Further developing incentives for digitalisation and innovation in incentive regulation for TSOs

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Preface

The successful implementation of the energy transition and increasing digitalisation require investments and innovations from the transmission system operators (TSOs). In addition, innovation projects are frequently run as collaborations of several grid operators, sometimes at the pan-European level. This also creates new challenges in terms of grid regulation, which is predominantly aimed at increasing efficiency at individual grid operators. This study focuses on the implications of the progressing digitalisation for regulation and endeavours to answer two questions. The first one: Are innovative activities sufficiently incentivised under the current grid regulation framework, for example the Incentive Regulation Ordinance (ARegV)? Secondly: Where this is not the case, how could incentivisation be made more effective? In our analysis we distinguish between innovative activities that have an effect mainly externally and those that have an effect mostly internally. In a third topic area we will look into innovative regulation enabling risk taking. In total, we will propose five direct recommendations for further developing the ARegV.

This study on further developing incentives for digitalisation and innovation in incentive regulation for TSOs was commissioned by TransnetBW and conducted by a team from Jacobs University Bremen, supported by Oxera Consulting. We hope that we have been able to significantly contribute to further developing TSO regulation for them to continue driving forward digitalisation and the energy transition, and we are looking forward to further discussions on this topic. The authors want to thank the members of the project group at TransnetBW for their many ideas and the discussions with them.

List of acronyms and abbreviations

ACER	Agency for the Cooperation of Energy Regulators
ACM	Dutch consumer and market authority (Dutch: Autoriteit Consument & Markt)
aFFR	automatic Frequency Restoration Reserve
ARegV	Incentive Regulation Ordinance (German: Anreizregulierungsverordnung)
BMBF	Federal Ministry of Education and Research (German: Bundesministerium für Bildung und Forschung)
BMWi	Federal Ministry of Economics and Technology (German: Bundesministerium für Wirtschaft und Energie)
BNetzA	Federal Network Agency (German: Bundesnetzagentur)
CAPEX	capital expenditure
DA/RE	data exchange/redispatch
digi-external	digitalisation & innovation with predominantly external effects
digi-internal	digitalisation & innovation with predominantly internal effects
DFSA	Danish Financial Supervisory Authority
dnbK	permanently non-controllable costs (German: dauerhaft nicht beeinflussbare Kosten
EE	renewable energies (German: erneuerbare Energien)
EC	European Commission
ENTSO-E	European Network of Transmission System Operators for Electricity
EOG	revenue cap (German: Erlösobergrenze)
EU	European Union
R&D	research and development
FCA	Financial Conduct Authority (in the UK)
FOCS	fixed OPEX-CAPEX share
FSV	voluntary self-commitment
FT	Fintech
GB	Great Britain
GLEB	Guideline on Electricity Balancing
IMA	investment measure

KKA	capital expenditure reconciliation (German: Kapitalkostenabgleich)
mf	market facilitation
NABEG	Grid Expansion Acceleration Act (German: Netzausbaubeschleunigungsgesetz)
NPV	net present value
NRA	National Regulatory Authority
OOR	output-oriented regulation
OPEX	operating expenditure
Picasso	Platform for the International Coordination of the Automatic frequency restoration process and Stable System Operation
PCI	Project of Common Interest
RegMo	regulatory model
RIT	Regulatory Innovation Trial
RPI-X	short for incentive regulation (aligning permissible rates with the inflation rate (Retail Price Index) minus efficiency (X) factor set by the regulator)
SINTEG-V	ordinance on creating a legal framework for gathering experience as part of the “Smart Energy Showcases – Digital Agenda for the Energy Transition” (SINTEG) funding programme
SRL	secondary control power (German: Sekundärregelleistung)
StromVV	Swiss Electricity Supply Ordinance (German: Stromversorgungsverordnung)
TOTEX	total expenditure
TSO	transmission system operator

1 Executive Summary

This study on further developing incentives for digitalisation and innovation in incentive regulation for transmission system operators (TSOs) was commissioned by TransnetBW and conducted by a team from Jacobs University Bremen, supported by Oxera Consulting. Oxera Consulting contributed, in particular, specialised regulatory knowledge and helped with quantification using the examples of DA/RE and Picasso.[1]

Due to the energy transition and digitalisation, the TSOs are faced with new challenges which require them to invest and be innovative. In addition, innovation projects are frequently run as collaborations of several grid operators, sometimes at the pan-European level. At the same time, the TSOs are subject to a regulatory system that is geared towards increasing efficiency at the individual grid operators and varies from country to country. In light of these factors, the study aims to answer two questions:

- Are innovative activities sufficiently incentivised under the current grid regulation framework, for example the Incentive Regulation Ordinance (ARegV), and do they enable partnerships and collaborations?
- Where this is not the case, how could incentivisation be made more effective?

This study focuses on the need to change the regulatory system due to progressing digitalisation. On the one hand, digitalisation requires many highly uncertain innovation activities. Such innovation activities in turn require cost-intensive research and development (R&D) and must be trialled before implementing them for commercial use. On the other hand, digitalisation creates new tasks, business areas and markets for the system operators. The structure and approach in this study are depicted in *Illustration 1-1*.

In this table, digitalisation and innovation with "internal" and "external" effects are mentioned. In this context, internal means that costs and benefits are mainly incurred by the decision-maker. External means that costs and/or benefits are incurred by third parties (e.g. wider society or other system operators) and not by the decision-maker. It is important to make this distinction in order to be able to incentivise appropriately, since incentive biases as well as proposed solutions differ accordingly.

[1] In particular, Oxera provided support with quantification in sections 3.3, 3.4 and 4.4 as well as relevant background analyses.

Thematic area	Challenges	Proposed solutions	Example of use*
Digitalisation & innovation with predominantly external effects (digi-external)	• *Value creation* (external effect) basically not incentivised by the Incentive Regulation Ordinance (ARegV) at all	Market facilitation incentive mechanism with estimated cost budget	Picasso
Digitalisation & innovation with predominantly internal effects (digi-internal)	• Underrecovery of costs due to base-year problem (in particular with initial expenses) ○ e.g. transition to Redispatch 2.0 • Increasing OPEX may lead to CAPEX-OPEX bias	Digitalisation budget, applying sharing factors	DA/RE
Innovative regulation enabling "risk taking" (promoting experiments)	Experiments can very quickly reach the limits of the regulatory framework • Legal uncertainty • Economic risk • Administrative effort • Limited scope for application	• Experiment budget • Regulatory Innovation Trial (RIT) to develop recommendations for action • Pioneer bonus	SINTEG-V

Illustration 1-1: Overview of study

Source: illustration by the authors

** Note: Initiatives and measures generally comprise internal as well as external aspects. The examples of use selected for internal and external aspects can thus only be allocated in terms of their main emphasis.*

In the study we distinguish between three thematic areas that are analysed and discussed using one concrete example of use each. Even though the study always references one particular example, the insights gained apply universally and are not limited to the respective examples.

- The first section looks mainly at digitalisation and innovation with predominantly external effects (*digi-external*) and provides an in-depth discussion of opportunities for incentivising new markets and sectors. A suitable example of use in this regard is the Picasso[2] project which is aimed at creating a pan-European market for trading secondary control power (German: Sekundärregelleistung / SRL). Picasso has external benefits, meaning that it is mainly wider society (or other grid operators) who benefit from it, and not the grid operator running it. Since external benefits (value creation) are not or not strongly incentivised by the Incentive Regulation Ordinance (ARegV), a significant potential for value creation may not be tapped

[2] https://www.entsoe.eu/network_codes/eb/picasso/

into. To incentivise such projects with predominantly external benefits, we are developing a *market-facilitation incentive mechanism*.

