

Reducing our emissions while achieving good status of our water bodies – is it possible? Swedish hydropower in the limelight

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Abstract: The conflict between climate change mitigation and ecosystems functions is highlighted in the implementation of two EU directives; the renewable energy directive (RES) and the water framework directive (WFD). This paper examines the Swedish implementation of the RES and WFD and possible outcomes in light of the setup and functioning of the present concession system of hydropower in Sweden. The paper discusses the degree of policy coherence of the present and foreseeable outcomes of the directives and suggests some possible policy alternatives to increase coherence in the implementation of the twin objectives.

Keywords: Renewable Energy Directive, Water Framework Directive, Sweden, hydropower, coherence

1. Introduction

“In reality we are talking about two goal conflicts. On one hand the renewable energy directive and the water framework directive where demands on increased minimum flow and bypass channels for fish could lead to decreased production of renewable energy. It is also a conflict between two environmental issues, local biodiversity conservation and [global] climate change.”

This view regarding the conflict between renewable hydropower production – which is seen as a crucial step in reduced emissions of greenhouse gases – and biodiversity conservation of the river and its surroundings appears in one or another way among various stakeholders connected to the hydropower sector in Sweden today. This twin objective of reducing the emission of greenhouse gases and halting biodiversity loss was already addressed in a formalized way by the adoption of the Swedish Environmental Quality Objectives in 1999. The implementation of the Renewable Energy Directive (RES) and the Water Framework Directive (WFD) has increased the pressure for action to reach these objectives which for many stakeholders appears to be contradictory.

The RES and WFD are EU directives that have to be implemented in the member states of the EU. The RES sets the target of 49% renewable energy of gross final consumption in Sweden by 2020 from a level of 39.8% in 2005. This important level of renewable energy production is to a large extent possible thanks to the high level of hydropower production in Sweden which in 2008 ascended to 69 TWh [1]. The installed capacity has been relatively stable over the past decade, although production fluctuates with precipitation patterns. The WFD has the overarching goal that no water body is to experience a decrease in water quality and that all water bodies should reach good status or good potential by 2015 with the possibility of extension until 2027. A number of quality elements – including biological, hydromorphological and flow regime – have to be fulfilled in order to achieve the required status of the water bodies in a member state. The significant level of hydropower production in Sweden is one important factor leading to many rivers in Sweden at present not reaching the level good status or potential required by the WFD. The high level of hydropower production in Sweden which is positive for the fulfillment of the RES therefore simultaneously makes it harder to reach the requirements of the WFD.

In light of this potential conflict the present paper is focused on the Swedish implementation of the RES and WFD and possible outcomes in light of the setup and functioning of the present concession system of hydropower in Sweden. The paper will in the final part discuss the degree of policy coherence of the present and foreseeable outcomes of the directives and suggest some possible policy alternatives to increase the synergy and coherence in the implementation of the twin objectives.

2. Methodology

The methodology that has been used is document analysis as a first step to identify important issues and possible contradictions that could come from the implementation of the RES and WFD and the functioning of the Swedish governance system of hydropower. The primary data for analysis has been gathered from review and analysis of management and policy documents and literature on the subject. Insights from this step informed the questions that were brought up during semi-structured interviews with relevant stakeholders engaged in the hydropower governance system. Interviews have been conducted with representatives from the four largest hydropower producing companies and representatives from the main authorities dealing with the implementation of WFD and RES in Sweden such as the Swedish Energy Agency and River Basin District Authorities. The lack of centralized and accessible data has limited the analysis of outcomes of actual hydropower concession reviews which would have strengthened the analysis.

Literature on policy coherence has been used to provide a frame with which to analyze arguments raised by the actors and possible outcomes of the implementation of the directives and to what extent they are coherent. Policy coherence is focused on the outputs, implementation and outcomes of different policies and the way they interact. Policy coherence can be viewed as two or more sets of policy objectives that have objectives, instruments and implementation practices that are free from contradictions and have a logical order and clarity [2].

3. Results

The passing of the Energy and Climate bill in 2009 the government can be seen as a major step towards the fulfillment of the RES since it aims at creating a third leg of electricity production from wind and combined heat and power production largely run on biofuels [3]. To achieve this the same bill sets a national planning frame of 30 TWh for wind power and a production goal level of the renewable energy certificates to 25 TWh for 2020. Apart from wind, solar and biofuel production certain types of hydropower production do receive renewable electricity certificate such as production from new plants, plants with an installed capacity not exceeding 1.5 MW and increased production from existing plants. In 2008 production from hydropower plants receiving certificates amounted to 2.6 TWh out of a total of 14.2 TWh [4]. Although hydropower is not identified as an area of priority for expansion to reach the RES goals it is clear that in practice hydropower production does contribute a fair bit in the quota fulfillment partially as a result of the design of the renewable electricity certificates. Due to the old age of the existing hydropower stations there is also quite some potential for efficiency increases from refurbishments that will take place in the coming years. There are calculations pointing towards a potential of 3 TWh increased production simply by replacing existing turbines and generators and modifying the water intake of the stations [5].

