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Incentives Schemes for regulating DSOs, including for Innovation

Consultation Paper

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Council of European Energy Regulators asbl
Cours Saint-Michel 30a, Box F – 1040 Brussels, Belgium
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INFORMATION PAGE

Abstract

The "Bridge to 2025 Conclusions Paper[1]" acknowledged that energy systems have been impacted by "s*ignificant structural and market developments which have* altered the characteristics of electricity and natural gas distribution activities". European energy regulators have committed themselves to developing guidelines of good practice for incentive schemes that are used as tools to regulate distribution system operators and that best fit the challenges of the new context in the European energy sector.

The present public consultation document describes European regulators' initial thinking on this important issue. The aim is to collect feedback from stakeholders in order to define Guidelines of Good Practice (GGP) on Incentives Schemes for regulating Distribution System Operators (DSOs), including for Innovation, expected in Q2 2017. The paper includes real world examples, in order to publish final guidance for national regulatory authorities (NRAs) about regulatory incentives. In particular, we are seeking views from respondents on the following key areas:

- Regulatory principles, goals and tools;
- Changing needs - how expected changes in the electricity sector raise new challenges for NRAs in designing effective regulatory models;
- Changing aims in regulation, which are driven by the energy transition, and approaches of good practice on areas which CEER regards as important where regulators and other stakeholders can take steps to reach an optimal outcome for the system.

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

Distribution networks, Regulation, Goals, Aims, Electricity, Gas, Incentives, Income, Costs, Innovation.

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

[1] http://www.acer.europa.eu/official_documents/acts_of_the_agency/sd052005/supporting%20document%20to%20acer%20recommendation%2005-2014%20-%20%20energy%20regulation%20a%20bridge%20to%202025%20conclusions%20paper.pdf

Related Documents

- Final CEER 2016 Work Programme, 6 January 2016, Ref. C15-WPDC-27-06
- Final CEER 2017 Work Programme, 5 January 2017, Ref. C16-WPDC-28-06
- The Future Role of DSOs, A CEER Conclusions Paper, Ref. C15-DSO-16-03, 13 July 2015
- The Future DSO and TSO relationship, A CEER Position Paper, Ref. C16-DS-26-04, 21 September 2016
- CEER Guidelines of Good Practice for Electricity Distribution Network Tariffs, Ref. C16-DS-27-03, 23 January 2017
- Energy Regulation: a Bridge to 2025, ACER in cooperation with CEER Conclusions Paper, 19 September 2014

EXECUTIVE SUMMARY

The ACER "Bridge to 2025 paper" described how structural and market developments have altered the characteristics of electricity and natural gas distribution activities. The paper committed CEER to developing guidelines of good practice for incentive schemes used in the regulation of distribution network companies.

The present public consultation document describes European regulators' thinking on this important issue. The aim is to inform stakeholders on European regulators' common perspectives on incentives schemes and collect feedback from stakeholders in order to contribute to the definition of Guidelines of Good Practice (GGP) that can inform NRAs including through real world examples. Those will inspire and further enable NRAs to identify regulatory models with incentive schemes that best fit the challenges of the new context in the European energy sector, taking into account also specificities of the concrete situation each NRA faces in its own country.

This report first presents goals for regulation of distribution network companies, along with the relevant regulatory tools. It recognises that the core aims of regulation, e.g. achieving cost efficiency and quality, remain important and can be supported by DSO innovation.

In this paper, CEER acknowledges that expected changes in the electricity sector raise new challenges for NRAs in designing effective regulatory models. We conclude that these changes and new challenges can be divided in three categories; technical, economic and organisational. Such new challenges may trigger the need for changes in regulatory tools and/or regulatory aims.

Whilst the original aim of regulatory intervention in grid-bound energy supply was to decrease inefficiencies in natural monopolies, the overall transformation of the energy system in general, and the significant changes on the distribution level in particular, require a critical reflection as to whether a realignment of regulatory aims is necessary and if so in which direction. The challenges for NRAs consist in integrating the new aims into the existing aims, and to operationalize them by introducing appropriate incentives in order to make network operators strive towards these aims. In that context, we then identify key important areas where, in CEER's view, regulators and other stakeholders can take steps to reach an optimal outcome for the system. For those areas, being the balancing of choices, innovation and the whole system approach, this report presents approaches that are good practice.

Regarding balancing of choices, we conclude that to reach common regulatory goals, in a changing environment, raises new regulatory challenges, NRAs must understand some critical points. These are the effect of their choices, the circumstances they operate in, and the stakeholders that are involved, to be able to balance different goals and incentives against each other. Therefore, the definition of regulatory incentives has to follow an interactive process with stakeholders. During this process, regulators should clearly present their proposals, preferably alongside supporting impact assessments of the incentives. Monitoring instruments and indicators should be developed afterwards and presented to stakeholders in order to evaluate the regulatory tools and adapt them if necessary.

The presence of innovation is a key element when considering the effectiveness of any regulatory framework. Incentives for innovation are mainly seen as a means to reach other aims, and can be delivered both indirectly and directly. Innovation is increasingly a crucial and widespread condition to achieve several main targets, such as quality of service, cost efficiency and security of supply.

Innovation may come in different forms, and so may the underlying regulatory aims. The present paper presents different approaches and their advantages and drawbacks. On the one hand, innovation can be interpreted as one among several other enablers to reach an aim, i.e. the regulatory aim of cost reduction/efficiency. In this case, providing incentives on the overarching aims provides incentives for innovation. On the other hand, NRAs may decide to explicitly incentivise innovation. In this case, innovation incentives can be considered as one of the main instruments to achieve regulatory aims. Depending on which of these strategies is pursued, the calibration and delivery (indirectly or directly) of regulatory incentives may vary significantly. Nevertheless, regardless of the type of innovation incentives applied (input or output based), when designing incentives for innovation it would be more adequate to let the DSO choose the most efficient solution to achieve a particular aim, providing a regulatory framework that promotes innovative approaches but does not impose them. Case studies from several NRAs illustrate a range of individual approaches.

When designing incentive schemes for DSOs to tackle new regulatory challenges, a holistic approach, i.e. a ”whole system approach”, has to be addressed. The whole system approach focuses on the “system” concept, trying to identify the net benefit that regulatory decisions may bring for the whole electricity system. Therefore, it is vital to recognize the roles and responsibilities of DSOs and TSOs, e.g. to clarify if benefits in distribution grids have an impact on transmission system operations. When adopting a forward looking perspective, regulators may consider the impact of DSO´s regulated network activities beyond the network, keeping in mind that this should only be used in areas where competition is absent.

The present document initiates a public consultation process, and it aims to support CEER in the definition of Good Practices for the design of forward looking and effective incentive schemes for DSOs, elaborating on previous CEER internal work as well as on stakeholders’ publicly available reports.

In short, the key areas for which CEER is seeking views from respondents are:

- Regulatory principles, goals and tools;
- Changing needs - how expected changes in the electricity sector raise new challenges for NRAs in designing effective regulatory models;
- Changing aims in regulation, which are driven by the energy transition, and approaches of good practice on areas which CEER regards as important where regulators and other stakeholders can take steps to reach an optimal outcome for the system.

This report will be followed by the analysis of stakeholders’ answers. Finally, a subsequent conclusions paper will present CEER’s Guidelines of Good Practice for incentives schemes for DSO , expected in Q2 2017.

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INTRODUCTION

Background

The "Bridge to 2025 Conclusions Paper[2]" acknowledged that energy systems have been impacted by "s*ignificant structural and market developments which have altered the characteristics of electricity and natural gas distribution activities".* In its Clean Energy for All Europeans Package, the European Commission also recognizes the changing role of DSOs in a context of structural changes in the market, which may raise the need for new regulatory solutions. Against this background, European energy regulators have committed themselves to developing guidelines of good practice for incentive schemes that are used as tools to regulate distribution system operators. This includes particularly those that encourage efficient innovation by energy distribution system operators (DSOs) in such areas where competition is absent. The present public consultation document describes European regulators' initial thinking on this important issue. The aim is to inform stakeholders on European regulators' common perspectives on incentives schemes and collect feedback from stakeholders in order to contribute to the definition of Guidelines of Good Practice (GGP) that can *inform* national regulatory authorities (NRAs), including through real world examples. These shall inspire and enable NRAs to identify regulatory models with incentive schemes that best fit the challenges of the new context in the European energy sector in a way that also takes account of the specific context facing the NRA in its own country.