- In the second section we mainly look at digitalisation and innovation with predominantly internal effects (digi-internal) and discuss the obstacles in the current version of the Incentive Regulation Ordinance (ARegV) for innovative but uncertain digitalisation activities as well as possible solutions. Such activities tend to be OPEX-intensive[3] measures for improving internal grid operations. The example for use in this context is the DA/RE[4] project, a platform for data exchange, coordination and optimisation to facilitate Redispatch 2.0 in Germany. The subject matter is regulation-specific and is strongly determined by regulatory details. Under the current Incentive Regulation Ordinance (ARegV), such OPEX-intensive innovative measures, in particular the base-year problem and a CAPEX-OPEX bias, present challenges for system operators. The base-year problem is due to OPEX being incurred in a non-base year, so that it cannot be included in the permitted revenues. This results in OPEX effectively not or not fully being compensated if it cannot be covered by the approved revenue cap (German: Erlösobergrenze / EOG). CAPEX-OPEX bias is the result of regulation setting distorted incentives, for example choosing a more CAPEX-intensive solution even though the more OPEX-intensive alternative would be more cost-efficient. To overcome these obstacles, we are proposing a *budget approach* for the ARegV for which different calculation options are specified using *sharing factors* (share of the grid operator in cost differences between planned and actual costs).
- In the third section, we will look into innovative regulation enabling “risk taking”. In particular, we are discussing the requirement for testing innovative, risky projects and regulations before their implementation with regard to *promoting experiments*. The “experimentation clause” in the SINTEG ordinance[5] is an example of some initial steps in this direction. Early results are somewhat disappointing, however, and there appears to be considerable potential for improvement. We are discussing three proposed improvements for handling (regulatory) experiments.
    1. *Experiment budgets* which can be made available to third parties by grid operators in order to provide stronger incentives to participate in experiments,
    2. *Regulatory Innovation Trial* (RIT), i.e. creating a suitable framework for also testing changes to the regulatory framework itself, and,
    3. *Pioneer bonus*, which grid operators receive for implementing an innovative collaboration project in order to make the development and financing of industry-specific individual innovations more flexible and more focused.

[3] OPEX = operating expenditure CAPEX is short for capital expenditure which, strictly speaking, is different from capital cost.
[4] https://www.dare-plattform.de
[5] SINTEG is the “Smart Energy Showcase – Digital Agenda for the Energy Transition” funding programme: https://www.sinteg.de/.

An intended special characteristic of this incentive is that all recommendations for action can also be applied across different system operators so that (pan-European) collaborations become possible and can even be promoted.

It is important to note that, for the purpose of this study, we were only able to depict the basic structure of the mechanisms in terms of the recommendations for action; their actual regulatory implementation would require many details to be worked out.

2 Background

Almost 40 years have passed since incentive regulation (i.e. RPI-X regulation) was developed first by Professor Littlechild (cf. Beesley & Littlechild, 1989). In Germany, an incentive-based regulatory system for the energy grids as set out in the Incentive Regulation Ordinance (ARegV) is in its third regulatory period and has been in effect for almost 15 years now. Currently, preparatory work for the fourth regulatory period is being carried out.

The recent general trend in incentive regulation points away from purely emphasising efficiency towards a stronger focus on developing the energy grids further, in order to be able to meet the expanding requirements the grid operators are faced with. We call this development, which takes place in addition to core incentive regulation, output-oriented regulation (OOR) (cf. Brunekreeft, Kusznir & Meyer, 2020 and 2021).

Three effects drive the development of output-oriented regulation.

1. As a result of the energy transition grid costs are rising; efficiency-focused regulation is not well equipped to handle the growing costs.
2. Innovative activities, driven by digitalisation, come with higher risks than conventional grid activities.
3. In actual practice, the regulatory models often do not provide incentives for developing new tasks and services (*value creation*).

These trends, although only at an early stage, also appear to emerge in practice. In a study for the European Commission, Haffner et al. (2019) investigate the regulation of gas and electricity TSOs in 26 member states in terms of incentives for investment with a focus on security of supply and innovation. The main conclusion (Haffner et al., 2019, p. 10) is that current regulation does not provide enough incentives for investment. The authors summarize the causes they identified as shown in Illustration 2-1.

A. Socially beneficial but (for the TSO) not viable projects are not sufficiently incentivised;
B. Bias towards capital expenditure (CAPEX) based solutions instead of operational expenditures (OPEX-solutions);
C. No specific provision related to innovation (e.g. allowances, duties, etc.);
D. TSOs are deterred from risky investments due to perceived high project risk and strict penalties for not meeting deadlines;
E. Smart grid technologies reducing need for physical investments lower TSOs' financial return, creating a disincentive to invest for TSOs; and
F. Lack of clarity of mandate for TSOs in certain innovative fields.

Illustration 2-1: Obstacles for efficient innovations
Source: Haffner et al (2019, p. 10)

Several points in this illustration require a closer look: Point A is about *value creation*. Some projects and/or investments have external benefits, i.e. they create benefits for society, but – depending on regulation – are not necessarily of commercial interest to the grid operator. Points B and E highlight CAPEX-OPEX bias. Even though an OPEX solution may be more cost-efficient, regulation could make the CAPEX alternative more attractive to the grid operator. Point C reiterates that innovation activities are often not sufficiently incentivised. The present study takes up these points and discusses them in detail.

ENTSO-E, the European Network of Transmission System Operators for Electricity, has also commissioned a study on this subject. Above all, ENTSO-E (2021) has identified that TSOs are not sufficiently incentivised for tasks beyond the core area and proposes to expand the regulation models. The network discusses obstacles in the regulation, but also makes suggestions for improvement. Here, three topic areas stand out in particular. Firstly, it points out that regulation should focus more on OPEX-based activities. Secondly, it proposes a budget for innovation activities. Thirdly, it suggests a FOCS (fixed OPEX-CAPEX share) approach to remedy CAPEX-OPEX bias. FOCS is a version of TOTEX regulation (cf. oxera, 2019). The present study takes up several of these topics and discusses them in detail.

3 Digitalisation & innovation with predominantly external effects (digi-external)

3.1 Example of use: Picasso

The TransnetBW-operated digital *Platform for the International Coordination of the Automatic frequency restoration process and Stable System Operation* (Picasso) is intended to connect the national markets for secondary control power and enable a cross-border exchange taking into account grid restrictions. Picasso thus provides an approach for implementing the networking of international balancing power markets as stipulated by the European Commission's Guideline on Electricity Balancing (GLEB).

Picasso delivers on three key services: activation optimisation for secondary control power (pricing and accepting best bids), the exchange of electricity between TSOs as well as settling the exchanges between the TSOs and resulting payment obligations (ENTSO-E, 2018). Picasso is thus defining the framework and the processes for coordinating the secondary control power market at the pan-European level.

The benefits that will be created by Picasso are key for our further discussion of this topic. Picasso is aimed at increasing cross-border competition by opening up European secondary control power potentials and thus reducing costs for activating secondary control power. TransnetBW's costs for developing and operating Picasso are covered, at least partially, by the participating TSOs and reimbursed in part via voluntary self-commitments and/or under the provisions of the revenue cap; however, a risk of the costs not being recovered fully remains. At the same time, a Europe-wide societal benefit is created by reducing the costs for providing secondary control power. However, this benefit is currently not being used for incentivising investments by TransnetBW and the other participating TSOs.

3.2 Problem analysis

The digi-external problem area is illustrated using the example of Picasso, but the basic principle of external benefits applies across the board. The basic structure of this subject matter can thus also be found in other contexts.

The key regulatory aspects of Picasso that are relevant to this study relate to costs and benefits of pan-European secondary control power trading. The benefits are mainly external, i.e. it is not the TSO who benefits from pan-European trading, but primarily society as a whole. [6] The benefits of pan-European trading come about due to lower production costs for providing secondary control power, i.e. a merit-order effect. This external effect is a type of value creation and increases welfare in society. However, the system operator is incentivised to generate such external benefits under basic incentive regulation.

This topic area of external benefits in the regulatory framework was discussed for the first time by Spence (1975) in the context of quality regulation. The key problem here is that quality incentives that can be provided for by price-based regulation, which is also used in the budget approach of ARegV, are not sufficient. Rewarding cost reductions could potentially incentivise TSOs to save costs by compromising security of supply. The incentives for the grid operators are thus lacking a “counterweight” that reflects external benefits (and the associated willingness to pay higher prices for better quality) in revenues and results in an efficient cost-benefit ratio for the grid operator. ARegV wants to achieve this for transmission system operators via the quality element.

[6] When the costs for secondary control power drop, expenditure of the relevant TSO also drops. However, these savings are passed on directly to the grid customers, possibly minus a small bonus or malus. We assume that this indirect incentive is negligible and ignore this effect from here on in.

