CEER

Council of European Energy Regulators

Fostering energy markets, empowering **consumers**.

Guidelines of Good Practice for Flexibility Use at Distribution Level

Consultation Paper

Ref: C16-DS-29-03
Final version
14 March 2017

Council of European Energy Regulators asbl
Cours Saint-Michel 30a, Box F – 1040 Brussels, Belgium
Arrondissement judiciaire de Bruxelles – RPM 0861.035.445

INFORMATION PAGE

Abstract

CEER's Conclusions Paper on 'The Future Role of DSOs' committed to carrying out further work on developing a regulatory toolbox for NRAs, as proposed in Agency for the Cooperation of Energy Regulators (the Agency) Bridge to 2025 paper. The toolbox is to be a means to establish regulatory guidelines on the DSOs' role in non-core DSO activities. The extent of DSOs' involvement in flexibility is one such activity.

The purpose of this consultation paper is to explore the use of flexibility services at the distribution level of the electricity network and gather views from respondents on the following key areas:

- the DSOs' role in accessing such services and facilitating an environment for the provision of flexibility; and
- the regulatory framework, including tools and principles to facilitate flexibility use at the distribution level.

The responses to this paper will be used as input when developing high-level guideline principles for NRAs, (i.e. the regulatory toolbox), to facilitate flexibility use at distribution level, to deliver benefits to consumers.

Target Audience

European Commission, energy suppliers, distribution system operators, other network operators, traders, electricity/gas customers, electricity/gas industry, consumer representative groups, Member States, academics and other interested parties.

Keywords

Electricity, distribution system operators (DSOs), national regulatory authorities (NRAs), network regulation, network flexibility, regulatory tools, flexibility use, regulatory guidelines, DSOs' role, and flexibility services.

If you have any queries relating to this paper, please contact:
Andrew Ebrill
Tel. +32 (0)2 788 73 30
Email: brussels@ceer.eu

How to Respond to this Consultation

Responses to the consultation can be made via an on-line questionnaire.[1]

The consultation will be open for an **8-week period**, closing on **25 May 2017**.

If you have any queries relating to this consultation, please contact:

Andrew Ebrill
Tel. +32 (0)2 788 73 30
Email: brussels@ceer.eu

All responses except confidential material will be published on the website www.ceer.eu. For further information, please see CEER‟s Guidelines on Consultation Practices.

[1] http://www.ceer.eu/portal/page/portal/EER_HOME/EER_CONSULT/OPEN_PUBLIC_CONSULTATIONS/PC_on_Flexibility_Use_at_Distribution_Level/Questionnaire

Related Documents

ACER documents

- Joint ACER-CEER response to the European Commission's Consultation on a new Energy Market Design, 7 October 2015
- ACER, *Work Programme 2016*, September 2015.
- Energy Regulation: a Bridge to 2025, ACER in cooperation with CEER, 19 September 2014

CEER documents

- CEER Position Paper on the Future DSO and TSO relationship, Ref. C16-DS-26-04, 21 September 2016
- CEER Report on Incentives Schemes for regulating DSOs, including for Innovation Ref. C16-DS-28-03, 24 January 2017
- CEER Guidelines of Good Practice on Electricity Distribution Network Tariffs: Guidelines of Good Practice, Ref. C16-DS-27-03, 2017
- CEER Position Paper on Principles for valuation of flexibility, Ref. C16-FTF-09-03, 12 July 2016
- CEER Discussion Paper on Scoping of flexible response, Ref. C16-FTF-08-04, 3 May 2016
- CEER's emerging views on key issues on DSOs in the context of the upcoming legislative package, C16-DS-26-03, 30 May 2016
- Final CEER 2016 Work Programme, Ref. C15-WPDC-27-06, 6 January 2016

- Final CEER 2017 Work Programme, Ref. C16-WPDC-28-06, 5 January 2017
- The Future Role of DSOs: A CEER Conclusions Paper, Ref. C15-DSO-16-03, July 2015
- CEER Advice on Ensuring Market and Regulatory Arrangements help deliver Demand Side Flexibility, Ref: C14-SDE-40-03, 26 June 2014

External documents

- Cambridge Economic Policy Associates Ltd, et al., *Demand Side Flexibility - The Potential Benefits and State of Play in the European Union*, September 2014.
- European Commission Smart Grid Task Force, *EG3 Report: Regulatory Recommendations for the Deployment of Flexibility*, January 2015.
- European Commission Smart Grid Task Force, *Annex to EG3 Report: Regulatory Recommendations for the Deployment of Flexibility*, September 2015.
- CRE *Study on the value of flexibility in the management and design basis of distribution networks in France*, December 2015.
- Ecofys, *Flexibility options in electricity systems*, March 2014.
- EDSO, *Coordination of transmission and distribution system operators: A key step for the Energy Union*, May 2015.

- EDSO, *Flexibility: The role of DSOs in tomorrow's electricity market*, 2014.
- Eurelectric, *Flexibility and Aggregation Requirements for their interaction in the market*, January 2014.
- ISGAN, *An Overview of current interaction between TSOs and DSOs and an assessment of their cooperation in Smart Grids*, September 2014.
- SWECO et al., *Study on the effective integration of Distributed Energy Resources for providing flexibility to the electricity system*, April 2015.
- THEMA Consulting Group, *Demand response in the Nordic electricity market*, 2014.
- A. Rautiainen, S. Repo, P. Järventausta; "Using frequency dependent electric space heating loads to manage frequency disturbances in Power Systems."
- A Rautiainen, J Markkula, S Repo, A Kulmala, P Järventausta; "Plug-in vehicle ancillary services for a distribution network."
- A. Rautiainen; "Aspects of electric vehicles and demand response in electricity grids."
- S. Repo, F. Ponci, D.D. Giustina; "Holistic view of active distribution network and evolution of distribution automation."
- E. Liu and B. J., "Distribution system voltage performance analysis for high-penetration photovoltaics," National Renewable Energy Laboratory, Tech. Rep., 2008.
- K. Knezovic et al., "Distribution Grid Services and Flexibility Provision by Electric Vehicles: A Review of Options."

Table of Contents

EXECUTIVE SUMMARY

The deployment of intermittent renewable generation, and changes in how energy is consumed, has driven significant change in European electricity systems over the last decade. National Regulatory Authorities (NRAs) must ensure that regulatory arrangements accommodate and manage the drivers of these changes in the most efficient way possible.

One approach to efficiently manage change and ensure secure system operation, at least cost, is through improving system flexibility. *Flexibility is the capacity of the electricity system to respond to changes that may affect the balance of supply and demand at all times.* The topic of flexibility is becoming increasingly important at European level, in the context of system changes. Flexibility is a cross-cutting issue; it is a subject that cuts through the entire energy chain of production, transmission, distribution, and consumption. This paper focuses exclusively on one component of the energy chain; the distribution component, of the electricity network. NRAs need to re-think the current and future frameworks for regulating DSOs, as they transition into their future roles.

In the context of the "*Clean Energy for All Europeans*" package discussions, and other CEER studies on flexibility, this work aims to establish guiding principles for NRAs on facilitating flexibility use at the distribution level of the electricity network where it is deemed economically viable, and where it does not unduly distort markets and competition. CEER wishes to hear your views on our thinking and, in particular, on the way forward in the areas identified in the consultation questions in this paper. To better understand flexibility from the perspective of the distribution electricity network, the form flexibility takes in different Member States, and how flexibility provisions may need to evolve in the future, CEER has:

- undertaken a literature review and received inputs from CEER members; and
- developed this Public Consultation document (drawing on the above review) with the intention to hold an 8-week consultation.

Flexibility in the power system, and the need for increased flexibility, have always been important issues, but have grown significantly in importance as a result of increased level of variable renewables in the power system and changes in energy consumption over the last decade. Flexibility has been a core characteristic of traditional energy systems, albeit not specifically at the distribution level. There are currently multiple projects investigating the various means for utilising flexibility, both in electricity markets and networks with many live operational examples, some of which are referenced throughout this paper. The literature review showed that there are a limited number of studies exploring flexibility from a distribution network management/ development perspective, which is the focus of this document. The reports and studies reviewed indicate broad agreement on the increased need for flexibility in order for DSOs to be able to cope with future challenges.

Electricity distribution networks face both challenges and opportunities brought about by system changes, such as the wide-scale deployment of variable generation, the bulk of which

is connected at distribution level, in addition to the changing patterns of electricity demand and energy consumption. The challenges include a change to networks' daily demand, load and flow patterns. As well as these challenges, this transition presents DSOs with opportunities to try new approaches, as DSOs transition from their traditional roles.

The DSO's role in using flexibility can be seen as the ability of the DSO to access and utilise services; to manage the distribution network in an economically efficient manner, avoiding undue distortions to markets and competition; and to deliver security and quality of supply at efficient costs.

There are many different sources and services available to deliver network flexibility on both the short-term operational timeframe and the long-term planning timeframe. Potential challenges faced by DSOs that could be alleviated by use of flexibility services are:

- insufficient transfer capacity in the network;
- excessive voltage rise/drop;
- overloading network equipment;
- planned/un-planned outages; and
- other challenges (such as fault levels limits, local energy initiatives, etc.).

Use of flexibility services by the DSO, to address challenges such as those listed above, could result in deferral or avoidance of distribution reinforcement, efficient management of distribution network issues and losses, and the potential for DSOs to access flexibility services on behalf of TSOs to the benefit of the wider system.

DSOs should be able, under the regulatory framework, to use flexibility (from demand, generation and storage) where the use of this flexibility is considered to be the most economical solution for operating and developing the distribution network, and avoids undue distortions to markets and competition. Equally, the regulatory framework should ensure that grid users with flexible resources are not unreasonably restricted from deploying their potential, where efficient, and from accessing a range of revenue streams from markets (wholesale and retail) and network operators. This presents a challenge for NRAs to ensure arrangements accommodate drivers of change in the most efficient way possible, so as to improve flexibility on the system. A stable framework is important if efficient investment signals are to be provided for future sources of flexibility.

This paper categorises DSOs' access to flexibility broadly under the headings of Rules Based Approach; Network Tariffs; Connection Agreements; and Market-based Procurement. Aside from their use of flexibility, DSOs have an important role in enabling the development of flexibility markets and services in a neutral, non-discriminatory manner. In particular, data management is a key area for the operation of existing and new markets, including in flexibility. There may, also, be circumstances where the distribution system could provide flexibility to the transmission system, delivering cost savings to customers.

NRAs have a key role in ensuring that the regulatory framework facilitates an efficient current and future energy system. In the context of flexibility use at distribution level, the regulatory framework must support the development of efficient network solutions, including the development and use of flexibility services on a non-discriminatory basis, where it is the most economically viable option. The framework should also encourage fair market access and efficient co-ordination among market players, including DSOs. This will require, inter alia, appropriate rules, incentives, and remuneration mechanisms. In order to facilitate the use of flexibility at distribution level, undue barriers must be removed. There are some common tools that European regulators can use to facilitate flexibility use by DSO's at distribution level such as; price or revenue controls; economic incentive schemes for DSOs; smart metering; the regulatory framework for tariffs; and contractual arrangements.

Finally, flexibility is not an end in itself, but a means to deliver a more affordable, secure and efficient power system. In order to give effect to this, this paper presents a set of high-level principles for comment. CEER seeks comments on whether the proposed principles-based approach is optimal to the regulatory framework, for the use of flexibility at distribution level, and for network planning and management by DSOs.

CONSULTATION QUESTIONS

This section provides a complete list of consultation questions as they appear throughout this paper. CEER welcomes readers' views on the following specific areas but also on broader issues of relevance. **When drafting a response to the consultation, please include a general overview of your position.**

Flexibility at Distribution Level (see sections 2.2 and 2.3)

1. What are, in your opinion, the main drivers for flexibility use by DSOs going to be in the coming years?

2. Please provide any alternative definitions for flexibility that you think capture the focus of this paper.

DSO Uses for Flexibility (see section 2.4)

3. Should DSOs be encouraged to use flexibility to manage the distribution network where this is more efficient than reinforcing the network? Please provide an explanation.

4. Should all sources of flexibility be treated equally in the market and by system operators?

5. Are there any uses for flexibility that you think we have missed and should be considered? If yes, please provide an explanation.

6. Do you think it is important for Member States to establish standardised EU definitions of the various flexibility products, to facilitate market participation in flexibility use at distribution level?

DSOs Accessing Flexibility (see section 3.1)

7. Should regulators seek a regulatory framework that can accommodate a range of models that would enable DSOs to access and use flexibility, while ensuring that competition and markets are not unduly distorted?

