CEER
Council of European
Energy Regulators

REPORT

Incentives in Regulatory Frameworks with a Focus on OPEX/CAPEX Neutrality

15.05.2025

Paper on incentives in regulatory frameworks with a focus on OPEX/CAPEX neutrality

Distribution System Working Group

Ref: C24-DS-91-06

15.05.2025

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

Information page

Abstract

The document explores the regulatory challenges and solutions related to achieving OPEX/CAPEX neutrality of incentives in energy network regulation. It highlights the inherent possible biases in current regulatory frameworks that favor capital expenditures (CAPEX) over operational expenditures (OPEX), which can hinder the development of efficient, smart grid solutions. The paper discusses the advantages of a TOTEX (total expenditure) approach, which treats CAPEX and OPEX equally, promoting technological neutrality and encouraging the most efficient combination of resources. It also examines various regulatory practices across Europe, including the use of fixed OPEX/CAPEX shares (FOCS) and TOTEX benchmarking, to mitigate CAPEX bias.

The document emphasizes the importance of aligning regulatory incentives with the goals of the EU's energy transition plans, which require both CAPEX-intensive infrastructure investments and OPEX-intensive digital and flexible solutions. A more balanced regulatory approach can incentivize network operators to choose the most cost-effective solutions, whether they involve CAPEX or OPEX, ultimately supporting the efficient and sustainable development of energy networks. The paper concludes with recommendations for improving regulatory frameworks to better support OPEX/CAPEX neutrality and enhance the overall efficiency of energy network investments.

Target audience

European Commission, gas/electricity industry, consumer representative groups, network operators, Member States, academics and other interested parties.

Keywords

CAPEX-bias, incentive regulation, TOTEX models, flexibility, OPEX / CAPEX neutrality

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

Related documents

CEER Documents

- CEER (2018) Conclusion paper on Incentives Schemes for Regulating Distribution System Operators, including for innovation.

External Documents

- ACER (2021) Position on incentivising smart investments to improve the efficient use of electricity transmission assets.
- ACER (2023) Report on Investment Evaluation, Risk Assessment and Regulatory Incentives for Energy Network Projects
- Averch, H., & Johnson, L. L. (1962). Behavior of the firm under regulatory constraint.
- Brunekreeft, G. (2023). Improving regulatory incentives for electricity grid reinforcement.
- Brunekreeft, G., & Rammerstorfer, M. (2021). OPEX-risk as a source of CAPEX-bias in monopoly regulation.
- European Commission. (2021). Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions: Fit for 55. EUR-Lex. https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52021DC0550
- European Commission. (2022). Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions: REPowerEU Plan. EUR-Lex. https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52022DC0230
- European Commission. (2023). Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions: Green Deal Industrial Plan. EUR-Lex. https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52023DC0757
- Florence School of Regulation (FSR). (2023). Benefit-based incentive regulation to promote efficiency and innovation in addressing system needs.
- Florence School of Regulation (FSR). (2024). Benefit-based remuneration of efficient infrastructure investments.
- Jamasb, T., Llorca, M., Meeus, L., & Schittekatte, T. (2021). Energy Network Innovation for Green Transition: Economic Issues and Regulatory Options.
- Kuosmanen, T., & Nguyen, T. (2020). Capital bias in the Nordic revenue cap regulation: Averch-Johnson critique revisited.

Table of contents

Executive Summary

Background

Efforts to address climate change are driving the electrification of various sectors, necessitating extensive expansion of fossil-free production and network infrastructure. The EU's Fit for 55 package, REPower EU plan, and the EU Action Plan for Grids, all highlight the need for cost effective solutions in electricity grids this decade to support decentralised and flexible systems. For example, the utilization of flexibility is an essential instrument alongside with other possible tools, as it can allow for more adaptive and efficient management of the grid. However, grid operators might choose not to utilise potential flexibility due to CAPEX biases embedded within regulatory frameworks. These biases tend to favour CAPEX-intensive solutions over potentially more cost-effective alternatives, namely more OPEX-intensive innovations. Addressing these biases is crucial for promoting efficient grid use and supporting the clean energy transition.

Objectives and contents of the document

The purpose of the paper is to identify based on the current literature and existing country practises possible solutions to specific types of CAPEX-biases (hybrid-regulation-related CAPEX bias and CAPEX bias due to operators' business interest to prefer stable long-term returns).

Brief summary of the conclusions

Network operators need technologically neutral incentives to address EU decarbonisation objectives and electrification challenges cost-efficiently. OPEX-based solutions can be viable alternatives to CAPEX-based ones, so incentives should align to consider both when they are economically sensible. This paper focuses on the possible CAPEX biases arising from 1) hybrid regulation (incentive strengths for OPEX and CAPEX based solutions differ within the framework) and 2) the operators' preference for stable long-term returns from CAPEX investments.

The paper identifies possible instruments to alleviate either or both biases: OPEX capitalisation, fixed OPEX/CAPEX share (FOCS), TOTEX benchmarking (coupled with general and/or firm specific efficiency targets) and output-based regulation (measured by benefits or performance targets).

Comparing regulatory frameworks is complex, as each framework's components impact overall incentive strengths. The paper does not therefore evaluate the effectiveness of instruments or national regulatory frameworks for providing stronger or weaker incentives to achieve OPEX-CAPEX neutrality. Generally, however, while the TOTEX models adopted by European regulators provide varying degrees of incentive strength and are set somewhat differently from each other, they all can be argued to mitigate the hybrid-regulation related bias (bias 1). Furthermore, FOCS have the potential to alleviate both biases (bias 1 and 2), and there are some concrete country examples to draw experience from (GB and Italy). The strength of this instrument may improve if the regulator applies performance sharing. Other regulatory design choices, such as updating regulatory parameters less frequently and longer regulatory periods, may also alleviate the discussed CAPEX biases. These practices are compatible with each other and can in fact complement each other in achieving specific regulatory objectives in a technology neutral way.

1 Introduction and purpose of the paper

1.1 Background

Efforts to address climate change are leading to the electrification of a wide range of sectors. Heating, transport, and many industry sectors are moving away from dependence on fossil fuels. To meet the increased demand and reduce the climate impact, an extensive expansion of fossil free production and network infrastructure are needed, as well as an efficient use of the existing infrastructure.

The EU has goals to increase renewable energy production, reduce primary and final energy consumption, and increase the interconnection between the member states. The fit for 55 package[1] lays the regulatory foundation to reach the targets in a fair, cost-efficient, and competitive way. The package was modified by the REPowerEU[2] plan, whose aim was to rapidly phase out dependency on Russian fossil fuels.[3]

To address the key challenges related to expanding, digitalizing, and optimising electricity transmission and distribution grids within Europe, in November 2023 the European Commission published its Grid Action Plan[4]. From the action plan the expansion of grids and adoption to new market conditions with more decentralised and flexible systems will play a crucial role in a successful increased electrification of energy uses. The action plan recognised the central role of the regulatory frameworks, set by the NRAs, in this challenge. More specifically, the plan called for better designed incentives for the uptake of smart grid, network efficiency and innovation while compensating sufficiently for operative costs related to digitalisation, data processing and flexibility procurement.