This positive cost-benefit ratio must be incentivised effectively, also with regard to positive external benefits of digitalisation and innovation.

For the purpose of this study we are assuming that costs for developing and operating the project in question have been fully identified and defined as such and are reflected fully in incentive regulation.

3.3 Recommendation for action: a market facilitation incentive mechanism with budget approach incorporating costs

To incentivise external benefits, we specify a market-facilitation incentive mechanism that may be implemented as outlined below.

$$IB_{i,t} = C_{i,t} + \alpha_i \cdot (W_t - R_x)$$

Legend:

$IB_{i,t}$ - incentive bonus (in €) for grid operator i in year t

$C_{i,t}$ - specific costs of the digitalisation and innovation project for grid operator i in year t (according to budget approach)

W_t - welfare gain from project in year t

R_x - reference value in year x

α_i - incentive parameter for grid operator i

Please note that the costs must be covered separately from the incentive bonus ($C_{i,t}$ part of the formula); the incentive parameter (α_i) is only intended for the external benefit (welfare gain).

The system can generally be applied across different grid operators, enabling and fostering collaboration. In the case of Picasso, TransnetBW is leading the project, but many other European TSOs are participating. Their costs and their contribution towards its benefit should be taken into account accordingly. The formula can thus be applied for all participating TSOs by adapting the parameter values. This approach has two consequences. Firstly, the regulator sets or approves a total incentive parameter α. The bonus resulting from this total incentive parameter is then shared among the participating TSOs. Secondly, the overall project costs are the sum of the aggregated TSO-specific costs for all participating TSOs. The overall project costs are submitted to the regulator for approval. The bonus is calculated on the basis of the total incentive parameter. How the bonus and the costs are shared between the individual TSOs is to be negotiated between the participating TSOs, whereby the regulator does not necessarily need to be involved.

Costs are approved using a budgeting approach. Costs and trends are specified based on the year and are thus included for a specific year in the incentive bonus. Even though it is not specified here, a sharing factor for staying below or exceeding the costs can also be included in the budgeting approach.

Many European grid operators participate directly or indirectly in pan-European collaboration projects. This implies that many different regulatory systems in the various member states are involved. This study was prepared primarily from the viewpoint of the German Incentive Regulation Ordinance (ARegV); however, it should also be assessed in detail if the mechanism is compatible with different regulatory systems.

The total incentive parameter (α), as well as the overall cost level and trend should be set by a regulatory authority. The TSOs share the total α and the overall costs during a negotiating process among each other. However, the mechanisms are implemented into the national regulatory systems and controlled by the national regulatory authorities (NRAs).

In addition, the question arises as to who will actually be paying the bonuses for market facilitation. If, as is the case with Picasso, a clearly defined market is created, we suggest that the market participants – instead of the grid user – carry the costs for the incentive mechanism, via a type of transaction or usage fee. In other cases, where it cannot be clearly determined which market participants are the users, refinancing should take place via the grid fees.

We are using the saved production costs (for secondary control power) as welfare indicator to illustrate how the incentive bonus works using the example of Picasso. A challenge when it comes to putting the mechanism into practice is to determine the details of the used indicators for welfare W_t and the reference value R_x. Several options would be possible for; the following considerations are important when it comes to choosing one.

- How much risk should the TSOs be prepared to carry? Some options leave more risk with the TSOs, other options tend to shift the risk towards the customers. Risk should be allocated according to the principle that the party who is best positioned to influence the risk should be carrying it. If it is not controllable for the TSO, it should be socialised. It thus follows that the more the fluctuations in the welfare effects are outside the control of the TSO, the more the fluctuations should be neutralised.
- The incentive effect should suit the project. Here, we need to distinguish between *marginal incentive effect* (marginal principle) and *project-specific incentive effect* (investment view).
    - Marginal incentive effect: The incentive to run a project in an increasingly (from year to year) more efficient manner and to thus bring about more and more cost reductions.
    - Project-specific incentive effect: The incentive to initialise and develop a project in the first place. This viewpoint is especially important for future projects that are still to be developed and implemented.

It appears to be important for innovative projects in particular to incentivise grid operators effectively and efficiently to start developing these projects in the first place.

Once such a project is established, the potential for further marginal welfare improvements is comparably low. This means that such projects have a “leap effect”. The actual welfare gain comes about as the result of the project being implemented, while there will not be significant additional improvements at a later stage. The incentive effect should therefore mainly be project specific (investment view).

With projects for which the project-specific investment view is dominant, we recommend setting the reference value (R_x) to zero, in order to incentivise this very leap effect. With regard to the welfare indicator, the risk resulting from possible year-to-year fluctuations should be limited. Therefore, we recommend using either a moving average value or the actual fluctuating annual value with upper and lower limits. These two options reflect that the TSOs, after implementing the project (e.g. after completing the Picasso platform), are not left with many options to influence welfare. The risk that they are exposed to year on year should thus be limited. The value of the incentive parameter α, is then negotiated between regulator and grid operators; if the reference value is set to zero, α should be relatively low, however, in order to share the welfare gain between grid operators and consumers in a sensible way.

3.4 Quantification

In order to make the scale of the proposed incentive mechanism more tangible, a quantification using cost and benefit data from the Picasso project was carried out. To this end, TransnetBW provided anonymised data at an aggregate level. An output-based incentive bonus is an obvious choice when the grid operator's activities create considerable societal benefits that by far exceed the costs. The chart below illustrates this for the Picasso project. Societal benefit is shown as 100%. The costs for the TSO associated with generating this benefit come to < 2% (once-off costs) or < 1% (running costs) of the benefit.

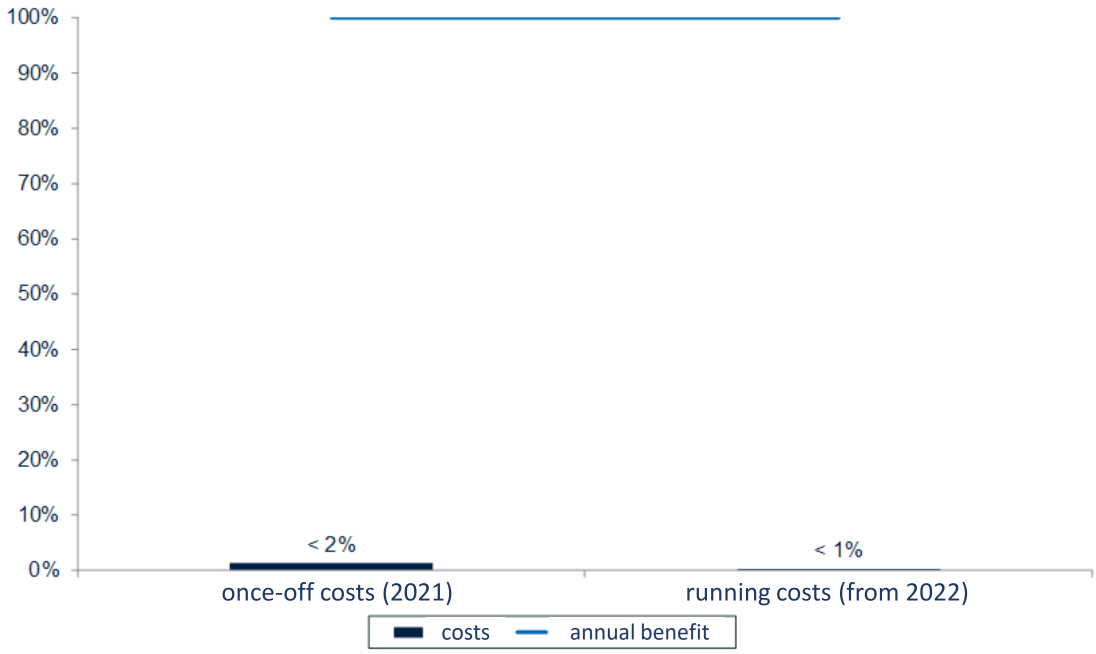

Illustration 3-1: Total costs and benefits of Picasso
Source: own illustration based on data from TransnetBW and the TSOs' stakeholder workshop.

