

**Power Transmission &
Distribution Systems**

The Role of Electricity Distribution Remuneration in Promoting Flexibility from connected users

Joint ISGAN WG9 - BRIDGE RWG Discussion paper

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Preface

This report has been developed within the framework of international collaboration between ISGAN, BRIDGE, and the European Commission's BeFlexible project. It reflects the joint efforts of project partners to analyse how electricity distribution remuneration schemes can promote an efficient use of flexibility solutions by DSOs. The results and discussion presented here combine regulatory principles with practical evidence from prior experience, survey data, and quantitative evidence from previous analyses. The aim is to provide a structured overview of remuneration schemes across several jurisdictions and to offer regulatory recommendations to enable the efficient integration of flexibility solutions into distribution network planning and operation.

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List of Acronyms

CAPEX	Capital Expenditure
CEER	Council of European Energy Regulators
DER	Distributed Energy Resource
DSO	Distribution System Operator
OPEX	Operational Expenditure
TOTEX	Total Expenditure

Abstract

The increasing penetration of distributed energy resources (DERs), such as renewable generation, energy storage, and electric vehicles, is creating growing congestion challenges in electricity distribution networks. While flexibility solutions enabled by smart-grid technologies offer cost-effective alternatives to traditional grid reinforcement, their deployment is strongly influenced by regulatory frameworks. In particular, distribution system operator (DSO) remuneration schemes shape incentives for adopting flexibility solutions. This report reviews the main characteristics of electricity distribution remuneration schemes across different jurisdictions, focusing on their incentives and potential biases between capital expenditure (CAPEX) and operational expenditure (OPEX). The analysis highlights how traditional cost-of-service and hybrid approaches often create a CAPEX bias, limiting the uptake of flexibility solutions, which mainly constitute OPEX, in favour of traditional network reinforcements, which mainly constitute CAPEX. Ex-ante remuneration schemes with profit-sharing mechanisms are recommended to promote cost efficiency and mitigate the CAPEX bias. The report concludes with additional recommendations, such as enabling adaptable planning to unlock the full potential of flexibility solutions and ensure efficient distribution network development in the context of decarbonization, which is characterised by increasing uncertainty.

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1. Introduction

The electricity distribution network faces significant operational and planning challenges due to the penetration of distributed energy resources (DERs), such as renewable generation and storage. The increase in intermittent renewable generation and the uptake of electric vehicles are among the main causes of congestion in distribution networks across several countries, including Germany, Norway, the UK, and the Netherlands [1]. While congestion in distribution networks in some other countries is not yet a significant issue, it is likely to increase as DER penetration spreads, compromising distribution networks' hosting capacity and delaying grid connections or limiting the operation of existing generation, demand, and storage resources.

At the same time, new technologies offer new opportunities for efficient operation and planning. Flexibility¹ solutions may reduce asset load during peak utilisation hours. This peak shaving allows for maintaining high service levels without committing to irreversible investments that may result in underutilised assets if demand does not grow as expected.

However, electricity distribution is a natural monopoly; therefore, it operates as a regulated business. As noted by the Council of European Energy Regulators [2]: "The distribution system operator's (DSOs) decisions when planning, expanding and managing their networks are led by the incentives in the revenue/remuneration regime and direct regulatory requirements." As stated by CEER, the use of smart-grid flexibility solutions by DSOs will depend strongly on the incentives in their remuneration schemes. Thus, regulatory frameworks and, in particular, remuneration schemes should be revisited to ensure they incentivise an efficient development of the distribution network by promoting an efficient combination of smart-grid flexibility solutions with traditional grid investment [3].

In this context, this paper analyses the main characteristics of remuneration schemes in several jurisdictions to provide regulatory recommendations for enabling efficient distribution network planning and operation by removing barriers to flexibility solutions.

