

**Universal**  
UMEI

MARKET ENABLING INTERFACE TO UNLOCK FLEXIBILITY SOLUTIONS FOR COST-EFFECTIVE MANAGEMENT OF SMARTER DISTRIBUTION GRIDS

## **Deliverable: D10.1**

**Business model canvas and comparison of CBA methodologies**



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**Document**

D10.1 Business model canvas and comparison of CBA methodologies

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## Abbreviations

DSO	Distribution System Operator
HV	High Voltage
LV	Low Voltage
MV	Medium Voltage
TSO	Transmission System Operator
UMEI	Universal Market Enabling Interface

# 1. Executive Summary

The aim of this deliverable is twofold: (1) analysing the business models of the EUniversal demos; and (2) examining distribution network planning methodologies in Europe. The objectives were analysed separately and the outcomes of both analyses are now described in more detail.

## Business model canvas analysis of the EUniversal demos

Chapter 3 describes the business model analysis of the three EUniversal demos using Osterwalder’s business model canvas. When mapping the different demos to the nine building blocks of the canvas, it became clear that the amount of information available for each building block varies. To express this variation, the building blocks of the business model canvas are divided in three categories, using the traffic light system. Each colour indicates whether the building block (1) is extensively analysed in the EUniversal project (green); (2) is considered in the final deliverables of the demos, but might require a broader examination in the future (yellow); or (3) is outside the scope of the EUniversal project, but could be an interesting topic for future research (orange).

Figure 2 from Chapter 3.4 illustrates the resulting colour of each building block and summaries some of the main identified research questions. Overall, this business model canvas analysis with traffic light system shows that, for the EUniversal project, the building blocks covering the internal operation of the demos are already well defined, and most open questions remain on the customer and financial side of the canvas. The identified questions can serve as inspiration for future research and H2020 projects.

Key Partners	Key Activities	Value Propositions <ul style="list-style-type: none"> <li>- How much are the potential revenues of customers defined by their location in the network?</li> <li>- Do non-financial value propositions impact the engagement of customers in flexibility markets?</li> </ul>	Customer Relationships <ul style="list-style-type: none"> <li>- Will a real flexibility market set-up be sufficient to remove the need to attract customers?</li> <li>- If DSOs need to attract new customers to the market, what is the best way to achieve this?</li> <li>- Is the market platform enough to maintain the relationship between DSOs and flexibility providers, or will active relationship-building be required to grow the participation in flexibility markets?</li> </ul>	Customer Segments
	Key Resources		Channels <ul style="list-style-type: none"> <li>- If there are multiple market platforms available in the same area, which channel will be used to procure flexibility services?</li> <li>- Are there interoperability issues between the different flexibility instruments?</li> </ul>	
Cost Structure <ul style="list-style-type: none"> <li>- What is the optimal price range to remunerate flexibility?</li> <li>- How big are the costs related to the customer and internal operation side of the business model canvas?</li> </ul>		Revenue Streams <ul style="list-style-type: none"> <li>- How can we define the benefits of flexibility services more robustly?</li> <li>- How can we choose the most optimal instrument of the flexibility toolbox to solve network challenges?</li> <li>- How can the costs of flexibility services best be remunerated via network tariffs?</li> </ul>		

Figure 1: Colours and research questions identified in the EUniversal demos for each building block of the business model canvas.

## Evaluation of distribution planning methodologies in Europe

Chapter 4 describes the evaluation of distribution planning methodologies in Europe, with a focus on the trade-off between flexibility and network investments. Based on a reflection of the Clean Energy Package, the following five aspects of distribution network planning were analysed: planning frequency, scenarios and alignment with the TSO, network representation, the inclusion of flexibility as an alternative to investments and transparency. The findings are based on interviews with experts from Agder Energi, Energa-Operator, E-Redes, ESO, Fluvius, i-DE, Mitnetz-Strom, Netz NÖ and UK Power Networks, and written reports from Enedis and Enel. A workshop with all participants was organized and had the following two objectives: (1) debrief the current practices of distribution planning methodologies; and (2) check to which extent DSOs are aligned and can come to a target model in the future.

Table 1 from Chapter 4.6 summarizes the findings of the current practices identified during the interviews and the results of the polling question on a future target model. The current practice of the DSOs shows that there is no single approach to distribution network planning, as for each of analysed aspects multiple answers were given and often different responses were combined within the network planning of each DSO. When the DSOs were asked in the workshop to vote on a future target model for distribution planning methodologies, the polling results showed that DSOs are already well aligned on planning frequency, scenarios and alignment with the TSO, network representation, and the trade-off between flexibility and network investments; but transparency is currently the most debatable topic.

*Table 1: Summary of the current practice and future target model of distribution planning methodologies based on interviews and workshop with 11 European DSOs.*

	Current practice	Towards a future target model?
<b>Planning frequency</b>	<p>How frequently do you currently report on distribution network planning?</p> <ul style="list-style-type: none"> <li>Yearly reporting cycle</li> <li>2 yearly reporting cycle</li> <li>3 yearly reporting cycle</li> </ul>	<p>What should be the planning frequency of the future target model?</p> <p>25% Yearly reporting cycle 75% 2 yearly reporting cycle</p>
<b>Scenarios &amp; TSO alignment</b>	<p>In creating your scenarios, are you aligned with the TSO?</p> <ul style="list-style-type: none"> <li>Yes, we have alignment meetings with the TSO</li> <li>Yes, we use the scenarios of the TSO</li> <li>Yes, alignment is ensured by the regulator</li> </ul>	<p>What should be the role of the regulator in aligning DSO and TSO on planning scenarios?</p> <p>75% Approves scenarios 17% Create scenarios 8% No role</p>
<b>Network representation</b>	<p>How do you represent your distribution network during planning?</p> <ul style="list-style-type: none"> <li>We use a manual representation of our network</li> <li>We use representative network models</li> <li>We make simulations of critical network areas</li> <li>We go towards a full simulation of our network</li> </ul>	<p>Will DSO planning evolve towards simulations of the entire distribution network in the future?</p> <p>83% Yes 17% No</p>
<b>Trade-off flexibility &amp; network investments</b>	<p>How do you intend to include flexibility as an alternative to network investments in distribution planning?</p> <ul style="list-style-type: none"> <li>We will follow the requirements of the regulator</li> <li>We are testing alternatives and use our experience to go into discussion with the regulator</li> <li>We are already convinced that it is valuable to make this trade-off</li> </ul>	<p>Should procuring flexibility be an alternative to network investments in the future target model?</p> <p>75% We were already convinced before this workshop 25% We will have to look into it more closely 0% We are still sceptical</p>

<b>Transparency</b>	<p>How should network investment plans be reported to comply with the Clean Energy Package?</p> <ul style="list-style-type: none"> <li>• Conversations with stakeholders on scenarios and investment priorities</li> <li>• Two different plans: a simple public plan and a detailed private plan</li> <li>• Heatmaps</li> <li>• Most information is already publicly available</li> </ul>	<p>Will more details of network planning be made publicly available by DSOs in the future?</p> <p>50% Yes 50% No</p>
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## 2. Introduction

The EUniversal project, funded by the European Union, aims to develop a universal approach on the use of flexibility by Distribution System Operators (DSO) and their interaction with the new flexibility markets, enabled through the development of the concept of the Universal Market Enabling Interface (UMEI) – a unique approach to foster interoperability across Europe.

