



Assessment and roadmap for the digital transformation of the energy sector towards an innovative internal energy market

Executive Summary



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"The transition to a smart, secure and sustainable energy system is no longer a choice for Europe; it is a responsibility towards all citizens, our future generations and the planet. This transition represents a real economic opportunity and requires first and foremost bridging energy and digital economy."

Dominique Ristori (former Director-General, DG ENER),

Roberto Viola (Director-General, DG CNECT)

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Executive Summary

Why this study?

Thanks to the European Union's policy pressure, the EU energy system is going through increasing decentralisation and decarbonisation processes. Digitalisation, in this context, is a key enabler, as it unlocks opportunities for actors across the value chain (i.e. consumers, prosumers, retailers, traders, producers, network operators), providing them with new solutions.

At the moment, digital technologies are already playing an important role in the energy sector. Internet of Things, Artificial Intelligence, Big Data, Cloud, 5G and Blockchain technologies are influencing changes both in energy companies' value creation strategies and in customer behaviour. They are expected to have an impact on long-time established roles, particularly by creating trust and empowering consumers.

In addition to this, digital technologies also provide the opportunity to integrate more renewable energy into grids and use energy more efficiently in households, industry and the whole system. They thus contribute to the creation of favourable conditions for tackling the sustainable low carbon economy challenge.

To support policy making, this study assesses in which way and to what extent are digital solutions affecting the energy transition. It does this firstly by analysing ten specific use cases which provide, altogether, a good coverage of what is happening in representative segments of the energy value chain; and secondly, thanks to such a comprehensive view, by proposing a Roadmap for future EU and MS actions aimed at removing existing barriers to the digital transformation and its opportunities unlocking potential.

Such a Roadmap presents a list of short-term actions able to remove those barriers and accelerate the implementation of the most relevant provisions of the Clean Energy Package. At the same time, looking forward, the recommended policy measures at EU and MS level are consistent with two of the six priorities of the new Commission, namely the "European Green Deal" and "Europe fit for the Digital Age", confirming the continuity of the EC's action in support of the energy transition.

Scope of the study

The study focuses on an overview of the European Commission's digitalisation policies, on the assessment of ten selected use cases which can be enabled by further actions removing hampering factors, on the design of four policy scenarios depicting such further actions and, finally, on a roadmap identifying timelines for both actions and implementation.

The main questions that this study addresses are: why do we need digitalisation in the energy sector, whether it is worth paying for it, and who shall pay for it. To respond to such questions, the study goes through five tasks, whose main objectives are to provide:

1. A description of the most relevant future business cases in the energy sector which are dependent on the digitalisation of the sector, identifying existing barriers to their development;
2. The design of four realistic scenarios for the digital transformation of the energy sector by 2030;
3. The evaluation of synergies among different policy making areas in view of a wider “digitalised energy sector” and the regulatory challenges stemming from the rising need for cross-sectoral cooperation among different policy areas, at the EC and MS level;
4. The indication of a preferred policy scenario with actions to take and objectives to be pursued;
5. A comprehensive policy roadmap (2020-2025-2030) and the related recommendations to implement the identified measures.

Policy Context

The digitalisation of the power sector calls for a coherent policy making in the Energy and ICT domain, namely in the implementation of the Energy Union and the Digital Single Market (DSM) strategies. The implementation needs to ensure coherence and develop synergies, in order to create the most suitable conditions for consistent public regulation and public/private investments on smart energy products and services across Europe. To this purpose, it is of paramount importance to apply consistency in the regulation of several cross-cutting issues – such as security, privacy, interoperability - and also in all the sectors involved (Energy, ICT, Transport, etc.).

The study analyses the relevant EU policies and investment programmes, with a focus on those bridging the Energy and Digital portfolios, and in line with the bond established by the new EC’s priorities between the “European Green Deal” and “Europe fit for the Digital Age”. On the policy side, the most notable are the Clean Energy Package, the Free Flow of non-personal Data Regulation, the Network and Information Systems Directive (NIS Directive), the Cybersecurity Package, the General Data Protection Regulation (GDPR) and the New Deal for Consumers. On the investments side, the study takes into consideration the information available on the new Multiannual Financial Framework 2021-27.

As a result, the study assesses the capacity of both public policies and investments to facilitate the penetration in the Energy sector of Big data and data analytics, AI, IoT, 5G and Blockchain. All of these are technologies with a significant potential to improve productivity, efficiency, competition and sustainability in energy systems, to deliver value to every segment of the power sector, and also to unlock opportunities for job creation.

Use Cases Analysis

Digitalisation has a barrier-removing effect along the entire energy value chain. To analyse the opportunities that digital technologies can create for energy businesses and consumers, ten use cases (UCs) relevant for the digitalisation of the power sector have been selected.

The ten UCs span the entire energy value chain to capture the full potential of digitalisation. They cover the following areas: smart homes, digital customer engagement, wholesale energy markets, smart cities, digital power grids, smart EV charging and digital power plants.

The starting point of the UCs analysis is the identification of opportunities that digitalisation can unlock for customers and society more widely, resumed in the following table for each UC.

