INCENTIVE SCHEME FOR EFFICIENT GRID UTILIZATION AND USE OF FLEXIBILITY SERVICES

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ABSTRACT

The NRA for energy in Sweden, the Swedish Energy Markets Inspectorate (Ei), determines a revenue cap for each DSO and for the TSO for a regulatory period of four years at a time. The revenue cap is adjusted based on e.g. the performance regarding efficient grid utilization and continuity of supply. Ei aims to continuously evaluate and improve the regulatory framework for DSOs and the TSO.

This paper describes the intended changes in the incentive scheme of the Swedish revenue cap regulation from the next regulatory period of 2024-2027, focusing on the intended changes to strengthen the incentives for efficient grid utilization and, following article 32 in the Directive (EU) 2019/944 of the European Parliament and of the Council of 5 June 2019 on common rules for the internal market for electricity and amending Directive 2012/27/EU (Electricity Directive), the use of flexibility services. Due to a new legal situation, the prerequisites for the methods for calculating the revenue caps have changed. To the next regulatory period, Ei intends to reduce bias between CAPEX and OPEX to strengthen the incentives for cost-efficient solutions, as well as to improve the load flow incentive by creating more focus on an even load flow during high-load days.

INTRODUCTION

The Swedish electricity market underwent a major reform in 1996. Trading in and generation of electricity was exposed to competition, while the infrastructure operation remained as regulated monopolies (i.e. unbundling). The first version of current ex-ante revenue cap regulation was introduced in 2012 [1]. Since then, many new rules affecting the distribution system operators (DSOs) have been introduced.

Sweden has approximately 170 DSOs (mostly local DSOs with a monopoly within an area up to a given voltage level, while the rest are referred to as regional DSOs) and one transmission system operator (TSO); all with different conditions regarding size, ownership, and clime/terrain, making it a challenge to develop an effective regulatory model. The national regulatory authority (NRA) for energy in Sweden, the Swedish Energy Markets Inspectorate (Ei), determines a revenue cap for each DSO and the TSO for regulatory periods (RP) of four years at a time since 2012.

The revenue cap is adjusted based on continuity of supply [2] and, as of 2016, on efficient grid utilization [3]. Well-designed incentive schemes are becoming increasingly important to meet future ambitious climate goals in a time of large technique shifts. Ei aims to continuously evaluate and improve the regulatory framework.

According to Article 15(4) of the Energy Efficiency Directive, EU member states shall ensure that DSOs are incentivized to improve efficiency in infrastructure design and operation. In Sweden, Ei was mandated to define what is considered an efficient utilization of the grid and to design a new incentive scheme within the revenue cap regulation. The grid utilization incentive scheme is divided into two parts, incentives to: a) reduce network losses (both for the TSO and DSOs) and b) reducing load flow peaks in connections to other grids (only for DSOs).

SUMMARY OF CURRENT REVENUE CAP REGULATION

The Swedish revenue cap regulation is divided into capital expenditures (CAPEX) and operational expenditures (OPEX), see Figure 1. The latter is in turn divided into controllable OPEX (COPEX) and non-controllable OPEX (NOPEX). The COPEX are based on a historical cost reference period of four years starting six years before the RP and are reduced yearly by an efficiency target based on benchmarking (efficiency requirement). The efficiency requirement is not applied to the NOPEX, as they are pass-through costs.