The UMEI represents an innovative, agnostic, adaptable, modular, and evolutionary approach that will be the basis for the development of new innovative services, market solutions and, above all, implementing the real mechanisms for active consumer, prosumer, and energy communities participation in the energy transition. In this context, the aim of Deliverable 10.1 is to analyse the current practice and trends in business models for flexibility markets and distribution network planning methodologies. Accordingly, this document will consist of two main parts:

First, a business model canvas analysis of the EUniversal demos. The business models of the three demo projects are analysed using the business model canvas of Alexander Osterwalder, Deliverable 2.2 of the EUniversal project, the EUniversal Grant Agreement, and feedback from the demo participants. From this analysis, the main elements explored in the demo projects are defined and interesting areas for future research are identified. The results are discussed in detail in Chapter 3.

Second, an evaluation of distribution planning methodologies in Europe, with a special focus on the trade-off between flexibility and network investments. For this analysis, semi-structured interviews were conducted with 11 DSOs. The framework used during the interviews was based on previous research by BMWi et al. (2014), Enedis (2017), Eurelectric et al. (2020), Nouicer, A. et al. (2020), and Keyaerts, N. et al. (2017). After the interviews, a workshop was organized to debrief the current practices on distribution planning methodologies and to check to which extent DSOs are aligned and can come to a target model in the future. Chapter 4 contains the highlights of five network planning aspects that were discussed during the workshop: planning frequency, scenarios and alignment with the Transmission System Operator (TSO), network representation, the inclusion of flexibility as an alternative to investments, and transparency. The findings are in line with Eurelectric's recent recommendations on network development plans for DSOs (Eurelectric, 2021).

Finally, this deliverable can serve several further purposes:

- The results of the business model canvas analysis can be used in the reporting of Deliverable 7.4, Deliverable 8.3, and Deliverable 9.4 of the EUniversal project, in which respectively the outcome of the Portuguese, German and Polish demo will be discussed.
- The research questions identified in the business model canvas analysis can serve as inspiration for future research and H2020 projects.
- The evaluation of distribution planning methodologies can serve as an input for the EU DSO Entity that has the task to promote a common methodology for network planning and operation in the coming years.

### 3. Business model canvas analysis of the EUniversal demos

In the first part of this deliverable, the business models of the EUniversal demo project are examined using Osterwalder’s business model canvas. There are three demos active in the EUniversal project: the German demo led by E.ON and Mitnetz-Strom, the Polish demo led by Energa-Operator, and the Portuguese demo led by E-Redes. A summary of the general description, problem situation and market design of the EUniversal demos can be found in Chapter 4 of Deliverable 2.2. When mapping the different demos to the nine building blocks of the business model canvas, it became clear that the amount of information available for each building block varies. Some components will be extensively analysed in the EUniversal deliverables, other elements will still need to be further defined. To express this variation, the building blocks of the business model canvas are divided into three categories using the traffic light system:

- Green building blocks, which are well-defined and examined in the EUniversal demos
- Yellow building blocks, which will be considered in the final deliverables of the demos, but might require a broader examination in the future
- Orange building blocks, which are outside the scope of the EUniversal project, but could be interesting topics for future research

Figure 1 shows an overview of the nine building blocks of the business model canvas with their respective colour. A detailed summary of each demo can be found in Annex I. In the remainder of this chapter, the main findings of the building blocks will be explained based on their colour category.

Key Partners	Key Activities	Value Propositions	Customer Relationships	Customer Segments
	Key Resources		Channels	
Cost Structure			Revenue Streams	

*Figure 2: The business model canvas with the respective colour category per building block. Green: extensively analysed in the EUniversal project. Yellow: considered in the final deliverables of the demos, but might require a broader examination in the future. Orange: outside the scope of the EUniversal project, but could be an interesting topic for future research.*

#### 3.1. Green building blocks

Four building blocks were already well-defined in Deliverable 2.2 and the Grant Agreement of the EUniversal project: key partners, key activities, key resources and customer segments. In the following paragraphs, we will highlight the key aspects of each building block. More detailed information on these topics can be found in the suggested documents.

**Key Partners** A first key partner of the DSO in every demo project is the market platform provider and operator. There are two platform operators active in the EUniversal project: Nodes and N-Side. Every demo will work with the Nodes platform, and the Portuguese demo will also use the N-Side platform. In Deliverable 2.2, the roles and activities of the platform operators are well defined, leaving limited questions for future research. A second key partner of the DSOs are technology and tool providers. Technology companies such as Mikronika, aggregators such as Centrica, and research institutes such as IEN, Inesc-Tec, KU Leuven, and VITO take up this role in the EUniversal demos. A

final partner in market-based flexibility procurement could be the TSO, but this is outside the scope of the EUniversal project.

**Key Activities** The different key activities of the DSO in the demo projects are specified in detail in Deliverable 2.2. Some of these activities include identifying flexibility needs, data management, assessing the impact of flexibility offers, and network optimization.

**Key Resources** The demo projects mostly focus on physical resources such as network and smart grid infrastructure. The German demo considers the LV network, the Portuguese demo the LV and MV network, and the Polish demo looks from the LV-MV interface up to the HV network. Besides that, appropriate communication, measurement and control technologies are required in the network to make the demos successful. When moving from a demo-setting to a real-life setting, it can be important to also consider other aspects of this building block such as intellectual, human, and financial resources.

**Customer Segments** Two types of customers were identified in the EUniversal demos: flexibility providers and flexibility buyers. Flexibility providers are resource aggregators or resource providers that comply with the prequalification requirements of the DSO. As DSOs have a wide knowledge of the customers present in their network, there is a good understanding of the amount and type of flexibility providers that could participate in the local flexibility markets. Customer types present in the different demos are residential, commercial, and industrial customers, depending on the analysed voltage level. Flexibility buyers are customers that buy flexibility from the DSO to optimize their operation. This concept is tested in the Polish demo, where owners of wind farms can buy flexibility when the planned (forecasted) generation of the next day exceeds the connection power agreed in the connection agreement. Another buyer could be the TSO, but this is not considered in the EUniversal project.