Use Cases	Opportunities for Customers	Opportunities for Society / Energy System
1. On-site optimisation for C&I and residential buildings	<ul style="list-style-type: none"> • Cost savings (bill reduction) • Customers empowerment Improvement of buildings maintenance in terms of performance and costs (predictive maintenance, early identification of faults)	<ul style="list-style-type: none"> • Contribution to the EU energy efficiency targets through enabling Nearly-Zero Energy Buildings • Increase of energy system flexibility • Improving distributed RES integration Support to EV integration
2. Smart Districts	<ul style="list-style-type: none"> • Reduction of energy bills for final users • Development of e-mobility thanks to the increased availability of charging stations at district level Improvement of buildings maintenance in terms of performance and costs	<ul style="list-style-type: none"> • GHG emissions reduction due to the increase of distributed generation from RES • Enhanced innovation push due to new forms of energy management solutions Improved life quality thanks to improved district service availability
3. Energy Aggregators	Valorisation of customers' flexibility, enabling reduction of the energy bill	<ul style="list-style-type: none"> • Lower balancing, energy and peak capacity costs Better RES integration
4. Customer Data Analytics	<ul style="list-style-type: none"> • Improved customer experience • Cost savings (bill reduction) Familiarity with market dynamics and energy efficiency programmes	<ul style="list-style-type: none"> • Optimising (reducing) energy consumption • Changing behaviour as a cost-effective way of cutting carbon emissions
5. Smart EV Charging and Charging Management	<ul style="list-style-type: none"> • Energy cost savings (off-peak charging) • Additional revenue streams by providing ancillary services to TSOs and local services to DSOs • Backup power source & resilience • Access to electric mobility via sharing 	<ul style="list-style-type: none"> • Energy cost savings • Avoidance of local grid issues • Higher RES shares through better integration • Provision of flexibility
6. Urban Data Platforms	<ul style="list-style-type: none"> • Access to integrated energy services • Improved mobility services • Lower taxes due to reduced bills for public energy consumption • Efficient public lighting, waste management, traffic monitoring, etc. 	<ul style="list-style-type: none"> • Air quality monitoring and prevention actions • Advanced traffic planning and management (both public and private transport) • Predictive maintenance on city infrastructures • Security/safety planning and management

Use Cases	Opportunities for Customers	Opportunities for Society / Energy System
7. Energy Communities	<ul style="list-style-type: none"> • More consumers can actively participate in the energy transition (e.g. tenants in a building, low-income or vulnerable household) • Reduction of the energy bill 	<ul style="list-style-type: none"> • Supporting RES development through better access to financing and self-consumption • Possibility to address local grid issues • Better allocation of RES support, towards the ones willing to pay for more local and green energy
8. RES Origin Tracking	<ul style="list-style-type: none"> • Choose the origin of the energy in an easier and more transparent way • Lower transaction costs 	<ul style="list-style-type: none"> • Improved access to PPAs will support the acceptability and further development of RES • Cost saving because of administrative simplification
9. Improved O&M	<ul style="list-style-type: none"> • High efficiency (optimizing performance while minimizing operational costs) • Lower costs for power plant start-ups • Increased revenue through fewer outages • Portfolio optimization 	<ul style="list-style-type: none"> • Optimisation of transmission and distribution grid management in terms of availability, reliability and flexibility • Lower carbon emissions from power plants thanks to improvement in their performance
10. Flexibility Market Platforms	<ul style="list-style-type: none"> • Valorisation of customers' flexibility • Lower grid charges through better coordination between TSOs and DSOs and better resource planning for (local) congestion management 	<ul style="list-style-type: none"> • Better resource planning through coordination and local congestion management, reducing overall system cost • More efficient RES integration, through local price signals

For each UC, the study identifies key issues by analysing major Business Models (BM) through a technical, market and regulatory feasibility assessment. Such key issues, listed in the table below, highlight market and regulatory barriers that need to be addressed via targeted policy actions (or in some cases, they have already been addressed, though partially).

Use Cases	Business Models	Key Issues
1. On-site optimisation for C&I and Residential buildings	Building Energy Management (BEM) Home Energy Management (HEM)	1. Customer privacy and data protection
		2. Cybersecurity of ICT products
		3. Interoperability between connected devices
		4. Lack of customer engagement
2. Smart Districts	Positive Energy District (PED)	1. Role of prosumers
		2. Interoperability between connected devices (IoT)
		3. Detachment from EU incentives??
3. Energy Aggregators	Aggregator = Supplier Independent Aggregator	1. Difficult market access by independent aggregators
		2. Limited access to consumption and production data
		3. Limited or uncertain market potential and difficulty to stack revenues
		4. Prequalification & product design requirements
4. Customer Data Analytics	B2C Customer engagement solutions B2B Customer engagement solutions	1. Customer privacy and data protection
		2. Cybersecurity of ICT products
		3. Data monetization
		4. Lack of customer engagement
5. Smart EV charging and charging management	V1G' Smart Charging V2G or V2X' Smart Charging	1. Lack of certification for power quality and standardisation for V2G
		2. Customer acceptance of EVs, smart charging and car sharing
		3. Double taxes, levies and network charges for storage
		4. Absence of e-roaming & charging interoperability
6. Urban Data Platforms	Vertical Platform Horizontal Platform	1. Customer privacy and data protection
		2. Cybersecurity of ICT products
		3. Interoperability between connected devices (IoT)
		4. Lack of business models on data access
7. Energy Communities	Peer-to-Peer (P2P) trading Collective self-consumption	1. Sharing of consumption and production data jeopardizing the contractual relationship of P2P trading business models
		2. Dependence of collective self-consumption business models on behind the meter advantages
		3. Definition of community's self-consumption when not everyone joins the community
8. RES Origin Tracking	Smart PPAs	1. Acceptance & sustainability of blockchain technology