[1] eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52021DC0550
[2] EUR-Lex - 52022DC0230 - EN - EUR-Lex (europa.eu)
[3] Energy policy: general principles | Fact Sheets on the European Union | European Parliament (europa.eu)
[4] EUR-Lex - 52023DC0757 - EN - EUR-Lex

When addressing the increased demand and new generation, it is important that network operators make cost efficient decisions. To ensure that network operators have the correct incentives for efficient operation, economic regulations need to be neutral between possible solutions. One of the main challenges for regulators in incentivizing efficient investment decisions is the capital expenditure (CAPEX) - bias. In a position paper from 2021[5], ACER highlights two aspects of current regulatory settings in need of improvements, the CAPEX-bias and the need for incentives to opt for the least costly investments. Due to the CAPEX bias, lower cost solutions, based on OPEX, may seem unattractive to the network operator compared to the higher profits of higher cost solutions from a CAPEX investment. In general, the attractiveness of innovative solutions, which are often more OPEX intensive, is according to ACER, currently far from optimal and needs to be aligned to the extent possible to CAPEX intensive solutions. ACER emphasises the need to improve regulations to encourage investments that lead to more efficient use of the electricity grid, thereby supporting the transition to clean energy.

CAPEX and OPEX are often treated differently from a regulatory perspective. In the majority of CEER member countries, incentive-based regulation is applied to OPEX, with the regulated company expected to improve the efficiency of its operations. The company always runs the risk of under-performance and therefore lower or negative margins. On the CAPEX side, a majority of the CEER member countries apply a 'rate of return' (RoR) or 'cost-plus' regulation. This means that, once the new investment is included in the Regulatory Asset Base (RAB), the regulated company is guaranteed recovery of the investment, including an appropriate return on the invested capital. Therefore, the larger the investment, the higher the allowed return-on-capital allowance, which means that higher-cost solutions generate larger profits. For energy networks (especially electricity), a CAPEX-bias can hinder the efficient development of smart grids. These types of smart solutions tend to rely on OPEX, whereas the alternative would be to expand the network, which is CAPEX-intensive. Thus, it is important to design symmetrical regulation that promote technological neutrality (Kuosmanen & Nguyen, 2020[6]).

[5] ACER - 2021- Position on incentivising smart investments to improve the efficient use of electricity transmission assets

[6] Timo Kuosmanen & Tuan Nguyen, 2020, Capital bias in the Nordic revenue cap regulation: Averch-Johnson critique revisited.

The topic of OPEX / CAPEX neutrality has also been identified and addressed to some extent in previous work by CEER. The CEER Conclusions Paper (2018)[7], recognised the advantage of a TOTEX approach in alleviating a CAPEX bias, as it "*incentivises companies to choose the most efficient combination of resources to achieve several regulatory aims, which could be less capital-intensive innovative expenses (higher OPEX in the short term) instead of network investments*" (p. 13) and, in fact, proposed a "*technology-neutral approach towards innovative solutions, that may be hindered, inter alia, by different treatment of costs*" (p. 33). In this regard, CEER suggested that regulators "c*onsider, where feasible, an output-based approach for setting incentives, because this approach has the advantage of considering what is important to customers, letting DSOs free to find optimal solutions*" and "*adopt a whole system approach*" (p. 34). These remarks are also in line with ACER's recent work[8] on regulatory incentives for TSOs, which recommends that NRAs use TOTEX models to incentivise more cost-efficient solutions among alternatives to address the same network needs, thereby mitigating CAPEX-bias.

The new electricity market design (EMD) rules that entered into force on 16 July 2024 also have relevant provisions that link to OPEX / CAPEX neutrality. Article 18(2) of the amended Electricity Regulation[9] text reads: "*Tariff methodologies shall reflect the fixed costs of transmission system operators and distribution system operators and shall consider both capital and operational expenditure to provide appropriate incentives to transmission system operators and distribution system operators over both the short and long term, including anticipatory investments, in order to increase efficiencies including energy efficiency*". Therefore, also from this point of view it is important to identify and review possible solutions.

1.2 Purpose and scope of the paper

The purpose of the paper is to identify possible solutions to specific types of CAPEX-biases based on the current literature and existing country practises.

The paper will focus on electricity DSOs and on selected sources of CAPEX bias outlined in section 2.

2 Definitions and sources of CAPEX bias

This section outlines the key definitions important to the discussion in the paper and summarises the literature on the sources of CAPEX bias.

[7] CEER (2018) Conclusion paper on Incentives Schemes for Regulating Distribution System Operators, including for innovation
[8] ACER (2023) Report on Investment Evaluation, Risk Assessment and Regulatory Incentives for Energy Network Projects
[9] Regulation (EU) 2024/1747 of the European Parliament and of the Council of 13 June 2024 amending Regulations (EU) 2019/942 and (EU) 2019/943 as regards improving the Union's electricity market design

2.1 Definitions

CAPEX-bias is the preference for CAPEX-intensive solutions due to different remuneration schemes of OPEX and CAPEX or business interests.

The CAPEX-bias discussed in this paper encompasses:

- Hybrid-regulation-related CAPEX bias, due to different remuneration schemes of OPEX and CAPEX and/or differences as regards the incentive strength, **bias 1.**
- Intrinsic CAPEX bias, due to operators' business interest, which could push the company to incur capital expenditures (at an efficient level of investment costs) instead of operational expenditures, as CAPEX will determine long-term and likely stable returns, **bias 2.**

For clarity, an inefficient increase of capital expenditures, merely to increase company profits when the rate of return on capital is higher than the company's cost of capital, ceteris paribus, is not considered under the second type of CAPEX bias. Such a situation, also known as the Averch-Johnson effect or 'gold plating' (to be discussed in further detail in section 2.2) would - at least in theory - be dealt with by aligning the regulatory rate of return on capital with the actual cost of capital.

Hybrid regulatory framework is a framework in which OPEX is treated under incentive regulation using for example efficiency benchmarking, but CAPEX is treated under cost-plus regulation. The definition does not therefore include the more nuanced cases where there is some incentive-based mechanism for CAPEX as well, although the incentive strength can still be different, contributing to bias 1.

TOTEX (total expenditures) related regulation refers to any regulatory framework which treats CAPEX and OPEX alike in terms of overall framework and of the incentive strength (i.e. the % of money DSO gets to retain or lose against a baseline[10]).

Fixed OPEX CAPEX share or fixed OPEX CAPEX structure (FOCS) means a regulatory framework - in which irrespective of the actual shares of expenditures - a fixed share of the total cost, set ex-ante by the regulator, is treated as CAPEX and contributes to the formation of the regulatory asset base, while the rest is treated as OPEX and remunerated within the book year. The FOCS methodology requires a regulatory design choice concerning how the OPEX/CAPEX share is defined (e.g. historical actual costs, forecasts of future costs, a theoretical optimal share, or a mixture of some of them) and how frequently the OPEX/CAPEX share is reviewed.