### 3.2. Yellow building blocks

Three building blocks will be considered in the final deliverables of the demos, but might require a broader examination in the future: channels, cost structure and revenue streams. The following paragraphs explain the different building blocks and remaining research questions in more detail.

**Channels** Flexibility instruments can be seen as the main channel through which the DSO services reach their customers. The first instrument is the market-based procurement of flexibility, which is the principal channel identified in the EUniversal demos. Moreover, the EUniversal project designs a Universal Market Enabling Interface (UMEI) to extend the scope of this channel towards flexibility providers, market operators, DSOs, and TSOs. The UMEI will be further developed in Task 2.4 and tested in the different demo projects. However, one remaining open issue has already been identified, namely on the competition between different market platforms: if there are multiple market platforms available in the same area, which one will be used to procure flexibility services? Should customers be able to choose their market platform freely, should the DSOs decide based on cost estimations or should there be a neutral player such as the regulator to make this decision? Other channels that are identified in the Polish demo are flexible connection agreements and bilateral contracts. Besides that, also other flexibility instruments, such as dynamic network tariffs, cost-based mechanisms, and obligations, might be in place in reality. While the Polish demo will give a reflection on the relation between flexibility markets, connection agreements, and bilateral contracts in their final deliverable, further research on the interoperability of the different flexibility instruments might be required.

**Cost Structure** A fundamental expense of market-based flexibility is the remuneration of flexibility providers. In the demo projects, two types of payments are tested: availability-based and activation-based remunerations. However, the optimal level of pricing remains an open question. While the demos will report on this in their final deliverable, an important question that remains is 'What is the optimal price range to remunerate flexibility?'. This might be an interesting topic for further research

in coordination with the regulator. Other key components of the cost structure are costs related to customers such as relationships and channels; and costs related to internal operation such as key activities, resources, and partners. While the demo deliverables will report on these elements, a more general approach to measure these additional costs might be needed to move from a demo setting to a real-life setting.

**Revenue Streams** The main revenue stream of the DSO will come from the positive impact of flexibility services. This can be solutions to specific grid issues, efficiencies in maintenance and operation of the network, and delays of network investments. Similar to cost structures, an estimation of the cost savings will be made in the demo projects, but a common methodology on the trade-off between flexibility instruments and network investments to use in real-life applications might require additional research. Interesting remaining research questions defined in the demos are: how can we define the benefits of flexibility services more robustly? And how can we choose the most optimal instrument of the flexibility toolbox to solve a certain network problem? Again, the regulatory context will be important to answer these questions. Another revenue stream of the DSOs are network tariffs. Here an open regulatory issue that remains is how the costs of flexibility services can best be remunerated via network tariffs.

### 3.3. Orange building blocks

Two remaining building blocks are outside the scope of the EUniversal project, but could be interesting topics for future research: value proposition and customer relationships. The next paragraphs describe the key aspects and open issues of these building blocks.

**Value Proposition** The main value proposed towards customers in the EUniversal demos is financial: by providing flexibility services, flexibility providers can make revenues. The concept of the UMEI enforces this value, as the interface will be designed to allow easy revenue stacking of different services. One interesting research question defined here is 'How much are the potential revenues from flexibility services of customers defined by their location in the network?'. Another financial advantage was defined in the Polish demo, where wind producers can buy flexibility from the DSO in a market-based way and generate above their connection agreement limit. Besides financial advantages, flexibility services might create additional values for customers such as community building, contributing to the energy transition, and contributing to a reliable, secure and efficient energy system. As a result, it might be interesting for future research projects to examine the impact of non-financial value propositions on the engagement of customers in flexibility markets.

**Customer Relationships** Customer relationships consist mainly of two parts: attracting customers and maintaining relationships. First, customers must be engaged to participate in flexibility markets and the way this is achieved looks different in every demo project. In the case of Portugal, customers were already contacted during previous pilot projects. In the German demo, the DSO is responsible to collect customers that will participate in the market, and in the Polish demo, this role is taken up by the market operator. However, there can also be made an abstraction between the demo setting and the real implementation of flexibility markets: it might be possible that in a real market set-up attracting customers will no longer be necessary, the market will take care of this. Therefore, it might be interesting to examine whether a real flexibility market set-up will be sufficient to remove the need to attract customers? And if DSOs need to attract new customers to the market, what is the best way to achieve this? Second, maintaining customer relationships might be important to grow the size of the flexibility market. One example from outside the EUniversal project is the UK Power Networks Flexibility Forum<sup>1</sup>, in which flexibility providers are engaged to explain their needs and barriers for future flexibility tenders. As a result, it might be interesting to analyse if the market platform will be

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<sup>1</sup> Reports of the UK Power Networks Flexibility Forum can be accessed via the UKPN Flexibility Hub – Events, using the link <https://smartgrid.ukpowernetworks.co.uk/flexibility-hub/>

enough to maintain the relationship between DSOs and flexibility providers, or if active relationship building will be necessary to grow the participation in flexibility markets?

### 3.4. Summary and conclusions

Figure 2 summarizes the two main aspects analysed in this chapter:

- The colours indicate whether the building block (1) is extensively analysed in the EUniversal project (green); (2) is considered in the final deliverables of the demos, but might require a broader examination in the future (yellow); or (3) is outside the scope of the EUniversal project, but could be an interesting topic for future research (orange).
- The text summarizes the main research question defined for the different building blocks.

This overview shows the added value of mapping the business model canvas on flexibility projects: it exposes the main focus of the demos and indicates areas that might require additional research. In the case of the EUniversal project, the results show that the internal operation of the demos is already well defined, and most open questions lie on the customer and financial side of the business model canvas.

Key Partners	Key Activities	Value Propositions - How much are the potential revenues of customers defined by their location in the network? - Do non-financial value propositions impact the engagement of customers in flexibility markets?	Customer Relationships - Will a real flexibility market set-up be sufficient to remove the need to attract customers? - If DSOs need to attract new customers to the market, what is the best way to achieve this? - Is the market platform enough to maintain the relationship between DSOs and flexibility providers, or will active relationship-building be required to grow the participation in flexibility markets?	Customer Segments
	Key Resources		Channels - If there are multiple market platforms available in the same area, which channel will be used to procure flexibility services? - Are there interoperability issues between the different flexibility instruments?	
Cost Structure - What is the optimal price range to remunerate flexibility? - How big are the costs related to the customer and internal operation side of the business model canvas?		Revenue Streams - How can we define the benefits of flexibility services more robustly? - How can we choose the most optimal instrument of the flexibility toolbox to solve network challenges? - How can the costs of flexibility services best be remunerated via network tariffs?		