The following CEER principles on regulatory incentives underpin this document:

1. **Level-playing field**: ensuring non-discriminatory access to the distribution network;
2. **Cost efficiency**: promoting cost efficiency of natural monopolies in the absence of competitive pressure. This encourages DSOs to perform their core tasks in a way which meets the reasonable expectations of network users and other stakeholders in the most efficient and economical way;
3. **Financial viability**: ensuring that DSOs have sufficient financial means to operate efficiently, based on a cost of capital which reflects national circumstances and their regulated status);
4. **Quality of service**: ensuring that DSOs offer the right services, with a quality of service level that is satisfactory for network users and which contributes to security of supply for the whole network system;
5. **Innovation**: applying regulatory mechanisms which facilitate the pursuit of innovative approaches by DSOs, which have the potential to bring savings or benefits to consumers. Regulatory tools should avoid undue bias towards capital expenditure;
6. **Security of supply**: promoting security of supply (including resilience of networks to extreme climatic events and cyber-attacks); and
7. **Holistic view**: ensuring a coordinated whole system approach.

[2] Bridge to 2025 Conclusions Paper, see: http://www.acer.europa.eu/official_documents/acts_of_the_agency/sd052005/supporting%20document%20to%20acer%20recommendation%2005-2014%20-%20%20energy%20regulation%20a%20bridge%20to%202025%20conclusions%20paper.pdf

Building on these principles, this CEER paper presents goals and tools for regulation of distribution system operators. It considers the implications of the development of the aims and approaches used by NRAs. It looks at how market developments might trigger changes to regulatory tools and/or regulatory goals.

As highlighted in the "The Future Role of DSOs" CEER Conclusion paper, while the basic functional models are broadly the same, there are significant differences between distribution systems and DSOs across Europe.

Those differences, together with distinct environments (i.e regulatory frameworks) in terms of the penetration of renewable distributed energy resources, justify different needs and goals for the energy sector across European NRAs. European NRAs do however share a common set of challenges in DSO regulation that are addressed in this consultation document.

It is also important to remember that regulatory decisions create a wide range of effects, where the NRA has to strike a balance in setting the (financial) *breadth* of regulation, efficiency incentives and explicit mechanisms for other aims like quality of service, market integration and the promotion of innovative solutions. For example, a very strong focus on cost efficiency may weaken incentives for quality or incentives for goals other than cost efficiency. These effects have to be balanced by each NRA, taking into consideration its regulatory framework. Therefore, there is no one unique solution in terms of regulatory approach. We think that NRAs should still try to keep regulation as neutral and unbiased as possible, so that DSOs can make their own decisions on how to achieve the goals under an optimal allocation of resources and balance between operational cost (OPEX) and capital cost (CAPEX). In other words, so that their decisions are made on a level playing field based on the economic circumstances.

Previous CEER work on the new role of DSOs considered that, in principle, DSOs must run their business in a way which reflects reasonable expectations of network users and other stakeholders. Incentive regulation is intended to trigger actions by DSOs that they might not undertake otherwise. The main goal is to let DSOs fulfil their legal obligations for network design, development and operation, including providing a non-discriminatory access to the grid, in such a manner that allows DSOs to achieve an optimal outcome on several fronts simultaneously, for example providing an optimal level of quality and security of supply, as well as achieving efficient costs. This could include less traditional goals, such as removing barriers for efficient balancing. Beyond traditional forms of regulation, the implementation of output-based regulation could also be an effective way to promote efficient investment and innovative approaches to the benefit of consumers and to tackle the challenges of the DSO, particularly in a more flexible and competitive environment. We note, however, that it can be challenging to set output targets accurately.

Since it is a complex and dynamic process, the design of incentives has to be done in a clear and transparent way, in which all stakeholders can participate. The increasing interactions between agents along the network, from the very high voltage to the low voltage, also requires that the process follows a forward looking and coherent "whole system" approach.

In "Future role of DSOs", CEER also highlights the growing importance of promoting innovation along the distribution system, which has, until very recently, been a very traditional and passive system, The presence of innovation is a key element when considering the effectiveness of any regulatory framework. Although the promotion of innovation may not be an aim in itself, it is increasingly a crucial and widespread condition to achieve several main targets, such as quality of service, cost efficiency and security of supply.

NRAs need to be endowed with sufficient resources and powers to be able to follow the development of the industry in their own countries and develop regulatory models with effective incentives. Furthermore, the regulatory models should enable DSOs to fulfil the demands that stem from new obligations and targets.

This consultation document raises a set of questions which aim to support CEER in the definition of good practices for the design of forward looking and effective incentive schemes for DSOs, elaborating on previous CEER internal works as well as on stakeholders' publicly available reports[3].

Consulation questions

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

Current principles and regulatory approaches

1. Is there any regulatory aim that should prevail over other aims?
2. What regulatory tools are the most effective to achieve regulatory aims?
3. Do you have examples of additional important tools in regulation?

Changing needs

4. Considering the national and the European regulatory frameworks, what are the main challenges for DSO regulation?

Changing aims and approaches of good practice

Changing aims

5. What are the most relevant new issues for DSO regulation?
6. What should be the main regulatory goals in the near future?

Balancing of choices

7. Do you agree that the regulatory process shall be an interactive process between regulators and stakeholders?
8. What can be done to allow a more active participation from the stakeholders?

Innovation

9. Do you agree that technologically neutral indirect approaches are the most efficient way to promote innovation?
10. Do you agree that innovation should be seen from the costumers perspective?

[3] CEER is working in several areas on the distribution system regulatory evolution, mainly regarding flexibility, tariffs, incentives and TSO/DSO coordination, according the "Future role of DSOs – conclusion paper".

11. Could you provide examples of indirect or direct incentives for innovation which you consider to be effective?

Whole system approach

12. What do you think about the CEER position on the whole system approach?
13. Could you provide examples of the whole system approach that bring added value?

Regulatory incentives for DSOs and energy consumers

Incentive regulation is intended to trigger actions by DSOs that they might not undertake otherwise. The main goal is to let DSOs fulfil their legal obligations for network design, development and operation, including providing a non-discriminatory access to the grid, in such a manner that allows DSOs to achieve an optimal outcome on several fronts simultaneously, for example providing an optimal level of quality and security of supply, as well as achieving efficient costs.

By incentivising DSOs to operate as efficiently as possible, regulators are thus benefiting energy consumers through, for instance, lower network charges. Therefore, designing the most effective incentive schemes that lead DSOs to reach the most efficient (i.e, less costly) outcome when operating and developing energy networks will likely lead to lower costs to consumers.

Moreover, the electricity sector can no longer be considered as being vertically-oriented, with financial and physical flows coming downstream from production to consumers through the transmission and distribution grids. Recent structural changes, such as distributed generation and the emergence of new roles for consumers (who should no longer be regarded by distributors as passive energy ‘takers’), have contributed to making distribution activities even more relevant for the proper funtioning of the electricity sector.

However, these structural changes and new challenges are taking place in parallel with increased concerns with the affordability of the energy sector for European economies and with demands that economic efficiency must not be compromised, since most energy consumers pay for costs related with the distribution system networks through tariffs or network charges. Therefore, throughout this paper we discuss how consumers can maximize the value for the money they pay through distribution system networks tariffs.

Chapter 1: Current principles and regulatory approaches

This chapter identifies current considerations and practices for setting regulatory schemes for price controls of DSOs. It begins by presenting and defining the main drivers for regulation. These are generally common across the European NRAs. The Chapter then examines some of the different regulatory tools which can be used to achieve these regulatory goals.

1.1 Principles and goals of regulation

DSOs must run their businesses in a way which takes both the network users and other potential stakeholders into account. Natural gas and electricity distribution activities display important differences in terms of their legal, economic and technical features. However, both the management and operation of the physical networks constitute natural monopolies. According to standard economic theory, regulation of energy distribution activities is thus required to achieve socialy desirable outcomes. Without regulatory action, DSOs might not proactively seek to improve the quality of supply, to decrease their costs to an efficient level or to ensure a non-discriminatory access to their grids. Economic regulation of distribution activities is underpinned by a series of common goals. Within the ambit of their responsibilities, European energy regulators share objectives to encourage delivery of high standards of public service, to promote economic efficiency, and to encourage security of supply and energy efficiency.

Given the fundamental importance of energy for society and the economy as a whole, European legislation (Third Energy Package[4]) establishes a legal framework for distribution network activities, including public service obligations. Those obligations shall be included in the objectives that NRAs are required to achieve, producing principles that shall be fulfilled and a common set of goals for European regulators.