TOTEX incentive is the part assigned to the network operator of a positive (bonus / reward) or negative (penalty) difference between the TOTEX baseline and the actual realised TOTEX.

[10] The methodology to set a baseline is another regulatory decision which impacts the risks and incentive strengths. However, it is deemed out of scope for this paper.

OPEX oriented incentives are specific incentives for OPEX-intensive solutions. One possibility for such incentives is, for example, exemptions from efficiency requirements for innovation or R&D-related OPEX expenses.

2.2 Sources of CAPEX bias

The CAPEX bias can arise from at least four potential sources. These are 1) CAPEX advantage, 2) OPEX disadvantage, 3) hybrid-regulation related CAPEX bias and 4) network operator's preference for long-term and stable returns which CAPEX-intensive solutions often provide.

The CAPEX advantage, presented originally by Averch and Johnson (1962)[11], arises when the regulatory cost of capital is higher than the firm's actual cost of capital, leading to gold plating and an inflated asset base. This can arise due to the valuation of capital or the estimation of the cost of capital.

This type of CAPEX bias can be handled within the current regulatory framework by adjusting the capital valuation and the return on capital to better reflect the companies' actual costs, in other words aligning the regulatory rate of return with the company's rate of requirement[12]. However, it is admitted that the alignment of the regulatory rate of return with the company's rate of return requirement is not a straightforward exercise. This complexity is evidenced by the fact that European regulators apply different methodologies and parameters when calculating it. Several factors contribute to this complexity. Firstly, due to asymmetric information, the regulated entities do not have an incentive to reveal their actual perception of risk and therefore return requirement but have an incentive to inflate these claims. Hence market information is often used to derive the parameters, especially the risk level relative to the market risk (beta) and the market risk premium that are then used to calculate a WACC. Secondly, and related to market information to derive betas, there are very few publicly traded unbundled DSOs within the EU, and there is no consensus on the perfect comparison group of publicly traded network operators or other utilities. Many of the chosen comparison companies also have other business activities that are subject to competition. Thirdly, there is no consensus on the right observation period or the method of averaging[13] for calculating the various WACC parameters. The practices also vary in terms of definitions of the risk-free rate, debt premium, potential risk premiums to reflect unsystematic risks and how inflation and its expectation is calculated and compensated for.

Nevertheless, given the extensive theoretical and practical work on WACC-setting, this paper focuses on the less discussed challenges in OPEX / CAPEX neutrality.

[11] Averch, H. and Johnson, L.L. (1962). Behavior of the firm under regulatory constraint.
[12] This is also one of the recommendations in ACER's position paper
[13] E.g. arithmetic or geometric mean, median or N^{th} quartile or percentile.

The second source for capital bias is OPEX disadvantage. The basis arises because some risks related to OPEX may not be generally remunerated under the regulatory framework, where OPEX at best is a pass-through item in the regulation. If a firm wants to make an investment in an innovative OPEX solution, it is likely to include some risk that will not be compensated for in the regulation. This risk can also stem from the possible time lag of the remuneration scheme, i.e. if OPEX increases during the regulatory lag and these increases are not passed through into revenues until the next regulatory period review. Hence, the OPEX risk (compared to CAPEX risk) is not fully captured by regulation. If OPEX and CAPEX are substitutes, the regulated firm can reduce the risk and thereby reduce the cost of capital by rebalancing OPEX and CAPEX. If the regulated rate-of-return on capital is not influenced by the firm's actions, this creates a margin between the regulated rate-of-return and the true cost of capital which again causes a CAPEX-bias. This is further described in Brunekreeft & Rammerstorfer, 2021[14]. Specific measures can be adopted to reduce the OPEX disadvantage related to time lag, e.g. a rolling OPEX baseline or a forward-looking OPEX baseline.

The third source for capital bias is due to different regulatory treatment of costs in a hybrid regulatory framework or other hybrid-incentive setting. **This is bias 1 that is assessed in this paper**. When incentives or benchmarking differ between OPEX and CAPEX, it can lead to weaker incentives to improve the efficiency of CAPEX (cf. Smith et. al., 2019). Different regulatory benchmarking and incentive regimes are applied to operating costs as compared to capital expenditure. This can lead to re-balancing of expenditure towards CAPEX, in other words, leading to the network operator choosing CAPEX-intensive solutions over OPEX-intensive solutions.

The fourth source of capital bias is due to the disparity between the long-term stability of returns when comparing OPEX versus CAPEX based solutions. **This is bias 2 that is assessed in this paper.** Network operators can be argued to prefer long-term stability of revenue and returns, which capital expenditure with long technical lives guarantee ("invest and forget"). This is in stark contrast to OPEX based technical solutions, where the company must be active and innovate on a yearly basis to secure the same level of return. In other words, there is no long-term stability about the level of return related to OPEX. Even if OPEX-based solutions are based on multi-year contracts, this is still in stark contrast to the (up to) 40+ years asset lives of CAPEX based solutions. This disparity arises partly from the different time profiles of costs and benefits of traditional CAPEX-intensive solutions versus more OPEX-intensive solutions[15]. Somewhat surprisingly, there is very little in the literature about this disparity.

As was mentioned in section 2.1, the third and the fourth types of biases are the focus of this paper.

[14] Brunekreeft & Rammerstorfer, 2021, OPEX-risk as a source of CAPEX-bias in monopoly regulation

[15] ACER's report discusses the importance of selecting an appropriate discount rate and incentive profile to incentivise the use of alternative innovative solutions: 2024_Report_Benefit_based_remuneration_infrastructure_investments.pdf (europa.eu).

3 Options to improve OPEX/CAPEX neutrality

This section outlines and briefly discusses the possible options to improve OPEX/CAPEX neutrality, both via direct changes to regulatory remuneration and via the role of other instruments (such as network development plans).

3.1 Possible solutions to improve OPEX/CAPEX neutrality

The regulatory environment should promote OPEX-CAPEX neutrality, where both operational and capital expenditures are treated equitably, ensuring that network operators have no bias toward CAPEX-intensive solutions. Regulators have implemented various methods to create a better and more efficient balance between the cost categories and thus improving technology neutrality without favouring a specific solution (building grid) over another (smart grids, use of flexibility, other innovations). For example, there have been bonus-related incentives for OPEX solutions (especially innovation related). Also, regulators have implemented different forms of TOTEX regulation coupled with efficiency targets in several regulatory models, which will be described later.

In recent years, output-based regulation has gained more prominence in the literature as a complement to existing regulation (see Brunekreeft, 2023[16], Jamasb et al., 2021[17], and FSR, 2023[18], and 2024[19]). Output-based regulation focuses on the problem to be solved, rather than the solution itself. Network operators are incentivised based on metrics such as reliability, energy efficiency, customer satisfaction or grid losses. For CAPEX-OPEX neutrality, it is important that the output-based mechanisms do not restrict the use of CAPEX or OPEX to attain the desired metrics and performances and, where applicable, refer to the total costs (CAPEX and OPEX) as a reference cost for any measure to pursue the performance.