Figure 3: Colours and research questions identified in the EUniversal demos for each building block of the business model canvas.

## 4. Evaluation of distribution planning methodologies in Europe

The second part of this deliverable examines distribution planning methodologies with a focus on the trade-off between flexibility and network investments. Evolutions in distribution network development plans are expected in the coming years due to the following key elements of the Clean Energy Package:

- Recital (61) of the Electricity Directive: the Member States “should introduce network development plans for distribution systems and provide to system users adequate information regarding the anticipated expansions or upgrades of the network” (European Parliament and Council, 2019a).
- Article 32(1) of the Electricity Directive: the Member States “shall provide the necessary regulatory framework to allow and provide incentives to distribution system operators to procure flexibility services in order to improve efficiencies in the operation and development of the distribution system” (European Parliament and Council, 2019a).
- Article 32(3) of the Electricity Directive: distribution network development plans “shall be submitted at least every two years to the regulatory authority and shall set out the planned investments for the next five-to-ten years” (European Parliament and Council, 2019a).
- Article 55(1a) of the Internal Market Regulation: the EU DSO entity “shall be promoting the operation and planning of distribution networks in coordination with the operation and planning of transmission networks” (European Parliament and Council, 2019b).

We made a reflection of these key elements of the Clean Energy Package by examining the following five aspects of distribution planning methodologies: planning frequency, scenarios and alignment with the TSO, network representation, the inclusion of flexibility as an alternative to investments, and transparency. Our findings are based on interviews with experts from Agder Energi, Energa-Operator, E-Redes, ESO, Fluvius, i-DE, Mitnetz-Strom, Netz NÖ and UK Power Networks (UKPN), and written reports from Enedis and Enel. A workshop with all participants was organized on the 17<sup>th</sup> of June 2021 and had the following two objectives: (1) debrief the current practices of distribution planning methodologies; and (2) check to which extent DSOs are aligned and can come to a target model in the future. The slides presented during the workshop and the results of the polling questions can be found in Annex II. In the remainder of this section, the findings on the current practice and target model will be explained for each of the analysed aspects of distribution planning methodologies.

### 4.1. Planning frequency

During the interviews, the current practice on the planning frequency was examined with the question: ‘How frequently do you currently report on distribution network planning?’. The answers belonged to the following three categories:

- Yearly reporting cycle
- 2 yearly reporting cycle
- 3 yearly reporting cycle

We found that, in current practice, a combination of the reporting cycles is used depending on the type of network development plan. A list of planned investments in the short-term is typically published yearly, while network development plans with a five-to-ten year horizon are mostly reported every two years. An exception to this is the case of Energa-Operator, where these longer-term network development plans are currently submitted every three years, but an update to every two years is expected in the Polish Energy Law by the end of this year. Besides that, additional reporting cycles can be in place. For example, Mitnetz-Strom performs an additional reporting cycle towards their stakeholders.

When a poll was launched on the target model of planning frequency, 75% of participants responded that we should go to a two-yearly submission in the future and the remaining 25% voted for yearly

reporting. Here the comment was raised that a yearly frequency is preferred only for certain parts of the network planning process and that network development plans are dependent on the range of voltage levels present in the DSO network.

## 4.2. Scenarios and alignment with the TSO

During the interviews, one interesting aspect that came up when asking about scenarios was the alignment of these scenarios with the TSO. On the question 'In creating your scenarios, are you aligned with the TSO?' the following responses could be distinguished:

- Yes, we have alignment meetings with the TSO
- Yes, we use the scenarios of the TSO
- Yes, alignment is ensured by the regulator

These results indicate that alignment with the TSO on scenarios used during network planning is important for all participating DSOs. However, there are three approaches to how this alignment is reached.

First, alignment meetings can be organised bilaterally between system operators. Most DSOs indicated that their company has alignment meetings with the TSO on the definition of scenarios. Moreover, this coordination is often expanded to additional domains. The Portuguese DSO E-Redes explained that they also align their strategies with the TSO and Enedis added that in France also a cost-benefit analysis is performed from a global point of view. In the case of Agder Energi in Norway, coordination with the TSO is likewise very important, as the DSO owns parts of the network assets that the TSO operates.

Second, scenarios can be aligned between system operators as the DSO uses parts of the TSO's scenarios in their network planning. This results often from data exchange, as the TSO requires input from the DSO for the creation of their scenarios. Accordingly, the TSO's scenarios contain a good estimation of some aspects of the distribution network and can be used in the distribution network planning methodology.

Last, alignment between the DSO and the TSO can be ensured by the regulator. In this case, the regulator prepares some scenarios that should be used by the system operators.

During the workshop was asked what the role of the regulator should be in aligning DSO scenarios with the TSO planning scenarios in the future target model. 75% of participants voted that the regulator should approve scenarios, 17% answered that the regulator should create scenarios and 8% responded that there is no role for the regulator in this alignment. Here it was noted that the regulator also has an important role in the approval of distribution planning methodologies.

## 4.3. Network representation

A third question that was raised during the interviews was 'How do you represent your distribution network during planning?'. The following four network representations could be identified:

- We use a manual representation of our network
- We use representative network models
- We make simulations of critical network areas
- We go towards a full simulation of our network

Before going into more detail, it must be noted that DSOs rarely use only one type of representation, and often a combination of the responses is used during distribution network planning. Two main factors define which representations are used: the type of analysis that is performed and the voltage level that is considered.

First, manual representations are used when there is insufficient information about the network available. In this case, the network is simplified as a list of assets, load source, or feed-in.

Second, higher accuracy of unknown areas can be achieved by using representative network models. Besides that, representative network models can be used to reduce calculation times. Typical examples of representative network models are rural, industrial, sub-urban, and urban areas. During the interviews, E-Redes mentioned that for certain characteristics in their LV network representative network models were developed together with Inesc-Tec. During the workshop, it was raised that representative network models can also be used to represent the transmission level in certain distribution network simulations.