The Third Package also places a number of responsibilities on NRAs regarding their oversight of DSOs, in particular in ensuring non-discriminatory access to the network, promoting not only economic efficiency but also other aims like market integration and security of supply, as well as supporting the related research activities through appropriate incentives. As one element of the regulatory framework, network tariff design can help to address access to the network, by preventing cross subsidies between consumers, or by imposing unbundling obligations (i.e. in terms of separated accounts or in terms of independence of some management functions)[5].

Meanwhile, promoting the economic efficiency of the network operator is more related to the definition of allowed revenues to be recovered in the network tariffs. This goal is broad in scope and includes several factors. Most of those factors are addressed by regulators based on regulatory methodologies that try to simulate a competitive environment, leading companies to comply with the regulatory goals through a variety of incentives. Such tools will be described in the next section.

[4] https://ec.europa.eu/energy/en/topics/markets-and-consumers/market-legislation

[5] This topic is addressed in CEER Guidelines of Good Practice on Distribution Network Tariffs.

Aiming for distribution costs that are efficient in the short and long run is a key component of this task, and entails ensuring i) that DSOs incur a minimal level of costs while performing their legal obligations; and ii) that users do not pay for inefficiencies. These two perspectives must therefore be taken into consideration by regulators when they are defining the DSO's allowed revenues or analysing its network development plans.

Promoting economic efficiency also requires that the return on the DSO's investments matches their cost of capital, i.e., the minimum return that investors expect for providing capital to the company, considering the level of risk of its activities. This calls for a continuous monitoring of the regulated company's economic performance. Regulators also seek to achieve economic efficiency through other ways not directly related to costs or to financial issues, like promoting quality of service – ensuring that DSOs offer the right services, with adequate quality while contributing to sustainability. Encouraging DSOs to innovate in their processes and services is another important goal, as it enables regulators to achieve other regulatory goals.

European legislation outlines other goals which can also be included in this "common set of regulatory goals", namely security of supply and energy efficiency. This latter goal was further reinforced by the 2012 Energy Efficiency Directive[6], which provides guidelines for regulators regarding the promotion of energy efficiency.

When weighting the costs, benefits, and other factors as part of their regulatory responsibilities, NRAs must also ensure that DSOs have sufficient financial means to carry out all their obligations. Their obligations include providing non-discriminatory network access and – in cooperation with the relevant TSO – a coordinated whole system approach, which is detailed below.

It should be noted that the goals presented above are not exhaustive and may differ according to the characteristics and energy context of each country. These characteristics depend on the economic, technical and geographical specificities of each country's energy system and the maturity of its energy market, as well as on political discussions and the corresponding regulatory framework. In particular, the duties, powers and resources of each NRA will to a large extent determine their activities and the measures which may be applied towards achieving these goals.

Thus, countries may rank the regulatory goals referred to above according to their different circumstances. In addition, other regulatory goals could be added to this list to the extent they are necessary to enable regulators to achieve all their current goals.

The table below summarizes the main goals that regulators may pursue in their regulation of DSOs.

These principles are reflected in regulatory goals. Beyond these goals, it is important to note that there have been significant structural and market developments which have altered the characteristics of electricity and natural gas distribution activities. Most of these changes have been triggered by technological progress with impacts on, for instance, information processing or energy storage capabilities.

[6] Directive 2012/27/EU of the European Parliament and of the Council of 25 October 2012; see: http://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1399375464230&uri=CELEX:32012L0027

Principles and goals of DSO regulation
Level-playing field: ensuring non-discriminatory network access
Cost efficiency: promoting cost efficiency in the absence of competitive pressure. DSOs perform their core tasks in a way which meets the reasonable expectations of network users and other stakeholders in the most efficient and economical way
Financial viability: ensuring that DSOs have sufficient financial means to operate efficiently based on a cost of capital which reflects national circumstances and their regulated status
Quality of service: ensuring that DSOs offer the right services, with a quality of service level that is satisfactory for network users, and contributes to security of supply for the whole network system
Innovation: applying regulatory mechanisms which facilitate the pursuit of innovative approaches by DSOs, which have the potential to bring savings or benefits to consumers
Security of supply: promoting security of supply (including resilience of networks to extreme climatic events and cyber-attacks)
Holistic view: ensuring a coordinated whole system approach

Innovation has consequences not only on the demand side, but also on the supply side, particularly at distribution level, with the emergence of smart grids. Smart grid solutions may enable costs to decrease, investments to be avoided, and an improvement in the quality of service. They also allow new challenges to be tackled, for instance the network wide integration of increased distributed energy resources. These developments have brought about new roles for distribution activities and, consequently, new goals for regulators. These new regulatory challenges are addressed in Chapters 2 and 3 of this Consultation Paper.

The "Bridge to 2025 Conclusions Paper[7]" acknowledged this new context and committed that CEER would develop guidelines of good practice for incentive schemes used in the regulation of distribution system operators, in particular to encourage efficient innovation by DSOs in such areas as smart grids. This consultation document presents regulators' initial thinking on this important issue. However, as distribution activities in Europe are characterised by different contexts, these recommendations must be viewed in perspective. For instance, a new goal for a regulator in a certain country could be a current goal for another regulator in a different country, and vice-versa.

[7] Bridge to 2025 Conclusions Paper; http://www.acer.europa.eu/official_documents/acts_of_the_agency/sd052005/supporting%20document%20to%20acer%20recommendation%2005-2014%20-%20%20energy%20regulation%20a%20bridge%20to%202025%20conclusions%20paper.pdf

In a forward looking perspective, a holistic approach (i.e. a ”whole system approach”) must be used. This approach evaluates the consequences of a DSO’s activity beyond the network, both at the transmission and the distribution level[8]. At a first level, DSOs and TSOs need to cooperate in carrying out their roles, taking a whole system approach for the different voltage levels in the energy system. This includes cooperation in the efficient use of innovative solutions and approaches for system operation and network planning. Regulatory arrangements for DSOs and TSOs should create incentives to optimise outcomes for the network system as a whole (all voltage levels), rather than focusing on minimising the DSO’s and TSO’s costs in isolation (high voltage levels vs. medium and low voltage levels). However, it has to be ensured that the services provided by the network companies, and associated cost recovery do not, and will not, unduly distort markets.

The regulatory goals outlined above can be addressed via various regulatory measures (i.e. tools). The following section addresses this in greater detail.

1.2 Regulatory tools

Where the previous section addressed the goals of regulation, in this section we examine how the regulatory system can be designed to allow or to incentivise DSOs to reach those goals. From the previous section, it follows that different goals can be conflicting. Also, tools can affect goals in different ways. The regulator will have to keep this in mind and strike a balance between the tools, considering the desired outcomes. In an annex to this report a summary of the main types of incentive for different goals is included.

There is a broad range of literature on different regulatory approaches for setting the allowed revenues to be recovered by tariffs. Traditionally a ‘cost plus’ approach was dominant, where all costs incurred by the DSO could be charged to the customers. This approach meant low financial risk for the DSOs, however efficiency incentives were low as well. With ex ante incentive regulation (e.g. price-cap or revenue-cap), stronger efficiency incentives are created, as the DSO is able to retain lesser or greater profits, depending on its capacity to achieve the goals defined by the regulators. Regulatory approaches imply important trade-offs. In this section we present tools related to the incentives and breadth of regulation, with regards to the more traditional goals of cost efficiency and financial viability, highlighting the trade-offs to be made by regulators. Subsequently, other aims are addressed.

On the one hand, the design of the regulatory system will include incentives to encourage the regulated companies to be efficient. This incentive is reflected in degree to which actual profits depend the regulated company’s own costs. In cost-plus regulation, the efficiency incentives are low. Generally, the costs are passed on to the customers and a set level of profits is received. Ex ante incentive regulation contains stronger incentives. As the income is generally fixed, the DSO’s level of profit depends on the costs the DSO bears. Subsequently, the determination of the ex-ante income becomes relevant. It could be endogenous, where the income depends on historical costs of the DSO itself.

[8] This is already considered by regulators in some incentives. For instance, it is usual to calibrate the incentives to reduce network power losses considering the Value of Lost Load, that estimates this impact in a broad perspective, for the whole economy.

It could also be exogenous, where the income depends on performance outside the DSO itself, normally defined using a benchmarking exercise (e.g. price cap or yardstick regulation). The exogenous approach would give even higher efficiency incentives. A mix between endogenous and exogenous figures can also be used. For instance, exogenous standardised costs, defined through engineering expertise, can be considered as a benchmark for capital costs and the DSO's historical costs as a reference for operational costs.