<p>9. Improved O&M</p>	<p>APM-Digital Power Grid APM-Digital Power Plant Platform-as-a-Service</p>	<ol style="list-style-type: none"> 1. Drone use regulations and constraints created by their limitation 2. Risk of cyberattacks and threats to a digitised energy critical infrastructure 3. Need for APIs and interoperability standards for integrated platforms
<p>10. Flexibility Market Platforms</p>	<p>Grid congestion management platform Single platform for energy trading and ancillary services</p>	<ol style="list-style-type: none"> 1. Low incentive for DSOs to procure market-based flexibility services 2. Insufficient TSO-DSO-Market coordination in the procurement of flexibility services 3. Absence of products reflecting "local" needs

In addition, for each UC, specific cases developed in nine selected EU countries are presented to illustrate the existing business models and the current issues for their full development.

Policy Scenarios

The study proposes targeted policy actions which tackle the most relevant and recurring key issues identified in the UCs analysis. The study considers various levels of intervention (legislative, regulatory, non-legislative measures) and levels of governance (EU, MS and industry). Key issues are grouped into four policy areas of intervention with the greatest potential to foster the digital transformation of the power sector: Flexibility services at the distribution level, Privacy and Data Protection, Cybersecurity, Interoperability and Standardisation.

The combination of the suggested policy actions defines the four policy scenarios for the digital transformation of the energy sector, namely the Business As Usual (BAU), Consistent Governance (CG), Reinforced Legislation (RL) and Active Digitalisation Policy (ADP) scenarios. For each scenario, the study identifies specific timelines (2020, 2025, 2030) for implementing the proposed measures.

The Business As Usual scenario foresees the full implementation of the already adopted provisions under the Energy Union and the Digital Single Market strategy, i.e. Clean Energy Package, GDPR, Free Flow of Data, Cybersecurity Package, NIS Directive and New Deal for Consumers.

The Consistent Governance scenario envisages the adoption of targeted policy actions addressing the key issues identified in the UCs analysis and aiming to safeguard consistency between different areas of sectoral regulation. This scenario entails technical and timely measures as well as binding guidelines and implementing acts to be made, mostly at the MS level, to accelerate the digitalisation strategy designed by the Commission. In this scenario, the Commission shall oversee the process and ensure homogeneous application of the current Directives and Regulations, by best practices sharing among NRAs and main market actors.

The Reinforced Legislation scenario foresees the adoption of additional regulatory measures to fully overcome the key issues, requiring an additional effort to the European Commission. To inform this additional effort, the scenario suggests new legislative

provisions which will address potential future changes in the market design and operations brought by P2P and VPP and on the ground of already well-established and mature regulatory frameworks for the integration of resources connected at the distribution level.

The Active Digitalisation Policy scenario incorporates the investments foreseen for 2021-2027 in the next EU budget which will have a direct impact on the key issues strictly related to energy infrastructure and digital technologies. The study proposes the Active Digitalisation Policy to be shaped as a combination of the Consistent Governance scenario reinforced with the investments foreseen by the EU budget 2021-2027.

For each key issue, only a few policy actions are selected among those proposed in the policy scenarios and in that way the study seeks to indicate a preferential path for the digitalisation of the power sector by 2030. Such policy actions are expected to overcome in the fastest and most effective way the key issues identified in each policy area, while best exploiting the new opportunities offered by digitalisation.

Synergies between different sectors will be crucial to stimulate joint investments and coherence in regulatory frameworks, in a way to identify cross-fertilisation solutions in areas of interoperability, common standards, access to data, data processing and cybersecurity. In this context we suggest a cross-sectoral approach to breaking down sectoral silos. Policy actions that most effectively capture the cross-cutting nature of digitalisation are, thus, selected as preferred actions.

Such actions are represented in the CG scenario, which is composed of sectoral or horizontal measures aiming at safeguarding consistency between for energy and digital economy sector regulation. Moreover, the CG scenario foresees the application of common horizontal measures. The added value of policies concerned by the CG scenario also relies on the technical and punctual measures it entails. Guidelines and implementing acts contained in the CG scenario may promote a more effective, straightforward and harmonised implementation of actions to encourage digitalisation in Member States.

In addition to these actions, the ADP scenario roadmap incorporates the foreseen investments for the next EU long-term budget 2021-2027. These investments will provide vital support to current and future digitalisation-enabling policies and will contribute to significantly boosting the digital transformation of the power sector.

The resulting actions of this ADP scenario (CG plus Investments) are, then, assigned to different time horizons to outline the roadmap to 2030 for the digital transformation of the power sector.