Third, simulations can be made of distribution network areas in which critical events such as new connections or obsolete assets occur. The amount of detail of the analysis is therefore high but limited to a certain grid area. Various software packages exist to do these calculations, and the DSO Energa-Operator mentioned that in the case of Poland this methodology is therefore aligned between most system operators. Besides that, Enedis explained that in their network planning a shift from critical network areas to critical network times is observed. This means that instead of performing simulation based on critical locations, the evaluation of their network is driven by periods in which their network is under the most pressure.

Last, DSOs can have a detailed representation of their whole network and move towards a full simulation of their network. Some examples of this are i-DE in Spain that performs detailed calculations of the available network capacity while using smart meter data; Agder Energi in Norway that use these simulations to assess whether network issues of households occur in their network or within the household itself; and Enel which completes a full simulation of their network every month and developed the Network Digital Twin®, a sort of digital model of the network created through a combination of real operational data, obtained using technologies such as Artificial Intelligence and drone scans, that is capable of replicating the network in its entirety and its operations, in addition to testing it under all possible conditions.

If we asked whether DSO planning will evolve towards simulations of the entire distribution network in the future, 83% of participants answered “yes” and 17% answered “no”. Most DSOs mentioned that they are working on developing detailed simulations of their network and that increasing computational possibilities make this feasible. One of the reasons to answer “no” was the fact that always running a full simulation is not the most efficient for all types of analyses and network areas, but there are reasons to have the capabilities to perform a full network simulation.

#### **4.4. Flexibility as an alternative to network investments**

To examine the trade-off between flexibility and network investments, the following question was posed during the interviews: ‘How do you intend to include flexibility as an alternative to investments in your distribution planning methodology?’. The answers could be categorised as follow:

- We will follow the requirements of the regulator
- We are testing alternatives and use our experience to go into discussion with the regulator
- We are already convinced that it is valuable to make this trade-off

First, flexibility instruments can be introduced by the regulator. One example is the 3% curtailment rule in Germany that allows Mitnetz-Strom to limit the yearly feed-in of renewable generators and take this into account in their long-term network planning. Another example is the Flemish DSO Fluvius that is allowed to make flexible connection agreements with generators and the regulator defined the benchmark value for this trade-off between investments and flexible connections.

Second, DSOs can use pilot projects to test flexibility instruments and use their experience to go into discussion with the regulator. Enedis, Enel, Energa-Operator, ESO, E-Redes, i-DE<sup>2</sup>, and Mitnetz-Strom set up demos to examine the trade-off between flexibility and network investments in H2020 projects

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<sup>2</sup> The latest publication of FutuRed on the impact of flexibility in distribution grids is available at <https://www.smartgridsinfo.es/2021/04/16/futured-publica-estudio-sobre-flexibilidad-redes-distribucion-electrica>

such as Coordinet, EUniversal, EU-SysFlex, OneNet, and ReFlex. Agder Energi has a pilot project in which flexibility has delayed the replacement of transformers for already 3 to 4 years, and Enel also recently launched a new initiative called the Flexibility Lab<sup>3</sup>. Besides that, Fluvius is considering to develop a market-based demo in close coordination with the TSO, and Netz NÖ is planning to test flexibility from a hydrogen power plant in the future.

Last, DSOs can be already convinced that the trade-off between flexibility and network investments is valuable. In 2018, UKPN has started long-term flexibility tenders and over the years, the amount of auctioned capacity and participating technologies has been increasing. During the interview, UKPN mentioned that they now have enough data to be convinced that flexibility is a valuable instrument in their network. They added that this is a recent development, and that starting flexibility resembles the chicken or the egg problem: to encourage the growth of flexibility markets, you have to start when flexibility is still limited. Also Enedis is convinced of the value of flexibility in their network, and systematically uses a cost-benefit approach. Enedis emphasises that long-term economic signals must be given to markets players in terms of prices and volume: the main value of flexibility will come from national mechanisms that can be valued anywhere and anytime, while the value of flexibility for local congestion ranges from 0 to 24k€/MW/year depending on the local situation (time and location).

When asking if procuring flexibility should be an alternative to distribution network investment in the future target model, 75% of participants answered they were already convinced before this workshop, 25% replied that they will have to look into it more closely, and 0% reacted that they are still sceptical about this trade-off. When discussing the results, it was clear that there is a willingness to do tests and that the possibilities are being discovered. Besides that, it was stated that a framework to trade-off flexibility and network investments is necessary to ensure cost-effective decisions at all times.

#### **4.5. Transparency**

Finally, the aspect of transparency was examined by the question 'How should network investment plans be reported to comply with the Clean Energy Package?'. The following four types of reporting were mentioned during the interviews:

- Conversations with stakeholders on scenarios and investment priorities
- Two different plans: a simple public plan and a detailed private plan
- Heatmaps
- Most information is publicly available

First, reporting of network investment plans can take the form of conversations with partners such as regulators, municipalities, governments, and stakeholders. The amount of detail that is reported during this conversation can differ. Some DSOs such as i-DE and ESO mentioned that detailed audits are performed. Other DSOs such as Mitnetz-Strom and Netz NÖ report more high-level on the required network investments as the regulator uses this information in a benchmark methodology with other DSOs of the country. The main reasons mentioned for not making network investment plans publicly available were security concerns.

Second, two different network development plans can be created to reduce the issue of security. Both Agder Energi<sup>4</sup> and Enel have the practice of creating a simplified document that can be shared with the public and a more detailed plan that remains private knowledge.

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<sup>3</sup> More details of the Enel Flexibility Lab are available at <https://www.enel.com/media/explore/search-press-releases/press/2021/05/enel-cuts-ribbon-on-flexibility-lab-promoting-innovation-towards-flexible-distribution-networks>

<sup>4</sup> All public distribution and transmission network plans of Norway can be found using the following link (only available in Norwegian) <https://www.nve.no/energiforsyning/nett/kraftsystemutredninger/kraftsystemutredninger-2019-og-2020/>

Third, heatmaps can be used to share information with network users. The detail of these heatmaps usually goes up to the level of the transformer substation. In this way, new customers of ESO and UKPN can check the available network capacity on online heatmaps when deciding on new network connections. Besides that, UKPN has designed a similar map for the connection of EV charging stations.

Last, DSOs can share most network information publicly. A good example of this is the reporting of UKPN's flexibility tenders, called the Flexibility Hub<sup>5</sup>. Here it was mentioned that is not only important to report on what happened in the past but to also report on what is expected in the future.

When asking whether DSOs will make more details of network planning publicly available in the future, 50% of the participants answer yes and 50% answered no. Here, the reporting of both a private and public plan was perceived most interesting. Besides that, a comment by UKPN was made that from their experience, detailed reporting on flexibility is very important to support the growth of the flexibility market.