A list of identified possible solutions to improve OPEX/CAPEX neutrality are described and summarised in the table below. It is not an exhaustive list of possible options. When reading the table, it should be kept in mind that bias 1 may be absent by construction (of the overall regulatory framework and of the CAPEX-OPEX incentive strengths). It is also important to note that the analysis focuses on whether the discussed CAPEX biases 1 and 2 are alleviated by the instrument and does not assess the incentive strengths that each instrument may or may not provide.

[16] Brunekreeft, 2023, Improving regulatory incentives for electricity grid reinforcement.
[17] Jamasb, Llorcaa, Meeus & Schittekatte, 2021, Energy Network Innovation for Green Transition: Economic Issues and Regulatory Options.
[18] FSR, 2023, Benefit-based incentive regulation to promote efficiency and innovation in addressing system needs.
[19] FSR, 2024, Benefit-based remuneration of efficient infrastructure investments

Solution	Description	Relevance to bias 1 / bias 2	Examples	Possible pros and cons
OPEX capitalisation	Allocate a selected and previously identified share of OPEX costs into the RAB (e.g. innovation-related costs), allow a return on this share (either the same or different return as for CAPEX).	Bias 2	Great Britain (Innovation Funding Incentives etc.), Italy (R&D and pilot project costs)	Pros: Alleviates bias 2. Cons: Expensive (emphasises the importance of an efficiency incentive alongside this measure). Impact limited to the selected operational costs.
Fixed OPEX/CAPEX share (FOCS)	Treats all expenditures alike, irrespective of their "OPEX" or "CAPEX" nature, sets an equivalent and fixed OPEX share (to be recovered as "fast money", i.e. OPEX-like) and a complementary and fixed CAPEX share (to be recovered as "slow money", i.e. CAPEX like). *Note: it does not necessarily imply using a TOTEX efficiency incentive*	Both	Great Britain, Italy	Pros: Bias 1 is removed (as there is no difference between CAPEX and OPEX treatment). Bias 2 is alleviated, to a different extent, depending on the frequency of updates of the sharing. Easy to measure the difference between the ex-ante set fixed sharing and the actual CAPEX and OPEX shares The sharing factor is relatively easy to implement (once defined). Cons: A criterion for an "optimal" sharing factor is difficult to define, it is subjective, and it can vary over time depending on the scale of investment needed. It also requires a decision also

Solution	Description	Relevance to bias 1 / bias 2	Examples	Possible pros and cons
				on how frequently the sharing factor is updated. It may be difficult and burdensome for the NRA to identify in a systematic way how the application of FOCS affected CAPEX vs. OPEX choices of the DSO for some specific activities. If the regulatory OPEX/CAPEX share deviates significantly from the DSO's actual share, it can have an impact on the financeability of the investments or, vice versa, create excessive returns in the short-term. Although bias 1 is removed, it does not incentivise for cost-efficiency as a standalone instrument.
TOTEX benchmarking with the application of a **general efficiency target** (Xgen)	Rather than benchmarking only controllable OPEX costs, or CAPEX costs separately, both OPEX and CAPEX costs are benchmarked with a general efficiency target.	Bias 1	Many countries	<u>Pros:</u> Many existing country practices to draw learnings from. Brings the incentive strengths for OPEX and CAPEX more in line. Design choices concerning whether e.g. real costs are only partially considered, and whether the cost structure is not completely reviewed after each regulatory period, can also alleviate bias 2. <u>Cons:</u> Controlling for background characteristics involves subjective decisions about which variables are used to control for DSO

Solution	Description	Relevance to bias 1 / bias 2	Examples	Possible pros and cons
				typology, no consensus on the 'right' methodology.
TOTEX benchmarking with the application of **firm specific efficiency target** (Xind) to OPEX and CAPEX	The incentive strength of TOTEX benchmarking can be further individualised by considering specific background characteristics of the operating environment and deciding how the results of the benchmarking are applied in the regulatory model, and on which costs the individual targets (calculated based on the efficiency values) have an effect.	Bias 1	Germany, Norway	<u>Pros</u> Can achieve more granular results depending on how different targets are calibrated. <u>Cons</u> More complicated than general TOTEX benchmarking. Firm specific efficiency target requires many DSOs to be in place.
Output-based regulation	Incentives are tied to achieving predefined outcomes (typically estimated benefits or performance targets) rather than the amount of capital invested.	Both	E.g. Quality and losses related incentives in many countries	<u>Pros</u> Widely used for quality related incentives – many examples to draw experience from. Network operators are free to choose the most appropriate expenditure, be it CAPEX or OPEX or both, to achieve the specific outcome. Very explicit signal to target specific outcomes that NRA deems preferable. <u>Cons</u> Company behaviour is tied closely to the chosen output

Solution	Description	Relevance to bias 1 / bias 2	Examples	Possible pros and cons
				variable → importance of choosing the correct variables to measure and the correct reward/penalty coefficients.
Performance incentive mechanisms (output-based 1)	Incentives in a specific domain (e.g. energy efficiency, storage or flexibility) where the incentive is calibrated to act as a bonus by default.	Bias 1		Pros: Easy to implement, faster scale up and development of smart solutions. Cons: Difficult to determine and calibrate the optimal incentive strength. Potentially expensive depending on the scale of incentive.
Shared savings mechanism (output-based 2)	Allow the DSO to retain a share of cost savings when implementing a cheaper solution than the default option (either OPEX or CAPEX based solution, preferably TOTEX based).	Both	Great Britain	Pros: A strong incentive for cost-efficiency and smart solutions. Alleviates both biases at the same time if implemented appropriately. Cons: Time/resource consuming (required CBA and NPV calculations of alternative solutions for each investment case). Difficult to identify and determine default solutions and relevant sharing factors. Future system needs are uncertain to a degree.

Table 1: Descriptions of identified measures to address CAPEX bias 1 and 2 (bias 1 = "hybrid-regulation related bias" and bias 2 = "preference for long-term and stable returns

The figure below organises the possible solutions considering whether they alleviate bias 1, bias 2 or both (higher and to the right is better).

Figure 1: Possible solutions relating to bias 1 and 2 mitigation.

Besides the application of the instruments described in the table and figure above, bias 1 and 2 may also be impacted by other aspects of the regulatory framework, such as the duration of the RP and the frequency at which the parameters are reviewed. In some countries, these two aspects are closely interconnected, as regulatory parameters (including cost bases) change only in the transition to a new regulatory period, but in other countries they are treated separately (some parameters are set only in the beginning of an RP, while others are updated within the RP, namely RAB or cost bases).