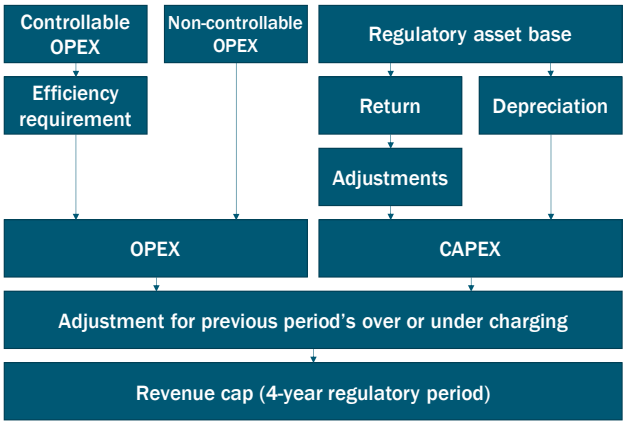

Figure 1. Overview of the Swedish revenue cap regulation in current RP 2020-2023

As for CAPEX, the regulatory asset base (RAB) is primarily valued based on replacement values for the existing assets, pre-set by Ei. When calculating the CAPEX, planned investments and disposals are considered, the RAB is age-adjusted, and a reasonable rate of return based on a weighted average cost of capital (WACC) method is applied on the age-adjusted RAB. Further, the return is adjusted based on the performance regarding efficient grid utilization and continuity of supply.

STRENGTHENING INCENTIVES FOR USE OF FLEXIBILITY SERVICES AND EFFICIENT GRID UTILIZATION

As stated in the Directive (EU) 2019/944 of the European Parliament and of the Council of 5 June 2019 on common rules for the internal market for electricity and amending Directive 2012/27/EU (Electricity Directive), DSOs must cost-efficiently integrate new electricity generation, especially installations generating electricity from renewable sources, and new loads such as loads that result from heat pumps and electric vehicles. For that purpose, DSOs should be enabled, and provided with incentives, to use services from distributed energy resources such as demand response and energy storage, based on market procedures, to efficiently operate their networks and to avoid costly network expansions. Member States should put in place appropriate measures such as national network codes and market rules and should provide incentives to DSOs through network tariffs which do not create obstacles to flexibility or to the improvement of energy efficiency in the grid.

In accordance with article 32(1) in the Electricity Directive, Member States shall provide the necessary regulatory framework to allow and provide incentives to DSOs to procure flexibility services, including congestion management in their areas, to improve efficiencies in the operation and development of the distribution system. In particular, the regulatory framework shall ensure that DSOs are able to procure such services from providers of distributed generation, demand response or energy storage and shall promote the uptake of energy efficiency measures, where such services cost-effectively alleviate the need to upgrade or replace electricity capacity and support the efficient and secure operation of the distribution system.

In the current revenue cap model, costs for use of flexibility services are allowed to be recovered as COPEX and the existing incentive scheme includes incentives for reducing peak load flow in connections to other, higher voltage grids (overlying grids). However, it has been argued that the incentives in the regulation to use flexibility services in distribution networks could be strengthened. To the next RP, Ei intends to improve the load flow incentive, reducing peak flow, as well as the incentive for use of flexibility services.

In 2020 Ei proposed an efficiency requirement on total expenditures

In 2020, Ei proposed changes to the national legislation aiming to incentivize DSOs to work with the efficiency of both CAPEX and OPEX by applying an efficiency requirement on total expenditures (TOTEX) [4]. This would mean that the DSOs are incentivized to optimize between different alternative solutions, and thus will contribute to benefiting new and alternative solutions, such as flexibility services, when these are more cost-efficient than grid investments. The proposal has been publicly consulted by the Ministry; however, the Ministry has not yet responded.

New legal situation changes prerequisites for the methods for calculating the revenue caps

In recent years, electricity network regulation has been subject to many court rulings. Since Ei's decisions on revenue caps for 2020-2023 were taken in 2019, the Court of Justice of the European Union (CJEU) has issued a judgement on whether Germany incorporated parts of the Electricity and Gas Directives correctly. The EU Commission considered it not to be the case and was also ruled in favour by the CJEU. Similar matters have been considered in the legal processes regarding the Swedish revenue cap regulation for electricity.