The Picasso platform (with a reduced number of participants) creates a high societal benefit of approximately €115 million p.a. This estimate was calculated by ENTSO-E and the participating TSOs and compares a functioning European secondary control power market (with a reduced number of participants) with a reference scenario in which all countries (except Germany and Austria) operate an isolated market. [7] However, according to TransnetBW, the calculated benefit may fluctuate significantly from year to year. The estimated total costs for the participating TSOs only make up a fraction of the generated value (see illustration). The costs are therefore disproportionately lower than the value created, even though the created value may still fluctuate considerably from year to year. The proposed incentive mechanism ensures that the grid operators can benefit to some extent from the value they created, whereby the exact level of the incentive value is to be determined. This creates incentives for actually efficiently implementing, operating, and further developing such projects.

4 Digitalisation & innovation with predominantly internal effects (digi-internal)

4.1 Example of use: DA/RE

In the amended German Grid Expansion Acceleration Act (Netzausbaubeschleunigungsgesetz, NABEG 2.0), the legislator stipulates, among other things, that all renewables and storage facilities with a capacity above 100 kW are to be included in the German redispatch process from October 2021. This means for the distribution system operators that they must replace their previous feed-in management processes, which are now only to be used in emergencies, with a redispatch process based on planned values. This implies that the grid operators must also order redispatch measures from smaller facilities in advance and organise balance-sheet settlement (Götz & Konermann, 2020). In order to implement these requirements, grid operators must introduce the relevant processes for exchanging data between themselves and the plant operators, coordinating measures between grid operators, managing the redispatch balancing group and billing. In collaboration with Netze BW, TransnetBW has addressed these new requirements via the digital DA/RE platform. DA/RE is short for "data exchange (German: Datenaustausch) / redispatch". The platform focuses on vertical coordination between grid operators to organise and

[7] The calculation was carried out by the participating grid operators and is based on simplified assumptions regarding pricing, bidding strategies and market design. See Picasso aFRR Platform Implementation Project, ENTSO-E Stakeholder Workshop from 26 March 2018.

optimise redispatch requirements and the relevant grid restrictions. This comprises, in particular, data exchange concerning the plants' master data, delivering timetables, grid planning data and grid condition assessments. DA/RE enables the exchange of data, aggregates grid planning data and coordinates redispatch measures across grid levels, generates and sends out activation documents for each redispatch measure and supports grid operators in managing the redispatch balancing group (Römer & Schairer, 2021).

A special feature of DA/RE in this context is that the platform is cloud-based. This eliminates the acquisition costs (usually CAPEX) for local server capacities that would otherwise host data and applications. Instead, hosting fees are incurred with the cloud solution that are subject to the data storage and/or transfer volumes and that may vary over time; the costs of the cloud solution are mainly OPEX. As is the case with the CAPEX version, during the year when the cloud solution is introduced, the costs are higher than for the following years, since the interfaces and systems must be integrated into the cloud solution. In the following years, the costs for the cloud solution will then depend on the frequency of data access and on the volume of the data, which in turn depends on the need for and number of redispatch measures at the grid operators participating in DA/RE. Since the need for redispatch depends on feed-in of electricity from renewables, the running costs for the cloud solution may fluctuate and are thus difficult to estimate.

4.2 Problem analysis

DA/RE is an example for the digi-internal problem area, i.e. for digitalisation measures that improve the internal efficiency of production and/or operations at the grid operator.[8] Even though improving efficiency is the actual key objective of incentive regulation, the specific application of ARegV may lead to biases.

Generally speaking, such biases are due to time-related effects (in this context particularly base-year effects) and asymmetrical regulation (in this context mainly the different ways CAPEX and OPEX are treated). The current version of the Incentive Regulation Ordinance (ARegV) treats OPEX and CAPEX asymmetrically. While CAPEX can be refinanced completely every year via investment measures as laid out in section 23 ARegV (IMA) and/or via capital expenditure reconciliation (KKA) from the fourth regulatory period, OPEX is subject to a five-year (t-5) time delay and thus problematic in terms of full refinancing. The mechanisms imply that the base-year problem plays an important role for OPEX while it is eliminated for CAPEX.

Base-year problem

OPEX incurred during the base year is the determining factor for the revenue cap for the five years of the next regulatory period. However, costs may also be incurred outside of the base year, resulting in them not being included at all or only at a later

[8] DA/RE also creates value externally. However, for this example of use we are focusing on the internal costs and benefits.

time for the revenue cap. This problem is particularly significant when it comes to statutory tasks, since the time of the expenditure cannot be chosen freely in those cases. This means that once-off mandatory expenditures may be incurred outside of the base year that could therefore never be included in the revenue cap.

CAPEX-OPEX bias

The asymmetrical treatment of OPEX and CAPEX may lead to a "CAPEX-OPEX incentive bias". OPEX stands for operating expenditure / costs. These are allocated within a book year; no interests or depreciation are incurred. CAPEX is capital expenditure. This refers to more long-term investments, with depreciation and interest being incurred due to prefinancing. It should be taken into account that due to the principle of depreciation (annual) capital expenditure is not equivalent to (once-off) capital investments.

CAPEX bias occurs when an OPEX-based approach would be more efficient than an output-equivalent CAPEX-based alternative, but the latter is economically more attractive than the OPEX-based solution due to the regulatory framework.[9] Two mechanisms in the Incentive Regulation Ordinance (ARegV) are relevant for such a CAPEX bias. Firstly, OPEX is subject to a time lag and thus affected by the base-year problem (see above), while CAPEX is reconciled on an annual basis via the capital expenditure reconciliation mechanism and/or investment measures. Secondly, the time lag in the regulatory period leads to costs not being fully recovered when OPEX increases during the regulatory period; due to capital expenditure reconciliation or investment measures this cannot happen with CAPEX. Increasing OPEX is plausible with new digitalisation projects such as DA/RE. From the viewpoint of the grid operator a CAPEX solution is thus more attractive than an OPEX solution for regulatory reasons.

4.3 Recommendation for action: digitalisation budget, applying sharing factors

The digitalisation budget we are proposing here is a budget approach for selected and approved digitalisation projects. The planned costs for the project-specific budget including the timeline are agreed with the regulator in advance. For ex-post cost overruns or underruns (actual costs) sharing factors or sliding scales may be used.

A "high" sharing factor is commonly defined by the grid operator taking on a large share of the cost difference between planned actual costs and the grid customers a small one (BMWi, 2020). And, accordingly: A "low" sharing factor means that the grid operator passes on a large share of the cost difference and the grid customers carry most of it.

The current revenue cap could be regarded as a linear application of the budget approach with high (100%) sharing factors; however, there is one significant difference. The revenue cap is based on base years as set out in the ordinance, whereas the budget approach can start in any given year and permits costing forecasts that are

[9] The opposite effect of an OPEX bias is theoretically also possible but is less relevant in practice for several reasons.

defined in advance, meaning that costs may increase as well. This approach thus cancels out the base-year problem. This is particularly important when innovative new projects are to be run, for which costs are not yet included in the base year.

The digitalisation budget is specifically intended to enable collaboration projects across different grid operators. In order to achieve this, an overall budget (with timeline) can be agreed with the regulator, which is shared by the grid operators among themselves.

Although a budget approach has many advantages, there are also two significant challenges associated with it. Firstly, calculating and getting approval for the appropriate budget is cost and labour intensive. In order to limit the workload, the budget approach presented here is intended for a limited number of larger innovative digitalisation projects. Secondly, a budget approach may contain strategic incentives to overestimate the submitted budget. If the sharing factors are high, a budget overrun may lead to inflated profits. It is up to the regulator to evaluate if the submitted budget is appropriate, which can be a difficult task due to the informational disadvantage compared with the grid operator.

Setting different sharing factors and selecting varying combinations of factors for OPEX and/or CAPEX results in three intuitive options for the digitalisation budget that we are discussing below.

- Option 1: TOTEX-based digitalisation budget
- Option 2: Project-specific annual OPEX reconciliation
- Option 3: OPEX-based digitalisation budget

Further down, Illustration 4-1 summarises these options in relation to the sharing factors.

4.3.1 Option 1: TOTEX-based digitalisation budget

TOTEX-based means that all expenditure, OPEX as well as capital costs calculated from CAPEX, are being included in the budget. The approved budget is updated annually and included in the revenue cap. This option is achieved when OPEX and CAPEX with symmetrical and high sharing factors are included in the budget approach.