#### 4.6. Summary and conclusions

Table 1 summaries the two parts of distribution planning methodologies that were analysed in this deliverable:

- The current practices of distribution network planning in Europe are based on interviews with 11 DSOs.
- The alignment of DSOs on a future target model for distribution planning methodologies based on polling questions raised during the workshop.

The current practice of the DSOs shows that there is no single approach to distribution network planning, as for each of analysed aspects multiple answers were given and different responses could be combined within the network planning of the DSOs. When the participating DSOs were asked to vote on a future target model for distribution planning methodologies, the polling results showed that DSOs are already well aligned on planning frequency, scenarios & TSO alignment, network representation, and the trade-off between flexibility and network investments; but transparency is currently the most debatable topic.

*Table 2: Summary of the current practice and future target model of distribution planning methodologies based on interviews and a workshop with 11 European DSOs*

	Current practice	Towards a future target model?
<b>Planning frequency</b>	How frequently do you currently report on distribution network planning? <ul style="list-style-type: none"> <li>• Yearly reporting cycle</li> <li>• 2 yearly reporting cycle</li> <li>• 3 yearly reporting cycle</li> </ul>	What should be the planning frequency of the future target model? 25% Yearly reporting cycle 75% 2 yearly reporting cycle
<b>Scenarios &amp; TSO alignment</b>	In creating your scenarios, are you aligned with the TSO? <ul style="list-style-type: none"> <li>• Yes, we have alignment meetings with the TSO</li> <li>• Yes, we use the scenarios of the TSO</li> <li>• Yes, alignment is ensured by the regulator</li> </ul>	What should be the role of the regulator in aligning DSO and TSO on planning scenarios? 75% Approves scenarios 17% Create scenarios 8% No role

<sup>5</sup> Detailed reports of the UKPN flexibility tenders are available at <https://smartgrid.ukpowernetworks.co.uk/flexibility-hub/>

<b>Network representation</b>	<p>How do you represent your distribution network during planning?</p> <ul style="list-style-type: none"> <li>• We use a manual representation of our network</li> <li>• We use representative network models</li> <li>• We make simulations of critical network areas</li> <li>• We go towards a full simulation of our network</li> </ul>	<p>Will DSO planning evolve towards simulations of the entire distribution network in the future?</p> <p>83% Yes 17% No</p>
<b>Trade-off flexibility &amp; network investments</b>	<p>How do you intend to include flexibility as an alternative to network investments in distribution planning?</p> <ul style="list-style-type: none"> <li>• We will follow the requirements of the regulator</li> <li>• We are testing alternatives and use our experience to go into discussion with the regulator</li> <li>• We are already convinced that it is valuable to make this trade-off</li> </ul>	<p>Should procuring flexibility be an alternative to network investments in the future target model?</p> <p>75% We were already convinced before this workshop 25% We will have to look into it more closely 0% We are still sceptical</p>
<b>Transparency</b>	<p>How should network investment plans be reported to comply with the Clean Energy Package?</p> <ul style="list-style-type: none"> <li>• Conversations with stakeholders on scenarios and investment priorities</li> <li>• Two different plans: a simple public plan and a detailed private plan</li> <li>• Heatmaps</li> <li>• Most information is already publicly available</li> </ul>	<p>Will more details of network planning be made publicly available by DSOs in the future?</p> <p>50% Yes 50% No</p>

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## Annex I – Business model canvas analysis

### I.1 The German demo

In Deliverable 2.2 of the EUniversal project, the following two business use cases were defined for the German demo by E.ON and Mitnetz-Strom:

- Congestion management & voltage control with market-based active power flexibility
- Congestion management & voltage control with market-based reactive power flexibility

These business use cases can be mapped in the following way on the business model canvas:

<b>Key Partners</b> - Market platform provider and operator: NODES - Technology and tools providers: Inesc-Tec, VITO, Centrica, KUL, N-Side	<b>Key Activities</b> - Operating, maintaining a secure and reliable system - Ensure grid access - Grid optimization - Assess impact flexibility and balancing - Provide required data - Identify flexibility needs - Technical validation - Data handling	<b>Value Propositions</b> Value for flexibility provider - Financial revenues - Revenue stacking via UMEI	<b>Customer Relationships</b> DSO is responsible for attracting customers to this demo	<b>Customer Segments</b> Households & SMEs that can become flexibility providers if they prequalify: - Resource providers - Resource aggregators
	<b>Key Resources</b> - Distribution network: LV grid - Smart grid infrastructure		<b>Channels</b> - UMEI with communication standards	
<b>Cost Structure</b> - Remuneration of flexibility (activation [€/MWh] [€/MVar])		<b>Revenue Streams</b> The positive impact of services: solutions to specific grid issues, delay in network investments - Congestion management & voltage control (active and reactive power) - Better monitoring and operation of the grid		

## I.2 The Polish demo

In Deliverable 2.2 of the EUniversal project, the following four business use cases were defined for the Polish demo by Energa-Operator:

- Congestion management & voltage control with market-based active power flexibility
- Congestion management & voltage control with market-based reactive power flexibility
- Congestion management using permissible line capacity based on a dynamic line rating system such that wind producers can buy flexibility from the DSO in a market-based way and generate above their connection agreement limit
- Voltage Control with the use of flex station solutions under a bilateral contract

These business use cases can be mapped in the following way on the business model canvas:

<b>Key Partners</b> - Market platform provider and operator: NODES - Technology and tools providers: IEN, Mikronika	<b>Key Activities</b> - Operating, maintaining a secure and reliable system - Ensure grid access - Grid optimization - Assess impact flexibility and balancing - Provide required data - Identify flexibility needs - Technical validation - Data handling	<b>Value Propositions</b> Value for flexibility provider - Financial revenues - Revenue stacking via UMEI Value for wind producers - Produce more than contracted in connection agreement	<b>Customer Relationships</b> Customers are attracted by key partners such as NODES in this demo	<b>Customer Segments</b> Residential customers, SMEs, and generators can become flexibility providers if they prequalify: - Resource providers Customers that can be flex buyers - Producers
	<b>Key Resources</b> - Distribution network: LVMV/MV/HV network - Smart grid infrastructure - Flex station		<b>Channels</b> - UMEI with communication standards - Connection agreements - Bilateral contracts	
<b>Cost Structure</b> - Renumeration of flexibility (activation [€/MWh] [€/MVar])		<b>Revenue Streams</b> The positive impact of services: solutions to specific grid issues, delay in network investments - Congestion management & voltage control (active and reactive power) - Better monitoring and operation of the grid - Producers buying flexibility		