In June 2022, The Swedish Court of Appeal announced its judgement in the electricity network cases. In some parts, the judgement is based on the judgement made by the CJEU in the case of Germany. For example, the regulations on which the calculation of the regulatory rate of return is based on may not be applied, as Ei's independence as an NRA from the Government and the Parliament is limited by the regulations. In the judgement, the Court of Appeal has stated that this also applies to more regulations. The judgement of the Court of Appeal has entered into force.

Overall, Ei assesses that the legal situation implies that detailed rules on calculating the revenue caps cannot be applied as they would conflict with the independence of the NRA stated in the Electricity Directive. Instead, Ei needs to independently decide which methods are to be used in the decisions when the revenue caps are established.

Ei is currently evaluating the regulations in detail. The changed legal situation may be followed by changes regarding the methods for calculating the revenue caps.

FEASIBLE WAYS OF STRENGTHENING INCENTIVES FOR USE OF FLEXIBILITY SERVICES

Strengthening the incentives for efficient grid utilization and the use of flexibility services, is a matter of (1) the model for calculating revenue caps as a whole, providing balanced incentives for cost-efficient solutions, as well as (2) potential improvement of the existing load flow incentive, providing a performance-based incentive to reduce the peak load and even out the load. The load flow incentive and its intended improvements to RP 2024-2027 is described in the next section.

Intended changes of the revenue cap model

Prior to the new legal situation, when the legal situation had not changed, Ei investigated alternative designs for an incentive for the use of flexibility services, including a specific incentive for flexibility services. However, Ei assesses the intended changes in the revenue cap calculation, made possible by the new legal situation, to have potential to incentivize the use of flexibility services in a required manner.

As the incentive for use of flexibility services is a result of the revenue cap calculation as a whole, the prerequisites for strengthening this incentive are affected by potential changes in methods. Striving for a regulation with more neutrality in the choice between traditional investments and flexibility services, some possible improvements have been identified. Introducing an efficiency requirement on both CAPEX and OPEX, as previously proposed in 2020, would incentivize the companies to use the most cost-efficient solution, whether it is investments or procurement of e.g. flexibility services. The costs for flexibility services will consequently be subject to an efficiency requirement. Thus, this method will provide incentive to choose the most cost-efficient solution in a given situation, while also incentivizing the most efficient flexibility services.

The current lag in remuneration of COPEX has also been identified as an economic barrier to the use of flexibility services. In the revenue cap calculation, the COPEX are based on a historical cost reference period of four years starting six years before the RP. As costs for flexibility services currently are considered to be new costs and may arise going forward, the current regulation creates an economic barrier where the actual costs will not be remunerated in the same RP that they are used. If COPEX instead would be based on forecasted costs before the RP and replaced with actual costs after the RP, this barrier to use flexibility services could be avoided.

However, further analysis of feasible methods for calculation of the revenue caps, from different perspectives, are ongoing. In end-October 2023, Ei will take decisions on the revenue caps of the DSOs for the RP of 2024-2027 based on the final methods.

LOAD FLOW INCENTIVE

The aim of the load flow incentive is to provide the DSOs an incentive to even out the load that is flowing in or out of the overlying grid and thereby reducing the need for capacity from the overlying grid. This can be achieved by the DSOs providing an incentive to their consumers and producers to use the grid efficiently and thereby evening out the load in the connection point to the overlying grid. One way of doing this is by using time-differentiated network tariffs, another is to use flexibility services.

Overview of the current load flow incentive

In the current load flow incentive, that is for RP 2020-2023, the indicator average load factor (Lf) is used to calculate the incentive. Lf is a measurement of how even the load is on average per day and per year (Lf is defined in equation 1).

$$Lf = \frac{\sum_{d=1}^{D} Lf_{day,d}}{D} \quad (1)$$

Lf is the average of all daily load factors, where the daily load factors ($Lf_{day,d}$) is the average hourly power divided by the maximum hourly power during the actual day d and D is the number of days during a period (e.g. a year). The hourly power is calculated by summarising the hourly power in all connections to other grids and if needed taking the absolute value (the load flow can be in two directions with a lot of local energy production).