The design of the regulatory system can result in different financial breadths. The breadth of regulation is the extent to which DSOs receive a remuneration which is in line with their efficient costs, including a reasonable return. Regulators are aware that there are conflicting interests between different stakeholders as a function of the breadth of regulation. The greater the breadth for the DSO, the higher the costs will be for the customers, and vice-versa. For example, setting the rate of return for the regulated asset base higher than is required by the suppliers of capital results in an extensive profit for the DSOs, higher than their cost of capital (breadth of regulation is wide). Another example is the choice of setting a benchmark on the 'best of class' performance, which creates stricter regulation (breadth of regulation is tight) compared to setting the benchmark on the average sector performance. This is reflected through affordability in terms of grid tariffs on the one hand and a favourable investment climate on the other.

The figure below illustrates the outcome of different regulatory combinations of regulatory breadth and efficiency incentives. In addition, the figure displays the likely type of action by the DSO a particular approach would trigger, and the consequences it could have.

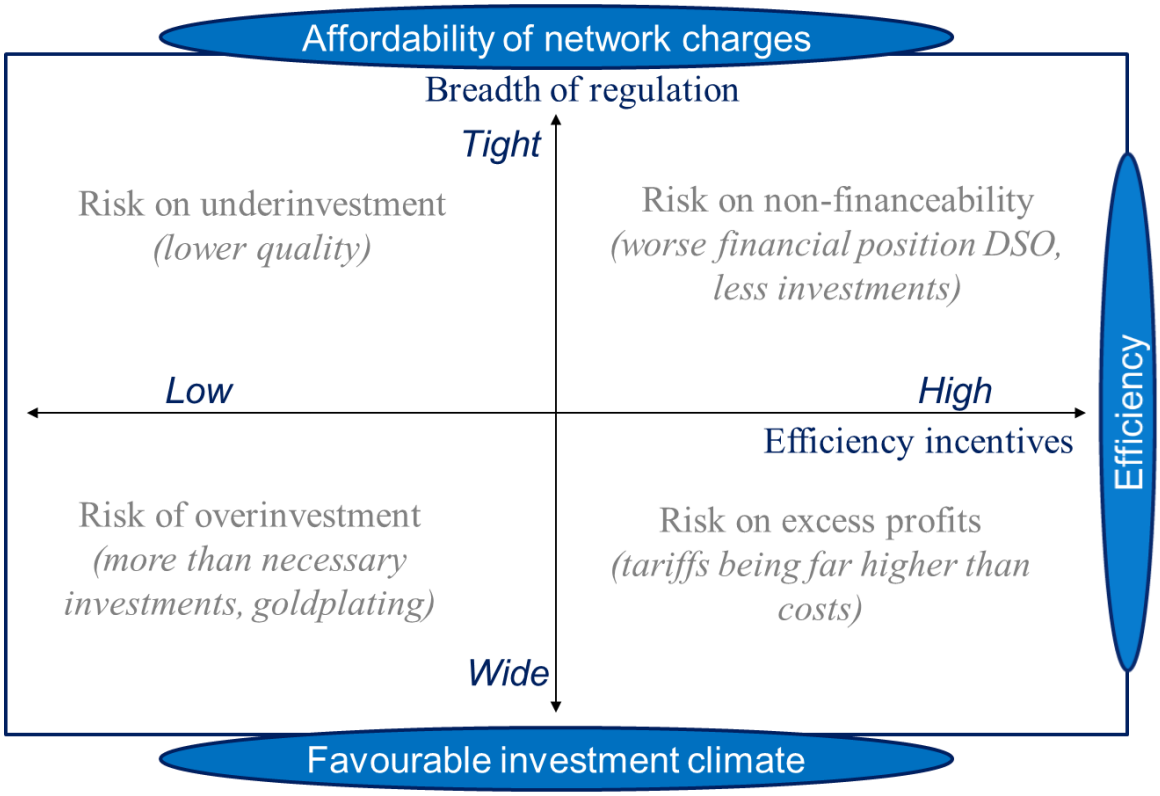

Figure 1: Efficiency incentives and breadth of regulation of energy grids.

Many regulators base the allowed income of a DSO on the expected or realised costs. Costs can be distinguished between operational and capital costs. It is a regulatory choice how to set targets for those costs. One approach would be to have specific targets for operational and capital costs. This could be done, for example, when expectations are that cost reductions on operational costs should be higher or when investments should be promoted. Another approach would be to set targets on the total costs (often called 'TOTEX regulation'), and treat the underlying operational and capital costs in a similar, or the same, way. The main advantage of this approach is that the DSO is not biased by regulation on the use of either operational and capital costs in operating the network. As such, the DSO can find the most optimal balance between operational and capital costs. This approach avoids applying "micro-regulation" that tends to replace company management with NRA management. Note that this regulation in itself may incentivise DSOs to decrease their level of investment in order to raise their rate of return in the short run. Again, there can be a mixed strategy. For example imposing other regulatory aims, namely in terms of quality of service or security of supply, can counter this effect.

Another important regulatory choice is whether to set the targets for a DSO on inputs or outputs. Under pure input regulation, the regulator focusses on cost and may define how certain targets should be met. An example would be prescribing how certain investments are done or how projects are conducted, often driven from a technical viewpoint. Another example of input regulation is basing the allowed income of a DSO on specific efficiency assessments of projects, grid design and operation. By way of contrast, under output regulation, the NRA generally sets goals not on the DSO's inputs, but on factors of importance from the grid user's perspective, that is, on achieving those through outputs. These factors of importance are usually reflected by thresholds for relevant parameters that describe the distribution task of the DSO. Outputs could be factors such as quality targets (e.g. SAIDI levels), capacity of energy delivered, or the facilitation of feed-in of electricity. Under output regulation the DSO has more freedom of choice on how the targets can be met. There is a strong incentive for cost efficiency: in order to maximise outputs, DSO have to identify the solutions able to minimise inputs used to extract a given output, or vice-versa, i.e. the most efficient ones (efficiency being the ratio between output and input).

The output-based approach is increasingly seen as an effective approach for tackling multiple aims. However, some drawbacks should also be noted, including the high level of information required to calibrate parameters effectively. Furthermore, output-based regulation implies a regulatory assumption on what is the right fulfilment of the distribution task and therefore a certain regulatory involvement in the DSO's business. Figure 2 below compares this approach with the input based approach, highlighting advantages and drawbacks of both approaches.

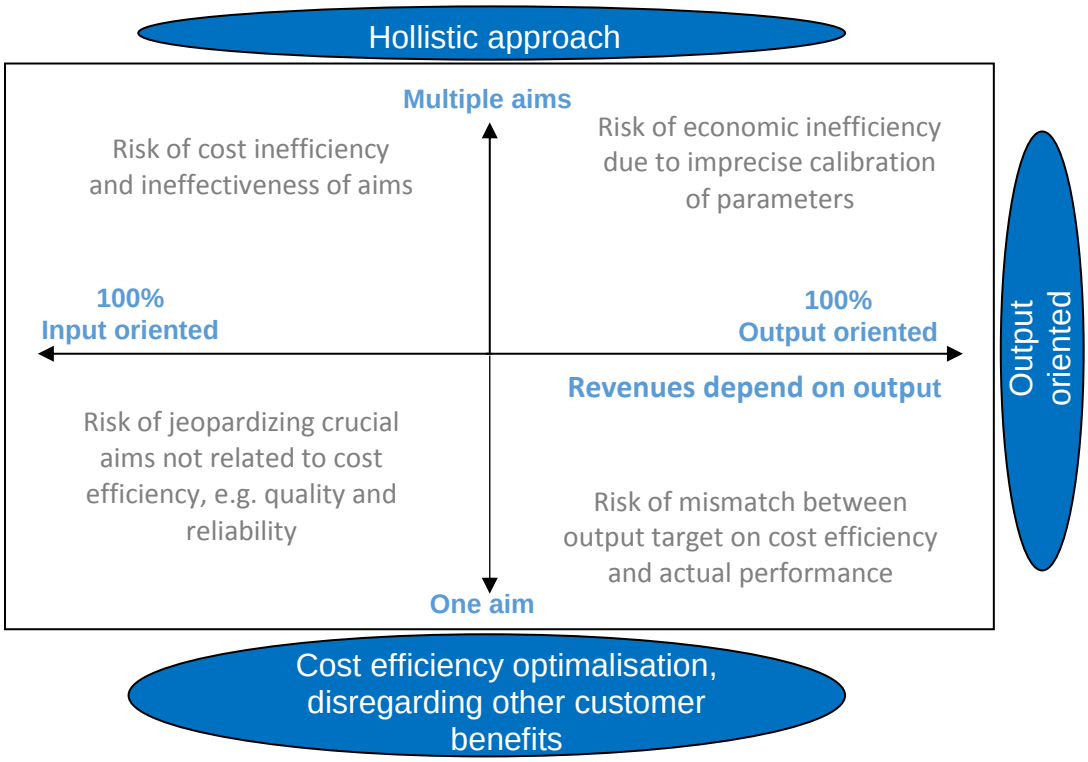

Figure 2: output based and input based regulation

Aside from the goals on cost efficiency, avoiding excess profits and having sufficient financial means to operate the grid, there are other goals to achieve through regulation of DSOs (as identified in the previous section). Some of these aims are becoming increasingly relevant in tackling the new challenges that regulators are facinge. Given the general regulatory approach, there are several ways for an NRA to incentivise a DSO to achieve these goals.