8. What do you consider to be the key benefits and key risks of particular models (rules-based, network tariffs, connection agreements, and market-based)?

9. What are the relative merits of a contracting strategy (competitive or otherwise) versus a real-time market approach to procurement of flexibility? Is the latter approach practicable?

10. Are there any models that would enable DSOs to improve system flexibility that you think we have missed and should be considered?

11. Are there case study examples of approaches to improve flexibility on the system that you think should be considered in this work? If so, please provide a summary of the key information and findings.

DSOs Enabling Flexibility (see section 3.2)

12. Beyond impartial provision of data to market participants, do you consider that there any other tasks that DSOs should carry out to enable the competitive provision of and access to flexibility by others?

DSOs Providing Flexibility (see section 3.3)

13. Do you think there are situations where DSOs should be allowed to provide flexibility beyond the distribution network component, where economically efficient to do so? Please provide reasoning for your answer.

14. Are there other examples where the DSO could provide flexibility to help to reduce the overall costs of the system?

Regulatory Framework (see section 4.1 and 4.2)

15. In principle, can the regulatory tools listed be used by regulators to remove barriers and facilitate the use of flexibility at distribution level?

16. Are there particular tools that you think would be the most effective in achieving flexibility use at distribution level? Please provide reasoning for your answer.

17. Are there any other regulatory tools that have not been included and should be considered?

18. Should the regulatory framework allow different solutions and combinations of tools to address the specific needs of the network?

Regulatory Principles (see section 4.3)

19. Is a principles-based approach (rather than one-size-fits-all) the correct one for national regulators developing a framework for facilitating flexibility use by DSOs at distribution level?

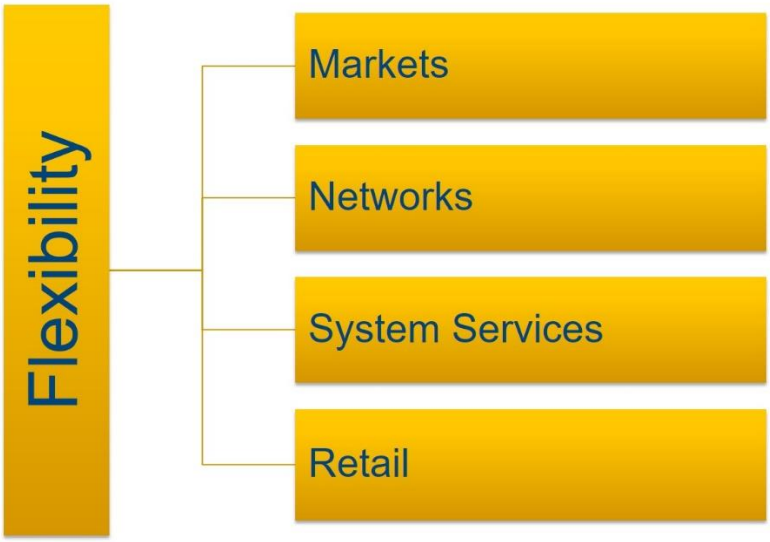
20. Are the principles outlined appropriate? Are there any fundamental principles that you think are missing in order to deliver maximum benefit to customers?

1. INTRODUCTION

European energy systems have seen significant change over the last decade – this will continue, driven by:

a. Wide-scale deployment of renewable generation of an intermittent nature (e.g. wind and solar) of which a significant share is connected at distribution level;
b. The changes in how energy is consumed, e.g. electric vehicles or heat-pumps, combined with enablers like smart meters and technological progress in the ICT sector, such as electricity storage and home automation; and
c. a decline in availability of some traditional sources of flexibility (e.g. thermal power plants).

These changes, while welcome, have had a significant impact on electricity markets and networks, at a system-wide and local level, and are likely to continue to increase their influence in the future. This presents a challenge for NRAs in ensuring arrangements accommodate and manage the drivers of change in the most efficient way possible. Flexibility needs to be encouraged through a set of different but complementary measures that capture the many components of flexibility provision, (see the diagram below).



While flexibility is a cross-cutting issue, ***this paper focuses exclusively on the network component of flexibility, in particular at the distribution level of the electricity network*** taking into account and aiming to minimise distortions to markets and competition.

For DSOs, flexibility is becoming an increasingly important area of focus, as the low carbon transition progresses, driving increased intermittency and changes in patterns of network use. In such challenging circumstances, what can DSOs do to improve system flexibility, and what will their core functions, roles and responsibilities be? Such questions require NRAs to re-think the current and future framework for regulating DSOs, as they transition into their future roles.

Consequently, the purpose of producing 'Guidelines for Flexibility Use at Distribution Level' is to explore some of these questions and to contribute to an integrated approach in maximising the significant potential of flexibility across the energy value chain, of which the distribution network is a key component.[2] While DSOs' key role and responsibilities lie within the distribution system, the regulatory framework should facilitate NRAs looking at issues beyond just the distribution network component.

In that regard, and in the context of the "*Clean Energy for All Europeans"* package discussions, this work aims to establish guiding principles for NRAs on facilitating flexibility at the distribution level of the electricity network where it is deemed economically viable and does not unduly distort markets and competition.

CEER wishes to hear your views on our thinking and, in particular, on the way forward in the areas identified in the consultation questions in this paper.

1.1 Background to this Work

In 2014, the Agency published its 'A Bridge to 2025'[3] paper, describing its thinking on the development of the energy sector and the role of regulation over the next ten years. CEER was a significant contributor to that paper, which outlines many high-level conclusions relevant to distribution systems. The paper also highlights a number of proposed actions that CEER will carry out regarding DSOs. One such action is the development of *'a "toolbox approach" for the regulation of DSOs'.*

Building on ACER's 'A Bridge to 2025' paper, in 2015, CEER published a conclusions paper on 'The Future Role of DSOs'. The paper details how NRAs intend to approach the issues facing DSOs, NRA's expectations of DSOs, and the future work that CEER plans to carry out regarding DSOs, including NRAs commitment to develop a regulatory toolbox, as proposed in ACER's 'A Bridge to 2025' paper.

The regulatory toolbox is to be a means to address non-core activities, or "grey areas", where DSOs may participate in activities but where there are issues to be resolved regarding their appropriate role. CEER indicated that it would consider the need for further guidance in such areas, one of which is the extent of DSOs' involvement in flexibility.

As a follow up to 'The Future Role of DSOs' paper, and to build upon the regulatory commitments outlined therein, CEER's Distribution System Working Group (DS WG) committed to some relevant work items for 2016 and 2017. Such items include CEER's paper on the future DSO and TSO relationship, published in September 2016[4] and CEER's paper on

[2] as referred to in the Future Role of the DSO Conclusions paper.

[3] Energy Regulation: A Bridge to 2025. Conclusions Paper, 19 September 2014

[4] http://www.ceer.eu/portal/page/portal/EER_HOME/EER_PUBLICATIONS/CEER_PAPERS/Cross-Sectoral/2016/C16-DS-26-04_DSO-TSO-relationship_PP_21-Sep-2016.pdf

Electricity Distribution Network Tariffs[5]. With the topic of flexibility being a cross-cutting issue, the DSO and TSO paper referred to above covers a range of issues relevant to DSOs and flexibility, in particular, the importance of ensuring optimum outcomes for the system as a whole. Similarly, the tariffs paper discusses the potential role for tariffs in signalling flexibility and how these would need to be aligned with broader flexibility considerations. This paper compliments those work items but also seeks to advance thinking by providing much greater detail on the distribution network and DSO components, in the light of the significant changes that energy systems have seen over the last decade.

1.2 Relevance of this Work

Flexibility is evolving as a key topic in European energy markets which is not surprising given the significant change that has taken place in European energy systems, the continued change that is expected in the future, and the associated challenges and opportunities for NRAs.

Consequently, examining flexibility within the power sector is highly relevant in the context of the European Commission's (EC) work programme, with many EC studies and publications existing on the topic[6], including the EC's study on 'Policies for DSOs, Distribution Tariffs and Data Handling', which is an impact assessment carried out to inform and support the proposed measures in the recently published *'Clean Energy for All Europeans'* package. It is clear from that study, along with the EC's package, that flexibility is recognised as an important aspect of future energy systems.

Due to the cross-cutting nature of power system flexibility, a holistic approach to examining the various components of flexibility is necessary. However, at European level, the discussion on flexibility pertaining to the electricity network component has not specifically addressed how regulatory frameworks may need to change to facilitate flexibility at distribution level, including changes to roles and responsibilities.

This work aims to examine how the regulatory framework may need to change to remove barriers to, and create incentives for, flexibility use where it can minimise overall network costs, while optimising system performance and efficiency for the ultimate benefit of consumers. This paper, and ultimately the resulting guidelines of good practice (GGP), aims to contribute to holistic approach to exploring flexibility and help inform future regulatory work and possibly influence future legislation.

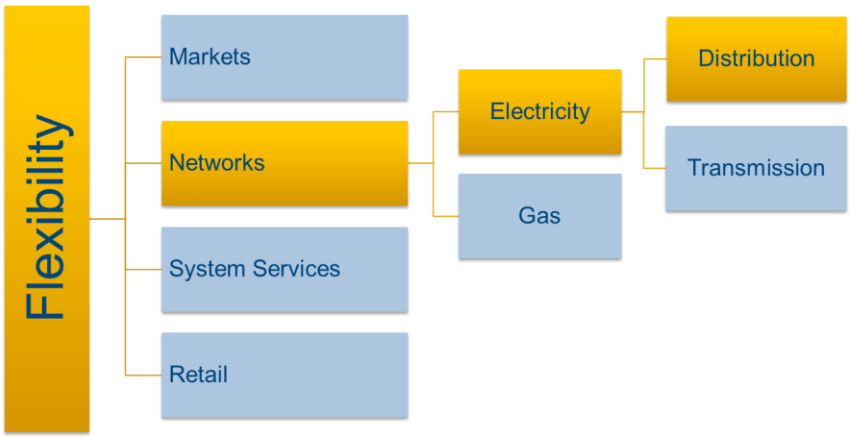
[5] CEER Guidelines of Good Practice on Electricity Distribution Network Tariffs: Guidelines of Good Practice, Ref. C16-DS-27-03, 2017

[6] The EC set up an expert group, which has produced Regulatory Recommendations for the Deployment of Flexibility. The EC has also commissioned studies associated with flexibility, such as 'Options for Future European Electricity System Operation' and 'the Role of DSOs in a smart grid environment'.

1.3 Scope

Within the overall context of flexibility, *this paper focuses on the electricity distribution network and DSOs*. The overall aim is to establish guiding principles for regulatory authorities on facilitating *flexibility at distribution level*. In particular, this report aims to identify what flexibility means in the context of a DSO, the need for DSOs to access and use flexibility, and the flexibility options available to them. Furthermore, the paper discusses the regulatory framework that will be necessary, including the regulatory tools that can be applied, to facilitate flexibility at the distribution level. The findings of this paper will contribute to a comprehensive approach to flexibility. It will compliment and build on recommendations and advice provided in other relevant documents.[7] Together, these findings are intended to build on existing thinking and contribute to a future power system that is more flexible.

This document does *not* consider flexibility of gas networks. However, this area may benefit from a future examination by CEER.



1.4 Energy Customers

The continuing changes to European energy systems are driving the need for DSOs to transition from their traditional roles. That transition creates opportunities for DSOs to try new approaches. This could lead to more efficient network use and system operation, which can benefit consumers, in ways such as improved engagement, enhanced participation, more choice, and greater cost savings. One such opportunity that can bring about those benefits is facilitating greater flexibility on the system. Therefore, CEER thinks it is important, in the interests of energy customers, to have an efficient and flexible electricity system.

Achieving the full potential of flexibility on the system involves many actors and the interaction of many interrelated components, such as networks and markets. Each component is important in its own right, but also must be considered in the context of wider system benefits.

[7] E.g. Scoping of flexible response, CEER discussion paper, May 2016; CEER Position Paper on Principles for valuation of flexibility, July 2016; the European Commission's Expert Group 3 Report and Annex on Regulatory recommendations for employing flexibility on the system and the papers referred to in Section 1.1

This paper focuses on the networks component, in particular at the distribution level of the electricity network.

