Evaluation of innovation approaches as additional regulatory instruments for the incentive regulation of grid operators in Germany

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Abstract

Promoting innovations in a cost-effective and risk-adjusted regulatory framework is required to reach the climate targets. The paper provides a needed classification of innovation and shows a range of options to tackle hurdles in the German regulatory framework. Furthermore, the most adequate solution is derived, reflecting also successfully implemented regulatory approaches in other European countries.

1 Introduction

With regard to the ongoing transformation of distribution networks (long-term) incentives for innovation are in the scope of current discussions. Hereby, both questions, i.e. if and how regulatory regimes should be reformed in order to foster more and further innovation are being debated.
Throughout all sectors and industries innovative investments are mostly irreversible and risky per se, as there is a high degree of ex ante uncertainty about development cycles and the probability of success. On the other hand, avoiding investment in general and innovations in particular can cause high social costs, especially in the long term. This is particularly true in a regulated environment like e.g. in electricity distribution grids where due to the monopolistic nature of the business competitive forces are not the only driving force for investment behavior.
The aim of this work is to show the current challenges with regard to the implementation of new and innovative solutions and to discuss and rank different development options for an innovation-friendly design of the regulatory framework for DSOs in Germany. In order to do this, we describe the general characteristics of innovations and typical barriers in Chapter 2. In Chapter 3 we describe our approach to narrow down the scope of an innovation. We develop and apply criteria in order to assess the development options in Chapter 4. Main results are based on a master's thesis [1].

2 Innovation and regulatory barriers

While being used rather frequently in regulatory and political discussions, the term "innovation" itself is somewhat "blurry" which in turn leads to challenges with regards to a suitable consideration on innovation in a regulated environment.

1) Innovation is not commonly defined and different interpretations may exist when asking several stakeholders.[1]
2) Companies must weigh up the chance of possibly setting market standards in the future and benefit from first-mover advantages against the inherent risk of unprofitable innovation costs.
3) Most innovations are generally more expensive than their current conventional alternatives, at least in the piloting phase. They therefore usually lead to a return on investment only in the mid or long run when being scaled up. Thus, (welfare) benefits may also only occur in the mid-/long-term. The timeframe that would need to be analysed in order to monitor such benefits properly is most likely (much) longer than the length of one specific regulatory period. If the DSO is actually supposed to consider such longer term benefits properly when making its intertemporal optimization decisions, their costs and (societal) benefits need to be met with an appropriate regulatory framework. Otherwise one must expect the DSO to optimize solely with regards to the shorter time span and more immediate effects and benefits.
4) That is to say that in reaction to incentives that are usually presented by regulatory regimes that include elements of incentive regulation, network operators are tempted to implement only innovations that lead to short-term efficiency gains, since only efficiency gains that exceed the efficiency targets can be retained.
5) In contrast to a competitive environment, revenues for regulated companies are capped both in height and in length. Hence, if a "unicorn" type innovation would

[1] e.g.: is a "new coloured" electricity pylon to reduce visibility an innovation? What about on-load-tap-changers in MV/LV transformers, being used in grids since a decade or the usage and costs for demand-side-flexibility?

occur the economic benefits (i.e. license fees etc.) would end up with grid users only and not with the innovating DSO that took the risk in the first place.