For example, in TOTEX models, the frequency of RAB adjustments allowed by the regulatory model impacts particularly bias 2. Indeed, if the forecasted investment costs, which were considered in the calculation of the total cost base in the beginning of the RP, are regularly reviewed with actual investment costs, the overall TOTEX incentive is distorted in the CAPEX side. In such situation, the outcome of the TOTEX model will come closer to a hybrid regulation model with a rate-of-return approach to CAPEX. Moreover, if such regular updates are applied only to actual investments costs and not to actual operational costs, the effects of different incentive strengths for CAPEX and OPEX will be prominent within the RP, thus worsening bias 1. For these reasons, in TOTEX models, adjusting the total cost base only for the next RP will maximise the incentive for OPEX-CAPEX neutrality.

The duration of the RP also matters, assuming that other parameters than the cost bases, such as the WACC and efficiency factors, are set only in the beginning of the RP. These parameters affect not only the overall TOTEX incentive, but also affect differently CAPEX and OPEX components. In the extreme case, if the share is revised frequently and is based on the actual past cost-structure of the DSO, there is very little difference to using the actual shares of expenditure.

For these reasons, assuming the operator internalises deviations between the allowed revenues and the actual total cost within the RP, the less frequent the reviews of parameters and the longer the duration of the RP, the greater the mitigation of bias 2 is. This is why Figure 1 includes a specific dot for the case of TOTEX (either with Xgen or Xind) used with longer regulatory periods or lower frequency or smoother reviews of regulatory parameters, because with such options in the setup of the TOTEX model, it will alleviate both biases 1 and 2.

Concerning FOCS, the frequency of OPEX/CAPEX share reviews also impacts the way this instrument mitigates bias 2. In fact, after an initial parametrisation, periodically the regulator will have to adjust the OPEX/CAPEX share considering, at least partly, the cost structure of the operator, particularly to reflect the actual company's RAB in the CAPEX component. Otherwise, this instrument may negatively impact on the operators economic and financial balance and consequently on operators' access to capital. The more frequent the reviews are, the more FOCS loses strength in the mitigation of bias 2.

3.2 The role of network development plans

Ongoing developments in European energy policy clearly emphasise the objective of increasing the integration of renewables. Specifically, to achieve this goal, the action plan for grids points to the need to strengthen cross-border infrastructure in the transmission networks and create regulatory incentives to anticipatory investments that facilitate the timely connection of new renewable capacity. These guidelines necessarily imply investments in new capacity on the transmission and distribution networks, which have significant impacts on the CAPEX side of network operators' allowed revenues. In this way, the European goals for energy transition may intrinsically cause a bias towards CAPEX, if all possible solutions to integrate clean energy sources are not analysed at an early stage on the same level playing field.

From another perspective, the action plan for grids also mentions the need to accelerate the transition to a decentralised, digitalised and flexible system, particularly on distribution networks. While requiring investments in further monitoring and remote control of the networks, as well as in new information systems (data collection and storage), this transition entails an increase in resources associated with the operation and maintenance of these new digital and IT components of the networks. Furthermore, the large volumes of data collected will enable the development of network planning methodologies, which are expected to maximise the use of installed capacity and optimise future investments in new capacity. Again, these developments and new approach to network planning will also require additional resources, potentially putting pressure on the OPEX side of network operators' allowed revenues.

Thus, the objectives of the action plan for improving long-term planning of networks to integrate more renewable generation and accommodate the growth in electricity demand, should not focus exclusively on building new network capacity (CAPEX-based). It should also consider the digitalisation of grids and the development of flexible resources, on both demand and supply side, which are boosted from planning to real-time operation by the knowledge created with the information gathered, as well as from a better coordination between transmission and distribution network operators (OPEX-based). This perspective should be encouraged or even made mandatory when network operators prepare and present their network development plans, which must include cost-benefit analysis of alternatives to respond to network needs, regardless of whether they are more CAPEX-based or OPEX-based solutions.

The existence of regulatory incentives that promote OPEX/CAPEX neutrality will induce transmission and distribution network operators to seek, right from the planning stage, solutions that allow them to meet the network needs (e.g. capacity for new connections to the network), not only at the most efficient total cost, regardless of whether these costs are more CAPEX or OPEX oriented, but also more quickly, which may contribute for example to reduce the connection times of new network users.

However, given the scale of the challenge that exists in terms of developing electricity networks, it is also essential to be careful when setting parameters for regulatory incentives focused on OPEX/CAPEX neutrality, to ensure sufficient resources for network operators. While avoiding CAPEX bias is very important to ensure efficient investment decisions, the regulatory models should also ensure enough confidence in order for investors to commit with network operators, thus avoiding problems for financing needed investments.

4 Review of current practices

4.1 Summary of current regulatory frameworks

There is a wide, diverse and complex range of regulatory frameworks for electricity networks in place across Europe[20]. Current regulatory frameworks utilise a combination of tools and mechanisms, namely incentive-based regulation, such as price caps and revenue caps, to promote efficiency and control operating costs. Broadly speaking, most countries have incorporated a rate-of-return methodology with some elements of incentive-based regulation including incentives for cost efficiency, quality of services and/or innovation. As CEER's annual Regulatory Frameworks report summarises, in electricity distribution, 24 NRAs (out of the 33 countries analysed) apply incentive regulation. Within these, price caps are used by five NRAs and 19 NRAs use revenue caps[21].

[20] Given the complexity of tariff regulation schemes, making a direct comparison of certain parameters, such as capital costs, is difficult and should only be done in the context of the entire regulatory system.
[21] For this paper, it is not necessary to differentiate between price and revenue cap methodologies further given that both can be designed in a way that results in the same overall allowed revenue and therefore the same incentive strength for OPEX and CAPEX.

Many components of the overall remuneration that form the allowed revenue for network operators can impact the balance of treatment between OPEX and CAPEX. In terms of CAPEX, one of the key focuses of the current regulatory frameworks is to set an appropriate RoR for network operators. This rate is used to compensate operators for the cost of capital and to incentivise investment in energy infrastructure. Most countries use the Weighted Average Cost of Capital (WACC) to calculate the RoR, with adjustments for risk factors, tax treatment and market conditions. For OPEX, the main elements are adjustments for inflation, efficiency factors and controllable versus non-controllable costs. Non-controllable costs, such as system losses and public service costs, are treated differently from controllable costs, such as labour and operational inefficiencies. These aspects are discussed in turns below.

4.2 Remuneration for capital expenditure (CAPEX)

If applicable, the remuneration for capital expenditure is formed from three building blocks: valuation of the regulated asset base (RAB), its depreciation and the regulatory rate of return (typically WACC). The specific treatment of all the three components partly impacts the possible bias compared to OPEX-related costs. Furthermore, the treatment of regulated asset RAB value and depreciation is often linked, meaning that any efficiency incentive for RAB also impacts the remuneration through the depreciation component.