Some aims may be mutually exclusive and regulators may have to make choices before defining an aim, namely when the aim's achievement depends on the allocation of resources and may conflict with cost efficiency. The trade-off between aims is an important regulatory issue that is developed in depth in Chapter 3.

Moreover, regulation can be classified as providing indirect or direct income incentives. The most direct incentive would be to create specific requirements for the DSO. In that case, certain obligations are set on the DSO when operating the grid. For example, this could include redundant grid requirements or services that are offered. It is important that the relevant remuneration and efficiency incentives take such obligations into account. Another way of dealing with these goals could be to include those in the existing efficiency targets. An example would be to include energy losses in the costs and income of the DSO. When the regulation sets the DSO efficiency incentives to reduce costs in general, the DSO is also incentivised to reduce expenses on energy losses. Innovation can be promoted this way. Finally, there can be specific incentive mechanisms on certain goals. This can be done to trigger specific actions, for example by using a separate and higher WACC for certain activities, such as the development of smart grids and other types of investments.

Due to the transition in the energy sector, there is considerable discussion on the position of innovation within regulation. CEER regards innovation as an effective means to achieve other goals in regulation, creating more value for money for customers and the system overall. To adequately address the new challenges that are presented in the next chapter, regulators should consider adopting more forward-looking perspectives that stimulate innovative processes and investments. This could also come from other aims set by the NRA. An example would be an output target for quality of service, which incentivises the DSO to reach – also through innovation – an improved level of quality of service.

Consultation questions

1. Is there any regulatory aim that should prevail over other aims?
2. What regulatory tools are the most effective to achieve regulatory aims?
3. Do you have examples of additional important tools in regulation?

Chapter 2: Changing needs

The documents “Bridge to 2025” and “The future role of DSOs” provide descriptions of the expected changes in the electricity and gas sectors in the future.

The electricity sector can no longer be considered as being vertically-oriented, with financial and physical flows moving downstream from production to consumers through the transmission and distribution grids. Consumers should no longer be regarded by distributors as passive energy ‘takers’. They can produce energy and inject it into the grid. They may sell services to the market, and may even be able to adapt their consumption on an hourly basis in order to lower their energy bills.

We build on this in this paper. We divide the changes and challenges into three categories; technical, economic and organisational. We discuss how these challenges may trigger a need for changes to regulatory tools and/or regulatory aims.

Technical challenges for the DSOs may come from technological changes that affect the DSOs’ tasks, or the technical changes that the DSOs themselves can actively use in performing their tasks. As for the changes affecting the DSOs tasks, the increase in distributed generation and emergence of “prosumers” can change the flow of power in the system. Power may flow both up and down the different voltage levels; it can flow both to and away from the prosumer. We expect that technology may change the profile of consumption due to the growth in appliances that consume more power but demand less energy. New technology will also give more information about consumption, which may provide more active consumers and a growth in demand-side response, both of which would also affect power flows. These changes in power supply, demand and flows on the system give the DSOs a more complex task regarding operation and maintenance of the grid. It can also affect investment decisions. The increased amount of distributed generation can challenge security of supply due to a higher risk of intermittences. Many DSOs will need to invest to maintain quality of supply, but better coordination between TSOs and DSOs (whole system approach) may reduce such a burden or provide a more efficient solution

Regarding technical changes that the DSOs themselves can actively use, DSOs can develop and/or install “smarter” solutions, such as assets that give more knowledge and information. For example, meters or network stations can have more computer technology installed, which enables remote operation of the assets. Also, the assets can log detailed information on the flows in the grid. The challenge for DSOs is to process this potentially large amount of new technical and economic data to improve operation and investment decisions. In some cases, this could lead to investments being delayed.

Economic challenges for the DSOs come from the increased operation and maintenance needs/costs following technical changes and investments that can take advantage of the opportunities provided by new technology. In addition, in many countries there is a demand for a higher quality of supply, that requires additional investment to meet. Also, many DSOs need to invest due to grid maturity. The economic challenge for DSOs will be to raise sufficient capital and knowledge to invest in the best solutions. One challenge for DSOs is to make an optimal choice in grid design, given the possibility that assets could become stranded. Once again, smart grid investments are a challenge but may also be the solution, since those investments may enable grid optimisation and, therefore, may replace the need for new “copper and iron” investments.

For regulators, the challenges concerning technological changes are mainly related to the economic challenges that DSOs face. The challenge for the regulator is to develop models that encourage DSOs to develop and take advantage of technological progress in order to provide better and/or less costly services for customers. It must be highlighted that energy sector utilities are still less innovative, on average, than other companies, namely than companies that perform their activity in a competitive environment[9].

In developing models, one challenge for the regulator is to provide incentives that are as technology neutral as possible. In general, the aim is to allow the market to decide on the best solutions or technologies, and to have no intervention from the regulator on deciding on the best solutions or technologies for the DSOs.

Organisational challenges arise from new responsibilities for consumers, suppliers, prosumers and equipment providers. In addition, the expanded tasks of the DSOs as a more active system operator require more coordination between DSOs and TSOs. The challenge for the regulator is to ensure clear obligations and authorisations for the different roles, and to enable a good coordination and communication between the different actors. The regulator has to ensure neutrality and a level playing field for all parties involved. The DSO will have to find its role as a neutral market facilitator, and act accordingly.

Consultation questions

4. Considering the national and the European regulatory frameworks, what are the main challenges for DSO regulation?

[9] EU R&D SCOREBOARD, European Comission, 2014 - http://iri.jrc.ec.europa.eu/scoreboard14.html

Chapter 3: Changing aims and approaches of good practice

As described in the previous chapter, new challenges may trigger the need for changes to regulatory tools and/or regulatory aims. Regulatory aims can be divided into the more traditional regulatory aims and the future aims that arise with external drivers affecting the role of the DSO and therefore the regulatory environment. In this chapter this paper first addresses changing aims in regulation, which are driven by the energy transition. Following this, it explores areas which CEER regards as important. and where regulators and other stakeholders can set steps towards reaching an optimal outcome for the system. CEER presents good practices to achieve outcomes that include sufficient innovation and utilise a whole system approach.

3.1 Changing aims

As described in chapter 1, the more traditional aims focus on the classical regulatory objectives of cost efficiency, and network quality and reliability, whilst allowing an efficient level of profit for the network operator. Meeting these aims is likely to involve a trade-off and a sensible combination of regulatory parameters is required to ensure an operational balance of regulatory goals. For example, cost efficiency targets may conflict with investments in quality of supply, or inefficient overinvestments may arise from a disproportionately high rate-of-return.

Whilst the original aim of regulatory intervention in grid-bound energy supply was to decrease inefficiencies in natural monopolies, the overall transformation of the energy system in general, and the significant changes on the distribution level in particular, require a critical reflection as to whether a realignment of regulatory aims is necessary and if so in which direction.

In more operational terms, these can be broken down to:

- What should be the main regulatory goals in the near future?
- How could these objectives be achieved?

Changing regulatory aims mutually interact with the changing role of the DSO. As elaborated in the CEER Conclusions Paper (2015) on the future role of DSOs, the areas in which DSOs are active may involve smart solutions, such as smart grids and smart meters, becoming increasingly important as would data and information flows, and coordination with TSOs.

In this perspective regulatory intervention may put a stronger emphasis on data and transparency issues. The increasing smartening of distribution systems and the rollout and implementation of smart meters go hand in hand with increasing amounts of data. Smart meters generate data on consumer consumption behaviour in high granularity. This brings transparency and data protection issues into play. In this context, regulatory intervention will, to an extent, focus on the assignment of roles and responsibilities to the DSO or third parties. This includes questions such as; who is the responsible party for data collection and processing, and who should be allowed to use the data for further commercialisation. Here, unbundling rules play a pivotal role. The aim would be at least to safeguard customer privacy, and to creat a level playing field in the (fair) use of the available data.