For customers, flexibility use at distribution level can:

- minimise current and future network costs by providing opportunities to delay or avoid network investment;
- avoid the need to curtail renewable energy[8], thereby, allowing lower cost energy onto the system;
- enable demand side participation, giving consumers opportunities to sell their flexibility and save on their electricity bills;
- increase transparency as a result of DSOs sharing information gathered on the status/needs of the network, which in turn could aid customers' understanding of how best to manage their consumption and bills; and
- improve/ maintain the quality and reliability of supply by offering DSOs alternative solutions, to traditional generation or reinforcement, for operating and developing the distribution network.

To deliver the benefits outlined above, there is a need for a regulatory framework that supports flexibility at the distribution level, particularly given that this is where the majority of customers and intermittent generation are connected. DSOs should be able to access grid user flexibility, including from demand side participation. However, customers with flexible resources should be able to value their flexibility across a number of options, i.e. beyond solely DSOs. This would enable flexibility providers to, *inter alia,* access a range of revenue streams from market players. Those actions will require appropriate rules, incentives, and remuneration mechanisms.

This presents a challenge for NRAs to ensure arrangements accommodate drivers of change in the most efficient way possible. In this regard, the paper seeks to establish guiding principles for NRAs on supporting the evolution and use of flexibility services at the distribution level of the electricity network on a non-discriminatory basis, where it is the most economical solution and avoids undue distortions to markets and competition. This reflects CEER's commitment to supporting regulatory frameworks that create a sustainable and affordable electricity system and deliver benefits to customers.

1.5 Methodological Approach

To better understand flexibility from a distribution level perspective among the different Member States, and how flexibility provision may need to evolve in the future, CEER has:

- undertaken a literature review and received inputs from CEER members; and

[8] References to avoiding curtailment of renewable generation in this paper are in relation to curtailment for system reasons rather than for market reasons.

- developed this Public Consultation document (drawing on the above review) with the intention to hold an 8-week consultation.

2. Background of Flexibility

Flexibility in the power system, and the need for increased flexibility, has always been an important issue but has recently grown significantly in importance as a result of increased level of variable renewables in the power system and changes in energy consumption. Flexibility is a core characteristic of traditional energy systems, albeit not specifically at the distribution level, and is a subject that cuts through the entire energy chain of production, transmission, distribution, and consumption.

The traditional power system model uses flexibility to match generation to customer demand. Transmission System Operators typically manage this flexibility to ensure continuity of supply at least cost. As a result, the traditional model does not typically provide for flexibility as a tool for DSOs to manage and develop a distribution system. In the face of the changes highlighted in this paper, such as increased variable generation and the evolution of energy consumption, improving system flexibility through different and complimentary sets of measures could optimise system performance and efficiency. Flexibility has a central role in the smart networks of the future. It is estimated that new models could result in downward pressure on network costs and that improved energy-efficiency would reduce the costs of maintaining the network, as well as facilitating decarbonisation of the electricity system at least cost.[9]

There are currently multiple projects investigating the various means for utilising flexibility, both in electricity markets and networks. with many live operational examples, some of which are referenced throughout this paper. While this paper primarily focuses on the networks component, other CEER work examines some of the other components, such as flexibility from a market perspective. An insight into a market perspective can be found in Annex 3, with further information detailed in other CEER work[10]. The work in this flexibility paper in relation to the distribution network acknowledges the important overlaps and links between this work and other CEER projects.

Section 2 of this paper will explore some current literature on the topic of flexibility, discuss flexibility in the context of electricity distribution networks, explore the definition of flexibility, and look at DSO use of flexibility to enhance system performance.

1.6 Brief Literature Review

Within the timeframe of this study, a wide-ranging review of relevant literature has been conducted.

[9]There are multiple different surveys of estimates, which can be found listed in ACER's Demand side Flexibility study (p.6-7): http://www.acer.europa.eu/official_documents/acts_of_the_agency/references/dsf_final_report.pdf
[10] Please refer to list of references at the beginning of this paper.

The literature review showed that much of the existing discussion concerning flexibility is about three main macro-issues: portfolio optimisation on the wholesale market, customer aspects, and market design for participation in the balancing market. There are also a more limited number of studies exploring flexibility from a distribution network management/ development perspective, which is the focus of this document.

The reports and studies reviewed broadly agree on the increased need for flexibility in order for DSOs to be able to cope with future challenges. Moreover, they note that the flexibility potential is not fully recognised today. CRE's study[11] has quantified the value of flexibility for distribution network operations as an alternative to reinforcements (or enabling their postponement) in several cases and has demonstrated that the approaches to flexibility had to be able to match with the form of the possible constraints. EDSO for Smart Grids believes that from a DSO perspective, services that provide flexibility should be delivered by a market party and procured by DSOs in order to maximise security of supply and quality of service in the most efficient way[12]. Both EDSO for Smart Grids and the Commission's Smart Grid Task Force – Expert Group 3 (SGTF-EG3) suggest that flexibility provided by distributed generation, energy storage and demand can be used by DSOs to delay or avoid network reinforcement and manage constraints at an efficient cost. More specifically, flexibility provision may help DSOs to avoid/defer distribution network investment costs, and reduce technical electricity losses; curtailment of renewable generation; outage times; and outage/fault management[8,13]. It can also be a way of enabling more timely and efficient network connections.

Several of the reports discuss the need for regulation and appropriate incentives to encourage flexibility where it can deliver benefits. SGTF-EG3 states that DSOs should be incentivised to take measures that enable and provide flexibility where it is most efficient to do so [9]. NRAs should ensure that any undue regulatory barriers to innovation are removed and that the return on investment is appropriate and reflects the nature of the benefit from the innovation and corresponding risks[14]. At the same time, putting risk fully onto consumers has to be avoided. SWECO et al. suggest that a focus on total costs (TOTEX approach) rather than CAPEX/OPEX should provide better incentives for DSOs to optimise between build and non-build solutions to managing the network[15].

The need for further coordination between DSOs and TSOs to ensure secure system operation is also highlighted in several reports. EDSO for Smart Grids states that using system flexibility services will require extensive cooperation and clear boundaries between TSO and DSO rights

[11] CRE Study on the value of flexibility in the management and design basis of distribution networks in France, December 2015
[12] EDSO, Flexibility: The role of DSOs in tomorrow's electricity market, 2014
[13] European Commission Smart Grid Task Force, EG3 Report: Regulatory Recommendations for the Deployment of Flexibility, January 2015
[14] European Commission Smart Grid Task Force, Annex to EG3 Report: Regulatory Recommendations for the Deployment of Flexibility, September 2015
[15] SWECO et al., Study on the effective integration of Distributed Energy Resources for providing flexibility to the electricity system, April 2015

and duties[16]. Further, SGTF-EG3 believes activation of flexibility options by DSOs or TSOs independently might impact each other's grid operations in such a way that system stability or security of supply may become at risk, which would lead to inefficient use of flexibility resources [17]. In its position paper on the Future DSO and TSO Relationship, CEER highlights the need for greater co-operation to manage these impacts and make the most of the potential synergies. This includes providing transparency on network status, as well as on forecasts of future status, for DSOs and TSOs to better manage the growing interactions between networks across all timeframes.

Given the DSOs' responsibility for ensuring the security of the distribution grid, the SGTF-EG3 report highlights that DSOs need to have the opportunity to be involved in the different stages of flexibility activation if it affects the grid operation and is efficient. In proven cases, DSOs may need visibility of the planned actions that will be connected to their networks. This would ensure that market schedules are not in conflict with network operation and would seek mitigation actions either through commercial services that provide flexibility, or internal network control actions, depending on the state of the system[18].

1.7 Flexibility Use at Distribution Level

This section provides some further detail on the challenges and opportunities faced by electricity distribution networks, brought about by system changes, such as the wide-scale deployment of variable generation, the bulk of which is connected at distribution level, in addition to the changing patterns of electricity demand and energy consumption.

One challenge resulting from such a transformation is a change to networks' daily demand, load and flow patterns. For instance, in considering network load, the current expectation is that the demand profiles for the members of a given group will not all peak at the same time. This provides a degree of diversity on the system. However, several elements of the new paradigm, such as electric vehicle charging, demand response, and variable generation such as wind and solar, tend to operate at the same time if unmanaged. For instance, this could be due to a reaction to wholesale prices, or as a result of energy production/consumption from intermittent sources being time and weather dependent, which injects fluctuating and uncertain loads onto the system[19]. This can result in larger swings of simultaneous demand or supply in an area, potentially causing congestion in distribution networks.

Another challenge is that traditional flexibility resources are being displaced. For instance, traditional stabilising elements such as inertia in the system, which can represent inherently stored energy and ensure that frequency variation does not occur instantly, are reducing with due to the increase in variable energy sources. The lack of such inertia in times where most

[16] EDSO, Flexibility: The role of DSOs in tomorrow's electricity market, 2014
[17] European Commission Smart Grid Task Force, Annex to EG3 Report: Regulatory Recommendations for the Deployment of Flexibility, September 2015
[18] European Commission Smart Grid Task Force, EG3 Report: Regulatory Recommendations for the Deployment of Flexibility, January 2015
[19] E. Liu and B. J., "Distribution system voltage performance analysis for high-pentration photovoltaics," National Renewable Energy Laboratory, Tech. Rep., 2008.

production comes from non-synchronous generators creates a need for faster frequency response, which can be provided using flexibility. Typically, frequency response and system stability (e.g., inertia) have been TSO issues, but such issues highlight the importance of ensuring co-ordination and co-operation among DSOs and TSOs to solve the growing challenges across the network system.

High volatility and varying types of distributed energy resources (DER) in addition to bi-directional flows – with associated potentially large swings – are beyond the design limits of existing electricity distribution networks and can contribute to increasing constraints on the network. DSOs would traditionally tackle these constraints with reinforcement, particularly given that traditional systems have been developed around various network-planning assumptions. It was not envisaged that DSOs would have to plan, control and balance such complex systems under these circumstances.

DSOs are undoubtedly transitioning from their traditional roles with the changing composition and operation of the energy system. This transition poses a number of technical and operational challenges for DSOs and their neighbouring systems, but also presents opportunities for new approaches. Handling changing circumstances with more decentralised network control for DSOs, through locally specific short term DSO actions, may be more efficient than using basic network reinforcements. In this way, DSOs could help to reduce the overall costs of the system; and ultimately the costs borne by consumers.

In any case, there is an increasing need for system operators, in particular DSOs, to work from a broadened perspective as they adapt to this new reality. This reality requires appropriate investment and is driving the ever-increasing need to maximise the potential of flexibility and, more specifically, for different sources of flexibility that would compete on a level playing field.

Consultation Question(s)
1. What are, in your opinion, the main drivers for flexibility use by DSOs going to be in the coming years?

1.8 Defining Flexibility

Flexibility is the capacity of the electricity system to respond to changes that may affect the balance of supply and demand at all times. However, flexibility, can be, and is, defined in many ways. To understand the link between flexibility and DSOs, it is helpful to consider what is being captured in some existing definitions:

- the overall need to maintain continuous service in the face of rapid change;
- the ability of the system to respond to bi-directional flows, less diversity of flows, and associated technical issues;
- the ability of the system to respond to changing patterns of supply and demand over various time periods, for instance, large swings over a short period, as experienced with increasing variable generation on the system; and

- the economic value of flexibility.

While flexibility is not an end in itself, it is a means to deliver a more affordable, secure and efficient whole power system. Therefore, CEER thinks it is important, in the interests of energy customers, that the regulatory framework encourages and facilitates an environment for flexibility use at the distribution level, where this is the most economical option and supports an efficient electricity system for the benefit of consumers.

Considering the above, DSOs' roles in improving the flexibility of the distribution system could be described as the ability of DSOs to access and utilise services to (a) manage the distribution network in an economically efficient manner, avoiding undue distortions to markets and competition; and (b) to deliver security and quality of supply at efficient costs.

Consultation Question(s)
2. Please provide any alternative definitions for flexibility that you think capture the focus of this paper.

1.9 Flexibility Services and Uses for DSOs

In the context of this paper, and to better understand the distribution network component of system flexibility, this section will examine some of the various DSO uses for flexibility services. DSO Flexibility services can be defined as any service delivered by market participants (who have the capability of modifying their injection/consumption patterns) and procured by DSOs to maximise the security of supply and quality of service in the most efficient way.

Sources of flexibility have expanded beyond the boundaries of that which was available in traditional systems. New services are emerging that can provide flexibility to the energy system which can help to minimise network costs and deliver benefits to customers. To maximise the benefits that such flexibility services can offer, DSOs should be able to access and use flexibility services in situations where it does not distort markets or competition and where they provide the best outcome for consumers. These services, which could stem from various sources including generation, storage, and demand side, should compete in the market on a level playing field.

