CHALLENGES IN THE DISTRIBUTION GRID DEVELOPMENT REGIME FOR DG INTEGRATION – THE NEED FOR PREDICTABLE PLANS AND ARENAS FOR COMMUNICATION

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ABSTRACT

In Norway, distribution companies experience that the grid regulatory regime, has not developed in line with the pressure stemming from the growth of distributed generation (DG). This paper presents two major non-technical challenges for the distribution companies. Firstly, the lack of incentives to ensure a holistic planning of the grid, and secondly, the communication challenge between the DG owner and the Distribution System Operator (DSO) in terms of information flow and dialogue through the process. Several initiatives have been taken to meet these challenges. However, the problems are still present. The paper seeks to address the existing plans in Norway for DG integration of small scale hydro power and grid development and assesses whether better use and coordination of regional and local plans can reduce the uncertainty faced by the DSOs through providing a more predictable picture of the DG development process for the actors involved.

INTRODUCTION

Integration of distributed renewable energy sources is gaining momentum in order to reach Norway's renewable energy goal of 67.5 % by 2020 [1]. In Norway, more than 90 % of existing and new distributed generation (DG) comes from small scale hydro units [2], thus representing an important element in reaching the national renewable targets. The increasing amount of DG has, however, put a pressure on the existing distribution grid due to the fact that most of the small scale hydropower production is located in areas with already limited grid capacity. Integration of DG can therefore trigger high costs in terms of grid investments. For the DSOs, the integration of DG imposes technical challenges such as increased risk of unintentional island operation and reduced quality of supply. The non-technical challenges are, however, just as important, as policies and regulations influence the DSOs' decisions to develop or upgrade the grid in specific geographical settings [3]. Also Ballen and Hassan [4] argue the importance of addressing non-technical challenges as economy, timing and location in the integration of DG in different countries. This paper focuses on the non-technical governance challenges that DSOs are facing in the process of integrating DG in the distribution grid in Norway.

BACKGROUND

Historically the distribution grid was constructed in order to deliver electricity to consumers, hence not to connect generation [5]. In Norway, the potential for DG is dominated by small scale hydro power which is located in remote geographical areas with low population density, as illustrated in Figure 1. These areas often have weak distribution networks, limited transfer capacity or without any network infrastructure at all.

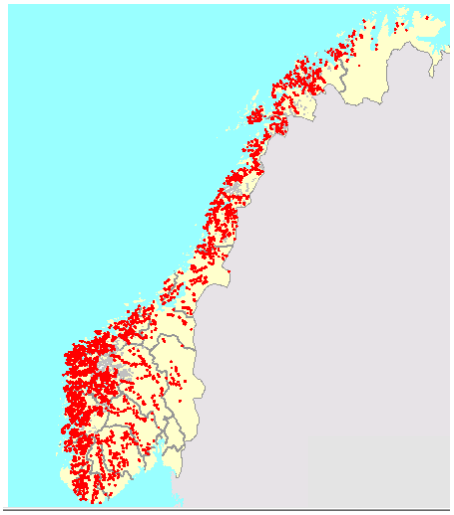

Figure 1 Potential for hydro energy DG in Norway with development cost < 3 NOK/kWh [6]

The resent development of DG is amongst other things a result of Norway and Sweden's agreement to implement a common electricity certificate market (1st of January 2012) in order to reach the national goals under the Renewable Energy Sources Directive (RES) [7]. In Norway the deadline for the DG developers to be approved for the certificates is set to 2020 [8]. This deadline has contributed to the increasing number of DG units being developed. Given the lack of grid capacity, this has put a large pressure on the DSOs to invest and develop their grid in a short period of time. Speeding up the actual realization of new projects represents a

challenge due to the prevailing concession processes in Norway [9].

THE PROCESS OF DG INTEGRATION

Once the DG developer decides to send an application to the concession authority in order to develop a power plant, the developer is obliged first to contact the network company to get information about the feed-in capacity of the distribution grid. However, although it is recommended to contact the network company early in the planning stage, many producers wait to inform the network companies about their plans. The lack of coordination between the DSOs and DG developers may delay the process.

The DG developer will, if granted concession, contact the grid company to provide information concerning the rated power to be connected. The rated power represents the basis for the connection agreement between the DG developer and the DSO. The network companies are obliged to connect the small scale hydro power plants if they are seen as 'socio-economic rational' projects due to the "duty to connect", partly imposed by the RES Directive [10]. If the DSO assesses the project to be 'socio-economic rational' and the grid has reached its hosting capacity, they will have to decide whether to reinforce the existing grid or upgrade it to a higher voltage level.