Compared to the picture sketched in the inception phase of the study, the need to include a 2025 deadline arose from the analysis, as reported in the Roadmap. In such a scenario, the Commission will create suitable conditions for the digitalisation of the power sector by capitalizing on the strategy-setting and market design effort made so far, by complying with the need for empowering customers, by enhancing competition and by creating new opportunities for the EU industry in the short term.

Roadmap

The roadmap starts with the full implementation of the policies that are either in force or will be adopted in 2020 at the latest. The roadmap consequently considers an

intermediate deadline (2025) by which the most urgent policy actions shall be implemented by the MSs to be compliant with the current legislative framework. Finally, in the time horizon 2025-2030 the roadmap identifies measures which are considered to be more effective in fully addressing the key issues emerged in the analysed UCs.

To deliver the digitalisation opportunities to the energy market, it is essential to address, in a timely manner, the emerging issues with respect to market design and operations that may affect the provision of flexibility services at the distribution level.

To this purpose, it appears desirable that Member States adopt all the necessary actions to comply with the current legislation, i.e. the Regulation (EU) 2017/2195, the recast Electricity Directive (EU) 2019/944 and the Electricity Regulation (EU) 2019/943. In addition, to enhance and support compliance by MSs, it is recommended that the latter implement the actions presented in the CG scenario, which mostly refer to the adoption of binding EU guidelines.

The choice of the CG scenario as the preferred one, is justified by the opportunity this scenario offers to address the harmonisation of MSs' regulatory framework by means of timely and binding rules. For example, regulations introducing network codes are effective as they provide detailed technical and operational rules to make electricity markets more functional, by assigning roles and responsibilities to the actors involved in these markets, ensuring compliance with the principles established by Directives or other Regulations.

Concerning digital-related policy areas, one of the key priorities is to build trust and acceptance of digital technologies among energy consumers. To this extent, the issues related to consumer concerns about their data protection, privacy and security need to be addressed in a timely manner.

A robust regulatory framework is already in place both in the field of data protection and cybersecurity. The former sees the General Data Protection Regulation (GDPR) and the Free Flow of non-personal Data Regulation in force and the e-Privacy Regulation expected to be adopted in the next months, while the latter can rely on the NIS Directive and the Cybersecurity Package implementation.

Therefore, actions mostly referring to the adoption of binding EU guidelines are needed, which are presented in the CG scenario.

Recommendations

The EU climate and energy goals to 2030 offer the most suitable framework to identify the objectives of the digitalisation of the energy sector.

The growing share of distributed generation, together with the increasing engagement of customers, may unlock unprecedented benefits for the energy system. All else being equal, the most significant benefits may arise from the provision of flexibility services by resources connected to distribution networks. The possibility to modify consumption and generation patterns at that level, in response to an external signal (e.g. electricity prices), may facilitate the integration of renewable generation sources while mitigating the costs for congestion management, grid and capacity reinforcement.

To make such benefits a reality it is essential to address in a timely manner emerging issues related to market design and operations, which may affect the provision of flexibility services at the distribution level.

In the following paragraphs, we provide recommendations for each of the key issues concerning the provision of flexibility services at the distribution level.

Flexibility services at the distribution level

Cooperation between TSOs and DSOs

To promote the efficient provision of flexibility services from distribution-connected demand and power generating facilities the cooperation between DSOs and TSOs is essential with respect to a wide range of aspects, as emerged from UCs and the review of the legislative framework in place.

To this purpose, the following actions are recommended:

- Member States' NRAs shall adopt the decisions discussed in the CG scenario to enforce in a timely manner the Electricity Regulation with respect to the monitoring of implementation of the network codes and guidelines and the planning and operation of networks. The definition of common rules in the development, operation and functioning of networks is a prerequisite for the development of an effective model for the procurement of flexibility services at the distribution level. The provision of flexibility services from distribution-connected resources cannot disregard, indeed, a coordinated access of TSOs and DSOs to demand and distributed power generating facilities.

Such actions shall be undertaken in 2020.

- Member States' NRAs shall adopt the decisions discussed in the CG scenario to enforce the operational requirements of KORRR and make the data exchange effective in a timely manner. Making data exchange effective and clarifying the role and responsibilities of TSOs and DSOs to this aim can promote flexibility services at the distribution level without prejudice to system security and stability.

Such actions shall be undertaken in 2020.

- The EC shall consult with relevant stakeholders and to organise expert panels to acquire knowledge on possible models of coordination between TSOs and DSOs implemented or under scrutiny across Member States. Such actions shall develop guidelines for:
 - the development of a coordinated approach between TSOs and DSOs in the procurement of flexibility services at the distribution level, according to different possible models by ensuring harmonisation across Member States without prejudice to national specificities;
 - the definition of guidelines for the development of pilot projects at the Member State level concerning the procurement and provision of flexibility services at the distribution level;
 - the acquisition of knowledge and the development of guidelines with respect to the development of flexibility platforms.

Such actions shall be completed by the end of 2021.

- The EC shall use the results of the consultation process and of the expert groups to adopt an implementing act concerning the design and operation of possible models of interaction between DSOs and TSOs with respect to the procurement of flexibility services at the distribution level. The implementing act will ensure a timely and harmonised enforcement by Member States of the provision of the Electricity Regulation and Directive concerning the role of TSOs and DSOs in the provision of flexibility services at the distribution level.