Considering the above, it is important for NRAs to ensure that the regulatory framework for DSOs, and the system as a whole, allows for the full range of possible flexibility services to develop. It is also important that the regulatory framework allows DSOs to access and use such services for network beneficial purposes, where the use of this flexibility avoids undue distortions to competition and ensures the best outcome for consumers. This will require co-operation and co-ordination between DSOs and TSOs and a framework that supports DSO actions that strike an appropriate balance between network investments versus flexibility use, so that such actions optimise the performance of the whole system and not just the distribution component.

While the firmness of flexibility services may not be directly comparable to developing new assets, flexibility services can serve to enhance distribution grid operation and the grid's hosting capability for decentralised generation, storage and demand side and new forms of demand such as electro-mobility. Flexibility should also aid management of short-term power system issues (e.g. congestion management) and lower overall network costs. Therefore, while the use of flexibility is not expected to completely replace traditional investment, flexibility services should be used as an alternative to traditional reinforcement where more efficient. Notwithstanding this, it is understood that DSO use of flexibility services will vary among EU DSOs given the diversity in their situations, including in relation to DSO size, local conditions, the national unbundling regime and the tasks they perform.

Without discussing specific services and their application for addressing distribution system issues, which is beyond the scope of this paper, it is important to highlight some instances whereby DSOs may consider using flexibility as a viable alternative to network reinforcement and more generally in their management of the grid. This is addressed in the remainder of this section, while further details on how DSOs could access and use flexibility services are addressed in Section 3.

1.9.1 DSO Uses for Flexibility

There are many different sources and services available to deliver flexibility on both the short-term operational timeframe and the long-term planning timeframe. This section discusses possible DSO uses for such flexibility services. Uses could include deferring or avoiding distribution network reinforcement (including through management of voltage and thermal constraints), managing distribution network issues (such as faults), and managing losses. In other words, DSO use of flexibility services where it could support efficient network and system management.

DSOs could use flexibility services to manage power flow on the system, particularly in situations where the distribution network is not able to accommodate all the desired transactions, i.e. is congested.

The flexibility services that could be used will depend on the needs of the system or the underlying event(s) causing congestion, such as changes in supply and demand patterns. In any case, flexibility services could play an important role in the context of planning future network expansion as well as in determining the best operation of existing networks. Use of appropriate flexibility services could offer an alternative to building back-up connection or reinforcing the distribution line.

Potential challenges faced by DSOs that could be alleviated by use of flexibility services are:

- insufficient transfer capacity in the network;
- excessive voltage rise/drop;
- overloading network equipment;
- planned/un-planned outages; and

- other challenges (such as fault levels limits, some local energy initiatives, etc.).

Considering the challenges listed above, flexibility services could enable increase power transfer capacities, reduce or shift demand to flatten the load shape,[20] which in turn could help to decrease grid losses. Flexibility services could enable DSOs to address power quality issues, such as those relating to harmonics, flicker, voltage rises/ drops, frequency and asymmetry in the network to alleviate the stress on the system by directing load away from areas of the network experiencing problems.

How these challenges are managed will affect:

- quality of supply;
- reliability of supply;
- curtailment of renewable generation;
- technical grid losses; and
- current and future network costs.

Consultation Question(s)
3. Should DSOs be encouraged to use flexibility to manage the distribution network where this is more efficient than reinforcing the network? Please provide an explanation. 4. Should all sources of flexibility be treated equally in the market and by system operators? 5. Are there any uses for flexibility that you think we have missed and should be considered? If yes, please provide an explanation? 6. Do you think it is important for Member States to establish standardised EU definitions of the various flexibility products, to facilitate market participation in flexibility use at distribution level?

2 DSOs and Flexibility

This section explores the DSO role in relation to flexibility provision. This is discussed in relation to DSOs accessing flexibility, DSOs enabling others to provide and procure flexibility and DSOs potentially providing flexibility. The latter may require regulatory approval. The DSO should be able, under the regulatory framework, to access grid user flexibility (demand, generation and storage) where the use of this flexibility is considered to be the most economical solution for operating the distribution network and avoids undue distortions to markets and competition. Equally, the regulatory framework should ensure that grid users with flexible resources are not unreasonably restricted from accessing a range of revenue streams from the wholesale markets, retail markets and network operators, and from deploying their potential where it is most efficient to do so.

[20] A Rautiainen, J Markkula, S Repo, A Kulmala, P Järventausta; “Plug-in vehicle ancillary services for a distribution network”

This presents a challenge for NRAs to ensure arrangements accommodate drivers of change in the most efficient way possible, so as to improve system flexibility through a set of various, yet complimentary, measures. A stable framework is important if efficient investment signals are to be provided for future sources of flexibility.

The European Commission's SGTF-EG3[21] recommended that NRAs should "define, on the basis of wide stakeholders' consultation, transparent, fair and clear boundary conditions for the market-based, where possible, provision of flexibility."[22]

The different starting points and the differences between DSOs and distribution systems among Member States, as highlighted in the introduction, mean that the deployment of flexibility is likely to vary from one distribution system to the next, as flexibility is used in different ways to address different challenges.

2.1 DSOs Accessing Flexibility

Currently, techniques for enabling DSOs' to access flexibility may be categorised broadly under the following three headings:

- **Rules-based Approach** – modify existing codes and rules to impose flexibility requirements.
- **Network Tariffs** – charging structures may be designed to encourage network users to alter their behaviour for a more efficient use of the distribution network.
- **Connection Agreements** – DSOs could reach arrangements with new customers for the provision of flexibility that form part of the connection agreement.
- **Market-based Procurement** – DSOs can explicitly procure grid user flexibility services from the market(s). This procurement could be for long-term contracts or in a short-term market.

Other approaches may already be emerging or develop in the future to signal network congestion to grid users, such as valuation of local network constraints in energy markets.

Rules-based Approach

DSOs could propose modifications to existing grid codes, connection codes, and other forms of codes and rules to impose flexibility requirements.

[21] See European Commission website on Smart Grid Task Force: http://ec.europa.eu/energy/en/topics/markets-and-consumers/smart-grids-and-meters/smart-grids-task-force
[22] Recommendation 12, *Regulatory Recommendations for the Deployment of Flexibility*, Expert Group 3 Report, January 2015

However, this could result in a service becoming a requirement set in the grid codes in one Member State, and sold on a market in another. Such arrangements may not be viable as they may not encourage investment in flexibility, undermining the ability of competition to promote the efficient transformation and ongoing operation of the power system. Ultimately, such a failure to foster competition in flexibility services markets could impose unnecessary costs on consumers.

Network Tariffs

DSOs may access flexibility through use-of-system tariff structures that send price signals to network users, incentivising them to modify how and when they use the network.

CEER's 2015 paper on the Future Role of the DSO, discusses the relevant factors to take account of when considering the appropriate structure of network tariffs. It discusses the extent to which network tariffs should incentivise more efficient use of the network and the fact that tariffs might need to change to reflect flexibility provision from distribution level.

Network charges have many different functions, and providing signals to incentivise more efficient and economic use of the network is only one of them. Ultimately, maximising flexibility provision is only one of a number of competing objectives. An element of the charging regime that could lead to such an outcome might be a signal to encourage customers to reduce consumption at local peak times. This will lower long-term costs for energy consumers because less reinforcement of the network will be needed (or this reinforcement may be postponed) and network losses will be reduced. Most Member States have long standing experience of static time-of-use tariffs, such as peak/off-peak or day/night tariffs.

Developments in smart meter and smart appliance technology also provide the possibility of more complex time-of-use tariffs, which may offer new possibilities for sending price signals. However, such price signals to encourage flexibility for network reasons should be separate from market-based price signals, in order to avoid behaviour in one market having a negative impact on another market.

In all cases, it is important that tariff structures reflect common core principles. Building on such principles, different countries will need to make trade-offs between these tariff principles depending on the specificities of their market structure, the wider pace of change in the energy system, and the level of development of their retail and other markets.

Connection Agreements

In some Member States, DSOs are deploying schemes enabling connecting grid customers, through smart technologies, to reduce their connection cost in exchange for variable network access in constrained network areas. Such agreements can be beneficial to both the connecting customer and the DSO (and therefore customers overall). Under such schemes, new grid customers commit to being flexible in their use of the network when requested by the DSO in exchange for a cheaper connection. DSO may also use enhanced monitoring and control techniques to manage the network in constrained areas, in response to changing conditions. The Smart Grid Task Force EG3 recommended that such schemes should be developed.

CEER is of the view that they are a potentially useful tool for DSOs in ensuring efficient network investments and optimal use of existing network capacity.

While encouraging DSOs to continue to develop flexible connection arrangements where they are an economical solution to connecting new customers and making efficient use of existing network infrastructure, DSOs must continue to act as neutral market facilitators. As such, connecting customers should be able to choose between available connection options, including obtaining a firm connection, where they are willing to pay the appropriate contribution towards network reinforcement.

Also all customers must be treated in a non-discriminatory manner. Where a flexible connection offer is made, DSOs should make efforts to be transparent about expected levels of curtailment and any limitations when connecting flexibly so that connecting customers can make an informed investment decision. There should be a reasonable, and mutually acceptable, sharing of curtailment risk.[23]

In developing flexible connection agreements, DSOs should engage with connection customers to understand their needs, including whether they expect to enter into additional flexibility contracts with other parties. NRAs will need to monitor the deployment of contracts of this type to ensure they are non-discriminatory, and do not restrict competition in markets or hinder access to the network. In particular, in developing these schemes, it is important that appropriate signals are in place to allow an assessment as to whether or not it is more economical to constrain customers on flexible contracts to reinforce the system, or to use other flexibility services to manage constraints.

Market-based Procurement

It is not clear, at this stage, how procurement of flexibility should develop in the Member States. There is a range of possible market-based models for DSO procurement of flexibility, which may yet emerge. However, bilateral flexibility contracts at distribution level (including via aggregators and other entities) are already emerging in some Member States. An example of various flexibility agreements that DSOs can contract with customers today is provided in Annex 4.[24]

As markets develop, DSO procurement of flexibility may include competitive tendering or procurement on exchanges or market platforms (which could, for instance, be run on a local basis, if these markets are liquid and unbundling is ensured). It is the recommendation of the Commission's Expert Group 3 that DSO procurement of flexibility should be, as far as is feasible, market-based. However, the precise nature of the market-based models that emerge will inevitably be shaped by the existing market arrangements in each Member State for balancing and ancillary services.

[23] On this matter, VREG in Belgium is carrying out a study with 3E to introduce an X% = maximum percentage of the yearly production that can be curtailed without compensation to facilitate greater reassurance to connecting customers.
[24] The findings are from a joint study carried out by EDSO and EURELECTRIC on the flexibility arrangements in 14 Member States.

In any case, the aim of NRAs with regard to market-based procurement of flexibility is to ensure that the regulatory framework for DSOs, and the system as a whole, allows for the full range of possible flexibility services to develop. Moreover, that such services develop according to market-based principles, avoiding undue distortions to competition, while also ensuring that it is robust enough to ensure the best outcomes for consumers.

Whichever models emerge in future, it is important that NRAs consider the system beyond the distribution network component and that interdependencies between parties are taken into account. Customers and parties that can improve the flexibility of the system by offering flexibility services may want to obtain value for their flexibility not just from the DSO but also other market participants, such as suppliers and TSOs.[25]

Therefore, the regulatory framework, independent of which market-based models ultimately emerge, will need to ensure proper alignment of market signals and the incentives for market participants in the wholesale, transmission, distribution and retail sectors. For DSOs, in particular, we consider it may be important that:

Flexibility providers should be able to value their flexibility across a number of options

While DSOs require a high degree of certainty that flexible services will be available at the required moment, DSOs' flexibility contracts should not unreasonably restrict the ability of flexibility providers to offer their service to other parties. In other words, DSO flexibility contracts should not unreasonably restrict flexibility providers from accessing a range of revenue streams (including from TSOs, suppliers or aggregators) and valuing their potential where it is most efficient to do so.

Such parties may require reasonable certainty of the availability of flexibility resources at certain times, or information of restrictions in sufficient time to react (e.g. to adjust bids in the balancing market). Cooperation among industry participants could be an effective approach to addressing issues of visibility, cooperation and certainty. For example, industry participants could develop standard contracts for provision of particular flexibility services, in addition to 'stacked' contracts, which would allow service providers to access value for their services from multiple parties under the same contract either for mutually beneficial or complementary services.