1.1. Electricity distribution remuneration schemes and incentives for flexibility solutions

Smart-grid flexibility solutions mainly represent an operational expenditure (OPEX) for DSOs. For instance, an annual contract with an industrial consumer to procure reductions in consumption during peak network utilisation periods, in accordance with DSO instructions. On the other hand, grid investments in distribution feeders or power transformers represent a capital expenditure (CAPEX) for DSOs. Both researchers and regulatory bodies have emphasised the importance of establishing neutral OPEX/CAPEX efficiency incentives in DSO remuneration schemes [4]. Incentive neutrality aims to promote overall system efficiency and remove barriers for innovative smart grid flexibility solutions. Next, we describe the different approaches to remunerating electricity distribution and the biases they entail.

The traditional approach is the cost-of-service. Under this ex-post approach, the distribution company is allowed to recover the costs incurred in carrying out its activities. A rate of return is set by the regulator to ensure the recovery of costs derived from capital expenditures. This approach provides no incentive for cost efficiency and may result in high costs for network users [5].

Incentivising cost-efficiency requires an ex-ante approach (i.e., a revenue cap or a price cap) that limits the company's revenues, encouraging the DSO to pursue cost-efficiency [6].

¹ Flexibility is defined as the modification of generation, injection, and/or consumption patterns in reaction to an external signal (price signal or activation) in order to provide a service within the energy system

A recommended approach is to combine both approaches, resulting in an ex-ante approach with an ex-post profit-sharing mechanism [5]. The profit-sharing mechanism allows the DSO to retain a share of the benefits from achieved efficiencies (i.e., the difference between the ex-ante revenue trajectory and the DSO's actual costs). This profit-sharing mechanism incentivises the DSO to pursue cost efficiency while sharing some of the savings with network users [7]. Still, this approach may present a bias toward CAPEX solutions because investments are capitalised and remunerated over time at an attractive rate of return, whereas that attractive rate of return does not apply to OPEX. This is known as the CAPEX advantage [8].

A widely accepted practice among regulators, believed to achieve incentive neutrality, is the implementation of a fixed capitalisation rate² that affects both CAPEX and OPEX. This remuneration scheme is known as the total expenditure (TOTEX) approach. However, this widespread acceptance relies on conceptual appeal rather than on quantitative evidence. A recent quantitative analysis demonstrates that the TOTEX approach introduces an OPEX bias, and a revenue cap with profit-sharing is recommended since it not only better achieves incentive neutrality but also results in a more practical regulatory choice [4].

A common approach in European countries is the hybrid approach. This combines an ex-ante approach to OPEX with a cost-of-service to CAPEX. This combination immediately creates a strong CAPEX bias, as efficiency incentives apply only to OPEX.

Moving from cost-of-service or hybrid approaches to ex-ante approaches (revenue-cap or price-cap) should be a priority for regulators to promote efficiency and mitigate the CAPEX bias [9].

2. Description of the adopted methodology

ISGAN WG 9 aims to identify best practices and barriers in the design, implementation, and adoption of flexibility solutions. The objective of this report is to deliver regulatory recommendations for evolving electricity distribution remuneration schemes that incentivise efficient integration of flexibility solutions into distribution network operation and planning. This report covers countries participating in ISGAN and BRIDGE, drawing on survey responses from working group contributors that addressed the main characteristics of the remuneration schemes in their countries. The results of the survey are combined with insights from a previous quantitative analysis [4] and the regulatory recommendations given in [9].

3. Results of the survey on remuneration schemes and discussion

A questionnaire was circulated to gather information on the current remuneration schemes for electricity distribution in the jurisdictions of the participants, with the aim of drawing conclusions that will ultimately help remove barriers to the use of flexibility solutions.

Figure 3.1 summarizes survey responses to the innovation incentives present in the different remuneration schemes. Results show that most jurisdictions have implemented mechanisms to promote innovation, such as pilot projects and sandboxes.

² Under TOTEX approach, the regulator fixes a capitalization rate for the regulatory period that affects both CAPEX and OPEX. The capitalization rate is the portion of expenditures that are capitalized (i.e., included in the regulatory asset base) and remunerated over time with the rate of return. This fixed capitalization rate is also known as the fixed OPEX/CAPEX share (FOCS).

