tariffs are charged for each kWh used. With an increasing share of prosumers and through successful energy efficiency measures, less electricity, gas and heat are transported through the networks. While this is contributing to the EU energy and climate objectives, it dramatically decreases the revenue for DSOs. At the same time, the network needs to be maintained, reinforced and extended and even consumers with microgeneration facilities will continue to be dependent on the

grid during certain times of the day. Moreover, for DSOs the cost driver of the network is supply of (peak) capacity and not volume. Therefore, a mixed tariff structure based on the capacity of the connection and the volume used, may constitute an interesting alternative, allowing network operators to recover their costs in a more balanced and consistent way (see for example in the Netherlands). In order to incentivise the necessary investments for the deployment of smart grids in Europe, CEDEC advocates for cost-reflective regulatory frameworks that recognize investments in innovative technologies, adapt to changing CAPEX/OPEX structures and minimize the time-delay between investments and adaptation of revenue caps.

Apart from adequate incentive regulation frameworks, supporting funding for smart grid demonstration projects has been provided by some national regulatory authorities (NRA), which has led to good results. For example, the British NRA Ofgem has launched the Low Carbon Networks Fund, which provided £500 million over five years for smart grid pilot projects. While part of the fund (£16 million annually) is spread across all DSOs to spend against specific criteria, some projects are selected in an annual competition for another tier of funding.[20]

Similarly, Italian regulator AEEG has initiated a call in which 8 smart grid pilot projects were selected, that profit from an extra WACC equal to 2% for 12 years for the related investments.[21]

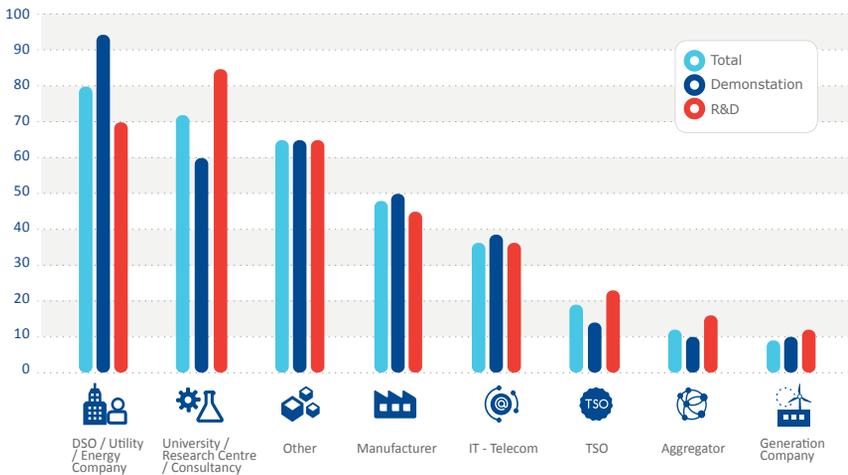
## DYNAMIC RETAIL PRICING

In order for demand-response programmes to deploy their entire potential, price signals are an important instrument for consumers to be willing to actively change their behaviour in return for financial benefits. To transmit price signals, time-differentiated pricing systems, such as time-of-use pricing (e.g. peak and off-peak prices) or real-time pricing, are necessary. In this regard, adverse effects between energy prices and network tariffs need to be avoided. At times of low energy prices due to abundant supply, a peak might be created on the network due to many consumers increasing their consumption simultaneously, consequently the network tariff should be high. These dynamics have to be taken into account when considering the introduction of dynamic network tariffs and how the price effects are to be weighed against one another.



### 3.2. FINANCIAL BARRIERS: FROM RESEARCH TO DEPLOYMENT

A recent update of a Commission report on the status of smart grids projects confirms DSOs are dedicated to innovation in network management and are leading over other market players in terms of investment in smart grid projects.



Source: European Commission

Impacted by the above-mentioned changes in the energy landscape, DSOs are particularly represented in technical layers of the smart grids (ICT solutions for integrating distributed resources).[22] With good technical developments, a shift from the R&D focus to demonstration focus of projects can be observed.

Currently, 80% of all projects are still depending on public funding. Therefore, better access to public funding for small and medium-sized pilot projects should be ensured. While some funding programmes have been created by regulators (see section 4.1.1) and national ministries, the European funding programmes tend to be less suitable especially for smaller DSOs. Many DSOs are small-to-medium-sized and their projects have a regional focus with smaller consumer numbers. Unnecessarily “high” thresholds for applicants (i.e. TSO involvement, trans-border aspect) make it currently extremely difficult to apply for European funding programmes, such as the Connecting Europe Facility.