A further topic of importance, in the light of the energy transition is flexibility. From a network perspective, access to and appropriate use of, flexibility services can potentially reduce network costs, by allowing for the deferral and/or avoidance of network reinforcement. There is a particular rationale for this in the context of the changing nature of the whole energy system due, *inter alia,* to facilitating increasing volumes of variable renewable generation. The CEER recognises the increasing importance of innovation and the use of services to provide necessary flexibility. Flexibility use by the DSO can support the efficient operation of the energy system. It is important, however, to ensure that flexibility is used in a way that strikes an appropriate balance between the costs of grid reinforcement and the use of flexibility. In that regard, the regulatory framework should support optimal system outcomes for the ultimate benefit of consumers. CEER's paper on *Flexibility Use at Distribution Level* discusses this topic in greater detail.

On sustainability, regulators could aim to increase the incentives for DSOs to reduce energy losses on the grid. DSOs should also take up their role as neutral market facilitators to facilitate the improvement of sustainability across the energy system.

As distribution systems, by their very nature, are natural monopolies, regulatory oversight determines the extent to which the regulated DSOs are encouraged or required to adapt their technological, economical and organisational strategy. The challenges for NRAs consist in integrating the new aims into the existing trio of aims, and to operationalize them by introducing appropriate incentives in order to make network operators strive towards these aims. As a consequence, the patterns of interaction between the traditional regulatory goals may change. CEER addresses the balancing of choices by regulators in the next section. Subsequently, CEER explores two areas in which good practice can improve the long-term optimisation of innovation, and the whole system approach.

3.2 Balancing of choices

Regulatory decisions create a wide range of effects. As mentioned in Chapter 1, some aims can work against each other, but others can be complementary. Strong incentives for cost efficiency may be achieved at the cost of the quality of service provided. Combining cost efficiency with quality of service targets may foster innovation. Neither path chosen to achieve those aims, i.e. regulatory tools, is fully neutral.

Some traditional regulatory tools may be ineffective to achieve most of the aims raised by the current challenges, namely because such challenges require innovative approaches that may not be incentivized by traditional input based tools. Those tools may not be technologicaly neutral, which can lead to undesirable forms of innovation. This will be addressed in the next sections. However, when those tools are applied in the earlier phase of the R&D process they could become more effective. Therefore, NRAs must understand the effect of their choices, the circumstances they operate in and which stakeholders are involved to be able to balance different goals and incentives in a complementary manner.

Furthermore, as some regulators may focus more on outputs than on inputs when they define incentives to address new challenges, they implicitly make assumptions on the correct delivery of distribution tasks, which also represents a certain regulatory involvement in the DSO's business, as mentioned in Chapter 1. This trend reinforces the need for regulators to balance aims and tools in advance, and to legitimise their options vis-a-vis the stakeholders, ensuring that the chosen options bring value for money for the stakeholders in the short and the long term.

NRAs should firstly define the main regulatory goals, following an interactive process with stakeholders. During this process, regulators should clearly present their proposals, alongside supporting impact assessments of the incentives. Monitoring instruments and indicators should be developed afterwards and presented to stakeholders in order to evaluate the regulatory tools and adapt them if necessary. This must be a clear and transparent process in order to ensure a stable and predictable regulatory framework.

Again, as new challenges prompt NRAs to consider the impact of their regulatory choices on the whole system, having an effective monitoring process may also ensure regulators can better evaluate the broader consequences of their regulatory options. Through consistent and efficient monitoring, regulators can focus on establishing outcomes, whilst being less concerned with defining inputs.

Such interactions with stakeholders can be seen as a continuous process that provides NRAs with valuable information regarding key performance indicators, which will in turn improve the process of balancing policy and outcome choices.

3.3 Innovation

In the absence of competitive pressure for DSOs, NRAs need to set incentives which deliver the most efficient long term outcomes for consumers. In general terms, CEER supports innovative solutions where they are in the energy consumer interest, avoiding regulatory overburdening when setting reporting requirements and allowing only efficient implementation costs for innovative solutions from DSOs.

Innovation may come in different forms. Innovation may enhance network operation, e.g. in terms of intelligent steering and control or measuring systems. Ideally, using innovative solutions leads to a more efficient system than using conventional ones. To give some examples, innovation may help to reduce network expansion, and maximize the use of the existing infrastructure. Likewise, the employment of network beneficial flexibility services and other innovative managements of the distribution grid may help to better exploit available network capacity or to avoid network expansion in case of network congestions due to increasing feed-in from renewables. Also, innovation can help to improve operational aspects within the DSO. Important as well is that innovative solutions can improve the reliability of the grid.

These activities may support the realisation of a cost efficient network operation. However, their actual deployment depends on the relevance NRAs accord to innovation. On the one hand, they can be considered as one, among several other, means to an end, i.e. the regulatory aim of cost reduction/efficiency or quality of service. In this case, innovation and flexibilities cannot be interpreted as a changing aim as such, but rather as an enabler to reach a general aim. On the other hand, NRAs may decide to explicitly incentivise innovation. In this case, innovation incentives can be considered as one of the main instruments to achieve regulatory aims. Depending on which of these strategies is being pursued, the calibration of regulatory incentives may vary significantly.

In the first case, where innovation rather constitutes a simple instrument to reach the regulatory aim of efficiency, incentives for innovation will come in an *indirect* form linked to the efficiency incentive applied. The following example explains this indirect approach: how a TOTEX benchmarking yields efficiency targets for a DSO. The benchmarking exercise shall be calibrated in a way that it detects inefficient employment of resources of the DSO vis-à-vis its peers. If DSO A realizes its distribution task with an innovative solution, which is less costly than the conventional solution employed by DSO B, the innovative DSO shall ceterus paribus have a higher profit. Innovations that increase efficiency pay off. Vice versa, if the conventional solution is less costly compared to the innovative one, the same consequences shall apply. Ideally, the indirect incentive is parameterized in a neutral way leaving the decision for the most efficient solution to the network operator. Here, innovation is not regarded as an aim by itself and the regulatory system rather focus on efficiency incentives, e.g. by providing a bonus for very efficient behavior. This would reward innovations indirectly, when the innovation leads to more efficiency. This approach is technologically neutral.

In the second case, where innovation is one of the main instruments, incentives may come in more *direct*, explicit forms. This happens mainly when the regulatory approach in place requires a stronger drive to implement certain solutions for changing needs. In these cases, the regulator can, for example, set premia on the rate of return for investments in certain innovative technologies (e.g. increase of WACC for special smart grid activities).

However, innovation can be effectively promoted with indirect incentives, for instance when a good performance indicator and a clear metric is identified, the regulator can set up an efficient, reliable and controllable output-based mechanism. Here, the performance-based revenues/penalties are based on some key performance indicators accurately selected and calibrated (like distributed energy hosting capacity, load factor, etc). Output based regulation can be effective to stimulate DSOs to deploy innovative functionalities where these are mostly needed. It can be challenging to find performance indicators for innovation specifically, but output indicators for other aims, e.g. quality of supply, may indirectly promote innovation if this increase the performance. Besides, the use of input and output based approach can be complementary. For instance, in what concerns innovation, an input based approach might be more suitable for the demonstration phase of the typical innovation process, and output based regulation for the final deployment phase, when a clear metric and indicators are finally identified. While direct incentives are not technologically neutral, output-based incentives leave DSOs responsible for selecting the best efficient technology; but constitute a special incentive to steer the activities of the DSO in a certain direction by the regulator, leading to a deeper interaction with the stakeholders, as was mentioned in the previous section.

The NRA may choose obligations to promote a very specific innovation, such as a minimum of “smart” metering functionalities for all customers. When requirements are too technically detailed, this approach risks to be not technology neutral and unbiased.

Coming back to direct incentives, a possible approach is to treat certain costs related to R&D as pass through costs in the model when setting revenues. Here, the NRA must define some criteria for what can be included in the arrangement. The challenge is to make those criteria both good enough to promote relevant innovations and easy enough to apply in practice. This is the usual balance between accuracy and simplicity that NRAs often face. The NRA can choose to do all evaluation of a project themselves, or try to leave the evaluations to some external bodies to reduce their own burden of work. For example, one criteria can be that the project has been found worthy of support by a grant institution/research council to be included in the arrangement. In the case of pass through costs, there should also be an upper limit to how much can be included in the arrangement. Also, cost for implementing/rolling out new innovations may be included in pass-through or funding arrangements.