As part of the implementation of the WFD water bodies affected by hydropower stations in Sweden are being classified as Natural, Heavily Modified (HMW) or Artificial depending

upon the extent of alteration of the water body or if it has been created for the purpose of electricity production. Natural water bodies are required to reach the environmental quality standards Good Ecological Status (GES) while heavily modified and artificial water bodies need to reach the less strict quality standard Good Ecological Potential (GEP). All water bodies in connection to hydropower stations with more than 10 MW potential have in the initial management round been given the status HMW. This adds up to roughly 200 dams in connection to hydropower stations that together represent 10% of the total number of hydropower stations that produce about 97% of the total of hydropower electricity [6]. These same water bodies have been given the general status moderate ecological potential which means that improvement measures should be required to reach GEP [7]. The extent and type of improvement measures needed to reach GEP is still not decided by the responsible River Basin District Authorities (RBDA). There are however indications that physical changes, such as construction of bypass channels, and changes to the flow regimes might be necessary. Bottenhavet RBDA have for example specified that they expect at least 55 new bypass channels to be constructed in hydropower and lake regulation dams in the coming years [7]. The changes required to reach GEP are specified in the program of measures that are created by the RBDA every six years. These programs of measures are targeted at public authorities who have the same tools – mainly supervision and review of concession and general regulation – as before the implementation of the WFD. The purpose is to make sure that the environmental quality norms are met in the water bodies adjacent to the hydropower stations [8].

The final step of implementation of both efficiency increasing measures of hydropower stations and changes required to reach GEP or GES in adjacent water bodies will normally go through the existing concession system of hydropower in Sweden. Hydropower concessions – which specify the conditions and restrictions of operations – are granted in a court of law, have legal force and unrestricted validity in time. This means that general regulations cannot limit the original freedom given in a concession while the operator has to stay within the restrictions of the same. No significant changes are allowed without a corresponding change to the concession which requires a new judicial process. Extended refurbishments which for example increase the water intake capacity of the turbines or increase the drop of the water require a change to the original concession. The vast majority - 88% - of hydropower concessions in force today have been given according to the 1918 Water Law or older [9]. An important number of these concessions allow full appropriation of the water flow for power production. In the case of stations with more than 10 MW potential this is allowed in the majority of cases while it is less common in smaller hydropower stations. Supervision of a given concession by the authorities will therefore often not lead to improved water quality of the adjacent water bodies.

The option that is left for significant changes to the hydropower stations with the current concession system is therefore a judicial trial of the change or a judicial review of the original concession. A judicial trial of a change to the hydropower station is a limited process where only the proposed change is examined by the court while the original concession stays largely unchanged. A judicial review is a more thorough process where the original concession is examined in light of the current Environmental Code and often leads to requirements of minimum environmental flow and in some cases bypass channels. When an old concession is up for review the operator has to tolerate a loss of up to 5% of the water flow for fish and environmental interests without compensation. The initiator of a judicial trial process has to pay the costs of all involved parties, the court process and the necessary investigations that form the basis of a ruling. When a review is initiated by public authorities in favor of general

interests the same rules apply except that the operator pays its own costs for participating in the process. A judicial process to change or review a concession is a very complex process where many stakeholders participate and where the nature of the process opens up many possibilities to protract the process if it is in the interest of either of the involved actors. A court ruling can for example be appealed to a Court of Appeal and in the final instance the Supreme Court. A single case can therefore take many years to solve if there is disagreement between the involved actors. One of the most protracted litigation processes in Sweden relates to the Stornorrfor's hydropower station where it took 46 years for the parts to agree on appropriate compensatory measures for the damage caused to the fish stocks. For the court process to be effective and lead to a satisfactory result at a reasonable cost it is therefore vital with prior agreement between the involved actors [10]

At present the possibility of reaching prior agreement is limited since the main actors involved have very divergent interests. Hydropower operators risk losing energy production and up to 5% revenue from a concession review since the old concession in most cases allows for more generous appropriation of the water than a reviewed concession would. It is therefore in the economic interest of operators to try to limit the amount of reviews that are initiated and carried through. At the same time the authorities responsible for environmental issues have an interest in trying to maximize the amount of reviews that are carried out to update as many concessions as possible to be in line with the demands of the Environmental Code of Sweden. Currently the main authority responsible for environmental interests in hydropower concession trials is trying to create court practice that a petition from an operator for a judicial trial due to a change for an extended refurbishment requires a review of the original concession. The issue is not that the extended refurbishment will cause an unacceptable impact in itself but rather if the hydropower stations should have a modern concession or be allowed to continue with old concession that are not in line with the demands of the Environmental Code. With such a practice the operator would also have to shoulder the costs of the process as the initiator. Currently there are various ongoing concession trial processes where this issue is being deliberated.