6) Innovative solutions and conventional options vary in terms of costs (operating expenditure (opex) and capital expenditure (capex)) that go along with their implementation and the treatment of such costs in regulation. Assuming that most innovative solution are more cost-intensive than conventional solutions in terms of the relative amount of opex [2], there may be distortions in the choice of solutions. This holds true for at least two different reasons in the German regulatory environment: a) Generally one euro spent on opex c.p. reduces the company's profits in the current year one-to-one while a euro that is being spent on capex (i.e. is being capitalized) reduces the profits only by a fraction of that euro (the relevant sum of depreciation, interest and taxes). b) Cost are being recognized by the regulator at different "speeds" in Germany, i.e. they become revenue-effective at different times – capex being recognized in the same year and opex being recognized only after the next base year, i.e. at the start of the next regulatory period. This means that there can be a delay of opex recognition between three and seven years, depending on the time of cost incurrence. Relevant issues that might distort the decisions are also present if the new and conventional solutions are included differently in the total cost (totex) benchmark, i.e. the question whether there is a structural parameter that is useful to explain these certain types of cost.
7) One further barrier to innovation can be seen in the fact, that there is no special depreciation for innovative solutions even if their working life tends to be shorter and the risk of failure higher. German regulation uses imputed capital costs i.e. the minimum and maximum lifetime of any asset that may be used for calculation purposes, is defined in a special ordinance. That is to say the DSO will have to carry the full burden of any failure while regulation will tend to allocate any cost-saving benefits also with grid users. Thus, there is an incentive for network operators to follow the conventional path with long working lives of the capital resources that are stated by law instead of implementing innovative solutions.

2.1 Narrowing down the scope of an innovation

Focusing on aspect 1, in what follows, concepts and ideas are to be considered "innovative" only if they have reached a certain degree of maturity and have already passed the invention and development phase. Thus we differentiate an invention (e.g. a new superconducting metal alloy) from an innovation that applies an invention in a real world environment (e.g. a superconducting cable product that may actually be used in inner cities in order to improve the DSOs performance). This differentiation is also helpful in understanding the DSOs role in innovation: The company applies a new product and experiments with its most helpful usage in the grid. Generally, DSOs are however not in the business of developing new alloys or any other kind of fundamental research. As of today, no such differentiation exists within the German legal or regulatory system; it is fundamentally unclear which criteria must be met. From the viewpoint of the regulator any definition must be unequivocal, otherwise there might be ambiguities or misuse by the DSO.

In order to address these and other issues we propose to define a positive list of eligible innovations for predictable, defined and new technologies fulfilling certain criteria. With this list a timely cost recognition and, at the same time, planning security for both, network operators and regulatory authorities would be enabled. While clearly being a second best option, the positive list – in our view – has the advantage of implying much less micromanagement within the regulatory framework. Such a list, in turn, partly contradicts the basic concept of incentive regulation and innovation: it tempers with technology neutrality and narrows down the available options and creativity through focusing on specific and previously known solutions. Hence, it needs to be updated on a regular basis. New, innovative approaches emerge over time and must not be ruled out by a regulatory framework geared to the status quo. In addition, the creation of a positive list requires a certain administrative effort to examine novel solutions and to include them in the list.

However, such a list could be used to determine which technologies will be needed in the future and require special funding. Many technologies are already available, but their implementation has so far failed due to innovation-regulatory obstacles or due to low technology readiness levels due to lacking scalability or R&D-efforts.

The following figure shoes the requirements for such an approach:

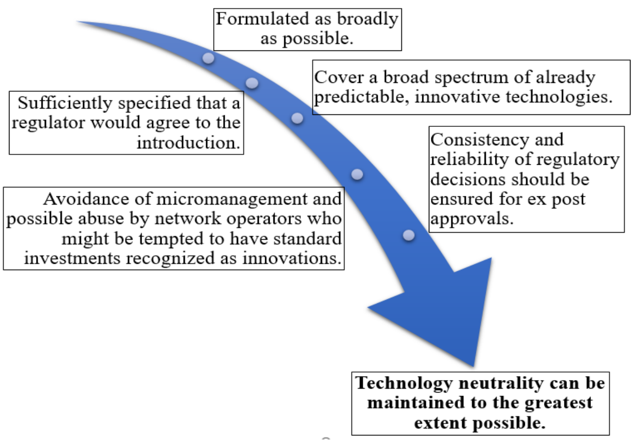

Figure 1: Requirements for a nearly technological neutral positive list

Similar to the requirements of the Network Innovation Allowance (NIA) and the Network Innovation Competition (NIC) as part of GB's innovative RIIO model