The main benefit of the budget approach is that cost forecasts, which may vary over time, are used as the basis for the revenue cap so that coverage of the costs does not depend on the exact starting year. In addition, the budget approach increases regulatory and/or planning security for the grid operator. One advantage of the symmetrical TOTEX approach is that CAPEX-OPEX biases, which occur under the Incentive Regulation Ordinance (ARegV) for OPEX due to the base-year problem, are eliminated here. Another advantage of the high sharing factors are the strong efficiency incentives. From the viewpoint of the grid operator this also implies opportunities to achieve additional profits through outperformance.

The associated disadvantage of the TOTEX budget with high sharing factors is that a relatively high risk remains for the grid operator. Once the budget is agreed, cost overruns and underruns (when actual costs deviate from forecast costs) are a risk factor for the grid operators. In this version CAPEX would also be affected, while the risk of refinancing with CAPEX is relatively low under the current investment measures (IMA) (or future capital cost reconciliation (KKA)) [10] regulation.

4.3.2 Option 2: Project-specific annual OPEX true up

In the current version of the Incentive Regulation Ordinance (ARegV), CAPEX is passed on in a regulatory sense year on year using the investment measures (IMA) (or, in future, capital cost reconciliation (KKA)) mechanisms, while OPEX are subject to the (t-5) time lag. OPEX is thus affected by the base-year problem, while it does not play a role for CAPEX. The present proposal aligns the rules for OPEX with the capital cost reconciliation (KKA) mechanism. Accordingly, project-specific OPEX is also passed on year on year in terms of regulation. “OPEX true up” of this type eliminates the time lag and thus the base-year effects.

This option is achieved through very low sharing factors for both CAPEX and OPEX. In the extreme case of passing on costs in a perfect manner, an agreed budget would obviously be no longer required, and this long-winded process could be dispensed with. An approach of this type will be particularly relevant when the expenditure (in this case OPEX) is becoming very uncertain and is outside the control or the influence of the TSOs. Using this approach, there will be no CAPEX-OPEX bias due to the base year, since the problem is eliminated for both expenditure types.

From the viewpoint of the grid operators, the biggest advantage of this approach is its very low risk. By passing on the costs fully, complete acknowledgement of the costs is always ensured, and it will not be possible for the costs not to be recovered in full.

At the same time, it is likely to be a disadvantage from the viewpoint of the grid operators that there is not much opportunity for outperformance, the incentives to exceed the efficiency targets are not strong, because the additional costs savings must be passed on. This directly results in the disadvantage of efficiency incentives being only being limited for annual OPEX true up, without effective benchmarking.

4.3.3 Option 3: OPEX-based digitalisation budget

Under the provisions of the current ARegV version, CAPEX is subject to investment measure (IMA) (or, in future, capital cost reconciliation (KKA)) regulation with annual reconciliation, while OPEX is subject to the revenue cap time lag. A hybrid option is basically very similar to the current system prescribed by the Incentive Regulation Ordinance (ARegV). A budget approach for OPEX in order to effectively address the base-year problem, while CAPEX remains within the investment measure (IMA) (or, in

[10] In terms of analyses IMAs and KKA are very similar, so that an explicit distinction is not made here. The analysis applies to both mechanisms.

future, capital cost reconciliation (KKA)) regulation. In analytical terms, this option can be seen as a budget approach with asymmetrical sharing factors for CAPEX and OPEX; the sharing factor for OPEX could be set high in order to ensure that efficiency incentives are maintained, while the sharing factor for CAPEX would be low, as in the capital cost reconciliation (KKA) system.

From the viewpoint of the grid operators, a partial risk remains for OPEX due to the high sharing factor; at the same time the risk is reduced because the base-year problem as such is being addressed. In addition, only specific digitalisation projects fall into the proposed regulation's scope of application. Since CAPEX is subject to the capital cost reconciliation (KKA) regulation, there is no risk of costs not being fully recovered due to the base-year problem here. This may result in a CAPEX bias.

A possible disadvantage of the approach could be a further CAPEX bias. Since CAPEX is passed on from year to year and OPEX compensation is set under the budget approach, there is – after the budget has been determined – an incentive to forego OPEX (provided for in the budget) and to choose an output-equivalent CAPEX-based solution instead, even when this is inefficient. However, the regulatory authority can prevent this by checking actual expenditure retrospectively and demanding considerable deviations from the pre-authorised budget to be justified.

In this case, efficiency incentives are rather moderate for CAPEX, but for OPEX they are considerable. Accordingly, the same applies for outperformance opportunities; they are limited for CAPEX, but clearly present with OPEX. Whether an OPEX-solution under this system is preferred by the TSO thus also depends on their willingness to take risks and/or the predictability of their operating expenditure.

Illustration 4-1 depicts the general structure of a budget approach using sharing factors.

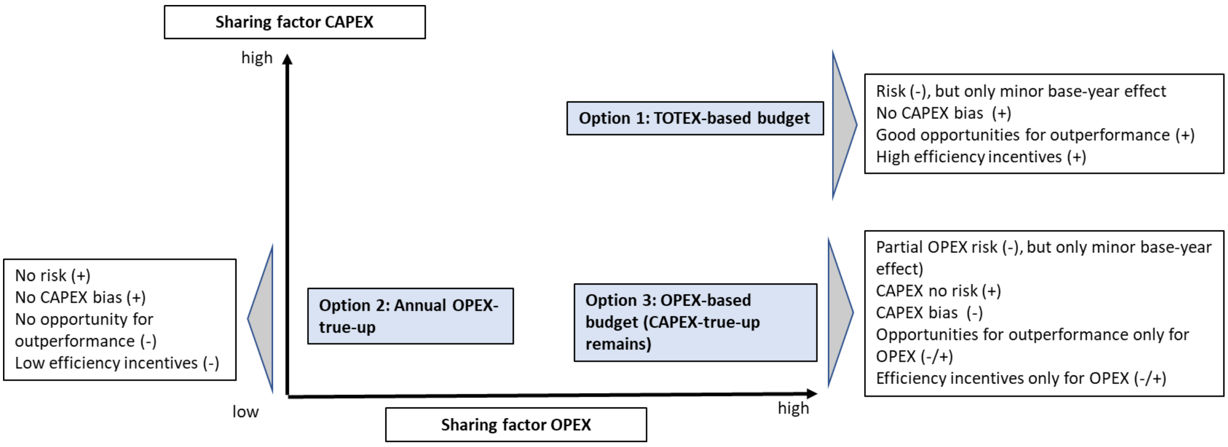

Illustration 4-1: Categorisation of possible variations of the budget approach depending on sharing factors.
Source: illustration by the authors.

4.4 Simulation and quantification

A simulation model and stylised figures illustrate regulatory problem areas and recommendations for action described above. The model is a simplified version of the regulatory model (RegMo)[11], which depicts revenue cap calculation under the German regulatory framework. A suitable evaluation criterion in this context is net present value (NPV).

The simulation uses two measures with different cost structures, one CAPEX and one OPEX option. The analysis is intended to assess how regulatory specifications affect the choice of the grid operator between those two options.

The difference between the options is the cost type of the initial expenses. For the CAPEX option these are investment expenditures the hat are dealt with in terms of regulation via capital expenditure reconciliation (KKA). For the OPEX alternative, the simplified assumption is made that the initial expenses are operating expenses, for example for developing a cloud solution. For the discounted total costs, the assumption is made that they are equal for the OPEX and CAPEX options (expenditure equivalence).

Two problem areas that could lead to incentive biases were analysed as part of a simulation. 1) Costs outside of the base years and 2) Increasing OPEX. Since the analyses are comparable for the most part, we limit the description to the first point, with costs outside of the base years.

For initial and operating expenses we assume a continuous progression; both expense parts are deferred and run for the duration of a five-year regulatory period. This simplifies analysis and representation, since only the base-year effects that are relevant for the analysis are to be assessed. For the chosen example, the start of the operating expenses occurs in a base year (2021), resulting in the (t-2) time lag only. Primarily, the focus should be on the base-year effects of the initial expenses which start as far back as 2019 and thus lie outside the base years and lead to the difference in the cost treatment in the OPEX and CAPEX options. While expenditure for the OPEX option was recorded only in 2021 and is included in the revenue cap from 2024, for the CAPEX option it is already included in the revenue cap calculation in 2019 due to the capital expenditure reconciliation (KKA) regulations.