### I.3 The Portuguese demo

In Deliverable 2.2 of the EUniversal project, the following four business use cases were defined for the Portuguese demo by E-REDES:

- Congestion management in MV grids for the day-ahead market (or between 1 to 3 days in advance)
- Integrated voltage control in MV and LV grids for the day-ahead market for active and reactive power flexibility
- Contracting flexibility services for avoiding voltage and/or congestion issues during planned maintenance action in MV grids
- Voltage control and congestion management for medium and long-term grid planning through market mechanisms

These business use cases can be mapped in the following way on the business model canvas:

<b>Key Partners</b> <ul style="list-style-type: none"> <li>- Market platform provider and operator: NODES &amp; N-SIDE</li> <li>- Technology and tools providers: Inesc-Tec, VITO, Centrica</li> </ul>	<b>Key Activities</b> <ul style="list-style-type: none"> <li>- Operating, maintaining a secure and reliable system</li> <li>- Ensure grid access</li> <li>- Grid optimization</li> <li>- Assess impact flexibility and balancing</li> <li>- Provide required data</li> <li>- Identify flexibility needs</li> <li>- Technical validation</li> <li>- Data handling</li> </ul>	<b>Value Propositions</b> <p>Value for flexibility provider</p> <ul style="list-style-type: none"> <li>- Financial revenues</li> <li>- Revenue stacking via UMEI</li> </ul>	<b>Customer Relationships</b> <p>Customers for this demo were attracted during previous research projects</p>	<b>Customer Segments</b> <p>Residential, commercial, industrial customers and the service sector can become flexibility providers if they prequalify:</p> <ul style="list-style-type: none"> <li>- Resource providers (MV)</li> <li>- Resource aggregators (LV)</li> </ul>
	<b>Key Resources</b> <ul style="list-style-type: none"> <li>- Distribution network: LV/MV network</li> <li>- Smart grid infrastructure</li> <li>- DSO owns flexible resources</li> </ul>		<b>Channels</b> <ul style="list-style-type: none"> <li>- UMEI with communication standards</li> </ul>	
<b>Cost Structure</b> <ul style="list-style-type: none"> <li>- Remuneration cost of flexibility (availability [€/MW/h] [€/MVar/h] or activation [€/MW] [€/Mvar])</li> </ul>		<b>Revenue Streams</b> <p>The positive impact of services: solutions to specific grid issues, delay in network investments</p> <ul style="list-style-type: none"> <li>- Congestion management &amp; voltage control (active and reactive power)</li> <li>- Better monitoring, operation, maintenance, and planning of the grid, both in the short-term and long-term</li> </ul>		

## Annex II – Slides workshop on distribution planning methodologies

Slide 1



This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 864334



# Universal

## UMEI

### Linking active system management to flexibility markets

Slide 2

### Agenda

 Universal  
UMEI

- Debrief of the interviews to summarize the current practice of distribution planning methodologies in multiple dimensions (e.g. planning frequency, scenarios, network representation, inclusion of flexibility as alternative to investments,..).
- Live polling on how distribution planning methodologies should evolve for DSOs in the coming years to comply with the Clean Energy Package and/or stakeholder expectations:
  - Planning frequency? (e.g. yearly reporting, 2yearly reporting)
  - Alignment with TSO? (e.g. no alignment, alignment meetings, alignment imposed by regulator, follow the TSO)
  - Network representation? (e.g. manual representation, use of representative network models, or towards full simulation of distribution network)
  - Inclusion of flexibility as alternative to investment in distribution planning methodologies? (e.g. it will be enough to argue why there is no business case, we will follow requirements of the regulator, we will test alternatives and use our experience to go into discussion with the regulator)
- Breakout discussion in small groups to debrief the polls
- Wrap-up & closing remarks

Slide 3

**Participants**



- EUniversal
- Vlerick DSO Chair
- E.DSO



Slide 4

**Objective of today**



- Check to what extent DSOs are aligned and can come to a target model on distribution network planning methodologies as described in the Clean Energy Package
- Key elements of the Clean Energy Package on network development plans
  - Biannual with a five-to-ten years horizon
  - Publicly available
  - Trade-off between flexibility and network investments
  - EU DSO mandate to work on a network planning methodology

Slide 5



# EUniversal UMEI

CURRENT PRACTICES

Slide 6

**Question 1** 

How frequently do you report on distribution planning?

- Yearly
- 2 yearly
- 3 yearly

## Slide 7

**Question 2**

**In creating your scenarios, are you aligned with the TSO?**

- No
- Yes, we have alignment meetings
- Yes, we use the scenarios of the TSO
- Yes, alignment is ensured by the regulator

## Slide 8

**Question 3**

**How do you represent your distribution network during planning?**

- We use a manual representation
- We use representative network models
- We make simulations of critical network areas
- We go towards a full simulation of our network

Slide 9

#### Question 4

**How do you intend to include flexibility as an alternative to investments in your distribution planning methodology?**

- It will be enough to argue why there is no business case
- We will follow requirements of the regulator
- We are testing alternatives and use our experience to go into discussion with the regulator
- We are already convinced that it is valuable

Slide 10

#### Question 5

**How should network investment plans be reported to comply with the Clean Energy Package?**

- Conversations with stakeholders on scenarios and investment priorities
- Two different plans: a simple public plan and a detailed private plan
- Heatmaps
- Most information is publicly available