[3], a positive list which requires the fulfillment of the following criteria ("and criteria") is being recommended. From our point of view, any eligible project should

a) offer environmental benefits and / or accelerates the development of a low carbon sector
b) offer a monetary benefit for customers in the medium or long run
c) generate knowledge or standards (i.e. data, software, hardware, further technologies, ...) which are shared with the sector
d) have an unproven business case and does not lead to a duplication to a project carried out by another network operator
e) not be conducted otherwise in the normal course of business due to technical, regulatory, (…) risks that shareholders would not speculative finance
f) have the following technical content (“or-criteria”): i.e.
   - operating equipment that avoids the usage of SF6
   - operating equipment that allows for a higher hydrogen concentration in the gas system
   - any other or criteria that might be reasonable in the context described above.

As the example shows, a positive list can be designed in a fashion that guides DSO in certain directions that are beneficial for the energy transition without precluding certain technologies or solutions. Further ideas could be developed in the implementing stage as such a positive list would have to be proposed by the regulatory agency and consulted with the sector to be robust but also open to promising kinds of innovations.

3. Criteria of Assessment

Focusing on the German regulatory framework, we evaluate options to combine a positive list with different modes of cost recognition in chapter 4. We evaluate these options by taking into account selected criteria based on key questions which are assessed and sorted by relevance, starting with the most relevant criteria in the following table:

Incentive and efficiency effect	To what extent are innovations incentivized with respect to the goal of a cost efficient and competitive fulfillment of the supply task? To what extent is the temporal effect of the innovation sufficiently reflected with regard to the length of the German five-year regulatory period?
Practicability/ complexity	To what extent can the efforts of implementing the instrument be classified as low? To what extent is there consistency with the current regulatory frame? How is legal security ensured?
Political / social acceptance	Are distributional effects perceived as fair? To what extent is the measure politically feasible?
Level of detail	How robust is the instrument against micromanagement? How low can the level of detail be designed? How small is the time delay between planning the option and regulatory consideration?
Acceptance of the authority	How robust is the instrument against abuse? Will trust in a stable regulatory framework be strengthened?

4. Considerations with regard to current regulation

In this chapter we assess different options for adapting the actual regulatory framework in Germany considering a possible introduction of a positive list. While the list itself would only describe eligible projects, the actual cost recognition remains an open issue. We consider different options and describe their effects based on the criteria in the table above:

4.1 Classification of innovations as cost pass-through

Currently, innovative solutions and their costs are subject to the efficiency benchmark and incentive mechanism and must be reduced in accordance to the efficiency factor like any other operating costs. Accordingly, a reclassification of innovative solutions as cost pass-through items is one option to ensure the refinancing of innovation-related operating and investment costs with a maximum delay of two years.
Financial incentives to reduce costs are minimized if these costs are not subject to incentive mechanisms and, thus, go along without opportunities *and* risks for the grid operators. One design option is to consider a fixed rate of the DSOs revenue in order to limit the scope of cost pass-through. In Norway this amounts to 0,3 percent of overall revenues which can be used for innovative projects without delay as a risk-free premium [4].
However, the question arises what level of a cap is appropriate for the industry and whether the cap should differ, i.e. in accordance with the volume of the DSOs revenue cap. In addition, a possible control of success should also be implemented.

4.2 Classification of innovations as volatile costs

Strongly fluctuating costs can be classified as volatile costs in the German system, minimizing the time delay for opex and capex equally due to annual adjustment. In contrast to the cost pass-through category, volatile costs are included in the efficiency benchmark. This leads to an identical evaluation of the incentive and steering effect as the consideration as a cost pass through item. However, there is no incentive for additional innovations for the network operator. The acceptance by the authorities should be much higher than for other instruments, since incentive structures and the competitive analogy will be maintained.