[11] RegMo was developed by the participating authors from Jacobs University Bremen.

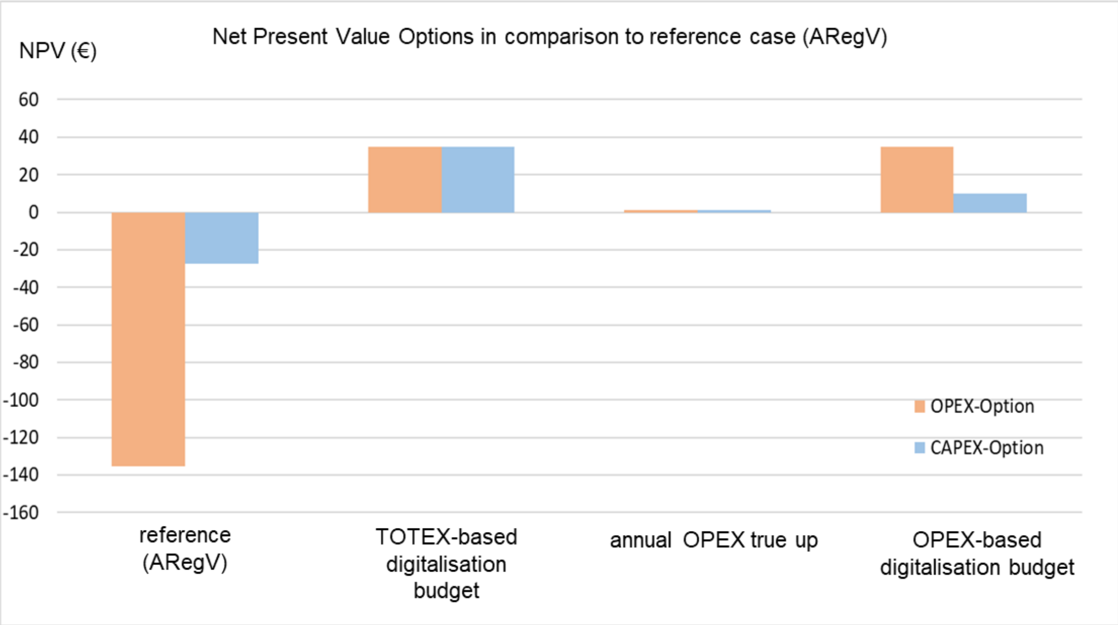

Illustration 4-2: Net present values for the OPEX and CAPEX options of the three recommendations for action versions compared with the Incentive Regulation Ordinance (ARegV) reference case.
Source: illustration by the authors

Illustration 4-2 (left) shows a comparison of the NPVs for the two options under the current ARegV and illustrates the resulting CAPEX bias. It shows a significant loss for the OPEX option due to the time lag until the initial expenses are taken into account. With capital expenditure reconciliation regulation in place, this time lag does not occur for the CAPEX option, so that costs will be recovered almost immediately. A (t-2) time lag remains for both options only with regard to running operating expenditure, which a minor negative effect on the overall result.

The three options for a recommended digitalisation budget were also simulated. 1) TOTEX-based digitalisation budget, 2) Annual OPEX true up, and 3) OPEX-based digitalisation budget

With the TOTEX-based digitalisation budget, a cost budget that is submitted ex ante is specified. For the simulation, a sharing factor of one is assumed, ensuring that the budget principle is applied in its purest form. In the present case the digitalisation budget is submitted for approval at the start of regulation period (2019) and is valid until the end of the regulation period. It is assumed that the actual costs are overestimated by 5%. Illustration 4-2 shows the results for the OPEX and CAPEX options. Firstly, it emerges that the NPV becomes positive, because the base-year problem is eliminated and the budget was overestimated Secondly, it shows that the CAPEX bias problem is effectively solved, since the NPV is the same for both options.

With the second option of the budget approach, annual OPEX true up, (project-specific) operating costs are passed on directly. Similar to capital expenditure, revenue is updated immediately for OPEX so that total revenue follows exactly annual total expenditure. For the simulation, a sharing factor of zero and annual cost reconciliation are assumed, resulting in cost deviations practically fully carried by grid customers. Overall, the CAPEX bias in the regulatory system is eliminated with this solution as well.

With the third option, the OPEX-based digitalisation budget, CAPEX remains within the capital expenditure reconciliation system, while the ex-ante project budget is limited to project-specific OPEX. Separate treatment of OPEX under the budget principle remains in place as with the current regulatory system; however, the base-year problem is eliminated here, since the budget can be submitted for approval at any time during the regulatory period on an ex-ante basis. Here, it shows that the OPEX-based digitalisation budget cannot remedy CAPEX bias. For OPEX a considerable impact on the results occurs due cost deviations, while these do not play a significant role with CAPEX because of capital expenditure reconciliation. In our simulation the overestimated costs even result in a relative advantage for the OPEX option.

The CAPEX bias was quantified using the example of DA/RE. TransnetBW provided the relevant cost data for this purpose. These show the annual costs (broken down into CAPEX, OPEX for development, OPEX for operational and personnel costs) for two alternative options for implementing DA/RE internally – the cloud-based solution and a data centre owned and run by the company. The first solution can be scaled more flexibly and is more cost-efficient overall, while the second one incurs higher estimated total costs and is more CAPEX-intensive. Illustration 4-3 provides an overview of costs and economic value added for both solutions. The illustration is structured in such a way that the costs for the data centre represent 100%. The costs for the cloud solution and the economic value created are thus shown relative to the costs for the data centre.

Overall, negative economic value is created for both options. The absolute value is less relevant here, since it also depends on other factors, for example for how long the OPEX costs continue to be incurred. However, the value for the OPEX option is relevant relative to the more CAPEX-intensive data centre solution. As a result of higher CAPEX as well as higher OPEX during the base year, the economic value added is higher (or the economic loss is lower) for the data centre solution than for the cloud solution.

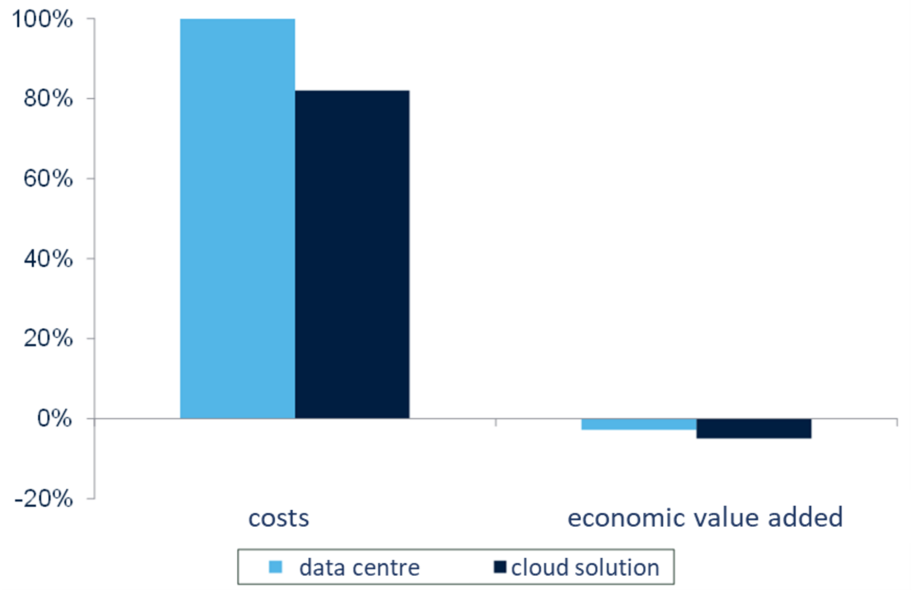

Illustration 4-3: Costs and value added for both solutions. Normalised chart showing the costs for the data centre as 100%.
Source: illustration by the authors

This demonstrates not only theoretically, but also based on actual cost estimations, that grid operators who are purely guided by profit-maximisation aspects would choose the data centre solution over the cloud-based solution, even though the costs for the data centre are higher in terms of the national economy, it is less scalable and expandable, and thus less future-proof. This highlights the CAPEX bias. In addition, the negative economic value added for the cloud solution shows that the risk for the grid operators to pursue OPEX-heavy projects is higher

5 Innovative regulation enabling "risk taking" (promotion of experiments)

The energy transition requires significant innovation activities, including those run by or with the participation of grid operators. In the given context, innovation activities and technological innovations are usually aimed at bringing about a more active coordination between grid operators and grid users or at utilising new digital approaches. There are at least three key challenges that have not or not sufficiently been addressed by the existing regulations concerning innovation activities (section 25a Incentive Regulation Ordinance (ARegV)) and scope for experimentation (SINTEG, regulatory sandboxes etc.).