Such action shall be completed by the end of 2022.

- Implementation of the Horizon Europe framework and CEF programmes. The implementation of the Horizon Europe framework to promote R&I in the field of AI and Data Analytics to foster the coordination and synergies between TSOs and DSOs may provide, in addition to regulatory measures, also an important contribution to the development of flexibility services at the DSOs level. Such funds may help the development of projects aimed at increasing network observability and security as well as the development of platforms for the trading of flexibility services at the distribution level. In addition, the utilization of CEF funds to develop e.g. digital platforms aimed at facilitating interactions between DSOs and TSOs can represent an effective add-on to this aim.

Characteristics of the products for flexibility services

The characterization of the products for flexibility services at the distribution level is an essential aspect for the provision of flexibility services. Such products, indeed, defines the characteristics of the services to be provided, rights and obligation of the providers of such services, the needed technical requirements and the roles and responsibilities of the TSOs and DSOs involved in the procurement of the services.

To ensure a proper characterisation of the products for flexibility services the following actions are recommended.

- Member States enforce by means of NRAs the provisions of the Electricity Directive with respect to aspects emerged in the BAU scenario. NRAs shall define the prequalification criteria necessary to provide flexibility services and develop a market design for the provision of flexibility at the distribution level which fulfils the non-discriminatory treatment of all market participants as suggested by the Electricity Directive.

Such actions shall follow consultations with DSOs and TSOs and shall be implemented before 2025.

- Further secondary legislation amending Regulation (EU) 2017/2195 (Balancing Guideline). To ensure a harmonised and timely development of the products for flexibility services, amendments at the current Balancing Guideline appear desirable. The Guideline should encompass the definition of the principles set in the CG scenario with respect to the characterisation of the products for flexibility services.

Such intervention shall be adopted no later than 2023.

More active role of DSOs in the provision of flexibility services

Network investments at the distribution level are an essential condition for a smarter role of distributors and customers and, consequently, for unlocking the opportunities of digitalisation.

To ensure that the most valuable investments and operations are undertaken to promote flexibility at the distribution level the following actions are recommended.

- Adoption of NRAs' decisions shaping the regulatory methodology for the remuneration of DSOs in the operation and development of their network according to the provisions of the Electricity Regulation. Such decisions shall encompass the adoption of an output-based regulation based on incentives and penalties to promote the development and management of smart grid able to promote the provision of flexibility services at the distribution level.

In addition, NRAs' decisions should also adopt a long-term approach by imposing, in compliance with the Regulation, the development by DSOs of network plans encompassing a five to ten year time-horizon.

Such plans shall become the base according to which NRAs assess the compatibility of network investments and operations with respect to the outputs set by national Regulators, over a given regulatory period, also with reference to the promotion of flexibility. It is thus recommended that network plans are developed and subject to the NRAs' assessment before the starting of each regulatory period to allow for a forward-looking approach to the operation and development of the network.

NRAs' decisions shall be adopted before 2025.

- Implementation of the CEF and Horizon Europe programme. The exploitation of the CEF and Horizon Europe programme can represent an additional lever to support investments in smarter and digitalised distribution networks to allow for the provision of flexibility services at the distribution level. It is thus recommended to consider a proper funding of such programmes in order to allow an adequate support to innovative projects in the digitalisation of the distribution network.

All these actions shall be implemented in a timely manner and before 2025.

- Adoption of Guidelines on the regulatory approach for distribution (and transmission network). Despite being binding, the Electricity Regulation only sets general principles with respect to the regulatory framework that DSOs shall put in place for DSOs. Therefore, heterogeneity across Member States can be expected with respect to the timely and uniform implementation of the recommendations set in the Regulation. In order to make sure that DSOs across MSs are engaged to the same extent and at the same pace in the promotion of flexibility, and smarter grids more in general, the Commission could adopt a Regulation establishing guidelines for detailed technical and operational rules to promote a forward looking and output-based regulation for distribution networks across Member States. A greater harmonisation of the regulatory approach for distribution networks will ensure that any Member State lagging behind in the development of smart grids is able to promote a more active role of demand with benefits for demand itself and the energy system as a whole.

This action shall be undertaken before 2030.

The role of aggregators in providing flexibility services

Given the distributed nature of demand and the increasing role of digitalisation to empower customers, independent aggregators may play an important role to unlock the

great potential of demand in contributing to the delivery of the energy transition. Aggregation of demand may, indeed, overcome several market failures which are currently preventing demand to deliver greater value to the energy system. Transaction costs, information asymmetry and lack of appropriate knowledge may deter demand from entering PPAs or providing flexibility services.

- Adoption of NRAs' decision to encourage the participation of independent aggregators to electricity markets according to a level playing field. The Regulation and the Directive on the IEM establish the adoption by MSs of a regulatory framework aimed at encouraging a non-discriminatory participation of aggregators in electricity markets. It is thus recommended that Member States comply with the provisions set in the Regulation and the Directive on the IEM by adopting NRAs' decisions promoting a non-discriminatory participation of independent aggregators in electricity markets at the level playing field with other market operators.