4.3 Classification of innovations as volatile costs with a waiting period

In this advancement of 4.2, costs arising from innovations are not included in the efficiency comparison for at least one regulation period. The costs are considered in the next but one benchmark if still remaining in the cost base. Minimizing the innovation risk for this period in turn does not show any analogy to competition and therefore requires justification and evidence of insufficient cost degression for innovations.

4.4 Return on operative cost for innovations

In order to achieve a balance for the assumed opex disadvantage compared to capex (see the time delay issue explained in Chapter 2[2]), a compensating return on operating costs of innovative solutions on the positive list is conceivable. Since there is no market-based reference interest rate, the decision on the level of the interest rate requires further analysis. The markup should not create a distortion in favor of opex in the totex benchmark. False incentives and new distortions in favor of cost-intensive measures and the resulting deliberate increase of operating costs to an inefficiently high level are to be avoided. In addition, special focus needs to be put on the separation between opex, which is incurred for innovative solutions, and "standard" opex of the normal course of business. As a new element, which moreover does not meet any competitive analogy, the acceptance is likely to be lower than for already established options. Due to the limited efficiency caused by the aforementioned distortions, the option receives a low rank in the assessment.

4.5 Operative cost comparison

An annual adjustment of operating cost for innovative solutions in accordance with the positive list may reduce the unequal treatment between opex and capex. Thereafter, the revenue cap is adjusted to changes in operating costs. In addition, the base year costs are also included in the efficiency comparison. The instrument requires a high level of detail, as a temporal and cause-specific differentiation between existing and newly incurred operating costs is necessary. Note that no incentive mechanisms are integrated in the annual adjustment and, thus, become only relevant if the costs are still existing in the next base year.

4.6 Efficiency Carry-Over

The five-year regulation period limits the amount of time any DSO might enjoy efficiency gains. Albeit innovations can develop differently on the time axis than the five-year regulation cycle would suggest. As a result, the opportunities and risks of an innovation are not properly reflected due to a larger time difference between a long start-up phase and the monetary payout of an innovation. Innovations initially generate high costs, but create impact beyond the end of a regulatory period. An introduction of an efficiency carry-over mechanism may solve this dilemma, i.e. transferring efficiency gains into the next regulatory periods is an option to generate an incentive for innovations and long-term efficiency gains. A market and competition analogy is clearly discernible, since even unregulated companies must first finance innovations from the existing revenues, but subsequently realize innovation advantages without time restrictions and benefit fully from the resulting profits.

4.7 Adaption of the structural parameters in the benchmark

In order to eliminate the disadvantage of innovative solutions with regard to the efficiency benchmark, the structural parameters should be analyzed. It is generally reasonable to use exogenous and non-influenceable parameters that are measurable, quantifiable and not already represented by other already existing parameters. For instance, the number of connection points and the area of the supplied area can hardly be influenced by the network operator.

Options to incentivize innovative solutions are the consideration of flexibility usage with regard to the resulting measured peak load after validating the data. However, this approach is very hard to be implemented properly and faultlessly as the Austrian example of E-Control shows [5].

An adjustment of the structural parameters in the benchmark would clearly be possible in Germany as mandatory parameters were eliminated at the beginning of the third regulatory period. However, the development of new benchmarking parameters that are as significant and exogenous as possible, i.e. cannot be influenced by companies, is associated with a high degree of complexity and therefore cannot be implemented promptly.

4.8 Special amortization

For innovative and therefore possibly riskier equipment, it might be reasonable to adjust the depreciation period individually according to the risk in order to avoid giving preference to conventional network expansion over innovative solutions. Two design options are possible: On the one hand, failed innovations can be written-off faster, so that their cost of capital has no further impact on the next benchmark. On the other hand, innovative solutions can be granted a higher depreciation and thus a faster amortization.