The grid investment plan along with technical requirements on the power plants, are included in an agreement between the DG owners and the DSOs. The agreement also includes an 'investment contribution' the producers is expected to pay as a share of the grid investment cost caused by their generation unit(s). This agreement has to be approved by both parties in order for the network company to make the necessary investments in the grid. If the investment is related to several projects, this process can be rather time consuming since the grid development requires that all producers have agreed to pay their share of the investment. Further delays can be caused as a result of complaints from involved parties in the concession processes.

Since the grid companies are dependent on the DG proposals to plan the rational size of grid investment and the DG developers on the other hand are dependent on the grid companies to provide the necessary capacity in the grid, a mutual dependency is created. At the same time established procedures are making necessary changes in the governance structures even more demanding due to the path dependency of the dominant energy system [11].

UNCERTAINTIES IN THE PROCESS

For the network companies the uncertainty related to the development of DG from the planning to the actual construction phase, poses a challenge to the long term planning of the grid [5]. The network companies are reluctant to take investment risks due to the economic regulatory framework which gives incentives to minimize costs and avoid overinvestment. This reluctance promotes planning based on case-to-case decisions and may impede further grid development. Measures have been taken to improve the economic regulation, but there are still needs for improvement.

Causes of uncertainty

The non-technical challenges the DSOs face relates both to the uncertainty concerning when and if a plant is constructed, as well as the level of the rated power [5]. The causes for this uncertainty can be divided in two main categories:

1) The lack of predictability of the concession process. There are uncertainties related to whether the DG unit is granted concession and not the least for which rated power (due to e.g. restrictions on minimum flow of rivers) and within which timeframe.

2) The lack of information flow between the DG developer and DSO. Even if the proposed project is granted concession, the final investment decision has to be taken by the DG developer; on the rated effect, whether to construct the plant, and when. These decisions are often communicated poorly or at a very late stage in the process to the DSOs. The DSOs will benefit receiving information about changes in the plans throughout the connection process regarding e.g. changes in rated power or abandonment of investment plans. In addition communication in the early planning phase could be of great value for the network company to map potential DG development in a given area.

While the former category of uncertainty calls for predictable development plans of small scale hydro power and clear political signals in the granting of such concessions, the latter calls for more organized and formal arenas for communication and coordination between the DSOs and DG developers. In other words, there is an urgent need to establish more solid governance structures.

USING EXISTING PLANS TO REDUCE THE UNCERTAINTY

The economic regulation's primary objective is to secure effectiveness in grid investment. Furthermore, the concession authority cannot predict how many concessions that will be granted since this decision have to be made case-by-case. Concerning the need for improvements in the communication between the DSOs and the DG developers there is a need for more formal communication arenas throughout the connection process.

Improved planning procedures may address both the predictability and communication challenges. Well founded plans for DG development can enhance the predictability in

the concession process while the planning processes can help improving information flow between relevant actors.

Using existing planning tools for distributed generation and grid development in Norway

In Norway the following plans are relevant when addressing the two main challenges identified above:

1) Predictability in the concession process. There are mainly two planning tools for production of small scale hydro power plants in Norway. These are also supposed to be instrumental for the concession process. First, there is the concession authorities' (NVEs) national mapping of small scale hydro power potential based on hydrology data and cost analysis [12]. Secondly, there are regional small scale hydro power plans. The regional plans are based on data from the national plan, but in addition they include an assessment of the social and environmental conflict potential in the region in question [13]. The plans can both give predictability in terms of what applications are more likely to be granted concession and which are not. One of the main objectives behind these regional plans is precisely to "strengthen the base for holistic assessment of concession applications for small scale hydro power plants and make this process more effective and predictable…" [13].

2) *Communication arenas for producers and network companies.* There are mainly two planning tools that today exist to coordinate production and grid development; one at the local and one at the regional level. At the local level, a local energy review (LEU) is published in each municipality. The LEU describes the local grid capacity, expected energy consumption and development and alternatives for grid development in the area. The DSOs with territorial concession in the municipality are responsible for formulating this plan. The local energy reviews should also take into account the concession authority's mapping of potential for small scale hydro power production and assess what new DG units are most relevant and feasible. The actors involved in the planning process include the local DSOs, DG developers and local authorities. Hence, the LEU does represent a formal communication arena at a local level [14].