- Innovation activities by the grid operators frequently require grid users to also be actively involved in developing and testing of innovations. However, grid users are currently not sufficiently incentivised to participate in experiments of this type.
- Innovations are often impeded by the existing regulatory framework. Therefore, there is a particular need for innovation activities to develop the regulatory framework as such further. However, there the necessary conditions in which such regulatory experiments can be conducted do not yet exist.
- Innovation activities often result in spill-over effects. Even though one innovator may carry the costs of the innovation process, a successful innovation will benefit a significantly larger group, without the innovator making a notable profit from this benefit.

The limitations in the existing regulatory framework hindering innovative activities can be illustrated using the experiences with the SINTEG projects. From interviews conducted with the experts and participants from the SINTEG projects as part of this study, it emerges that for example the participants in the showcase hardly used the experimentation clause at all, which is the key part of SINTEG-V. The interview partners named four constraints in terms of effectively applying the experimentation clause.[12] 1) Legal uncertainty, 2) economic risk associated with the ex-ante cost approval process and the lack of monetary incentives for other parties to participate in projects, 3) administrative workload with regard to the application process, and 4) limited scope for application. Recently, the need for action was also highlighted by the Conference of Ministers for Economic Affairs on 17/18 June 2021 and a concept for addressing this need for action was presented on 1 September 2021 by the Federal Ministry for Economic Affairs (BMWi, 2021). In light of these factors, we are outlining three recommendations for action in order to address three key challenges for grid operators to initiate innovative activities.

5.1 Recommendation for action: experimentation budget

The experimentation clause in SINTEG-V creates a compensation for disadvantages. With the existing regulations, participants in regulatory experiments are potentially subjected to economic disadvantages, which are to be eliminated by the compensation for disadvantages. However, the participants' experiences with the experimentation clause in SINTEG-V were disappointing. Above all, the regulation was perceived as too bureaucratic by the participants, and they emphasised the lack of incentives to participate beyond the compensation for disadvantages. The experimentation budget we are proposing addresses these points.

The central idea of the experimentation budget is for grid operators to have a budget available that is defined ex ante for *third parties* participating in an experiment, for example to compensate for disadvantages or to generally incentivise participation. The grid operators decide the subject of the experiment, the participants and how they should be incentivised. The authorities are then merely responsible for approving and setting the budget as well as supervising the activities in terms of abusive practices.

The experiment budget can be set up up in such a way that it can be used across different grid operators; the respective budgets would then be included in the relevant revenue caps.

The grid operator is free to use the experimentation budget to offer a bonus for participation, for example. In this way, the experimentation budget enables the grid operator to pro-actively set incentives for participation in a targeted manner. This goes beyond the scope of a pure compensation for disadvantages. A set bonus for participation, defined ex ante, increases legal security and reduces the economic risk for the recipient of the bonus.

When implementing the experimentation budget, the budget should be set in such a way that sufficient incentivisation is created without excessive costs. In addition, it

[12] The energy industry positions (Energiewirtschaftliche Positionen, EPos) of the SINTEG project C/sells (C/sells, 2020, paragraph 4.6) identify comparable obstacles.

needs to be ensured that implementation complies with state aid legislation, because the bonus is paid to third parties.

5.2 Recommendation for action: regulatory innovation trial

In addition to technological innovations or new business models, innovations of the regulatory framework itself (e.g. the Incentive Regulation Ordinance (ARegV) or the Grid Charges Ordinance) may also be required, which should be trialled before they are implemented. A "regulatory innovation trial (RIT)" is aimed at testing new or changed regulatory options under real-world conditions in order to assess their impact before they are introduced permanently. Key in this context is that the regulatory framework for the experiments is developed in collaboration with the regulatory authorities.

RITs would thus also be suitable to trial approaches like the digitalisation and experimentation budget proposed in this study in terms of their effectiveness and feasibility.

The key advantage of RITs is that they provide a framework for trialling innovative regulatory approaches and their effects in detail before the regulation ordinance is formally adapted. The basis for RITs would be a provision within the Incentive Regulation Ordinance (ARegV) for such regulatory innovation trials. The details of the structure, the external conditions and the regulatory requirements for the experiments as such should be set out in administrative acts in collaboration with the Federal Network Agency (BNetzA) (cf. Fietze, 2020). Another advantage of RITs is that the Incentive Regulation Ordinance (ARegV) does not need to be adapted immediately (after a provision for using RITs is introduced) in order to trial innovative regulations faster and more flexibly. RITs implement the framework for experiments in the ARegV, the details of which will then be agreed with the Federal Network Agency (BNetzA), without requiring changes to the legislation.

The main challenge in implementing the RIT approach is the lack of experience with this specific instrument. Another challenge is that, as a testing procedure, an RIT requires a specific design and a methodology for evaluating the results (cf. Bischoff et al., 2020).

5.3 Recommendation for action: pioneer bonus

The basic idea of the pioneer bonus is for several grid operators to collaborate on an innovative activity with one grid operator (the "pioneer") actually conducting the activity. The selected innovating grid operator receives a (pro rata) payment to cover the costs of their innovation activity (the " pioneer bonus").[13]

[13] The energy industry positions (Energiewirtschaftliche Positionen, EPos) of the SINTEG project C/sells (C/sells, 2020, paragraph 33) recommend a similar a approach with the "remuneration pot"..

Two versions for financing the costs are possible.

- In the first version the participating grid operators finance the innovative activity, i.e. a type of cross-subsidising would take place between the grid operators. In turn, these grid operators will receive the results from the innovation project and a licence to use these results. The expenditure of the participating grid operators will be included in their revenue cap for refinancing and will thus be carried by the grid customers.
- The second version is more wide ranging. In this version *all* grid operators pay into an innovation fund (according to one criterion, e.g. turnover); expenditure is included in the revenue cap, ensuring that grid customers (not the taxpayers) carry the costs for the innovation projects. Every grid operator can submit a project application. The selection process and contributions are set by the Federal Network Agency (BNetzA).

The key advantage of the pioneer bonus is that it facilitates flexible implementation of innovative projects. An alternative route would be research collaborations under the ministries' research programmes (e.g. Federal Ministry of Education and Research (BMBF)) or even the EU Commission's framework programmes. However, experience shows that such framework programmes are limited in terms of their thematic scope and that it takes a long time to develop new suitable framework programmes. With the pioneer presented here, grid operators can implement and trial innovative ideas with a focus on grid operation far more quickly.

6 General issues

This concluding chapter deals with two cross-sectoral topics that equally affect all three fields of action. 1) Selection of qualifying projects and 2) clear definition of projects and prevention of strategic expenditure shifts.

6.1 Selection of qualifying projects

The devised recommendations for action are intended to be used only in qualifying use cases and should not become the rule in incentive regulation. In order to keep workload and costs for the instruments at a feasible level, a minimum project size (e.g. in terms of turnover) should be adhered to. Application is thus limited to a specific class of clearly defined and identifiable projects. In addition, it must be clarified how the projects could be selected. Two basic versions are conceivable.

Version 1: Qualifying projects are specified in the Incentive Regulation Ordinance (ARegV)

With section 23 ARegV (investment measures), a general exception rule was created in which qualifying projects were specified. Section 23 was drawn up because investment was not sufficiently incentivised under the standard rules of the incentive ordinance. Therefore such projects may fall under the investment measures rules pursuant to section 23; primarily, section 23 eliminates the time delay until the next regulatory period. Section 23 paragraph 3 specifies that the grid operators submit the application themselves.