Regulatory frameworks in the analysed countries define the value for the regulated assets and therefore also for the regulatory depreciation based on actual historical costs, revalued costs (for example by using a unit price list)[22], or a mixture of the two. The most recent Regulatory Frameworks report found that about 30% of electricity distribution regulators applied efficiency requirements for capital expenditure. Countries such as Finland, Latvia and Sweden use a reference cost approach for CAPEX remuneration, which incentivises network operators to invest efficiently given that a part or all of the underspent (overspent) is rewarded (penalised). Such methodology essentially sets an efficiency incentive for CAPEX, which if set up correctly, can reduce bias 1[23] compared to a case where a hybrid approach is used (CAPEX as cost-plus and OPEX with an efficiency incentive). However, comparing the incentive strengths of separate efficiency requirements for OPEX and CAPEX is difficult to do. A separate positively calibrated incentive for CAPEX could introduce further CAPEX bias, especially if the incentive strength for OPEX is in the opposite direction.

Furthermore, some countries such as Great Britain and Norway benchmark and therefore set an efficiency incentive for the total expenditure (TOTEX) of CAPEX and OPEX and therefore effectively setting a reference cost indirectly to capital expenditure. TOTEX frameworks are further discussed in Section 4.4.

[22] Historical costs can either be valued as is or indexed (re-valued) depending on the treatment of inflation in the regulatory rate of return (WACC).
[23] Correctly meaning that the incentive is similar in strength and direction compared to OPEX efficiency incentive strength.

As was discussed in Section 2, the rate-of-return methodology inherently creates a CAPEX bias (at the very least bias 2) against OPEX-based solutions and therefore the rate of return set by the regulator may also impact the neutrality of CAPEX and OPEX costs. Most countries utilise the weighted average cost of capital (WACC) model when setting the rate of return for capital expenditure. The parameters for the WACC are often derived from market information, including comparative publicly traded utilities companies to capture (symmetric) industry risk. The used WACC varies somewhat across countries and across time, however, in general it can be stated that the higher the WACC, the stronger the CAPEX bias may be, all other things being equal.

Additionally, Austria[24] and Slovenia adjust the rate of return based on the efficiency of the network operator. The incentives and possible drawbacks of such adjustment are like those discussed above in reference to using a reference cost when setting the value of the regulated asset base (RAB). The only difference is that tying the cost efficiency incentive of investments to the WACC does not directly impact the calculated regulatory depreciation.

4.3 Remuneration for operational expenditure (OPEX)

4.3.1 Remuneration for controllable and non-controllable OPEX

Although electricity network operation has traditionally been and still is capital intensive business activity, a portion and potentially increasing share of costs comes from everyday operations. In most countries, a significant portion of OPEX costs is passed through, either based on a reference level of costs or in reference to general inflation, but many countries also set an efficiency incentive for (parts of) OPEX costs. Non-controllable OPEX costs are typically electricity purchases to cover grid losses and any pass-through costs such as TSO charges.

The most recent CEER Regulatory Frameworks report[25] found that most of the regulators within CEER in electricity focus on cost saving on the OPEX side (rather than CAPEX) and about half have an X-factor for OPEX. Efficiency requirement is typically if not always on the controllable costs. The efficiency or productivity requirement, also known as the X-factor, distributes some of the potential efficiency gains to the consumer by lowering the allowed revenue of the network operator. It can be set either by benchmarking network operators against each other while controlling for key environmental characteristics, or as a general factor to reflect the typical productivity trend that should be expected from network operations, or both.

[24] Austria's case is further described in Section 4.4.
[25] Report on Regulatory Frameworks for European Energy Networks 2023

Such efficiency incentive solely on OPEX may worsen OPEX / CAPEX neutrality (bias 1) especially if set asymmetrically towards a penalty with a general x-factor. Therefore, consideration should be given to applying a general industry productivity target ("Xgen") to the CAPEX as well to ensure more symmetrical strength of incentives for OPEX and CAPEX. As Brunekreeft et al. (2020)[26] note, OPEX related efficiency requirements and their application are especially relevant in the context of smart grids. The incentives should be designed in a way that considers the long-term benefits of a smart grid against the short-term costs, while also recognising that breaks in productivity trends may make historical data inapplicable to benchmarking future productivity. They note that these timing discrepancies of costs and benefits could be overcome with a profit-sharing mechanism.

4.3.2 Remuneration for innovation

Incentive-based regulation may be additionally used to incentivise innovation, given that natural monopolies do not have the market driven pressure to innovate. Depending on the incentive's design, whether they only relate to OPEX or CAPEX costs, can have implications on their impact on CAPEX bias (especially bias 1). However, this is also dependent on the overall design of the regulatory framework, whether there is bias 1 in the first place from other elements of the regulatory framework.

In terms of innovation, some countries such as Austria, Finland, Slovenia, Norway and Iceland have an additional revenue allowance for costs relating to research and development, but the overall additional allowance is capped[27]. In these cases, such incentives may alleviate bias 1 (if it exists) by improving and aligning the incentive strength of operative expenditure, although its impact is limited given that only a smaller share of OPEX costs relate to innovation and in many cases, it means that these innovation costs are only passed through at best, and no return per se is allowed on the expenditure. Therefore, the incentive signal strength may still differ from incentive strength on CAPEX. They also cannot alleviate bias 2 given that these incentives require an active involvement of the network operator to innovate every year and therefore do not provide the long-term certainty and stability on remuneration that capital expenditure typically does provide.

Additionally, to these countries, companies are given a longer control period to encourage investment in innovation projects in Great Britain.

[26] Incentive regulation of electricity networks under large penetration of distributed energy resources - selected issues (econstor.eu)

[27] In Finland's case, approved innovation related costs are essentially passed through even though they are still included in the OPEX efficiency incentive calculation.

4.4 Remuneration for total expenditure (TOTEX)[28]

As was identified in Section 3, a TOTEX approach may alleviate CAPEX bias, especially bias 1, if implemented appropriately. Several countries have implemented a TOTEX approach, and these are described and compared below. In summary, many different implementations can be called "TOTEX" approaches in theory. However, the specifics of the overall framework matters, and different models can be further categorised based on the degree that they address CAPEX biases 1 and 2. The various instruments utilised by different countries are first summarised in the matrix below.

	AT Austria	**DK** Denmark	**DE** Germany	**GB** Great Britain	**IT** Italy	**NL** Netherlands	**NO** Norway	**PT** Portugal
Fixed OPEX/CAPEX share				●	●			
TOTEX with general efficiency (Xgen)		●	●	●		●		●
TOTEX with firm specific efficiency (Xind)	●	●	●			●	●	
Output-based regulation	●	●	●	●	●	●	●	●
Shared savings mechanism				●				●

Table 2: Summary of solutions currently in use in each country from those listed in Table 1

In **Austria,** a revenue cap methodology is applied for revenue for the 38 electricity DSOs. The approach is based on a benchmarking system that uses controllable TOTEX to compare the performance and efficiency of different DSOs. The methodology incorporates specific structural characteristics of the DSOs, such as metering points, maximum grid load and the transformed area-weighted connection density. CAPEX is included in the benchmarking analysis in two different forms: on the one hand standardised CAPEX based on annuities and on the other hand imputed CAPEX. This aims to not disproportionately punish capital-intensive DSOs with new grids. The Austrian regulatory system then applies a best-of approach of the efficiency values via the respective cost base.