The difference between the outcome of Lf and the norm value for Lf is multiplied with the total costs for getting power to the own grid (mainly cost for subscriptions to overlying grids), “feed-in costs”. The norm value is the average of Lf during a four-year period starting six years before the RP. If the outcome is greater than the norm, the DSO gets a bonus and if the outcome is less than the norm the DSO gets a penalty.

Development of the load flow incentive

This section presents the considered changes for the load flow incentive for RP 2024-2027. During the development of the load flow incentive for RP 2020-2023 the indicator load factor (η) was proposed by the DSOs and was deemed

interesting by Ei. Like Lf, η is a measurement of how even the load is in the grid, but it only takes the four highest daily peaks into account instead of every daily peak (η is defined in equation 2). However, η was proposed relatively late in the process and had to be further analysed before it could be determined if it was a suitable indicator for the incentive. In 2020, Ei started collecting η from the DSOs so that it could be used in the incentive for RP 2024-2027. The load factor, η, is also collected as part of Ei's assessment and monitoring of smart grid development (described in a parallel CIRED paper).

$$\eta = \frac{P_{average}}{P_{max,4}} \quad (2)$$

$P_{average}$ is the yearly average power and $P_{max,4}$ is the average of the four highest peak load hours (power) during a year (separate days). Unlike the Lf calculation, where the underlying grids, overlying grids and contiguous grids are included, only the overlying grids and the contiguous grids where the grid companies are not responsibly for measuring are included in calculating η.

The current indicator, Lf, provides an incentive to DSOs to even out the load during all days of the year. An incentive that assigns equal weight of reducing the load to each day does however not consider that it is, from a socio-economic standpoint, more beneficial to even out the load when the grid is mostly used. Which the indicator η does since it focuses on the highest loads. A more even load has several potential benefits; it can lead to a reduced investment need in the own grid and the overlying grid, lower costs for the overlying grid and to a certain degree reduce grid losses.

Significant changes in the amount of installed production between the norm and the outcome can have a negative impact on the outcome of η, even if actions have been taken to reduce the maximum peaks. In general, solar and wind power production lowers the average power that is taken out from the overlying grid ($P_{average}$) without having a significant impact on the average of the four highest peak load hours (power) during a year ($P_{max,4}$). This is due to the highest peak load hours usually occurring during cold, windless winter days with few hours of daylight.

A high share of weather dependent production in the grid is in itself not problematic for the indicator. The problem occurs when there is a steep increase of the amount of installed production between the norm period and the output period (RP) that the incentive can become misleading. At the same time, it is important that the DSOs have an incentive to affect both production and consumption to achieve an efficient grid utilization.

Ei is considering making it possible for the DSOs with an increased amount of new local production to use an adjusted load factor ($\eta_{adjusted}$) for the outcome. $\eta_{adjusted}$ is calculated in the same way as η, but new production installed after the norm period is excluded from the calculation of the outcome. For DSOs that report $\eta_{adjusted}$, the outcome of η would be compared to $\eta_{adjusted}$ and the highest value would be used in the calculation of the incentive. With this option new production would be excluded during one RP and then be included in the incentive during the following RP.

CONCLUDING REMARKS

The Swedish NRA determines revenue caps for the DSOs and the TSO. To the next RP of 2024-2027, Ei intends to strengthen the incentive for efficient grid utilization as well as for the use of flexibility services. The new legal situation makes it possible for Ei to evaluate and improve the methods for calculating the revenue caps for the DSOs in detail.

Ei has not yet taken any decisions on the methods for calculating the revenue caps for RP 2024-2027 and onwards. Further analysis of the development of the methods, from different perspectives, are ongoing. In end-October 2023, Ei will take decisions on the revenue caps of the DSOs for the RP of 2024-2027 based on the final methods.

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