However, the wording of section 23 does not cover the subject matter of this study. This could be addressed using an alternative definition for "innovative measure", like that in article 13b of the Swiss Electricity Supply Ordinance (StromVV) (as of 01 January 2021):

"An innovative measure for intelligent grids is defined as the testing and use of innovative methods and products from research and development for the purpose of enhancing security, performance or efficiency of the grid in the future."

This definition emphasises the use and the testing of the innovation; this covers the three areas for incentivising taking risks as analysed in this study. In addition, the objective is outlined sufficiently broadly to encompass the enhancement of grid efficiency.

Version 2: The grid operator submits an application

An alternative approach for selecting projects would be an open application process initialised by the grid operator. Here, two aspects in particular need to be considered for implementation.

- The introduction of a minimum limit for the scope of the innovation activity, ensuring that the transaction costs for approving the innovation measure are proportionate. In order to ensure proportionality, a social cost-benefit analysis could be conducted.
- An obligation to provide evidence of regulatory bias should be introduced in order to justify application of the provision.

Comparable criteria were drawn up in a different context. Article 13 of the EU PCI Regulation 2013 (EC, 2013) is aimed at improving incentives for higher-risk projects of common interest (PCIs), using priority bonuses, for example. A priority bonus is a risk-equivalent project-specific increase of the permissible return on equity. The priority bonus should be applied for to the relevant regulator by the grid operator. ACER (2014) developed a 7-step procedure for these applications, whereby the onus of proof lies with the grid operator. One of the stipulations is for the grid operator to credibly demonstrate that the project-specific risk is higher than for conventional projects and thus is not covered by the set average return on equity. Such a proof presents a challenge for the grid operator, but the procedure outlined above puts the onus of proof on the grid operator rather than the regulator.

6.2 Definition of projects and prevention of strategically moving and reallocating costs: avoiding double allocation

For the regulation of companies in general, it must be noted that the scope for strategic behaviour by the businesses grows with the number of exceptions included in the regulatory framework. This scope should be kept as small as possible.

The main problem arising here is the potential for strategically moving around costs between different budgets. How can creating incentives or possibilities for strategically reallocating costs be avoided?

- If possible, regulation should be structured symmetrically with regard to opportunities and risk.
- Projects should be clearly specified and defined so that “external costs” can be easily identified.
- Regulatory control mechanisms would create additional pressure to desist from the strategic shifting of costs. A type of process benchmarking with comparable projects could be used as a control mechanism.
- A clear allocation of costs, possibly according to set rules with a single allocation of cost centres would make strategic shifts difficult.

The problem of costs being strategically reallocated is well known both in regulatory theory and practice. Although solving this problem is a regulatory challenge, regulators have gained extensive experience with this issue over the years.

7 Conclusion

This study analyses the incentives provided for in incentive regulation (like the German Incentive Regulation Ordinance (ARegV)) in three areas with innovative digitalisation measures:

- *Digitalisation & innovation with predominantly external effects. Digi-external* investigates the possibility of incentivising the development of new markets and business.
- *Digitalisation & innovation with predominantly internal effects. Digi-internal* looks at obstacles in the current version of the Incentive Regulation Ordinance (ARegV) to conducting innovative but uncertain activities for improving efficiency through digitalisation.

- *Innovative regulation enabling "risk taking". Promoting experiments* discusses the need for trialling innovative, risky projects and regulations before they are implemented.

Where distorted or insufficient incentivising effects were identified, the authors derived suggestions for improving incentivisation. Illustration 7-1 below summarises incentive biases that were identified and suggestions for improvement.

This study differentiates between digitalisation and innovation with "internal" and "external" effects. In this context, internal means that costs and benefits are mainly incurred by the decision-maker. External means that costs and/or benefits are incurred by third parties (e.g. wider society or other system operators) and not by the decision-maker. It is important to make this distinction in order to be able to set incentives, since incentive biases as well as proposed solutions differ accordingly.

Thematic area	Challenges	Proposed solutions	Example of use*
Digitalisation & innovation with predominantly external effects (digi-external)	• *Value creation* (external effect) basically not incentivised by the Incentive Regulation Ordinance (ARegV) at all	Market facilitation incentive mechanism with cost budget approach	Picasso
Digitalisation & innovation with predominantly internal effects (digi-internal)	• Underrecovery of costs due to base-year problem (in particular with initial expenses) ○ e.g. transition to Redispatch 2.0 • Increasing OPEX may lead to CAPEX-OPEX bias	Digitalisation budget, applying sharing factors	DA/RE
Innovative regulation enabling "risk taking" (promoting experiments)	Experiments can very quickly reach the limits of the regulatory framework • Legal uncertainty • Economical risk • Administrative effort • Limited scope for application	• Experimentation budget • Regulatory innovation trial (RIT) to develop recommendations for action • Pioneer bonus	SINTEG-V

Illustration 7-1: Overview of study
Source: illustration by the authors

** Please note: The examples selected for internal and external comprise internal as well as external aspects and can thus only be allocated in terms of their main focus.*

For the area of *digitalisation & innovation with predominantly external effects* (digi-external), a *market facilitation incentive mechanism* was developed. In this context, the example of Picasso facilitates a Pan-European market for secondary control power. The value created via this market benefits mainly society and other grid operators, not the grid operator running the measure, and is thus considered external. The value created via the market are savings in production costs. The market facilitation incentive bonus is basically value added multiplied by an incentive parameter set by the regulator, so that the grid operator directly benefits from some of the value created. In this way external effects become internalised.

For the area of *digitalisation & innovation with predominantly internal effects (digi-internal)*, this study develops a *digitalisation budget, applying sharing factors*. Digitalisation measures such as the data platform for redispatch DA/RE, are increasingly OPEX-based. The key problem with digi-internal under current regulation and thus the primary objective of the digitalisation budget is to eliminate the OPEX base-year effects. With the budget approach, a project-specific budget for each year is agreed with the regulator ex ante. In contrast to the set base year for the revenue cap, the starting year can be chosen specifically for the project with the budget approach, eliminating the base-year problem to a large extent. By employing sharing factors in a targeted manner, efficiency incentives can be amplified, and risks reduced. The budget approach can be adapted to suit different combinations of sharing factors.

The subject matter in the area of *innovative regulation enabling "risk taking"* (promotion of experiments) is relatively new. With the increasing demand for innovation, the demand for testing innovations before they are implemented and for experimenting is also growing. This study is primarily concerned with changes to the regulatory framework. In this context we must differentiate between innovation in technology and business models that affect the limits of the regulatory framework on the one hand, and changes to the regulatory framework as such on the other hand. This affects a wide area in which we only looked at individual aspects and made the following three suggestions for improvement.

- The central idea of the *experimentation budget* is for grid operators, after approval by the Federal Network Agency (BNetzA) to have a budget available that is defined ex ante for *third parties* participating in an experiment, for example to compensate for disadvantages or to generally incentivise participation. This proposal is an adaptation of the rarely used experimentation clause in SINTEG-V.
- A *regulatory innovation trial (RIT)* is aimed at the testing of and experiments with changes to the regulatory framework as such (e.g. the Incentive Regulation Ordinance (ARegV)). An RIT is not a funding instrument in itself but facilitates other funding instruments (e.g. the budget approach presented in this study) to be trialled flexibly before they are set in stone and written into the ordinances. The key advantages of RITs are thus speed and flexibility.

- The basic idea of the *pioneer bonus* is for several grid operators to collaborate on an innovative activity with one grid operator (the "pioneer") actually conducting the activity. The selected innovating grid operator receives a (pro rata) payment to cover the costs of their innovation activity (the " pioneer bonus"). The key advantage of the pioneer bonus is that it facilitates flexible and sector-specific implementation of innovative projects.

An intended special characteristic of this incentive is that all recommendations for action can also be applied across different system operators so that (pan-European) collaborations become possible and can be promoted. All aforementioned proposals are project specific. For the purpose of this study, the criteria for selecting qualified projects could not be discussed in great detail; they need further, more in-depth discussion.

Several recommendations for actions are, at least in the context of the Incentive Regulation Ordinance (ARegV), relatively new and their implementation and details are yet to be worked out further. Due to the challenges the transmission system operators will be faced with as a result of current social and technological developments, which can only be overcome with innovations, this is not just recommended in our view, but imperative.

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