As a result of the functioning and incentives in the concession system and operators and authorities following lines of action that are logical in light of their interests the Swedish concession system is currently working rather slowly and ineffectively. About 2/3 of the resources invested for restoration of water bodies are required for the process and only 1/3 goes to actual physical changes and improvements [10]. Between 1999 and 2009 a total of 73 hydropower concessions out of 3727 have been reviewed which amounts to about 2% of the total [9]. From interviews with operators it is also clear that the full efficiency gains from refurbishments of hydropower stations is not always reached since operators at times opt for a more limited refurbishment to avoid a protracted judicial process that could lead to a review of the original concession. The actions in court from both sides seem to have led to a rather antagonistic situation which became obvious from comments by a representative from one of the responsible authorities. "They [one of the studied energy companies] have stated that they do not intend to spill a single drop of water for environmental causes. I do not see why we should enter into negotiations with them". In interview, at a different time, the responsible hydropower manager of the concerned company also had strong feelings on the subject "My opinion is that what they [the responsible authority] is doing...appears to be some sort of vendetta against the energy companies in cooperation with the Swedish sport fishing association"

The current functioning of the hydropower concession system therefore leads to results where the full efficiency gains from hydropower refurbishments are not always reached. This limits hydropower's share of the fulfillment of the RES objectives in Sweden. At the same time the slow functioning of the concession system makes it highly unlikely that it will be able to implement necessary changes emanating from the implementation of the WFD if the requirements for reaching GEP and GES require significant changes to a large part of existing hydropower stations.

4. Discussion and conclusions

At the strategic policy level there is a relatively high coherence between the implementation of the RES and WFD since the focus in Sweden lies almost exclusively on expansion of wind power and biofuel production to reach the mandatory level of renewable energy production. The integration of up to 30 TWh of intermittent wind power also seems to be possible to balance with 80% of the existing hydropower capacity which indicates that balance capacity in the Swedish electricity grid is not a limiting factor in the selected path to reach the RES targets [11]. The renewable energy certificate is however constructed in such a way that it gives a push for hydropower production as well and we have seen that around 18% of the increase in renewable electricity production to date comes from hydropower production increases.

At the level of implementation, that is at the project level, there is however a risk of some policy contradiction in the implementation of the WFD and RES since measures to improve the water quality could require a certain amount of water flow for bypass channels and minimum environmental flow in the rivers. There is however an important potential to increase the coherence by combining the measures for improved status of the water with extended refurbishments which would allow for higher production of renewable electricity despite of using a smaller share of the water. There is therefore a potential for win-win solutions where the increased efficiency of the hydropower stations could allow for both measures to improve the water quality and increased hydropower production or at least limit the production loss from measures to improve the status of the water. The results in this paper however clearly indicate that the current concession system and the behavior of the main actors involved in it makes it highly unlikely that such synergetic fulfillment of both the RES and WFD will take place.

One of the main barriers for the effective functioning of the system is the economic risk that operators face when engaging in a concession trial or review process since such a process could lead to a 5% loss of energy production and revenue. A possible policy alternative to remove this barrier could be to create a general insurance scheme from which resources could be taken to fully compensated operators from changes emanating from a concession review. By creating a general insurance scheme that all operators are required to participate in a common source of finance would be created that can be used to fully compensate concerned operators from changes to their concessions in a review process. Operators would in this case not have an incentive to protract review processes nor limit the amount of concession reviews that are carried out. Such an insurance scheme could be obligatory for all hydropower producers and consist of a sum of up to 5% of the production value of hydropower in Sweden which is the established limit in the Environmental Code of production loss that operators are required to bear.

With a more effective functioning of the concession system – and with the operators fully compensated for any energy losses in reviews – operators would be more inclined to realize

extended refurbishments, requiring concession reviews, which would yield higher efficiency gains in the refurbished hydropower plants and increased renewable electricity production than today. An important part of the energy loss that could result from diverting water for biodiversity requirements if it is necessary to achieve GEP could in this case be compensated for by increased efficiency gains from extended refurbishments of the hydropower stations. The total loss of potential renewable energy production in Sweden would with such a solution be significantly less and it is even probable that the net result would be an overall increase in hydropower production if the space for water improving measures is restricted to up to 5% for hydropower stations that have concessions according to the 1918 water law or older.

There is also an additional source of finance possible for the costs that the operators have to shoulder from review of concessions which comes from the renewable energy certificates. The overarching goal of the renewable electricity certificate is to “establish a more ecologically sustainable energy system in Sweden” [4]. At present this is focused solely on increased production of renewable electricity but with only slight changes it could also work in favor of improving the status of water bodies in Sweden. This would be possible by introducing a requirement that hydropower plants need to possess a reviewed concession according to the Environmental Code and WFD to be entitled support from the renewable electricity certificates scheme. Such a modification would increase the coordination between the WFD and RES and work towards the fulfillment of the twin environmental objectives of CO₂ reduction and biodiversity conservation necessary for a more ecologically sustainable energy system.

Research on a global scale is pointing towards the increasing urgency of action both in terms of CO₂ reduction and biodiversity conservation which leaves us little option than to tackle the two issues simultaneously [12]. The policy suggestions made in this paper are therefore aimed at improving the ability of the Swedish concession system of reaching synergetic and effective solutions in the hydropower sector that can provide solutions to both environmental challenges.

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