In principle, DSO procurement of flexibility should be on a competitive basis

DSOs should procure flexibility services, wherever possible, through competitive tendering or exchange/ platform based procurement, which may be more efficient, once markets for flexibility are sufficiently developed, due to their encouraging competition for the provision of services. However, bilateral contracts may continue to be appropriate where a DSO needs to

[25] The CEER paper "The future DSO and TSO relationship" (June 2016) discusses further principles on enabling flexibility providers to access a range of revenue streams

contract with a specific party to resolve a specific flexibility need without unduly distorting the market and ensuring compliance with unbundling rules. These contracts should be of an appropriate length, balancing the need for service certainty with wider considerations around efficiency and competitiveness. Furthermore, bilateral contracts with certain specifics should be made clear to the market. This would offer an opportunity for the market to develop more cost-efficient flexibility alternatives.

DSOs and TSOs should co-operate effectively

Effective co-operation and co-ordination between DSOs and TSOs could help to ensure that flexibility procured at DSO level supports whole-system efficiency, and that actions to procure flexibility at distribution level do not have a negative effect on other parties. This is discussed in greater detail in CEER's 'The future DSO and TSO relationship'.

Consultation Questions

7. Should regulators seek a regulatory framework that can accommodate a range of models that would enable DSOs to access and use flexibility, while ensuring that competition and markets are not unduly distorted?
8. What do you consider to be the key benefits and key risks of particular models (rules-based, network tariffs, connection agreements, and market-based)?
9. What are the relative merits of a contracting strategy (competitive or otherwise) versus a real-time market approach to procurement of flexibility? Is the latter approach practicable?
10. Are there any models that would enable DSOs to improve system flexibility that you think we have missed and should be considered?
11. Are there case study examples of approaches to improve flexibility on the system that you think should be considered in this work? If so, please provide a summary of the key information and findings.

2.2 DSOs Enabling Flexibility

DSOs have an important role to play in enabling the development of flexibility markets and services in a neutral, non-discriminatory manner.

In particular, data management is a key area for the efficient operation of existing and new markets including in flexibility. In most cases, DSOs obtain data directly from smart meters, in addition to technical network data derived from network monitoring. DSOs have a special duty to share all relevant data with the market in a timely manner, to support a level playing field in which new energy services can be provided on a competitive basis, while respecting data protection legislation and the fact that consumers own their data. This is emphasised in 'The

Future DSO and TSO Relationship'[26], where it states that there is a need for transparency on network status, as well as on forecast of future status.The paper goes on to list possible instruments to achieve this, including:

- Information on projected congestion;
- Connected capacity including distributed resources, both existing and planned;
- Information on connection or injection capacity available (for significant customers or producers);
- Medium-term forecast of network needs/service requirements; and
- Plans for outage, maintenance, construction and faults.

The CEER view, as noted in the Conclusions Paper on the Future Role of the DSO, is that there is a need for a neutral data coordinator or data hub to manage and provide access to data. This role can be provided by a number of different parties, as is already the case in some countries. DSOs should remain as neutral market facilitators; this does not automatically confer the status of data management coordinator to a DSO. Where DSOs do retain the role of data management coordinator, NRAs may need to consider imposing rules on DSOs regarding data reporting.

DSOs may also have a role in enabling flexibility under certain forms of load management schemes. For example, they may be active in mapping and connecting customer loads to a load management system while the actual demand response is based on a contract between the customer and a supplier or third party.

Consultation Questions
12. Beyond provision of data to market participants, do you consider that there any other tasks that DSOs should carry out to enable the competitive provision of and access to flexibility by others?

2.3 DSOs Providing Flexibility

In principle DSOs should not be both the owner and provider of a flexibility service and should not compete in the market. Notwithstanding this, there are actions that, if a DSO carried out, could provide flexibility beyond the distribution network component. These actions could include voltage control techniques on the distribution system to deliver frequency response to the transmission system operator, and reactive power absorption to the transmission system for constraint management purposes. Under certain models, they may also include the DSO accessing distribution-connected flexibility on behalf of the TSO, if this facilitates better coordination/co-optimisation of access to flexibility, and minimises whole system cost.

[26] CEER's "The future DSO and TSO relationship" paper

Such an approach would need to be economically efficient, in accordance with the DSOs' role as a neutral market facilitator, and would need to ensure that markets and competition are not unduly distorted. That then raises a question over whether the DSO, under the regulatory framework, should be incentivised and allowed to provide flexibility beyond the distribution network component to help to reduce the overall costs of the system and ultimately deliver cost savings to customers.

Consultation Questions
13. Do you think there are situations where DSOs should be allowed to provide flexibility beyond the distribution network component, where economically efficient to do so? Please provide reasoning for your answer. 14. Are there other examples where the DSO could provide flexibility to help to reduce the overall costs of the system?

3 Regulatory Framework

NRAs have a key role to play in ensuring that the regulatory framework encourages and facilitates an efficient current and future whole energy system. In the context of flexibility use at distribution level, the regulatory framework must support the development of efficient network solutions, including the evolution and use of flexibility services on a non-discriminatory basis, where it is the most economically viable option. The framework should also encourage fair market access and efficient cooperation among market players, including DSOs. This will require, *inter alia*, appropriate rules, incentives, and remuneration mechanisms.

When considering the framework that is needed, it is important for NRAs to understand how a market for flexibility services should function, particularly at distribution level. Broadly speaking, this market should be open, transparent and competitive, with common regulatory principles where possible across Europe. There needs to be neutral facilitation of markets, while minimising operation and construction costs. In this regard, the appropriate role for ownership unbundling in ensuring neutrality needs to be fully considered, while being cognisant of the need to facilitate smaller local communities' full participation in the energy system. Neutrality can also be addressed with rules on business separation and surveillance from NRAs. Full functional separation of grid operations from all other activity is potentially costly for smaller companies and their customers. There will also be a need for much closer coordination between TSOs and DSOs. Finally, any approach to unbundling will need to be based on common rules at European level to avoid distorted competition.

3.1 Role of Regulators in Facilitating Flexibility

NRAs aim to ensure that the regulatory framework creates the right environment for market actors to participate, invest in and deliver flexibility across the whole system, so that benefits for consumers can be realised as soon as possible.

In the CEER paper on the 'Future Role of DSOs', views were sought on some of the issues relevant to flexibility from a DSO perspective. The DSO-TSO relationship, the use of incentives, and tariffs were examined. Work has continued in parallel to develop in more detail common European principles and regulatory guidelines for each of these areas.

The future role of the DSO in enabling and using flexibility may, depending on the Member State, be considered as "grey areas" and, therefore, be permitted under certain conditions. This means that NRAs will need to determine under which conditions the DSO may carry out these activities, as well as ensuring they have the tools to carry out monitoring to ensure that competition is not distorted. When considering whether an activity may be permitted and the necessary conditions for such permission, NRAs should consider the role of the DSO in contributing to the economical operation of the energy system as a whole.

NRAs need to ensure that the regulatory framework does not hinder or disincentivise DSOs from facilitating the development of flexibility at distribution level or from using flexibility services for managing the distribution network, where it is economic and efficient to do so, while simultaneously ensuring that markets and competition are not unduly distorted.
This could include the development of incentives on DSOs' stakeholder engagement activities.[27] NRAs will also need to consider how the wider regulatory framework may need to be adapted to ensure that the value of flexibility to the whole system and interdependencies are taken into account.

Because the issues to be addressed are many and diverse, and because the circumstances in each Member State (and indeed even in each DSO area) are currently also so varied, different steps may be required to introduce the necessary enablers for flexibility or to remove existing barriers. When considering what these steps might be, NRAs must ensure that the full range of possible models for the deployment of flexibility are given an equal consideration, and ensure that no options are prematurely ruled out. Also, regulatory incentives should avoid any bias towards specific technologies that deliver flexibility.

It is recognised that changes to facilitate the development of flexibility at distribution level may pose challenges to existing market actors, but also that these changes will create new opportunities and ultimately benefit consumers by facilitating a more efficient network use and system operation.

3.2 Regulatory Tools

This paper notes the increasing need for flexibility of the power system and, in particular, of the distribution network.

[27] Stakeholder involvement on the topic of flexibility is considered to be part of the new tariff methodology in Flanders for 2017-2022 in the light of the on-going discussion on changes to the current market model to facilitate flexibility.

To encourage the use of flexibility at distribution level, undue barriers must be removed. There are some common tools that NRAs can use to facilitate flexibility use at distribution level. These are as follows:

Price or Revenue Control

It is within NRAs' remit to set the framework for providing network companies with a future level of revenue and appropriate incentives to meet their statutory duties and licence obligations, while delivering optimal outcomes for customers. Price or revenue controls allow NRAs to set a framework that ensures efficient whole system outcomes, and can be used to stimulate certain behaviour from network companies. While price or revenue control models encourage DSOs to stay within their allowed envelope of expenditure, the framework can go further.

NRAs can use this tool to support an environment where appropriate remuneration is provided for efficient expenditure, considering short and long term objectives and build and non-build solutions, while ensuring the most efficient outcomes for the system as a whole to the ultimate benefit of consumers. This approach will involve appropriate incentives and ensuring effective co-ordination of actions between DSOs and other system operators for the purposes of system operation. Such a framework will facilitate DSOs using flexibility on their networks where it is considered to be the most economical solution and should be used to remove barriers to flexibility use at the distribution, as well as at the whole system level.

Economic Incentive Schemes for DSO

Economic incentives are a key component of revenue regulation. Incentives are applied by NRAs to complement and enhance the requirement for a regulated business to efficiently manage costs, while also improving performance in the delivery of its responsibilities, particularly with regard to quality, efficiency and timeliness of service delivery.
In that regard incentives, including on the promotion of innovation, should be viewed as an important means to an end. NRAs can use incentives as a tool to achieve regulatory outcomes, which may not otherwise occur. For instance, economic incentives can be used to support coordinated interactions between DSOs and other system operators to ensure that the actions of the various operators support optimal network system outcomes for the benefit of consumers. They can also be used to encourage DSOs to explore innovative solutions to achieve desired outcomes, including the use of flexibility at distribution level where appropriate.

For instance, in Great Britain, Ofgem established an innovation fund to encourage DNOs to use innovation to manage their networks more efficiently and to meet the needs of users as the transition is made to a low carbon economy. The funding aims to stimulate the real world trialling of new technologies and services (including the use of flexibility), knowledge and learning exchange, and a culture change amongst DNOs so that innovation becomes part of everyday decision making.

A number of papers[28] have been published which summarise the learning from the innovation trials, including learning about how flexibility can be used to deliver more efficient networks.

CEER has published a separate consultation paper on Incentives Schemes for regulating DSOs, including for Innovation, which explores this topic in greater detail.

Smart Metering

NRAs have a key role in making sure that regulatory arrangements facilitate an efficient current and future energy system. Smart metering may support future functionality between the end user of the power system and the grid operators. Smart meters can empower energy customers to take a more active role in the energy system, including the provision of flexibility services in a smart grid. Furthermore, smart metering may provide opportunities for network companies to gain operational efficiencies and to utilise the infrastructure and granular consumption data to deliver "smart grid" benefits. Important in this respect is also to offer the possibility for settlement with measured values (not standard load profiles). NRAs may bring about the necessary changes (such as amendments to the relevant licences and codes of practice applicable to the networks companies and suppliers) to enable smart services to be introduced. This will then facilitate demand side resources to participate in an open, competitive market for flexibility.

Regulatory Framework for Tariff Structures

Network tariffs are set to recover the costs of operating and investing in electricity networks. In addition to regulating overall revenues, the regulatory framework for tariff structures is a core regulatory responsibility. Tariff structures vary widely across the EU and are currently based on a traditional use of the network approach. NRAs can change tariff structures to ensure they contribute to the efficient use and development of the network, including the ability to adapt to recent changes and technological advances.[29] As well as recovering costs, distribution tariffs can be designed so that they send short-term operational price signals to trigger actions that have beneficial impacts on end user behaviour to reach desired network objectives.

For example, signals for consumers to provide demand side flexibility will benefit network operation.

---

[28] Please see EA technology's summary of learning, undertaken on behalf of Ofgem: https://www.ofgem.gov.uk/publications-and-updates/ea-technology-s-summary-low-carbon-network-fund-learning and the review undertaken by the University of Strathclyde, funded by UKERC and HubNet: http://www.ukerc.ac.uk/publications/a-review-and-synthesis-of-the-outcomes-from-low-carbon-networks-fund-projects.html

[29] CWaPE in Belgium is considering organising a tariff for grid users that would vary depending on whether the grid users capacity is permanent or flexible. It is proposed that a lower capacity tariff (near to €0) would be set for the grid user that agrees to part of his connection capacity being curtailed when there are grid constraints. This would be considered "flexible capacity". Alternatively, a higher capacity tariff would apply to grid users that do not want to be curtailed (under normal circumstances) below a certain level of capacity. This would be considered "permanent capacity". The tariff combination would aim to incentivise flexibility at DSO level, rewarding possible savings on distribution costs and avoiding as much as possible conflicts with other flexibility price signals.