In addition, it appears desirable that NRAs encompass the obligations of TSOs and DSOs in promoting the participation of independent aggregators in electricity markets as well as of electricity suppliers. The latter, in particular, shall avoid practices preventing customers to stipulate contracts with independent aggregators.

All these actions shall be implemented before 2025.

- Implementation of the CEF programme. The CEF programme can provide an important contribution to the role of aggregators by promoting e.g. the development of platforms connecting the different stakeholders of the energy system involved by the provision of flexibility services and encouraging synergies between digital and energy infrastructures.

The employment of the CEF programme shall be performed in 2021.

- Adoption of Guidelines on independent aggregators. To ensure the integration and harmonisation of electricity markets, Member States shall establish consistent and harmonised regulatory frameworks to allow the participation of independent aggregators in progressively more integrated regional electricity markets. For this reason, and given the emergent nature of independent aggregators, the adoption of binding EU guidelines on independent aggregators (as suggested in the CG scenario) is recommended. Guidelines may support Member States in the implementation of consistent and exhaustive technical and operational rules for the participation of independent aggregators in electricity markets and in particular in the provision of flexibility services.

Guidelines should be implemented before 2025.

The access to consumption and production data

The Directive on the IEM establishes the right for customers and third eligible parties to access consumption and production data in order to promote an active role of demand in fostering the transition through renewable generation and the provision of flexibility services. In addition, the Directive affirms the necessity to promote interoperability for data access. In particular, the EU encourages interoperability to foster the realization of an integrated internal market increasingly based on digitalisation.

- Adoption of NRAs' decision to promote customers' right to access data. NRAs shall adopt decisions aimed at promoting customers' empowerment by ensuring their

right to access their consumption and production data upon request and in an understandable format. Such regulatory provisions shall be adopted as soon as feasible to allow for a responsible participation of customers in electricity markets according to the principles established in the Electricity Directive. The possibility for customers to access to their metering data is, indeed, an essential condition to allow them to benefit from competition in the retail electricity markets as well as to engage them in more sophisticated activities such as the provision of flexibility services with opportunities for customers themselves and the energy system as a whole.

NRAs' decision shall be adopted by the end of 2021.

- Adoption of binding interoperability standards. The Commission shall consult with ACER, ENTSO-E, NRAs and the EU DSO-entity in order to establish binding guidelines for the adoption of interoperability requirements. As data will increasingly shape the development of electricity markets - in terms of both customer empowerment and the development of new tariffs, new figures such as aggregators will also impact, consequently, the integration of electricity markets. Therefore, it is important that binding and harmonised interoperability requirements are developed across Member States.

These actions shall be implemented by the end of 2023.

Privacy and Data Protection

The Electricity Directive promotes the adoption of a regulatory framework for data protection of smart meters, embedding relevant GDPR provisions and tailoring those to the needs and specificities of smart meters' implementation and functioning.

To this purpose, the following actions are recommended:

- MSs shall comply with the provisions set in the Electricity Directive by adopting a data management model for smart meters in order to ensure efficient and secure data access and exchange. Independently of the adopted data management model, each MS shall authorise, certify or, where applicable, supervise the parties responsible for data management.
- MSs shall carry out the collection and processing of personal data coming from smart meters in accordance with the GDPR. In line with customer-centric policies aiming at increasing energy consumer engagement and empowerment, MSs shall ensure that, prior to or at the time of installation of smart meters, final customers are duly informed about their energy consumption.

Given the high priority of addressing privacy concerns expressed by consumers over their personal energy-related data treatment, all these actions shall be adopted in a timely manner - and no later than 2022 - in order to build trust in more digitally engaged consumers.

Finally, to facilitate the large-scale deployment of smart metering systems across all MSs, the Commission shall develop EU guidelines on principles that need to be complied with by all data management models for smart meters in place or currently under design.

Cybersecurity

Cybersecurity of ICT products

The NIS Directive proposes a set of measures to boost the level of cybersecurity of network and information systems in Europe in order to increase resilience and enhance cybersecurity preparedness in Europe.

To this purpose, the following actions are recommended:

- MSs shall improve their national cybersecurity capabilities by designating one or more national competent authorities on the security of network and information systems, who shall monitor the application of the Directive at national level and shall coordinate with ENISA.
- MSs shall establish Computer Security Incident Response Teams (CSIRTs) to deal with incidents and risks and ensure efficient cooperation at EU level between the MSs. ENISA shall intervene when MSs have not developed national CSIRTs.

MSs should have complied with such provisions by May 2019.

Over the recent years, the Commission carried out consistent work on cybersecurity certification schemes in order to tackle security concerns expressed by consumers about the cybersecurity risks associated with the ICT products and servers storing their personal data.

The Cybersecurity Act is the greatest expression of this work, as it sets up an EU cybersecurity certification framework for ICT products, services and processes. The proposed framework creates a comprehensive set of rules, technical requirements, standards and procedures to agree each scheme.

To this respect:

- The EC shall define a roadmap to deliver in a timely manner a common certification scheme for each relevant EU area and proceed with consultations with national competent authorities to harmonise with existing standards at the national level. By doing so, it would be possible to align efforts towards the identification of common certifications for the main European Industries. In tandem with developments on the proposed Cybersecurity Act, there will be supports for repositories, tools for awareness raising and assistance for security certification of digital products and services.