A variant on this approach that offers stronger incentives is where the NRA can provide funding for innovative projects. The funds can be applied for by the DSOs, for example in a tendering process. The companies compete for the funding and the funds can be raised through the tariffs, and be equally shared across all customers because the projects provide benefits for all customers in the country. This is different to the arrangement with special WACC/pass through where costs will be shared by consumers connected to the DSO that invests.

Each member state has different characteristics, and each NRA must determine its goals and activities based on the circumstances that they operate in. There is no “one model fits all”, but these are some examples of good practice that can be considered to incentivize innovations among DSOs.

It is important to note that these approaches interact with the conventional regulatory aims. Direct incentives for innovation may have a certain bias towards the efficiency aims. This is the case under the condition that the network operator chooses an innovative technology (due to a strong incentive to innovation) although a conventional solution would have been more efficient. Therefore, it would be more adequate to let the DSO choose the most efficient solution to achieve a particular aim, providing a regulatory framework that promotes innovative approaches but does not impose them.

Independent from the respective approach towards innovation, innovation by DSOs should be seen from a customer perspective. The DSO should not spend money on something that users do not benefit from. Further, innovation does not necessarily mean new technology; it could also be aimed at the normal corporate process. Innovation as such has always been part of the DSO’s day-to-day business. In the context of *The Future Role of the DSO*, CEER emphasises that DSO innovation should not be outside their own activities as a neutral market facilitator.

3.4 Whole system approach

The main task of the DSO is to operate the distribution grid and act as a neutral market facilitator to all actors involved with its grid. The customers of the DSOs pay for this through grid tariffs. In the performance of DSOs in general, but also in calculating the benefit of an innovative solution on distribution activity (both for management or investment), there can be broader benefits across the energy system as a whole. Therefore, the NRA should also keep a wide and forward looking perspective and have a good understanding of the whole system.

The whole system approach focuses on the “system” concept, trying to identify the net benefit that regulatory decisions may bring for the whole electricity system. Therefore, it is vital to recognize the roles and responsibilities of DSOs and TSOs, e. g. to clarify if benefits in distribution grids have an impact on transmission system operations.

For example, enhancing the visibility of distributed resources may help both, DSO and TSO activities. Indeed, the cooperation between DSOs and TSOs in finding the best design of the integrated transmission and distribution networks could reduce the total network system costs and avoid duplication of investments.

When adopting a forward looking perspective, regulators may consider the impact of DSO´s regulated network activities beyond the network, keeping in mind that this should only be used in areas where competition is absent. In this case it is necessary to guarantee that the services provided by network companies facilitate societal benefits for the good of customers and do not, and will not, unduly distort markets.

Consultation questions

3.1 Changing aims
5. What are the most relevant new issues for DSO regulation?
6. What should be the main regulatory goals in the near future?

3.2 Balancing of choices
7. Do you agree that the regulatory process shall be an interactive process between regulators and stakeholders
8. What can be done to allow a more active participation from the stakeholders?

3.3 Innovation
9. Do you agree that technologically neutral indirect approaches are the most efficient way to promote innovation?
10. Do you agree that innovation should be seen from the costumers perspective?
11. Could you provide examples of indirect or direct incentives for innovation which you consider to be effective?

3.4 Whole system approach
12. What do you think about the CEER position on the whole system approach?
13. Could you provide examples of the whole system approach that bring added value?

Chapter 4: Next steps

CEER invites all interested stakeholders to respond to this public consultation via the dedicated online tool. The deadline for responses is **12 May 2017**.

Following the 12 week consultation period, CEER will consider responses to this consultation carefully and prepare an evaluation of responses.. We will then publish a conclusion report and take forward further relevant actions.

Annex 1 – List of abbreviations

Abrreviation	Definition
ACER	Agency for Cooperation of Energy Regulators
CAPEX	Capital Expenditure
CEER	Council of European Energy Regulators
DSO	Distribution System Operator
EC	European Commission
GGP	Guidelines of Good Practice
MS	Member States
NRA	National Regulatory Authority
OPEX	Operational Expenditure
RES	Renewable Energy Source
SAIDI	System Average Interruption Duration Index
TOTEX	Total Expenditure
ToU	Time of Use
TSO	Transmission System Operator
WACC	Weighted Average Cost of Capital

Annex 2 – Glossary

Term	Definition
Cost plus regulation	Cost plus based regulatory approach focuses on the realised costs, which are passed through into the allowed regulatory income or tariffs.
Direct incentives	The NRA explicitly incentivizes specific behaviour or technology, e.g. by granting a higher rate of return for certain assets or technologies.
Indirect incentives	The NRA implicitly incentivizes a certain behaviour by incentivising overarching regulatory goals, e.g. efficiency incentives may lead to more innovation together with cost reductions.
Input-based regulation	Input-based regulatory approach focusses on costs or processes, where the NRA may prescribe how certain investments are done or projects conducted.
Output-based regulation	Output-based regulatory approach focuses on parameters that describe the distribution task of the DSO or focuses on the performance of the DSO for achieving any regulatory aim. The NRA may set thresholds for relevant parameters to incentivise the DSO in a certain direction.
Price-/revenue cap regulation	The NRA ex-ante determines a regulatory allowance (price or revenue cap) for the DSO which forms the basis for the DSO's allowed revenues recovered through the tariffs charged on third parties for using its network infrastructure. The regulatory allowance is based on the DSOs individual cost structure, considering cost efficiency targets. With the calibration of the cap regulation, regulatory objectices (e.g. in terms of efficiency, quality of supply or innovation) may be calibrated.
Standardised cost regulation	Efficient costs are defined through engeneering experience. This could for example be done by calculating the involved (efficient) costs of the existing of required grid.
Technologically neutral regulation	Regulatory incentives do not create any bias towards a certain technology or cost category (e.g. CAPEX vs. OPEX).
Totex regulation	Allowed revenues do not differentiate between CAPEX and OPEX, bust considers the whole costs, instead. Therefore, it ensures that the incentive is technologically neutral.
Whole System Approach	Approach that focuses on the "system" concept, trying to identify the net benefit that regulatory decisions may bring for the whole electricity system
Yardstick competition	See cap regulation. Here, the regulatory allowance is based in parts or in total on exogenous (efficient) cost structures, for example of other DSOs.

Annex 3 – Main regulatory tools by goals

Cost efficiency
Focused on OPEX
1. Price cap/revenue cap
2. Standardised cost
3. Yardstick competition
4. Cost plus
Focused on Capex
5. Price cap/revenue cap
6. Standardised cost
7. Yardstick competition
8. Cost plus
Focused on Totex
9. Price cap/revenue cap
10. Standardised cost
11. Yardstick competition
12. Cost plus
Promote quality of service
Output-based regulation (penalties/rewards)
Quality of service obligation, i.e., with penalties/rewards
Ensure that the level of profits are close to cost of capital
Monitor and review after each regulatory period
Any automatic mechanism (ex.: cap or floor defined in the rate of return)
Promote innovation
Output-based regulation
Input based regulation (ex: higher WACC for specific investments)
Obligation for users (i.e. connection minimum requirements)
Obligation for DSOs (i.e. minimum smart functionalities)
Promote energy efficiency
Output-based regulation
Input based regulation (ex: higher WACC for specific investments)
Tariff mechanisms
Obligation (i.e. low losses transformers)

Annex 4 – Case studies

Output regulation and indirect innovation incentives - Case Study The Netherlands

ACM regulates the Dutch DSOs by using yardstick competition. ACM combines this with output regulation and sets the income based on the total costs. This regulatory approach offers DSOs the incentives to innovate.

In the Netherlands, seven electricity and eight gas DSOs are present. Since 2000 and 2002 respectively, ACM has used yardstick regulation to set the income of these DSOs. This income is set ex-ante at the start of a regulatory period of three to five years. The income is based on the total costs of the sector, which allows the DSOs to recover sufficient income and provides incentives for them to reduce the costs. As ACM does not treat capital costs and operational costs in a different manner, it is up to the DSO to run its own business without bias.

The yardstick regulation creates an environment where DSOs are incentivised to perform better, both in the short and the long run. Costs for innovation are included in the total costs of the sector and are remunerated to the DSOs through the yeardstick approach. In this way, the DSOs can find their own balance in their degree of innovation and are able to optimise their choices.

ACM distinguishes several different output factors for the electricity DSOs. In setting the income level for a DSO, it is not only the transport and connection to customers that is valued. Also, the performance on facilitating the feed-in of electricity and the quality of supply (frequency and duration of outages) are included. As such, DSOs have other incentives than only reducing their costs.