It is important, here, to distinguish between signals sent by the electricity price that reflect scarcities in the generation sector, and network tariffs that reflect costs for network usage. Both signals trigger consumer reactions and do not necessarily do so in a complimentary way.

However, smart metering and tariff structure design can compliment one another. For most new price and tariff structures, more detailed measurements are needed (i.e. smart metering). Smart metering can enhance DSOs' knowledge about power flows and load on networks. This, along with appropriate tariff structures, can increase the DSOs' ability to use different flexibility options.

CEER has published a separate paper on 'Guidelines of Good Practice on Electricity Distribution Network Tariffs',[30] which explores this topic in greater detail.

Contractual Arrangements

DSOs can enter into contractual arrangements for particular services giving DSOs an option to ask market participants to perform certain functions or adjust their production or consumption. This could be at very short notice (e.g. within seconds of receiving an instruction to do so), in order to maintain the stability of the system. TSOs routinely contract via an organised market or through direct bilateral contracts. This is not common for DSOs. There may be a greater need for DSOs to use direct, bilateral contractual arrangements, while avoiding the creation of market distortions. Such arrangements can be an effective, bespoke tool, which is easier to integrate than contracting via an organised market. They represent an effective means for the DSO to have flexible control over assets on the network, without actually needing to own those assets, which can be offered by the market. The duration of the contract, and it's openness to all participants, are important considerations. NRAs could have an important role in overseeing such arrangements or may have a role in the generic signing of contracts that meet certain criteria.

Consultation Question(s)
15. In principle, can the regulatory tools listed be used by regulators to remove barriers and facilitate the use of flexibility at distribution level? 16. Are there particular tools that you think would be the most effective in achieving flexibility use at distribution level? Please provide reasoning for your answer. 17. Are there any other regulatory tools that have not been included and should be considered? 18. Should the regulatory framework allow different solutions and combinations of tools to address the specific needs of the network?

[30] CEER Guidelines of Good Practice on Electricity Distribution Network Tariffs: Guidelines of Good Practice, Ref. C16-DS-27-03, 2017

3.3 Guiding Principles

Flexibility is not an end in itself, but a means to deliver a more affordable, secure and efficient whole power system. To give effect to this, CEER seeks to develop high-level guiding principles for NRAs on facilitating flexibility at the distribution level of the electricity network, where it is deemed economically viable and does not unduly distort markets and competition. The responses to this consultation paper will be used as input when developing these principles. At this stage, however, derived from the contents of this report, the following set of high-level principles are proposed. CEER seeks comments on whether the proposed principles outlines below should underpin the regulatory framework, for the use of flexibility at distribution level, and for network planning and management by DSOs. Furthermore, CEER welcomes respondents' proposals on additional relevant principles.

- A **common set of high-level European principles** on how DSOs should go about enabling, accessing and using flexibility services should underpin NRA regulatory frameworks.

- The **regulatory framework for DSOs should not hinder or unduly disincentivise DSOs from facilitating** the development of flexibility.

- The **regulatory framework should enable the development of a full range of possible flexibility services**, while also ensuring that it is robust enough to deliver the best outcomes for consumers. NRAs should ensure that no options are prematurely ruled out.

- **All sources of flexibility**, including generators, storage, and demand side response, **should be treated equally** by network operators. Regulatory incentives should avoid any bias towards specific technologies that deliver flexibility.

- **DSOs should be able**, under the regulatory framework, **to access and use flexibility services** provided by grid users **for managing the distribution network**, where the use of this flexibility is considered to be the most economical solution and avoids undue distortion to markets and competition.

- **Details** on the roles and responsibilities of DSOs **should be determined at national level**, given the diversity of situations, legislation and needs across EU Member States and the varying nature of DSOs (i.e. size and location).

- **NRAs must have the necessary** human, technical and financial **resources** available to review and modify the existing regulatory framework to remove barriers and facilitate flexibility use at distribution level.

Consultation Question(s)
19. Is a principles-based approach (rather than one-size-fits-all) the correct one for national regulators developing a framework for facilitating flexibility use by DSOs at distribution level? 20. Are the principles outlined appropriate? Are there any fundamental principles that you think are missing in order to deliver maximum benefit to customers?

The following principles, while not part of the consultation, as they are taken from 'The future DSO and TSO relationship' [31] paper, are highly relevant in the context of this work and reflect the CEER thinking on the matter. They are listed below for ease of reference.

- DSOs must act as neutral facilitators for the market in flexibility services and should not operate in ways, which unduly foreclose or distort this market. DSOs compliance with the Third Package requirements will be necessary to achieve this.

- NRAs should ensure that a clear framework and processes are in place to facilitate coordinated access for DSOs to flexible resources and allow coordinated interaction between DSOs and other system operators when flexibility is being used at distribution level to ensure efficient whole system outcomes and deliver optimal outcomes for customers.

- The regulatory and legislative framework should ensure that providers of flexibility services are not unreasonably restricted from accessing a range of revenue streams and valuing their potential where it is most efficient to do so.

- Where DSOs are data management coordinators, they must make available necessary data to the market in a non-discriminatory manner, while respecting data protection legislation.

- Regulators should ensure that DSOs' incentives are not distorted between build and non-build solutions. DSOs should consider the range of available solutions when planning investments that could lead to the reduction of network reinforcement costs and the most efficient use of the system. The most economically viable option from an overall electricity system perspective, and not solely the distribution system, should be taken forward.

4 Conclusion and Next Steps

This paper has highlighted some significant changes that European electricity systems have seen over the last decade, including changing load and consumption patterns. In the light of such changes, and as suggested by the literature review, introducing more flexibility to the

[31] CEER's "The future DSO and TSO relationship" paper

energy system can be an efficient and effective means to achieve optimal outcomes for consumers, and realise the opportunities to try new approaches afforded by the changing composition and operation of the energy system. In this regard, the paper does not consider flexibility as an end in itself but rather a means to deliver a more affordable, secure and efficient whole power system.

Flexibility can feature within many interrelated components that make up the energy chain of production, transmission, distribution, and consumption. This paper focuses exclusively on one component of that chain, the distribution component, in particular of the electricity network. Flexibility use at the distribution level provides opportunities for DSOs to manage the distribution network in an economically efficient manner, minimising costs, while delivering security and quality of supply, as well as other benefits to customers.

This paper frames possible DSO uses for flexibility, but also explores how DSOs could access and use flexibility services, whether via a rules-based approach; network tariffs; connection agreements; or market-based procurement. In any case, this paper suggests that DSOs should be able, under the regulatory framework, to access grid user flexibility (demand, generation and storage) on a non-discriminatory basis, where it is the most economically viable option for operating and developing the distribution network and avoids undue distortions to markets and competition.

Furthermore, the paper suggests that aside from DSOs' use of flexibility, as neutral market facilitators, DSOs have an important role to play in enabling the development of flexibility markets and services in a non-discriminatory manner. Consequently, grid users with flexible resources should be able to access a range of revenue streams from markets and from network operators for providing their flexibility services.

The paper has listed common tools that European NRAs could use to assist with addressing the actions outlined above and facilitating flexibility use at distribution level. These tools include price or revenue controls; economic incentive schemes for DSOs; and contractual arrangements. In any case, addressing the challenges will require, *inter alia*, appropriate rules, incentives, and remuneration mechanisms. CEER seeks to establish guidelines of good practice for NRAs on facilitating the evolution and use of flexibility services at the distribution level of the electricity network. In order to give effect to that, the paper presents, for comment, a set of high-level principles aimed at providing guidance to NRAs for the use of flexibility at distribution level, and for network planning and management by DSOs. Those principles are based on fair market access, equal treatment, appropriate cost recovery, transparency, predictability and efficiency.

CEER wishes to hear your views on our thinking and, in particular, on the way forward in the areas identified in the consultation questions in this paper. CEER invites all interested stakeholders to respond to this public consultation via the dedicated online tool. The deadline for responses is **25 May 2017.**

Following the 8-week consultation period, CEER will consider all responses to this consultation carefully and prepare an evaluation of responses. We will then publish a conclusion report within which we will propose any further relevant actions.

Annex 1 – List of Abbreviations

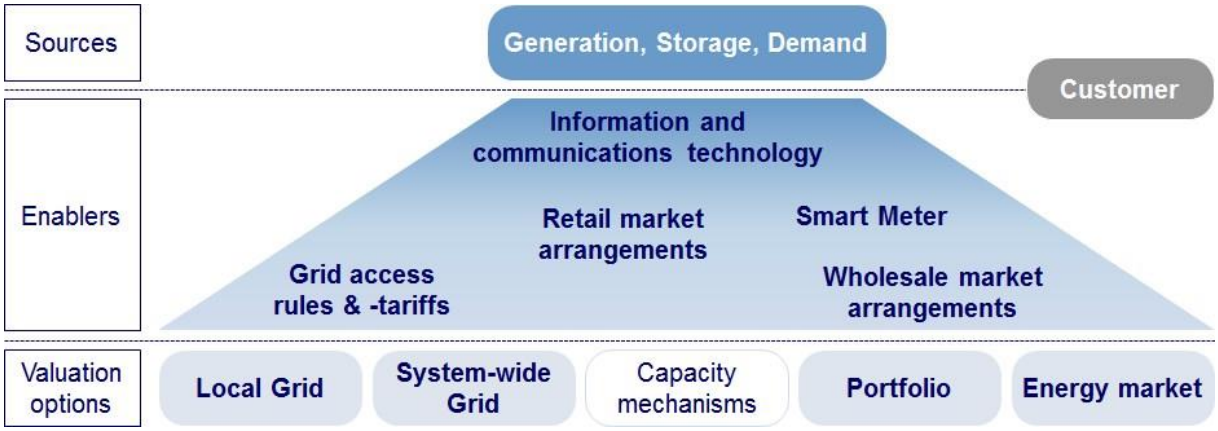
Term	Definition
ACER	Agency for Cooperation of Energy Regulators
CEER	Council of European Energy Regulators
DER	Distributed Energy Resource
DG	Distributed Generation
DR	Demand Response
DS	Distribution System
DSO	Distribution System Operator
DSF	Demand side flexibility
HV	High Voltage
ICT	Information and Communication Technology
LV	Low Voltage
NRA	National Regulatory Authority
TSO	Transmission System Operator

Annex 2 – Market Component of Flexibility

In the markets where MSs deem at their discretion it is efficient to allow the development of new actors, the Agency and CEER consider it is also important to ensure a fair level playing field between suppliers and new kind of actors.

The diagram below illustrates:

- different sources of flexibility (blue box);
- enablers like smart meters and settlement regimes (middle); and
- options for valuation of flexibility - the(bottom).



The key challenge is to ensure that the design of the enablers (technical, commercial, and especially regulatory) and of the framework encompassing the options for valuing flexibility influence each other, and are be considered holistically. Participation of flexible customers via retail markets should be incorporated in a way that optimises benefits for the energy system and therefore for all customers.

An ideal system should minimise the net cost of energy for consumers, through a level playing field for all kinds of flexibility and overall optimized access to the sources of flexibility through a reasonable framework. These objectives were included from the start in the development of the European Network Codes and Guidelines. Therefore, any integrated view need to start from the applicable legislation in the Network Codes and guidelines.

Further details on the above diagram

Sources of flexibility are

- Generation: conventional power plants and via interconnectors, decentralised generation like PV, Wind, Hydro etc.;
- Storage: conventional storage, decentralised storage, electric vehicles etc.;
- Demand: demand side flexibility from existing and growing applications such as heat-pumps, other thermic, etc.

Enablers have a big effect on efficient use of flexibility. They are:

- Information and communications technology (ICT): includes broadband information exchange, home automation, etc. ;
- Grid access rules & -tariffs: interruptible contracts etc. ;
- Retail market arrangements: energy access contracts, e.g. time of use tariffs etc., data provision etc.;
- Smart Meter: the use of smart meter data is an important enabler, but without metering and settlement the use for the system efficiency is not facilitated; and
- Wholesale market arrangements: roles and responsibilities, product requirements, metering and settlement, aggregation, data exchange etc.