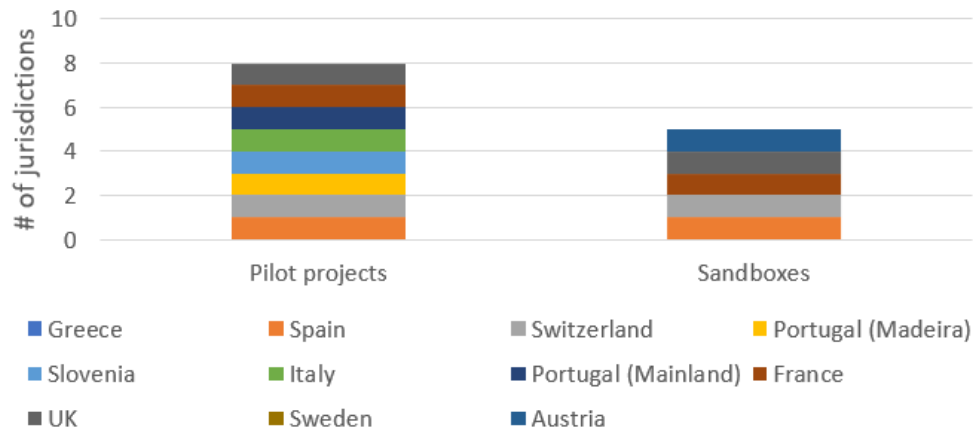


Figure 3.1: Survey responses to the presence of innovation incentives in DSO remuneration schemes in different jurisdictions

Regarding remuneration for flexibility, Figure 3.2 shows that 6 out of 11 jurisdictions have not yet included flexibility solutions in their remuneration schemes. Regulation needs to advance towards incentivising efficient operative solutions, such as flexibility procured through markets, bilateral contracts, and flexible connection agreements.

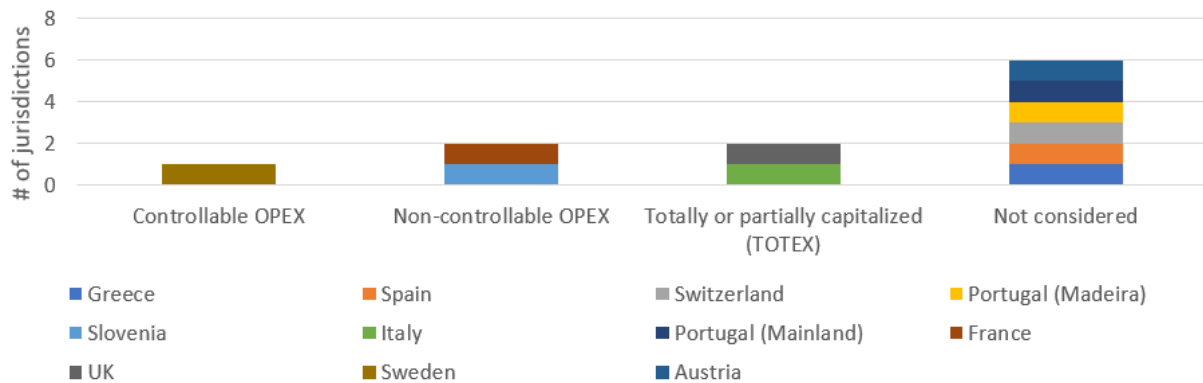


Figure 3.2: Survey responses to the remuneration of flexibility in different jurisdictions

Even if flexibility is remunerated, some remuneration schemes, as already discussed, may disincentivise flexibility solutions. In Figure 3.3, we classify remuneration schemes across jurisdictions based on the questionnaire responses and analyse the results based on the learnings from the quantitative analysis performed in [4].