### 3.3. CONSUMER ACCEPTANCE

Consumers and their attitudes towards smart technologies will play a central role in the deployment and success of smart grids. As the Council of European Energy Regulators (CEER) establishes in its discussion paper for a 2020 customer vision, the involvement of consumers in the energy market has traditionally been very low.[23] They have been mere users of energy at the end of the supply chain. Therefore, the European Commission's Task Force for Smart Grids emphasised that with the introduction of new technologies, such as smart meters, home automation, microgeneration plants, the information, engagement and education of the consumer is the key task in order to tackle the concerns about technology complexity, privacy and data protection.[24] In order to actively participate in the energy market and to tap the potential benefits of smart grids, consumers rely on sufficient, simple and transparent information, attractive, reliable and secure products and services, as well as incentives to make use of them.

DSOs have always been very close to all consumers in their region through their long-term relationship with them; the energy networks being a natural monopoly, switching DSOs is not possible for consumers. DSOs are therefore ideally placed to fill the gap between consumers and the energy market. The fact that DSOs are especially consumer-oriented is proven in that most smart grid projects currently running with a special focus on consumer involvement are led by DSOs and this number has been growing significantly over the past years.[25] Especially the issue of data management and privacy is pivotal for DSOs in this regard. In order to ensure compliance with data protection rules and thereby create acceptance on the consumer side, clear rules and responsibilities for the data communication need to be established. This point will be addressed in more detail again in section 4.



### 3.4. TECHNICAL STANDARDS

With regard to technological development, most technologies needed for smart grid operations are already available. The challenges primarily are to be found in the interoperability of these technologies as well as in their integration in existing energy infrastructure and management.[26]

Against the background of the envisaged completion of the internal market for energy, the European Council confirmed the need for common standards for smart grids in February 2011.[27] Following a communication by the Commission of the same year, the European standardisation organisations CEN, CENELEC and ETSI were given a mandate to develop a first set of standards for smart utility meters, communication protocols and other functionalities in order to guarantee interoperability of equipment. Although this first set of standards was published in 2013, standardization, for instance for demand-response services, is still pending. As for smart meters, it is important that first movers are not put at a disadvantage.



### 3.5. MARKET STRUCTURES

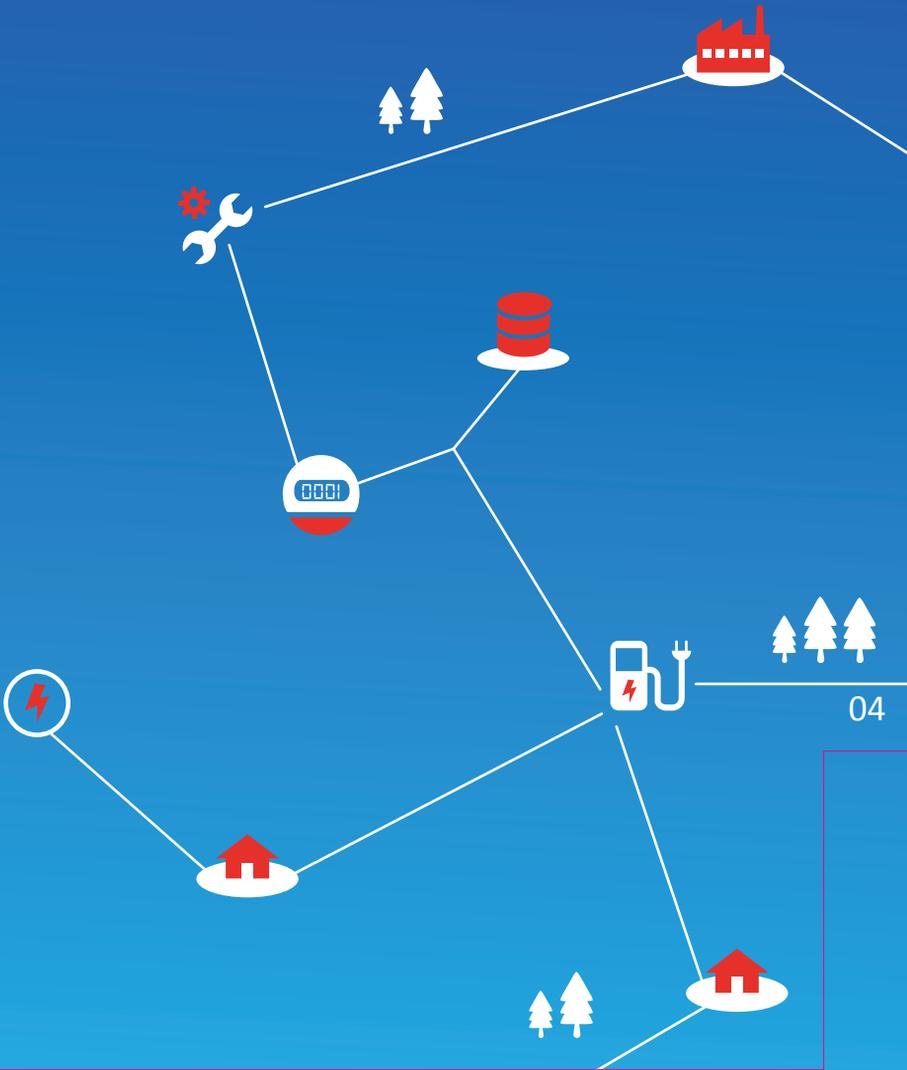
In the conventional energy system, the typically large-scale generation plants were connected to the transmission networks. TSOs have been responsible for balancing demand and supply and congestion management for which they have a set of instruments. The main task for distribution system operators was to deliver energy to the end-consumers, guaranteeing security of supply at all times, with limited tools. With more distributed resources connected at low-and medium-voltage levels, DSOs now face increasing dynamics and new complexity in their networks. In order to be able to actively and efficiently manage their system while offering reliable and high-quality services, they require flexibility instruments, similar to those of TSOs. Distributed energy resources also offer the possibility for system services that could facilitate system management. For example, services of DER can be used to solve short-term problems in the grid, optimise the cost of maintaining desired quality of service, reduce grid losses and reduce or postpone future investments.[28]