As the proposed EU cybersecurity certification schemes are not mandatory, but will be on a voluntary basis:

- The EC shall adopt a new EU Regulation on Cybersecurity defining the creation of EU cybersecurity certifications for different areas with mandatory standards and sanctions in the case of incompliance with set requirements. For example, the creation of ad hoc minim requirements for relevant operators and a clear definition of the role of the National competent authorities and CSIRTs. ENISA shall be enabled to make random checks of compliance and to request National authorities to provide information at any time.

The Cybersecurity Act also reinforces the role and responsibilities of ENISA. In order to better define areas of intervention of ENISA and its coordination with national authorities, the Commission shall envisage a series of provisions in an Implementing Act to efficiently tackle common challenges and bring forward best practices of MSs.

The combined effect of these actions will result in increased cyber-resilience and consumer trust in digital products and services. The investments proposed in the framework of the Digital Europe Programme for 2021-2017 will reinforce capabilities and ensure that the Union has technological and industrial capacities to secure its economy, society and democracy.

Cybersecurity of energy critical infrastructures

The NIS Directive aims to build and spread a culture of security across sectors that are vital for EU economy and society, where a cyberattack could disrupt an essential service, and rely heavily on ICTs, such as energy and digital infrastructure.

To this purpose, the following actions are recommended:

- Each MS shall identify Operators of Essential Services (OES) among key economic actors and businesses in these sectors, which will have to take appropriate security measures and to notify serious incidents to the relevant national authority. Under the Directive, also key Digital Service Providers (DSP), such as search engines, cloud computing services and online marketplaces, will have to comply with the security and notification requirements.
- The EC shall adopt new cybersecurity guidelines to set procedures for essential operators notification requirements, including deadlines, responsible bodies (stronger role of ENISA), format, definition of a common standard at the European level with respect to the information to be exchanged. Moreover, the new cybersecurity guidelines should define the modalities of collaboration between the EU DSO with National Competent authorities, CSIRTs and ENISA.

The Commission shall adopt these guidelines no later than 2022.

The Electricity Directive establishes that MSs shall implement smart metering systems in accordance with European standards on security in order to ensure the highest level of cybersecurity protection while bearing in mind the costs and the principle of proportionality. To this regard:

- MSs shall follow the “security by design” principle when proceeding with the deployment of smart meters.

Following the Electricity Regulation:

- The EC shall adopt delegated acts in the form of network codes on cybersecurity to provide indications on minimum requirements to guarantee data security of smart meters.

The Commission shall adopt these network codes no later than 2023.

Interoperability and standardisation

The Electricity Directive envisages smart metering systems interoperability as a fundamental requirement to promote the active participation of consumers in the electricity markets.

In the deployment of smart metering systems:

- MSs shall promote and adopt relevant available standards, including standards that enable smart meters interoperability on the level of the data model and the

application layer and best practices. To this extent, MSs shall consider future and innovative energy services and the importance of the development of data exchange, smart grids and the internal market for electricity.

- MSs shall facilitate the full interoperability of energy services within the Union in order to promote competition in the retail market and to avoid excessive administrative costs for the eligible parties.

In line with the provisions of the Electricity Directive:

- the EC shall adopt Implementing Acts to determine interoperability requirements and non-discriminatory and transparent procedures for access to metering data, consumption data, as well as data required for customer switching, DR and other services.
- MSs shall ensure that electricity companies comply with requirements which are yet to be developed by the Commission taking into account existing national practices.

Such actions shall be taken no later than 2023.

In order to enable interoperability in the smart appliances' domain relevant for energy:

- the EC shall promote the adoption of the SAREF family of standards (reference ontology) by widespread dissemination actions to support their wider diffusion across all Europe.

This action shall be taken as soon as possible.

Roadmap to 2030

Key Issues	2020	2020 - 2025	2025 - 2030
Cooperation between TSOs and DSOs	<p>Full implementation of the Regulation on the IEM to enhance the cooperation between TSOs and DSOs in the implementation of network codes and guidelines, network planning and operation and the procurement of flexibility services at the distribution level.</p> <p>Compliance by Member States with the Regulation (EU) 2017/2195 with respect to the obligation of TSOs and DSOs in the implementation of the guideline on electricity balancing.</p>	<p>Full implementation of the Balancing Guideline with respect, in particular, to the obligation to consults on the implementation of the Guideline itself; the definition of a joint methodology for the allocation of costs related to the provision of active power reserves.</p> <p>Full implementation of the Regulation on the internal market for electricity with respect to: the monitoring of implementation of the network codes and guidelines; the network planning and operation.</p> <p>Adoption of NRAs' decisions for the enforcement and operational implementation of the KORRR.</p> <p>Consultation processes and creation of expert panels at the EU level to develop guidelines for the promotion of the provision of flexibility services at the distribution level by means of coordination between TSOs and DSOs and flexibility platforms.</p> <p>Exploitation of the Horizon Europe framework to promote R&I in the field of AI and Data Analytics to achieve greater coordination and synergies between TSOs and DSOs in the planning and operation of networks and develop pilot projects for the provision of flexibility services at the distribution level.</p> <p>Implementation of the CEF programme to promote synergies between digital and energy infrastructure to support e.g. the development of digital platforms aimed at facilitating the interactions between the different actors of the energy system including TSOs and DSOs.</p>	<p>Adoption of an Implementing act on flexibility services from distribution-connected demand and power generating facilities</p> <p>Adoption of a new Directive on the internal market for electricity to address emerging issues in market design arising from the development of P2P trading and VPP and the procurement of flexibility services at the distribution level</p>
Specifications of the products for flexibility services	<p>Full implementation of the Regulation on IEM to promote the obligation for TSOs and DSOs to adopt market-based mechanisms for re-dispatching.</p>	<p>Adoption of a further secondary legislation amending the Balancing Guideline and aimed at regulating issues as: characteristics of products for flexibility services; guideline concerning actions for the mitigation of the</p>	