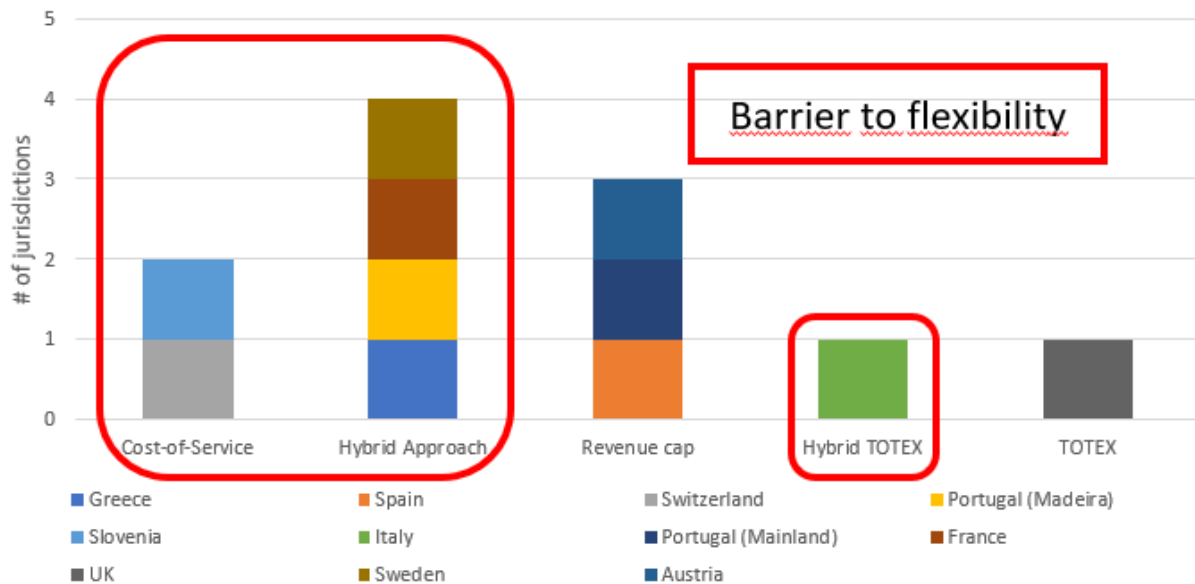


Figure 3.3: Classification of remuneration schemes in different jurisdictions

Results show that 7 out of 11 jurisdictions use either a cost-of-service or a hybrid scheme, which poses a barrier to the use of flexibility for investment deferral. This is an important result because, while innovation is promoted through pilot projects and sandboxes in most jurisdictions, 70% of the evaluated jurisdictions face barriers to the use of flexibility, disincentivising its use when the projects come to an end. It is important to address this, and the BeFlexible project proposed a regulatory roadmap to guide the evolution of remuneration schemes in the current context of decarbonisation [9]. The roadmap prioritizes reforms with higher impact based on empirical evidence and quantitative analyses [9]. The first priority is to move from ex-post to ex-ante schemes with profit-sharing to promote productive efficiency; second, to mitigate allocative inefficiency by decoupling investment plans from ex-ante revenue calculations and introducing drivers to adjust these calculations; third, to enable adaptable planning which can increase the value of flexibility, enhancing efficiency in a context characterised by high uncertainty. As a last step, a mechanism for neutralising incentives is presented as an alternative to the extensively recommended TOTEX with a fixed capitalisation rate. Neutralising incentives is the last priority because the revenue cap approach with profit-sharing, when the incentive rate is sufficiently high ($\geq 50\%$), already mitigates the CAPEX bias to a large extent [9]. Moreover, the TOTEX with a fixed capitalisation rate is not recommended as it introduces an OPEX bias [9].

4. Conclusions

This report highlights the need for remuneration schemes to evolve:

- Regulatory frameworks generally support innovation and, in particular, flexibility solutions (pilot projects and sandboxes). However, remuneration schemes can hinder innovation once temporary support ends. Remuneration schemes may pose a barrier to the use of flexibility solutions (e.g., flexible connection agreements, market-based flexibility procurement, bilateral contracts...), which play a crucial role in the current context.
- It is urgent to move from ex-post remuneration schemes to ex-ante schemes with profit-sharing mechanisms and use drivers to adjust ex-ante revenue calculations, promoting both allocative and productive efficiency. Then, enabling adaptable planning should be a priority because it can deliver substantial efficiency gains in the current decarbonisation context, characterised by high uncertainty.

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