Services by generation plants and storage for example could be used as ancillary services by DSOs. For realisation, DSOs, decentralised generation plants, and market players such as aggregators, need to have access to market places to trade flexibility. Flexibility markets should therefore be created to offer access to DSOs and other market parties, with low entry thresholds, corresponding to the requirements for local system management. Moreover, effective and formalised coordination and information exchange between TSOs and DSOs need to be established as dynamics in the respective networks could have mutual repercussions and could lead to outages or system instability.

# 04

## FACILITATING THE MARKET

HOW ACTIVE DSOs WILL OPERATE THE SMART GRID

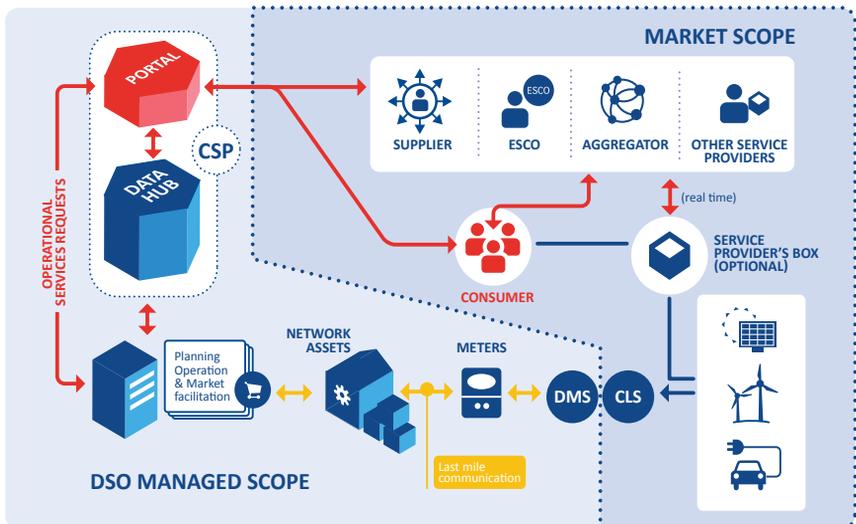


In a system with new technologies such as electric vehicles and variable energy sources, where flexibility is key and market and system functioning undergo significant changes, DSOs are becoming active system managers and “agents managing a local market”.

Due to their single main task, secure and reliable distribution of gas, electricity and heat, DSOs will play the most central role in the deployment of smart grids. Based on their imminent position, as a natural monopoly and highly-regulated party, they are the interface between smart grids and smart markets. A clear recognition of roles and responsibilities of regulated and commercial actors is therefore needed to ensure a smooth functioning of the system and market, which facilitates and accelerates the transition towards a sustainable energy system.

There are many small- and medium-sized DSOs in Europe and they have to be able to expand their field of action. It has been shown in several studies, that there are no correlations between company size and efficiency, nor between the number of DSOs operating in a market and the quality of supply. Germany for instance has several hundred DSOs and according to figures of the System Average Interruption Duration Index (SAIDI), has the most reliable grids in Europe.[29] Hence, DSOs will also in the future be able to manage new challenges and tasks either themselves or with suitable partners.