The efficiency score affects the OPEX via an individual cost-reduction target which is however limited by a minimum efficiency of 80%. This aims to limit the pressure of cost-reduction on the companies. By contrast, the CAPEX is subject to an efficiency-related RoR. An individual efficiency below the median reduces the return on equity granted to the grid operator for assets acquired up to a certain cut-off date (year on which the benchmarking analysis is based). The effects of a low efficiency value therefore have an immediate impact on the operator's RoR. The individual WACC aims to introduce an efficiency element to CAPEX and to incentivise efficient behaviour amongst regulated companies.

[28] For more details, see CEER Report on Regulatory Frameworks for European Energy Networks 2023 (https://www.ceer.eu/publication/report-on-regulatory-frameworks-for-european-energy-networks-2023/)

Denmark applies an efficiency benchmark to TOTEX thanks to the sufficient number of active DSOs operating (38), while also including an x-factor to reflect overall productivity changes in the Danish economy. The RAB and therefore the allowed return is divided into two parts, a forward-looking asset base and a historical asset base. Each asset base is coupled with its own RoR and the WACC is only used as the RoR on the forward-looking asset base. The forward-looking asset base consists of regulatory assets invested from 1 January 2018 onwards. The RoR on the historical asset base is a continuation of the previous definition of allowed RoR, which is not comparable with the WACC definitions and methods.

Germany utilises an efficiency-based revenue cap methodology with firm-specific efficiency targets ("Xind") to benchmark the controllable TOTEX costs[29] of the 870 electricity DSOs against each other while also considering structural and environmental characteristics such as area supplied, and customers connected. The benchmark costs are based on the actual costs incurred in the third year of the previous five-year regulatory period. The return on equity that is included in the CAPEX costs of the TOTEX is based on the actual share of equity, any equity exceeding a share of 40 % is considered in the TOTEX at a lower rate of return. The split between OPEX and CAPEX recognised in TOTEX is endogenous and therefore not fixed.

The German regulator BNetzA calculates four different efficiency scores using different benchmarking methodologies and different types of TOTEX. The highest score of the four is then used to calculate a remuneration path ex-ante for the regulatory period. The bottom of the efficiency score (penalty) is capped at 60 %, and overperformance (above 100 %) is capped at 105 %. In addition to the between-DSO-performance benchmarking, a general sector productivity factor (X-factor, "Xgen") is also taken into account when calculating the allowed TOTEX path.

In **Great Britain**, in 2013, Ofgem moved to the "RIIO" price control framework, which is Revenues = Innovation + Incentives + Outputs. Under the RIIO framework, companies are held responsible for maintaining high service quality by meeting specific output targets. They are offered financial incentives and a longer regulatory period to promote investment in innovative projects. Additionally, the bias toward capital expenditure (CAPEX) has been reduced with TOTEX allowances, which cover both capital and operational expenses (OPEX). As a result, a fixed portion of a company's total expenditure (TOTEX) is added to the RAB, regardless of whether the actual costs were CAPEX or OPEX, similarly to Italy, which alleviates both biases 1 and 2.

[29] Permanently non-controllable costs are, for example, upstream network costs, non-wage labour costs and concession fees.

Investment plans for the entire RP are approved up front, based on established needs cases and having a positive cost-benefit analysis (CBA). To further alleviate bias 1, TOTEX is benchmarked by combining a top-down assessment of TOTEX with a bottom-up assessment of disaggregated costs[30]. These assessments are combined using the sample of all DSOs (6 in total) to calculate efficient cost allowances for the regulatory period for each DSO. There is a profit/loss sharing mechanism depending on DSO performance (cost outturn) relative to the efficient reference costs. Ofgem also utilises an X-factor when setting the efficient costs, to mimic general productivity gains.

In **Italy**, ARERA introduced from 1/1/2024 a fixed OPEX/CAPEX share (FOCS) for all DSOs above 25 000 customers (which currently represent more than 99% of Italian customers), as well as for the electricity TSO and for the gas TSOs. From 2024, a fixed share of the actual expenditures is added to the regulatory asset base. ARERA's decision considered the ongoing and expected increase of capital expenditures in electricity distribution when setting the FOCS parameter. In detail, FOCS is set for each DSO based on a combination of historical OPEX/CAPEX shares as well as forward-looking projections of CAPEX and OPEX: namely, the FOCS for years 2024 and 2025 is an average of the actual expenditure shares of 2021 and 2022, of the preclosing expenditure share of 2023 and of the forecast expenditure shares of 2024 and 2025. ARERA also decided that the FOCS value for years 2026 and 2027 will be updated under the same approach (combination of historical OPEX/CAPEX shares and forward-looking projections). It is already decided that FOCS will also apply for the next regulatory period 2028-2031, while its parameters are still to be set and will be defined after a review of the ongoing experience. Lastly, there is no efficiency benchmarking in place in Italy for the time being.

In **the Netherlands**, a yardstick benchmarking across the six electricity DSOs is used to calculate an average cost (TOTEX) per unit of output, which the NRA coins as 'static efficiency'. Some of these costs are adjusted on a per DSO basis due to regional differences, similarly to what is done in other countries as well. 'Dynamic efficiency' is calculated from the mean of historical differences in the actual costs versus outputs ratio since 2005. This dynamic efficiency is comparable to accounting for general productivity gains in other regulatory frameworks. These estimates are used to then set the allowed revenues for the upcoming regulatory period. The applied methodology alleviates possible bias 1 since both operative and capital expenditure is included in the benchmarking even if the benchmark is set somewhat differently compared to other countries.

[30] Further discussion on Ofgem's RIIOD2 methodology can be found here: Frontier Economics - Benchmarking techniques (acm.nl)

Norway uses an incentive-based revenue cap methodology, where a significant portion (70 %) of the allowed revenue is determined from benchmarking models. The benchmarking can be described as yardstick competition thanks to the large number of natural regional monopolies operating (85 in 2024). The model takes the total expenditures of the different network operators as an input[31] in the cost-minimisation model and contrasts them against three output variables relating to the scale of the network activities. For local distribution networks, a range of environmental factors, that capture differences between operators, is then used as a second step to correct for these differences. The model can be called a TOTEX model due to the fact that the efficiency of the costs as a whole is benchmarked, and in that sense OPEX and CAPEX costs are treated neutrally when setting the efficiency criteria, however the model itself may still have inherent CAPEX bias as the regulatory rate of return is set and applied for CAPEX only and the share of costs between OPEX and CAPEX is endogenous (compared to exogenous share in case of FOCS).
Portugal has used a TOTEX approach since 2022 in electricity distribution and transmission activities, with a profit/loss sharing mechanism. The remuneration of the asset base in the TOTEX cost base includes a remuneration using a pre-tax nominal WACC.
The allowed revenues are based on the historical share of “efficient OPEX”/”efficient CAPEX”, as well as forward-looking projections of theoretical CAPEX and OPEX. During the regulatory period, the OPEX/CAPEX share is not reviewed. In addition, the difference between theoretical/efficient and real OPEX and CAPEX is treated as a measure of the company’s efficiency performance. This “performance” is shared between the regulated company and the consumers. Therefore, the economic difference between theoretical/efficient and real OPEX and CAPEX is only partially taken into account in each new regulatory period.