An adjustment of the useful periods by one new asset group for innovative equipment from the positive list could be made quickly. For network operators, the risk of an investment decreases the shorter the useful life period is. The incentive effect is mainly caused by the shift in tax burdens over time. However, there is a potential for abuse, as the preferred use of equipment that may be depreciated faster can occur even if the use of such equipment would

2 we do not intensify the analysis and compensation of a possible Averch-Johnson-effect in this context.

not be explicitly necessary. This potential for misuse significantly limits acceptance. Therefore, the question is rather whether depreciation periods should be reconsidered in principle, since an individual determination of the useful lives of innovative solutions involves a high degree of detail and discretion.

4.9 Specific R&D legislation (§25a ARegV)

In Germany, specific legislation has been implemented for publicly funded R&D-projects. With this, 50 percent of R&D expenditures of funded projects can additionally be implemented into the revenue cap. A public funding decision of the Federal Government is required. So far, a total of 48 applications have been made in accordance with this §25a ARegV, of which only 5 have been granted in full. Hence, this option can be cited as an example of long evaluations limiting the "spirit of innovation" and approval processes resulting from complexity and bureaucracy.
However, a reform of the instrument is hardly realizable in the near future, highly complex and aims at unspecific R&D topics, which are sometimes far from being implemented. Nevertheless, future efforts to adapt the instrument are welcome, as it has a recognizable but insufficient incentive and a visible steering effect.

4.10 Regulated Asset Base (RAB) premium

Innovation costs could also be included in a RAB surcharge. This results in a higher return on the capital employed, as is the case in Hungary with the 1.1 multiplier on the RAB. The instrument represents a stronger innovation incentive than a pure refinancing of innovation costs, as an additional reward is given and includes interest and depreciation in the surcharge. The approach requires further analysis regarding the exact amount of the surcharge or multiplier. The amount has to be based on the optimal equity interest rate for innovations, which has not yet been determined. Since the totex benchmark is applied in Germany and not, as in Hungary, an operating costs efficiency comparison only, there is a higher efficiency risk, since the RAB surcharge influences the efficiency comparison as an additional influenceable cost factor. Thus, the surcharge cannot be included in the efficiency comparison wherefore an implementation can be classified as challenging. This illustrates that national approaches always need to be evaluated with a broader view on the complete regulatory system. Furthermore, such a surcharge based on the interest rate has certain repercussions on the general determination of the equity interest rate. The risk component as part of the return on equity would have to be reduced, as innovative assets no longer influence the risk component of the return on equity but are shown separately by the surcharge. This might lead to a reduction in the interest rate for other assets as well, so the actual "net" benefit would have to be examined. A RAB surcharge may well promote innovation under certain conditions in the regulatory regime. However, due to the different starting conditions, the approach applied in Hungary cannot be consistently transferred to the German regulatory system. In addition, the political/societal and official acceptance is likely to be low, as it is difficult to justify why consumers have to pay in advance to reward for innovations. Since the distortion of incentives in the overall system cannot be resolved and the bonus is an element outside the system, the RAB bonus cannot be recommended for the German regulatory scheme.

5 Economic significance for DSOs and conclusion

We analyzed the options described above with special emphasis on the efficiency effects for the DSOs. It can be demonstrated that with an efficiency value of 100 percent there is no difference between the options cost pass-through, volatile costs and volatile costs with waiting period. Only the scenario of the status quo (efficiency value <100 percent) shows a negative effect on the operating result in each case, since the time delay of the base year has an effect and innovation costs are included in the efficiency comparison which results in higher costs that are subject to the efficiency factor. From the point of view of a DSO with an efficiency value of less than 100 percent, a classification as cost pass-through has the best effect on the operating result, providing risk-free incentives for innovation.
Taking a more holistic view, the recommended development option is classifying the cost of innovative solutions as volatile costs. The option includes efficiency incentives as well as an annual cost compensation; the time delay between cost incurrence and cost recognition is minimized and the revenue upper limit becomes adjusted annually. The option keeps efficiency incentives as the main element of the incentive regulation framework to make regulatory standards as competitive as possible.

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