**DSO AS MARKET FACILITATOR**



As concluded in the recent THINK study by the Florence School of Regulation “Whenever new responsibilities show sufficient synergies with traditional activities of regulated natural monopolies that regulate the network, the DSO should be made responsible for these new services”. [31]

In the following, this paper will elaborate on a (non-exhaustive) list of tasks, which should be allocated to DSOs.



#### 4.1. SYSTEM MANAGEMENT

As elaborated on in the section on current market barriers, DSOs will become more active system managers with increasing complexity of network dynamics at local level. Apart from efficiently exploiting the synergies between their networks, for instance through P2G and using gas connections for cooling demands, network operators should also be enabled to procure services for grid management from DER on commercial market places. Clear rules for DSOs to purchase system services as discussed in the Think report by the Florence School of Regulation, will counteract the inherent conflict with other market actors, i.e. ESCOs, bidding for the same services and will allow DSOs to fulfil their tasks as neutral market facilitators. For example, transparent auctions overseen by the regulator with detailed protocols of bidding procedures would prevent any kind of abuse of positions and guarantee that vertically-integrated DSOs do not give preferential treatment to their own group’s retailer. [32]



#### 4.2. DATA MANAGEMENT

The operation of smart grids and smart markets both rely on data about all parties connected to the grid, distributed resources and consumers. In CEDEC’s view it is therefore indisputable that the management of data (consumption patterns, actual loads, generator outputs, congestions) is best placed within the responsibility of DSOs for various reasons.

First and foremost, DSOs are responsible for grid stability and security of supply. They should not depend on commercial market parties for data availability if security of supply and system integrity is to be guaranteed. In the changing energy system, with growing shares of variable supply sources, fast and smooth data communication to ensure system stability is essential to meet Europe’s climate and energy targets.

Secondly, as a non-commercial parties, DSOs will provide data to third parties in a non-discriminatory manner and thereby create a level playing field for all market players. Delivering data will stimulate the entrance of new market actors and enable new business models (aggregators, ESCOs).

Finally, and very importantly, as regulated entities, which have no interest in treating data as commercial products, DSOs can be easier and more effectively controlled by regulators than third (commercial) parties. This is a safeguard for the privacy of consumer data. If any other unregulated party becomes responsible for data handling, this contains fundamental risks for data privacy and security.



### 4.3. METERING

In 26 European Member States (except UK and Germany), DSOs are in charge of ownership and management of metering equipment. In Germany, although in theory the metering market is liberalised, it is in practice mostly the DSOs which own and manage the meters.

DSOs are highly-dependent on the information provided through smart meters, for instance about real-time consumption and feed-in of energy into their network in order to manage and plan their grid, and reduce grid losses. The authors from the Florence School of Regulation conclude that as neutral market facilitators, DSOs do not run the risk of creating barriers for supplier switches as if for example retailers were responsible for meter ownership (technology and commercial lock-in). Moreover, through the possibility to create economies of scale and the whole metering being in one hand, the roll-out of smart meters can be both more cost- and time-effective.



### 4.4. ELECTRIC VEHICLES CHARGING INFRASTRUCTURE

In a recent proposal by the European Commission for a Directive on the deployment of an alternative fuel infrastructure, the limited number of charging points for electric vehicles has been brought into focus as one of the main barriers to the uptake of electric mobility.[33]

DSOs have played a central role so far in the deployment of the EV charging stations, taking the lead in solving the “chicken-and-egg-problem” of missing infrastructure and affordable, consumer-friendly vehicles.[34] While several market models and ownership structures have been discussed among stakeholders, in CEDEC’s view, several arguments speak in favour of a model in which DSOs can be in charge of the deployment of electric

charging points in the public domain as part of their regulated business.

Firstly, there is not yet a tangible market for electric vehicles and related infrastructure and the roll-out of public charging stations is not yet profitable. Hence, DSOs can step in by deploying the electric charging infrastructure as part of their regulated asset base. The costs would therefore be included in the network tariffs and socialised among all consumers. Moreover, apart from the direct advantage of the public charging stations, this would have an indirect effect of increasing the range of EVs, and therefore decreasing the barrier of range-anxiety prevailing among many potential consumers.[35] Moreover, the price for EVs is decreasing with growing market share.

Secondly, incorporating EV infrastructure in the regulated asset base of DSOs, would give regulators the opportunity for tight cost controls.