Valuation options of flexibility have influences on each other. They are:

- Local Grid (TSO and DSO): Non frequency ancillary services, alternative to grid reinforcement, congestion management, emergency interruptible contracts etc.;
- System-wide Grid (TSO): Frequency ancillary services (balancing capacity and energy), system adequacy etc.;
- Capacity mechanisms (optional);
- Portfolio (BRP, supplier etc.): (internal) portfolio optimisation including sourcing (through load shift etc.), imbalances (through load shift in real time), also via aggregators possible; and
- Energy market (generators, suppliers etc.): all markets including long term, intraday, day-ahead etc.

The role of the **customer** includes a possibility to participate in all forms of valuation of flexibility.

Annex 3 – EDSO and EURELECTRIC Questionnaire

The tables below provide information on the flexibility arrangements existing in 11 Member States. The arrangements include voluntary and mandatory contracts either contracted directly with the customer or through a third party. Out of the 11 countries interviewed, there were eight that allowed DSOs to contract flexibility agreements under the current legislation.

	Type of customers			
Country: Austria	**household customers**	**small and medium sized enterprises**	**industrial customers/generators**	**Comments****
Current national legislation allowing DSOs to contract flexibility	Yes	Yes	Yes	
Please describe the types of devices used (heat-pumps, emobility, wind turbines, PV, etc)	interruptable load contracts with heat pumps, agricultural sprinklers, animal food heaters, hot water boilers, etc.)	interruptable load contracts with heat pumps, agricultural sprinklers, animal food heaters, hot water boilers, etc.)	power consumption/generation depending on ability	
Type of flexibility contract (mandatory or voluntary)	voluntary	voluntary	voluntary	
direct contracts between DSOs-customers	Yes	Yes	Yes	
contracts between DSOs-customers via retailers/aggregators	No	No	No	
contracts between DSOs-customers via other regulated parties *(i.e. services provided by customers to TSOs)*	No	No	No	
Reflected in the network tariff or flexibility contract*				
direct contracts between DSOs-customers	network tariff	network tariff	flexibility contract	
contracts between DSOs-customers via retailers/aggregators				
contracts between DSOs-customers via other regulated parties *(i.e. services provided by customers to TSOs)*				
Please describe the type of flexibility service *(i.e. curtailment, peak shifting, etc)*	interruptable load/curtailment	interruptable load/curtailment	power consumption/generation	
Does the regulatory framework reward DSOs for these flexibility services *(i.e. load curtailment), and how?*	No	No	No	
Are the customers remunerated for providing these flexibility services, and how?	Yes, lower tariffs for interruptable load	Yes, lower tariffs for interruptable load	Yes (via connection costs)	

**Tariff contract/flexibility contract: Is a 'flexibility contract' or is a 'grid tariff contract including flexibility services'*
*** if you don't fit in this table, please make your comments here. You can also explain any other detail*

	Type of customers			
Country: Belgium	**household customers**	**small and medium sized enterprises**	**industrial customers/generators**	**Comments****
Current national legislation allowing DSOs to contract flexibility	No	No	Yes	
Please describe the types of devices used (heat-pumps, emobility, wind turbines, PV, etc)	-	-	industrial customers/generators	Generators (curtailment) : only green and in Wallonia Industrial customers: ex-ante Network Flexibility Study as a precondition for balancing
Type of flexibility contract (mandatory or voluntary)	-	-	Manadatory	
direct contracts between DSOs-customers	no	no	Yes	generators - flexible access contracts between DSO and renewable generators which allow the DSO to curtail RES under certain circumstances.
contracts between DSOs-customers via retailers/aggregators	no	no	Yes	only industrial customers
contracts between DSOs-customers via other regulated parties *(i.e. services provided by customers to TSOs)*	no	no	no	
Reflected in the network tariff or flexibility contract*				
direct contracts between DSOs-customers	-	-	Flexibility contract	generators
contracts between DSOs-customers via retailers/aggregators	-	-	Flexibility contract	industrial customers
contracts between DSOs-customers via other regulated parties *(i.e. services provided by customers to TSOs)*	-	-		
Please describe the type of flexibility service *(i.e. curtailment, peak shifting, etc)*	-	-	Curtailment for generators, ex ante limits for industrial customers	
Does the regulatory framework reward DSOs for these flexibility services *(i.e. load curtailment), and how?*	-	-	Yes	For non produced energy in some (regulated) conditions
Are the customers remunerated for providing these flexibility services, and how?	-	-	Yes	For non produced energy in some (regulated) conditions

**Tariff contract/flexibility contract: Is a 'flexibility contract' or is a 'grid tariff contract including flexibility services'*
*** if you don't fit in this table, please make your comments here. You can also explain any other detail*

	Type of customers			
Country: Bulgaria	**household customers**	**small and medium sized enterprises**	**industrial customers/generators**	**Comments****
Current national legislation allowing DSOs to contract flexibility	NO	NO	NO	In Bulgaria, in legislation nor in practice a concept and/or definitions of flexibility, service flexibility, service contracts for flexibility, etc. including at the level of electricity distribution companies, don't yet exist.
Please describe the types of devices used (heat-pumps, emobility, wind turbines, PV, etc)	..	..	..	
Type of flexibility contract (mandatory or voluntary)	-	-	-	
direct contracts between DSOs-customers	-	-	-	-
contracts between DSOs-customers via retailers/aggregators	-	-	-	
contracts between DSOs-customers via other regulated parties *(i.e. services provided by customers to TSOs)*	-	-	-	
Reflected in the network tariff or flexibility contract*				
direct contracts between DSOs-customers	-	-	-	
contracts between DSOs-customers via retailers/aggregators	-	-	-	
contracts between DSOs-customers via other regulated parties *(i.e. services provided by customers to TSOs)*	-	-	-	
Please describe the type of flexibility service *(i.e. curtailment, peak shifting, etc)*	-	-	-	
Does the regulatory framework reward DSOs for these flexibility services *(i.e. load curtailment), and how?*	-	-	-	
Are the customers remunerated for providing these flexibility services, and how?	-	-	-	

**Tariff contract/flexibility contract: Is a 'flexibility contract' or is a 'grid tariff contract including flexibility services'*
*** if you don't fit in this table, please make your comments here. You can also explain any other detail*

	Type of customers			
Country: Czech Republic	**household customers**	**small and medium sized enterprises**	**industrial customers/generator**	**Comments****
Current national legislation allowing DSOs to contract flexibility	Yes / at low-voltage level	Yes / at low-voltage level	Yes / at low-voltage level	
Please describe the types of devices used (heat-pumps, emobility, wind turbines, PV, etc)	Electric storage heating, boilers for water heating, electromobility, heat pumps	Electric storage heating, boilers for water heating, electromobility, heat pumps, public lighting	Electric storage heating, boilers for water heating, electromobility, heat pumps, public lighting	
Type of flexibility contract (mandatory or voluntary)	voluntary	voluntary	voluntary	**voluntary with mandatory obligations**: in the Czech Republic, there is so called **"district ripple load control"** system in place since 1960s, that enables sending of commands or signals in order to switch on or switch off appliances, and tariffs switching. Basis for the HDO system exploitation is a customer agreement with remote blocking of heating appliances in pre-defined time band by the DSO. Nowadays, the DSO controls consumption by the HDO system, shave peaks of the load profile, reduces losses, and more importantly controls generation in small decentralised sources. This significantly contributes to the optimisation of distribution network operation. Subsequently billing of consumption in this time band is calculated for low tariff, which has advantageous price. HDO system applied at generators is used for a stepwise output regulation according to agreed rules. Customer concludes with the DSO an agreement that its consumption of heating appliances is blocked in the period of high load (high tariff), and in the case of emergency situation. Consumer receives a benefit of lower price during remaining daytime (low tariff). Customers enter into contract with DSO via their supplier.
direct contracts between DSOs-customers	Yes	Yes	Yes	It is possible, but mainly included in the contract with supplier (on low voltage level, in bundled DSO-retail contract)
contracts between DSOs-customers via retailers/aggregators	Yes	Yes	Yes	
contracts between DSOs-customers via other regulated parties *(i.e. services provided by customers to TSOs)*	N/A	N/A	N/A	
Reflected in the network tariff or flexibility contract*				
direct contracts between DSOs-customers	flexibility contract	flexibility contract	flexibility contract	
contracts between DSOs-customers via retailers/aggregators	flexibility contract	flexibility contract	flexibility contract	
contracts between DSOs-customers via other regulated parties *(i.e. services provided by customers to TSOs)*	N/A	N/A	N/A	
Please describe the type of flexibility service *(i.e. curtailment, peak shifting, etc)*	peak shifting	peak shifting	peak shifting	
Does the regulatory framework reward DSOs for these flexibility services *(i.e. load curtailment), and how?*	No	No	No	no explicit reward
Are the customers remunerated for providing these flexibility services, and how?	Yes	Yes	Yes	via lower price of electricity in low tariff, as described above

**Tariff contract/flexibility contract: Is a 'flexibility contract' or is a 'grid tariff contract including flexibility services'*
*** if you don't fit in this table, please make your comments here. You can also explain any other detail*

	Type of customers			
Country: Finland	**household customers**	**small and medium sized enterprises**	**industrial customers/generators**	**Comments****
Current national legislation allowing DSOs to contract flexibility	Yes	Yes	Yes	Legislation doesn't prevent DSOs from contracting flexibility with their customers. General terms of contract allow DSOs to contract with customers on flexibility. However, the regulatory model doesn't provide insentives to use/provide demand response services. DSOs are allowed to limit customers' use of electricty in special cases (e.g. national lack of power). DSOs are not allowed to operate in energy or capacity markets (neutral regulated entities).
Please describe the types of devices used (heat-pumps, emobility	Electrical heating, water boilers	No	No	
Type of flexibility contract (mandatory or voluntary)	both	both	both	
direct contracts between DSOs-customers	yes	Yes	Yes/No	Mandatory is allowed in limited special situations (e.g. national lack of power). This is allowed in legislation and specified in general terms of contract approved by the NRA.
contracts between DSOs-customers via retailers/aggregators	no	no	no	
contracts between DSOs-customers via other regulated parties *(i.e. services provided by customers to TSOs)*	no	no	no	
Reflected in the network tariff or flexibility contract*				
direct contracts between DSOs-customers	network tariff	network tariff	network tariff	Night-day tariffs widely in use. DSOs offer control equipment (via Smart Meter) of night-day use of electrical heating (e.g. water boilers)
contracts between DSOs-customers via retailers/aggregators	No	No	No	
contracts between DSOs-customers via other regulated parties *(i.e. services provided by customers to TSOs)*	No	No	No	
Please describe the type of flexibility service *(i.e. curtailment, peak shifting, etc)*	Night-day control of electrical heating	..	..	
Does the regulatory framework reward DSOs for these flexibility services *(i.e. load curtailment), and how?*	No	No	No	
Are the customers remunerated for providing these flexibility services, and how?	No	No	No	Customers benefit via network tariffs.