Moreover, a profit/loss sharing mechanism is applied, which assesses annual profitability deviations against the defined asset return rate, with activation triggered by a comparison of the average regulatory operating profitability over the regulatory period with the average rate of return (WACC) for that period. This system includes three tiers, which activate progressively the mechanism while the deviation increases, whether above or below the target return rate. Non-TOTEX revenues are excluded from the profitability calculations to maintain a clear cost base. This mechanism is calculated after the end of the regulatory period to reflect the actual values that occurred throughout that period. The profit/loss sharing mechanism ensures that extra losses or gains obtained by the companies in the previous RP are recovered or paid during the new RP. A general x-factor is applied to the OPEX and CAPEX of assets invested from 2022 onwards.

The above-described country practices are not a complete picture of the incentives in place in the listed countries that can impact OPEX / CAPEX neutrality. Nevertheless, some of the practices have similarities and differences.

[31] TOTEX = OPEX + depreciation + return on BV + cost of network losses + cost of network outages

All except Italy apply an efficiency incentive in their TOTEX framework with variations in how benchmarks are set and what the efficiency incentives (general, firm-specific or both) are applied to OPEX and CAPEX. Denmark, Germany and the Netherlands incorporate both an x-factor to reflect general productivity changes and a firm-specific efficiency factor as well. Great Britain and Portugal apply a general x-factor whereas Austria and Norway apply a firm-specific efficiency factor.

Germany's and Denmark's methodologies are similar to Norway's in their endogenous split between OPEX and CAPEX in TOTEX. In addition to this, Denmark and Germany also split the Regulatory Asset Base (RAB) into forward-looking and historical asset bases. In contrast to these countries, the split between OPEX and CAPEX is exogenous in Italy and Great Britain as they apply a FOCS. Portugal's methodology is somewhere between those that apply FOCS and those that apply endogenous TOTEX benchmarking, as Portugal recognises costs partially on actual and partially on theoretical efficient costs.

5 Conclusions

The incentives that network operators face need to align with the interest to implement solutions in a technologically neutral way. This contributes to solving the electrification challenges of EU decarbonisation objectives cost-efficiently. Cost-wise, OPEX based solutions can be a viable alternative or complement to CAPEX based solutions. Therefore, network operators should have their incentives aligned to consider and utilise OPEX-based solutions when they make economic sense. The existence of regulatory incentives that promote OPEX / CAPEX neutrality will induce network operators to seek solutions at the most efficient total cost, regardless of whether these costs are more CAPEX or OPEX oriented, right from the planning stage. However, financial implication of improving OPEX/CAPEX neutrality should also be taken into consideration.

As things currently stand, there are several possible issues regarding the OPEX / CAPEX neutrality of network remuneration frameworks. This paper addresses two of these possible biases: 1) bias arising from hybrid regulation meaning that OPEX costs are under incentive-based regulation while CAPEX costs are under cost-plus methodology, or that both costs are incentivised but with different incentive strengths, and 2) the inherent preference for stability of returns by network operators which rate of return framework on capital expenditure has historically provided.

There are many useful examples from literature and regulatory practice that all NRAs can draw their attention to when considering and evaluating the OPEX / CAPEX neutrality of their current regulated network remuneration methodology. These include the utilisation of TOTEX benchmarking to address bias 1 and the implementation of FOCS to address both. Other regulatory design choices that can alleviate the discussed CAPEX biases include updating regulatory parameters less frequently, for example, the regulatory OPEX/CAPEX share used in FOCS or the total cost base used in TOTEX models, as well as longer regulatory periods, which will improve mitigation of both bias.

An objective comparison of different regulatory frameworks and their incentive signal strengths between OPEX and CAPEX is challenging given that a framework is the sum of its parts, where each component and parameter has been a regulatory decision that will impact the overall incentive strengths of the regulatory framework.

Many different remuneration methodologies may be called” TOTEX” models, but they can differ quite significantly from each other in practice in terms of neutrality of OPEX and CAPEX solutions. One of the main contributions of this paper is that it presents regulatory examples and, further, maps and categorises such practices.

Annex 1 – List of abbreviations

Term	Definition
CAPEX	Capital expenditure
CEER	Council of European Energy Regulators
FOCS	Fixed OPEX CAPEX share
MS	Member States
NRAs	National Regulatory Authorities
OPEX	Operative expenditure
R&D	Research and development
RAB	Regulated asset base
RoR	Rate of return
RP	Regulatory period
TOTEX	Total expenditure
WACC	Weighted average cost of capital
XGEN	General efficiency target
XIND	Firm specific efficiency target

About CEER

The Council of European Energy Regulators (CEER) is the voice of Europe's national energy regulators. CEER's members and observers comprise 39 national energy regulatory authorities (NRAs) from across Europe.

CEER is legally established as a not-for-profit association under Belgian law, with a small Secretariat based in Brussels to assist the organisation.

CEER supports its NRA members/observers in their responsibilities, sharing experience and developing regulatory capacity and best practices. It does so by facilitating expert working group meetings, hosting workshops and events, supporting the development and publication of regulatory papers, and through an in-house Training Academy. Through CEER, European 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.

In terms of policy, CEER actively promotes an investment friendly, harmonised regulatory environment and the consistent application of existing EU legislation. A key objective of CEER is to facilitate the creation of a single, competitive, efficient and sustainable Internal Energy Market in Europe that works in the consumer interest.

Specifically, CEER deals with a range of energy regulatory issues including wholesale and retail markets; consumer issues; distribution networks; smart grids; flexibility; sustainability; and international cooperation.

CEER wishes to thank in particular the following regulatory experts for their work in preparing this report: Isabelle Bartes, Jaakko Kennilä, Paulo Paulino, Hilda Ralsmark, André Rocha, Riccardo Vailati and Mattias Önnegren.

More information is available at www.ceer.eu.

Learn more about us

Our public documents are available for download from www.ceer.eu or can be obtained from the CEER Secretariat upon request.

Each month we dispatch a free electronic newsletter, CEER Newsletter, directly to the e-mail inbox of interested subscribers. You can sign up at www.ceer.eu/news-media/newsletters/

Council of European Energy Regulators
Cours Saint-Michel 30a, box F - 1040 Brussels - Belgium
Tel. +32 (0)2 788 73 30 | brussels@ceer.eu

WWW.CEER.EU