Thirdly, the costs for the charging infrastructure primarily consist of costs for the connection, the meters and the hardware – typically the DSO domain. Additionally, the impacts of EV charging on the distribution grids are still in a very early investigation phase. DSOs as experts are ideally placed to deploy the infrastructure and monitor the development closely to ensure smooth network operations.

Finally, DSOs are neutral and non-discriminatory actors, which have no commercial interest in lock-in of first-mover EVs. They also have no interest in a lock in of the interface between the charging point and the vehicle. In fact, they are promoting standardisation of open-interfaces that allow for interoperability.

The Think study on the future role of DSOs outlines the advantages of DSO-led roll-out of public charging stations at least in the early phase of the market, in order to move ahead with deployment of an alternative fuel infrastructure.





# GLOSSARY & REFERENCES



## GLOSSARY:



### **AGGREGATOR:**

Entity acting as an intermediary among various consumers and other players in the system. Its main function is to group large numbers of relatively small consumers so as to create economies of scale and simplify overall system operation; some of these consumers may have storage and/or production capacity (Address Project). [36]



### **ANCILLARY SERVICE:**

Means a service necessary for the operation of a transmission or distribution system (Directive 2009/72/EC).



### **DATA MANAGEMENT IN SMART GRIDS:**

In smart grids there are typically four types of data (as defined in Taskforce Smart Grids):

1. Technical configuration data (characteristics of the connection and what is behind) needed for connection, specific technical intervention and smooth switching of energy suppliers;
2. Technical dynamic data, essential for operational control and grid management;
3. Consumer behaviour data (consumption and generation);
4. Consumer contact data (name, address, EAN, ...)



### **DECENTRALISED ENERGY SUPPLY:**

Generation plants connected to the medium- to low-voltage distribution networks.



### **DEMAND RESPONSE:**

Voluntary changes by end-consumers of their usual energy use patterns – in response to market signals (such as time-variable energy prices or incentive payments) or following the acceptance of consumers' bids (on their own or through aggregation) to sell in energy markets their will to change their demand for energy at a given point in time.[37]

**DISTRIBUTED ENERGY RESOURCES (DER):**

Small-scale generation plants, storage facilities or electric vehicles, connected to the distribution network.

**DISTRIBUTION SYSTEM OPERATOR (DSO):**

Means a natural or legal person responsible for operating, ensuring the maintenance of and, if necessary, developing the distribution system in a given area and, where applicable, its interconnections with other systems and for ensuring the long-term ability of the system to meet reasonable demands for the distribution of energy.

**PEAK DEMAND:**

Simultaneous and high consumer demand.

**VEHICLE-TO-GRID (V2G):**

Connecting the electric vehicle to the grid to enable controlled flow of energy and power from the vehicle to the grid through safe, secure, and efficient transfer of electricity and data.

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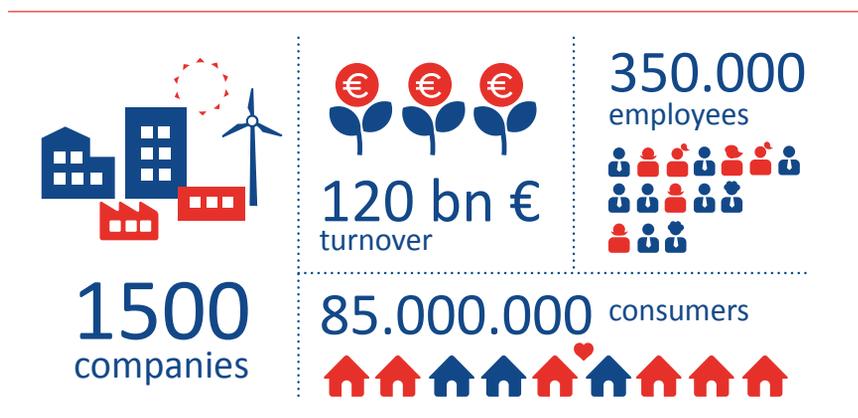
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## CEDEC represents the interests of local and regional energy companies.

CEDEC represents more than 1500 companies with a total turnover of 120 billion Euros, serving 85 million electricity and gas consumers & connections, with more than 350,000 employees. These predominantly medium-sized local and regional energy companies have developed activities as electricity and heat generators, electricity and gas distribution grid & metering operators and energy (services) suppliers.



The wide range of services provided by local utility companies is reliable, environmentally compatible and affordable for the consumer. Through their high investments, they make a significant contribution to local and regional economic development.

We would like to thank CEDEC member companies – and in particular the members of the **CEDEC Working Group on Smart Grids** – that have actively contributed to this publication, for their sharing of know-how, experiences and expectations on smart grids and smart markets.



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