ACM subscribes to the view that innovation is a means to reach other goals. With the above characteristics of regulation, ACM believes that DSOs have the right incentives to reach the relevant goals. Due to these incentives, DSOs are also triggered to innovate to improve their performance. One of many examples is that Dutch DSOs are moving towards smart grids, where stations can be controlled from a distance and the quality of service increases. The expectation is that this will reduce outage duration considerably.

Incentives for innovation - Case Study Norway

NVE regulates the Norwegian DSOs by using a combination of the company's own costs and the costs from benchmarking models. In addition, costs for R&D are treated as pass-through costs when they fulfill certain conditions, in order to avoid short term disincentives.

The Norwegian NRA calculates yearly revenue caps with elements of yardstick competition. 40% of the revenue cap is based on the company's own costs, and 60% on the cost norm where benchmarking models are used. In the benchmarking, total costs are minimised given the outputs defined in the model.

Research and development rarely increase outputs of the model in the short run. This means that conducting R&D for a DSO would increase costs without any corresponding increase in output, i.e the DSO would perform worse in the benchmarking. This would give disincentives against R&D for a DSO and that is not desirable in a time where there are changes happening in the industry. Based on this, a new mechanism was introduced in 2013 to strengthen the incentives for investing in R&D. In the mechanism, R&D costs are treated as pass-through costs, i.e they are not included in the benchmarking and can be included directly into the tariff base. Three conditions must be fulfilled before the costs are accepted in this mechanism:

1. The R&D is useful for grid operation/investments/planning;
2. It represents a maximum of 0.3 % of the DSO's regulatory asset base;
3. The R&D project is approved by an external body, e.g. the research council. This ensures the burden of work for the NRA is reduced. As the NRA must not evaluate whether it can be considered as research, that decision is delegated to a third party.

Transparent Processes in Regulation - Case Study Portugal

In order to enable the definition of effective incentive schemes, which balance different perspectives, the Portuguese NRA (ERSE) has implemented a set of regulatory policies which are based on several rules, such as transparency, collaboration with stakeholders, and monitoring, under a stable and predictable regulatory framework. These rules have consistently supported ERSE in defining its main regulatory goals and in evaluating, or adapting if necessary, the regulatory tools it applies, based on the feedback from stakeholders.

For instance, to set network access tariffs, regulatory financial reporting rules were established following several discussions with regulated companies. Each year, ERSE's network access tariffs proposal undergoes a public consultation process, during which all of ERSE's tariffs documentation is shared with the public, and representatives of all stakeholders are invited to provide their views and comments before the final tariffs proposal is approved and published. The publication of regulatory codes that imply changes to the regulatory framework, and other statutory responsibilities such as providing non mandatory opinion on companies' network investment plans are also carried out through a process that includes a consultation period, where all relevant information is transparently shared. In this case, even though ERSE's opinion is not binding, it can have a significant influence in the process because it considers stakeholder perspectives.

Another key tool that has contributed to the effectiveness and stability of the Portuguese regulatory framework has been the periodic monitoring of a set of variables which guide regulatory strategies, such as quality of service, regulated activity profitability, the level of infrastructure utilization, and cost efficiency. This set of variables is under review in order to capture further outputs of the network service.

The mechanism adopted by ERSE to promote innovation[10] also benefits from this effective governance framework. Innovation incentives were designed after a consultation process in which stakeholders perspectives were balanced: on the one hand consumers, who tend to be more concerned with cost control in the short run, and on the other hand the DSO, that requires a stable regulatory framewework in the long run. The current version of the mechanism encourages regulated companies to invest in projects/technologies that would lower operating costs while also generating other benefits (i.e, improved quality of service). Moreover, DSO's innovation is also fostered through an incentive based tender process designed to promote energy efficiency, which is open to all kinds of stakeholders. The incumbent DSO has participated with projects focused on energy efficiency in public lighting (one of its core activities).

[10] Portuguese regulatory framework has enabled innovation at DSO level that may push the DSO to higher service levels, like meter reading frequency and consumption data acquisition, dispersed generation metering, quality of service data coverage and reporting, distribution network asset reporting and implementation of automation and remote control solutions, etc..

Output regulation and incentive schemes for innovation - Case Study Italy

In 2016 AEEGSI introduced an output based incentive mechanism for large scale investments on innovative systems for electricity distribution. Based on the results of tests conducted in smart grid pilot projects which were initiated in Italy in 2011, the new regulation overpasses the input based incentive mechanism (extra-WACC) and the attention to the mere "grid" ("smart grid"), focusing on output and the "system" concept ("smart distribution system"), trying to identify the net benefit that innovation may bring at system level and not just at the network level.

The incentive mechanism aims at stimulating DSOs to deploy innovative functionalities where these are mostly needed (areas with huge RES penetration) and where, without such an incentive and with the current tariff system, the DSO could have no interest in developing such innovative solutions.

The analysis undertaken leads to the identification of two innovative functionalities that are not promoted by existing incentive regulatory mechanisms:

- observability of distribution system (power flows and the state of distributed resources);
- ability to regulate the voltage profile of the MV networks.

The mechanism focused on different levels of increasing complexity which could be developed even without challenging telecommunication systems, without any direct involvement from widespread resources and, of course, without distorting the market (in the absence of competition).

A cost benefit analysis has been set for the valuation of the outputs, based on the examination of the performances that are actually necessary, so as to ensure, at the lowest cost, the innovative functionalities of smart distribution systems and the assessment of the costs associated with such performances, taking into account the economies of scale that might arise.

According to these guidelines, this incentive mechanism have two characteristics:

- "output-based": it is correlated to an indicator that expresses in a simple manner the level of benefit from the intervention, since this mode allows the DSO to focus on the more efficient choices for the system;
- "selective" in nature: it is able to orient itself primarily toward those areas in which the intervention yields the greatest net benefits.

The index to selectively steer the development priorities of the functionalities towards the most critical areas with the highest penetration of renewable sources, is based on the Reverse Power Flow Time Indicator that has to exceed 1% on each transformer of PS.

As for the outputs, different benchmarks were chosen for the two functionalities:

- as regards the observability of power flows and the state of network resources, the rated power of DG from RES, in standard network structure, associated with the transformers of the PS in which the "smartization" investment is put into operation;

- as regards voltage regulation on the MV networks, the rated power of transformers of PS in which the “smartization” investment is put into operation.

More detailes: Regulatory order 646/2015/R/eel, Annex A “Testo integrato della regolazione output-based dei servizi di distribuzione e misura dell’energia elettrica” and a dedicated web page:

http://www.autorita.energia.it/it/operatori/smartgrid.htm

Efficiency Bonus - Case Study Germany

As part of the reformed ordinance, an efficiency bonus may be granted to eligible DSOs. It is connected to the benchmarking system, as DSOs are eligible for the efficiency bonus only if they are determined to be fully efficient as a result of the benchmarking process. Bundesnetzagentur carries out a superefficiency analysis – based on the Data Envelopment Analysis of the regular benchmarking – for eligible DSOs, both with actual costs and with standardised costs. The superefficiency value is the difference between the results of the superefficiency analysis and the efficiency values from the regular benchmarking (which is 100% since only efficient DSOs are eligible), capped at 5 % for both cost bases and averaged afterwards. The bonus is then determined by multiplying the superefficiency value with the temporarily non-controllable costs and split evenly over the duration (years) of the regulatory period.

The bonus is designed to enhance innovation as DSOs now have an incentive not only to be fully efficient, but to constantly try to exceed 100 % (relative) efficiency. Thus, it also rewards longer-term innovations which ensure that DSOs reach superefficiency status in future regulatory periods.

About CEER

The Council of European Energy Regulators (CEER) is the voice of Europe's national regulators of electricity and gas at EU and international level. CEER's members and observers (from 33 European countries) are the statutory bodies responsible for energy regulation at national level.

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. CEER actively promotes an investment-friendly and harmonised regulatory environment, and consistent application of existing EU legislation. Moreover, CEER champions consumer issues in our belief that a competitive and secure EU single energy market is not a goal in itself, but should deliver benefits for energy consumers.

CEER, based in Brussels, deals with a broad range of energy issues including retail markets and consumers; distribution networks; smart grids; flexibility; sustainability; and international cooperation. European energy regulators are committed to a holistic approach to energy regulation in Europe. Through CEER, NRAs cooperate and develop common position papers, advice and forward-thinking recommendations to improve the electricity and gas markets for the benefit of consumers and businesses.

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.

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More information at www.ceer.eu.