	Full implementation of the Directive on the IEM to establish the obligation for TSOs and DSOs to define the technical requirements for the provision of flexibility services by resources connected at the distribution level (also through aggregators).	impact of congestions and redispatching measures; prequalification technical and non-technical criteria for the provision of flexibility services.	
More active role of DSOs in the provision of flexibility services	Full implementation of the Regulation on the IEM to promote the implementation of incentive- and output-based regulatory frameworks for electricity distribution networks.	Full implementation of the new Regulation on the IEM with respect, in particular, the adoption of incentive-based and consistent regulatory frameworks acknowledging the new role of distribution networks. Exploitation of both the Horizon Europe and CEF programmes to complement national regulatory approaches in promoting network investments and encouraging a smarter and more active role of DSOs.	Adoption of Regulation (EU) establishing guidelines on the remuneration of distribution networks
The role of aggregators in procuring flexibility services	Full implementation of the Directive on the IEM to promote the adoption of a regulatory framework at the Member States' level aimed at encouraging the development of independent aggregators, and their non-discriminatory participation to electricity markets. Full implementation of the Regulation on the IEM to establish obligations aimed at deterring electricity suppliers from hampering the right of customers to stipulate contracts with independent aggregators.	Full implementation of the new Regulation on the IEM with respect, in particular, the promotion of independent aggregators' participation to electricity markets. Utilization of the CEF programme to promote e.g. the development of market platforms aimed at fostering an active role of aggregators and their interactions with other stakeholders of the energy system.	Adoption of Regulation (EU) establishing guidelines on independent aggregators
The access to consumption and production data	Full implementation of the Directive on the IEM to establish the right of customers and third eligible parties to receive all relevant consumption and production data, in an understandable format able; the development of interoperability requirements at the EU level.	Full implementation of the new Directive on the IEM with respect, in particular, the access and exchange of customers' consumption and production data. Development of EU recommendations/guidelines on interoperability standards at the EU level.	Adoption of binding (EU) interoperability requirements
Customer privacy and data protection	Full implementation of the Directive on the IEM including the provisions related to data protection of smart meters' data in the smart metering system deployment.	Full implementation of the new Directive on the IEM with respect to smart meters data management model.	Development of EU recommendations/guidelines for setting principles that need to be complied by all data management models for smart meters in place or currently under design.

<p>Cybersecurity of ICT products</p>	<p>Designation one or more national competent authorities on the security of network and information systems.</p>	<p>Definition of a roadmap to deliver common certifications for each relevant EU sector. Adoption by the Commission of a series of provisions in order to efficiently tackle common challenges and bring forward best practices of MSs.</p>	<p>Adoption by the Commission of a New EU Regulation on Cybersecurity:</p> <ul style="list-style-type: none"> ▪ defining the creation of EU cybersecurity certifications for different areas with mandatory standards and sanctions in the case of non-compliance with set requirements ▪ including a cybersecurity network code for critical infrastructures, in order to address roles and responsibilities of the European DSO in guaranteeing cybersecurity of critical infrastructure.
<p>Cybersecurity of energy critical infrastructures</p>	<p>Full implementation of the Regulation on the IEM to establish a European entity of distribution system operators in the Union ("EU DSO entity") in order to raise efficiencies in the electricity distribution networks in the Union and ensure close cooperation with transmission system operators and ENTSO for electricity.</p>	<p>Adoption by the Commission of new cybersecurity guidelines to define the modalities of collaboration between the EU DSO and National Competent authorities, CSIRTs, and ENISA. Adoption by the Commission of a cybersecurity network code for critical infrastructures. Implementation of the CEF programme to improve MSs compliance with the NIS Directive and higher levels of crisis response.</p>	
<p>Interoperability between connected devices</p>	<p>Full implementation of the Directive on the IEM to define smart metering systems interoperability as a fundamental requirement to promote the active participation of consumers in the electricity markets.</p>	<p>Adoption by the Commission of common guidelines to MSs for the adoption of standards and best practices for smart metering systems interoperability. Adoption by the Commission of Implementing Acts to determine interoperability requirements and non-discriminatory and transparent procedures for access to data.</p>	<p>Adoption of binding (EU) interoperability requirements supported by the introduction of relevant parameters (KPIs) for products and parts.</p>