Slide 11



# EUniversal UMEI

BREAKOUT DISCUSSION

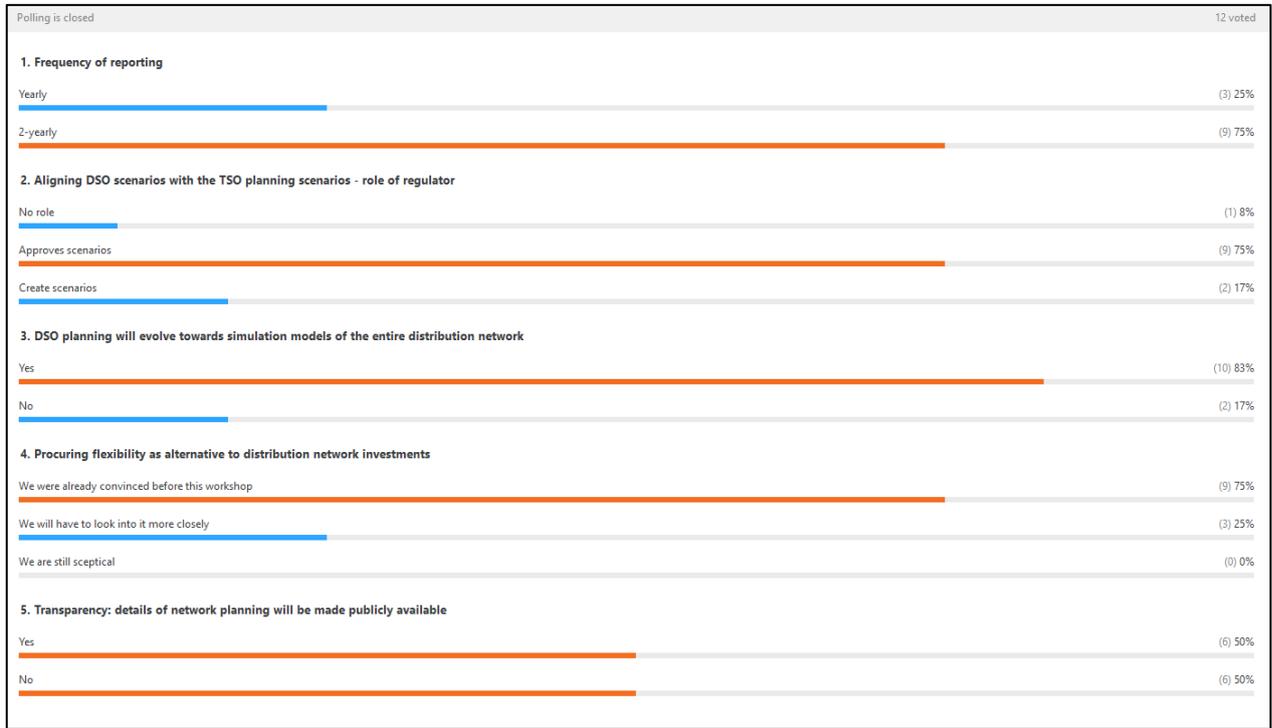
Slide 12

## From current practice to target model



- How frequently do you report on distribution planning?
- In creating your scenarios, are you aligned with the TSO?
- How do you represent your distribution network during planning?
- How do you intend to include flexibility as an alternative to investments in your distribution planning methodology?
- How should network investment plans be reported to comply with the Clean Energy Package?

## Polling results



## Slide 13



**Universal**  
UMEI

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## Slide 14

## Clean Energy Package - Directive (EU) 2019/944

- (61) Distribution system operators have to cost-efficiently integrate new electricity generation, especially installations generating electricity from renewable sources, and new loads such as loads that result from heat pumps and electric vehicles. For that purpose, distribution system operators should be enabled, and provided with incentives, to use services from distributed energy resources such as demand response and energy storage, based on market procedures, in order to efficiently operate their networks and to avoid costly network expansions. Member States should put in place appropriate measures such as national network codes and market rules, and should provide incentives to distribution system operators through network tariffs which do not create obstacles to flexibility or to the improvement of energy efficiency in the grid. Member States should also **introduce network development plans for distribution systems** in order to support the integration of installations generating electricity from renewable energy sources, facilitate the development of energy storage facilities and the electrification of the transport sector, and **provide to system users adequate information regarding the anticipated expansions or upgrades of the network**, as currently such procedures do not exist in the majority of Member States.

## Slide 15

## Clean Energy Package - Directive (EU) 2019/944

## Article 32

**Incentives for the use of flexibility in distribution networks**

1. Member States shall provide the necessary regulatory framework to allow and provide incentives to distribution system operators to **procure flexibility services, including congestion management in their areas, in order to improve efficiencies in the operation and development of the distribution system**. In particular, the regulatory framework shall ensure that distribution system operators are able to procure such services from providers of distributed generation, demand response or energy storage and shall promote the uptake of energy efficiency measures, where such services cost-effectively alleviate the need to upgrade or replace electricity capacity and support the efficient and secure operation of the distribution system. Distribution system operators shall procure such services in accordance with **transparent, non-discriminatory and market-based procedures** unless the regulatory authorities have established that the procurement of such services is not economically efficient or that such procurement would lead to severe market distortions or to higher congestion.
3. The development of a distribution system shall be based on a transparent network development plan that the distribution system operator shall **publish at least every two years and shall submit to the regulatory authority**. The network development plan shall provide transparency on the medium and long-term flexibility services needed, and shall set out the **planned investments for the next five-to-ten years**, with particular emphasis on the main distribution infrastructure which is required in order to connect new generation capacity and new loads, including recharging points for electric vehicles. The network development plan shall also include the use of demand response, energy efficiency, energy storage facilities or other resources that the distribution system operator is to use as an alternative to system expansion.

Slide 16



## Clean Energy Package - Regulation (EU) 2019/943

*Article 55*

**Tasks of the EU DSO entity**

1. The tasks of the EU DSO entity shall be the following:
  - (a) promoting operation and planning of distribution networks in coordination with the operation and planning of transmission networks;
  - (b) facilitating the integration of renewable energy resources, distributed generation and other resources embedded in the distribution network such as energy storage;
  - (c) facilitating demand side flexibility and response and distribution grid users' access to markets;
  - (d) contributing to the digitalisation of distribution systems including deployment of smart grids and intelligent metering systems;
  - (e) supporting the development of data management, cyber security and data protection in cooperation with relevant authorities and regulated entities;
  - (f) participating in the development of network codes which are relevant to the operation and planning of distribution grids and the coordinated operation of the transmission networks and distribution networks pursuant to Article 59.

Slide 17

## EU DSO Entity



**The EU DSO Entity is an expert entity strengthening the cooperation between DSOs at European level**

The EU DSO Entity has been legally set up by the Electricity Regulation (EU) 2019/943.

It is a body fostering the cooperation between all electricity Distribution System Operators at European level, irrespective of their size and type, working for the common European interest.

As an entity focusing on technical issues in a neutral manner, it does not aim at representing particular policy. Neutrality has to be ensured.

<b>Main tasks</b>	<ul style="list-style-type: none"> <li>DSO/TSO cooperation: promoting the optimal and coordinated operation and planning of DSO/TSO networks</li> <li>Consultation on Guidelines and participating in the elaboration of Network Codes which are relevant for DSO grids</li> </ul>
<b>Others tasks</b>	<ul style="list-style-type: none"> <li>Facilitating the integration in DSOs grid of Renewable, Distributed Energy Resources and storage</li> <li>Facilitating demand side flexibility and distribution grid users' access to markets</li> <li>Contributing to the digitalization of distribution systems (deployment of smart grids and smart meters)</li> <li>Supporting the development of data management, cyber security and data protection</li> </ul>