At the regional level, the power system review (KSU) coordinates grid and generation planning. Even though the review has no direct effect on the investments in the distribution grid (since the information flow usually goes upwards from distribution to regional network and not the other way), the review is important in order to coordinate investments needed at higher levels (for instance upgrading of the regional or central grid) e.g. due to large scale integration of DG at a local level. Furthermore, the KSU process is an important communication arena for actors at both the generation and grid development side ranging from the local to the national level and including different authorities, generators and network companies. The concession authority (NVE) has lately focused more on improving the dialogue between the actors in the regional planning process. Initiatives have therefore been taken to strengthen the communication- and participation issues for the KSU [15].

The current use of the plans and possible improvements

Even though the existing plans on development of small scale hydro power may contribute to improved predictability in the concession process, they are not frequently used by the DSOs in their long term planning.

The concession authority's mapping of potential of small scale hydro power is based only on hydrology data and cost analysis. Environmental concerns are not taken into account despite being one of the main reasons many projects are rejected. The regional county plans, on the other hand, take both environmental and social concerns into the conflict assessment of areas for small scale hydro power. By drawing more on regional assessments, the DSOs may easier consider which local projects that are more likely to get concession. However, not every county has yet developed a KSU. In order for such plans to be helpful for the DSOs it is therefore crucial that the concession authority sees them as relevant and instrumental for the granting of specific concessions.

However, since most of the network companies still base their planning of the grid more on direct information from DG developers, well-functioning communication arenas seems even more crucial to reduce the uncertainty than improved predictability in the concession process. The LEU seems like the most fitting arena, but an evaluation of the planning process in 2010 [16] has shown rather negative results. The evaluation concluded that the support and interest in the LEU process was week. Public meetings are arranged to create a contact arena for producers, companies, landowners and the municipality, but the general interest in attending these meetings is low. Due to this situation the network companies do not see the LEU process as an important arena in improving the dialogue with either the general public or the DG developers [14].

The focus on dialogue and participation in the regional KSU process could also potentially help improving the communication between network companies and DG developers. Many of the actors invited to participate in the KSU process are the same involved in the LEU process. If contact and dialogue are created at the regional level, this can be followed-up at a local level as well through the LEU process itself. For this spin-off to happen, however, there is a need for a stronger connection between the local LEU and the regional KSU. Sabatier [3] also emphasizes the need to combine bottom-up initiatives and top-down efforts. Better governance through improved coordination and

communication by using and improving already existing planning tools, seem to be a promising way to secure a sustainable development of the distribution grid.

CONCLUSION

The DSOs face non-technical challenges which often are more difficult to handle than the technical challenges. Uncertainty related to when and if concession is granted or the plant constructed, as well as the level of the rated power pose challenges for the DSOs.

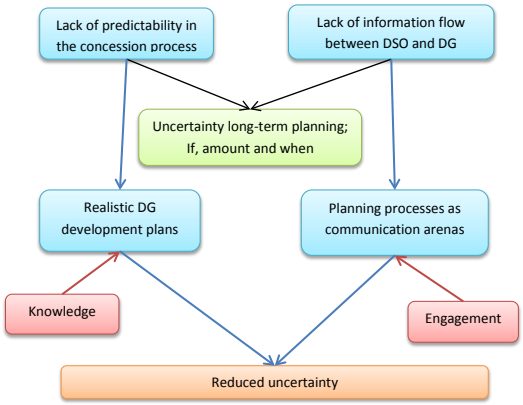

Figure 2 Overview the potential role of the existing planning instruments reducing uncertainties within existing governance structures.

As illustrated in Figure 2, two main non-technical challenges related to uncertainty where presented in this paper; lack of predictability in the concession process and the lack of information flow between the DG developer and DSO. The existing planning instruments in Norway were examined in order to determine in which ways they can help the DSOs in reducing the uncertainty related to predictability and information flow. However, it is still too early to determine if the DG development plans can improve the predictability in the concession process. At the same time the regional plans do have a potential to give a realistic picture of possible DG projects. Additionally the LEU and the KSU represent communication arenas that have potential in improving the formal dialogue between stakeholders, that is, if the engagement of all the stakeholders in these arenas is strengthened. Although adaption to the new situation already is happening, as described in the analysis, elements in the governance structure are hard to change due to path dependency in the regulatory framework as well as in local and regional processes related energy issues. The task of integrating a large number of DG units in the grid within 2020 in order to reach the RES targets will therefore be a difficult one for the relevant DSOs in Norway as well as other countries with similar challenges of integrating DG in the distribution grid.

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