**Tariff contract/flexibility contract: Is a 'flexibility contract' or is a 'grid tariff contract including flexibility services'*
*** if you don't fit in this table, please make your comments here. You can also explain any other detail*

	Type of customers			
Country: France	**household customers**	**small and medium sized enterprises**	**industrial customers/generators**	**Comments****
Current national legislation allowing DSOs to contract flexibility	see comment	see comment	see comment	The current legislation has set up an experimentation allowing DSO to contract a local flexibility service. Beyond this experimentation, the legal framework doesn't prevent the DSO to procure flexibility services. For example, some French DSO are experimenting alternative connection contract for generation, relying on generation' flexibility.
Please describe the types of devices used (heat-pumps, emobility, wind turbines, PV, etc)	..	..	..	
Type of flexibility contract (mandatory or voluntary)	-	-	-	voluntary
direct contracts between DSOs-customers	No	No	yes	For generation (experimentation)
contracts between DSOs-customers via retailers/aggregators	No	No	No	
contracts between DSOs-customers via other regulated parties *(i.e. services provided by customers to TSOs)*	Yes	Yes	Yes	experimentations only
Reflected in the network tariff or flexibility contract*				
direct contracts between DSOs-customers	No	No	yes	For generation, through the connection contract (experimentation)
contracts between DSOs-customers via retailers/aggregators	No	No	No	
contracts between DSOs-customers via other regulated parties *(i.e. services provided by customers to TSOs)*	flexibility contract	flexibility contract	flexibility contract	
Please describe the type of flexibility service *(i.e. curtailment, peak shifting, etc)*	wide open provided it has a value for the network	wide open provided it has a value for the network	wide open provided it has a value for the network For generation : curtailment contract	
Does the regulatory framework reward DSOs for these flexibility services *(i.e. load curtailment), and how?*	No	No	No	
Are the customers remunerated for providing these flexibility services, and how?	Yes	Yes	Yes	via flexibility contract. For the alternative generation contract, the producer gets the benefits of its service through a cheaper quote for its connection to the network

**Tariff contract/flexibility contract: Is a 'flexibility contract' or is a 'grid tariff contract including flexibility services'*
*** if you don't fit in this table, please make your comments here. You can also explain any other detail*

	Type of customers			
Country: Germany	**household customers**	**small and medium sized enterprises**	**industrial customers/generators**	**Comments****
Current national legislation allowing DSOs to contract flexibility	Yes, but it is regulated by § 14 a ENWG; usally no direct-contractally between DSO/customer	Yes , but it is regulated by § 14 a ENWG; usally no direct-contractally between DSO/customer); exceptionally direct grid contracts with bid SMEs	Yes - by contract between the parties of the contract possible and usal, 19 II StromNEV ; here mainly direct contracts between DSO and customer)	
Please describe the types of devices used (heat-pumps, emobility, wind turbines, PV, etc)	heat pumps, boliers, night-storage heaters AND emobility	heat pumps, boilers, night-storage heaters AND emobility	all (individual) contracts depending on agreement	
Type of flexibility contract (mandatory or voluntary)	mandatory/voluntary (depends on the kind of contract; if you choose the "flexible" one the flexibility comes mandatory)	mandatory/voluntary (depends on the kind of contract; if you choose the "flexible" one the flexibility comes mandatory)	mandatory/voluntary	
direct contracts between DSOs-customers	Yes, but only in some exceptions, see comment	Yes, but only in some exceptions, see comment	yes	In terms of private households and sme's there is a legally foreseen right to flexibility for specific contract types/products like nightstore or emobility. In that cases the grid operator is usually allowed to use the flexibility autonomously, which means that the customer has to accept it as a standard.
contracts between DSOs-customers via retailers/aggregators	yes	yes	No/Yes (usually in this case direct contracts with grid operators)	
contracts between DSOs-customers via other regulated parties *(i.e. services provided by customers to TSOs)*	no	no	no/yes	some contracts between TSOs and big industrial customers to secure the national balance
Reflected in the network tariff or flexibility contract*				
direct contracts between DSOs-customers	see above	see above	see above	
contracts between DSOs-customers via retailers/aggregators	see above	see above	see above	
contracts between DSOs-customers via other regulated parties *(i.e. services provided by customers to TSOs)*	see above	see above	see above	
Please describe the type of flexibility service *(i.e. curtailment, peak shifting, etc)*				
Does the regulatory framework reward DSOs for these flexibility services *(i.e. load curtailment), and how?*	no	no	no	
Are the customers remunerated for providing these flexibility services, and how?	yes	yes	yes	reduced grid charges impacts customer tariffs (but reather limited)

**Tariff contract/flexibility contract: Is a 'flexibility contract' or is a 'grid tariff contract including flexibility services'*
*** if you have any other cathegory, please make your comments here, also you explain any helpful detail*

	Type of customers			
Country: Hungary	**household customers**	**small and medium sized enterprises**	**industrial customers/generators**	**Comments****
Current national legislation allowing DSOs to contract flexibility	Yes	Yes	Yes	not applied
Please describe the types of devices used (heat-pumps, emobility, wind turbines, PV, etc)	not applied	not applied	not applied	
Type of flexibility contract (mandatory or voluntary)	not applied (should be voluntary)	not applied (should be voluntary)	not applied (should be voluntary)	
direct contracts between DSOs-customers	No	No	No	
contracts between DSOs-customers via retailers/aggregators	No	No	No	
contracts between DSOs-customers via other regulated parties *(i.e. services provided by customers to TSOs)*	No	No	No	
Reflected in the network tariff or flexibility contract*				
direct contracts between DSOs-customers	heat pumps, boylers	not applied	not applied	
contracts between DSOs-customers via retailers/aggregators	not applied	not applied	not applied	
contracts between DSOs-customers via other regulated parties *(i.e. services provided by customers to TSOs)*	not applied	not applied	not applied	
Please describe the type of flexibility service *(i.e. curtailment, peak shifting, etc)*	switching by DSOs	not applied	not applied	
Does the regulatory framework reward DSOs for these flexibility services *(i.e. load curtailment), and how?*	Legal obligation	not applicable	not applicable	
Are the customers remunerated for providing these flexibility services, and how?	lower grid fees	not applicable	not applicable	

**Tariff contract/flexibility contract: Is a 'flexibility contract' or is a 'grid tariff contract including flexibility services'*
*** if you don't fit in this table, please make your comments here. You can also explain any other detail*

	Type of customers			
Country: Netherlands	**household customers**	**small and medium sized enterprises**	**industrial customers / generators**	**Comments****
Current national legislation allowing DSOs to contract flexibility	Yes	Yes	Yes	It is not forbidden in the legislation, but there are only a few pilots.
Please describe the types of devices used (heat-pumps, emobility, wind turbines, PV, etc)	washing machines, heatpumps	-	decentral RES / CHP's	
Type of flexibility contract (mandatory or voluntary)	voluntary	voluntary	voluntary	
direct contracts between DSOs-customers	no	no	no	no regular contracts
contracts between DSOs-customers via retailers/aggregators	yes in pilots	Yes in pilots	Yes in pilots	only in pilots
contracts between DSOs-customers via other regulated parties *(i.e. services provided by customers to TSOs)*	no	no	no	
Reflected in the network tariff or flexibility contract*				
direct contracts between DSOs-customers	N/A	N/A	N/A	
contracts between DSOs-customers via retailers/aggregators	flexibility contract	flexibility contract	flexibility contract	only in pilots
contracts between DSOs-customers via other regulated parties *(i.e. services provided by customers to TSOs)*	N/A	N/A	N/A	
Please describe the type of flexibility service *(i.e. curtailment, peak shifting, etc)*	peak shifting	peak shifting	RES / CHP: curtailment	
Does the regulatory framework reward DSOs for these flexibility services *(i.e. load curtailment), and how?*	No	No	No	
Are the customers remunerated for providing these flexibility services, and how?	Yes	Yes	Yes	renumeration is specific for the pilot. No information available

**Tariff contract/flexibility contract: Is a 'flexibility contract' or is a 'grid tariff contract including flexibility services'*
*** if you don't fit in this table, please make your comments here. You can also explain any other detail*

General comment: Dutch DSOs operate networks up to 50 kV. The answers above do not apply for the TSO (TenneT)

	Type of customers			
Country: Norway	**household customers**	**small and medium sized enterprises**	**industrial customers/generators**	**Comments****
Current national legislation allowing DSOs to contract flexibility	Yes	Yes	Yes	
Please describe the types of devices used (heat-pumps, emobility, wind turbines, PV, etc)	No contracts in open market (it may be some pilots)	Only load management so far	Load management and services for the reserve market	
Type of flexibility contract (mandatory or voluntary)	voluntary	voluntary	voluntary	
direct contracts between DSOs-customers	No	No	No	Detailed regulation on this is not yet in place but this approach is included in the Nordic market model
contracts between DSOs-customers via retailers/aggregators	yes	Yes (interruptible tariffs)	Yes (interruptible tariffs and energy options)	Households: so far we do not know if there is a contract like this in the market (flexibility is extremely cheap in Norway because of the hydro power). Our member Agder is now looking into a pilot project where they want to buy flexibility behind a transformer station that is overloaded (bottleneck); this may also include households
contracts between DSOs-customers via other regulated parties *(i.e. services provided by customers to TSOs)*	No	Yes **	Yes **	(some interruptible tariffs are ruled by TSO)
Reflected in the network tariff or flexibility contract*	No	Interruptible tariff	Interruptible tariff	
direct contracts between DSOs-customers	No	only interruptible tariffs	Interruptible tariffs and energy options (with TSO)	
contracts between DSOs-customers via retailers/aggregators	flexibility contract	flexibility contract	flexibility contract	
contracts between DSOs-customers via other regulated parties *(i.e. services provided by customers to TSOs)*	No	Yes **	Yes **	Interruptible tariffs is partly for DSO and TSO
Please describe the type of flexibility service *(i.e. curtailment, peak shifting, etc)*	No	Peak shifting	Peak shifting	
Does the regulatory framework reward DSOs for these flexibility services *(i.e. load curtailment), and how?*	No	no **	No **	Interruptable tariffs gives DSO reduced cost because not guaranteed delivery
Are the customers remunerated for providing these flexibility services, and how?	Yes/No	Yes, Reduced tariffs	Yes, reduced tariffs	

**Tariff contract/flexibility contract: Is a 'flexibility contract' or is a 'grid tariff contract including flexibility services'*
*** if you don't fit in this table, please make your comments here. You can also explain any other detail*

	Type of customers			
Country: Slovenia	**household customers**	**small and medium sized enterprises**	**industrial customers/generators**	**Comments****
Current national legislation allowing DSOs to contract flexibility	No	No	No	Flexibility as a service is envisaged in the 43th paragraph of the National Energy Act (Uradni list RS, št. 17/14 z dne 7. 3. 2014), DSOs have a possibility to perform DSM services, but with the confirmation/ in accordance of National Agency for Energy
Please describe the types of devices used (heat-pumps, emobility, wind turbines, PV, etc)	None	None	None	
Type of flexibility contract (mandatory or voluntary)	-	-	voluntary	
direct contracts between DSOs-customers	No	No	No	
contracts between DSOs-customers via retailers/aggregators	No	No	Yes	
contracts between DSOs-customers via other regulated parties *(i.e. services provided by customers to TSOs)*	No	No	No	
Reflected in the network tariff or flexibility contract*				
direct contracts between DSOs-customers	No special net usage tariffs for Flexibility;	No special net usage tariffs for Flexibility;	No special net usage tariffs for Flexibility;	
contracts between DSOs-customers via retailers/aggregators	No special net usage tariffs for Flexibility;	No special net usage tariffs for Flexibility;	No special net usage tariffs for Flexibility;	
contracts between DSOs-customers via other regulated parties *(i.e. services provided by customers to TSOs)*	None	None	None	
Please describe the type of flexibility service *(i.e. curtailment, peak shifting, etc)*	None	None	mFRR (manual Frequency Restoration Reserve)	
Does the regulatory framework reward DSOs for these flexibility services *(i.e. load curtailment), and how?*	No	No	No	
Are the customers remunerated for providing these flexibility services, and how?	No	No	For both, for the Capacity and for the activated energy	

**Tariff contract/flexibility contract: Is a 'flexibility contract' or is a 'grid tariff contract including flexibility services'*
*** if you don't fit in this table, please make your comments here. You can also explain any other detail*

About CEER

The Council of European Energy Regulators (CEER) is the voice of Europe's national regulators of electricity and gas at the EU and international level. Through CEER, a not-for-profit association, the national regulators cooperate and exchange best practice within and beyond Europe's borders. CEER includes national regulatory authorities from 35 European countries (the EU-27 (excluding Slovakia, Iceland, Norway, Switzerland, FYROM, Montenegro and growing).

One of CEER's key objectives is to facilitate the creation of a single, competitive, efficient and sustainable EU internal energy market that works in the public interest. More specifically, CEER is committed to placing consumers at the core of EU energy policy. CEER believes that a competitive and secure EU single energy market is not a goal in itself, but should deliver benefits for energy consumers.

CEER works closely with (and supports) the Agency for the Cooperation of Energy Regulators (the Agency). The Agency, which has its seat in Ljubljana, is an EU Agency with its own staff and resources. CEER, based in Brussels, deals with many complementary (and not overlapping) issues to Agency's work such as international issues, smart grids, sustainability and customer issues. European energy regulators are committed to a complementary approach to energy regulation in Europe, with the Agency primarily focusing on its statutory tasks related to EU cross-border market development and oversight, with CEER pursuing several broader issues, including international and customer policies.

The work of CEER is structured according to a number of working groups and task forces, composed of staff members of the national energy regulatory authorities, and supported by the CEER Secretariat.

This report was prepared by the CEER DS Working Group.

CEER wishes to thank in particular the following regulatory experts for their work in preparing this report: Aoife Parker-Hedderman, Andrew White, Suvi Lehtinen, Joel Seppälä, Jori Säntti, Veli-Pekka Saajo, Ville Väre, Cathrine Åsegg Hagen, David Epelbaum, Jill Thinnes, Pauline Henriot and Anastasio Sofias.