SEI STOCKHOLM ENVIRONMENT INSTITUTE

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Constant Concessions Under Changing Circumstances: the Water and Renewable Energy Directives and Hydropower in Sweden

Peter M. Rudberg

Second Revised Edition

CEDREN

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The views and conclusions expressed in this report are solely those of the author.

ENGLISH-SWEDISH GLOSSARY

Organizations

Confederation of Swedish Enterprises	Svenskt Näringsliv
River Basin District Authorities (RBA)	Vattenmyndigheter
Riversavers	Älvräddarna
Swedenergy (SE)	Svensk Energi
Swedish Board of Fisheries (SBF)	Fiskeriverket
Swedish Energy Agency (SEA)	Energimyndigheten
Swedish National Grid (SNG)	Svenska Kraftnät
Swedish Society for Nature Conservation (SSNC)	Naturskyddsföreningen
Swedish Sport Fishing Association (SSFA)	Sveriges Sportfiske- och Fiskevårdsförbund
The Legal, Financial and Administrative Services Agency (LFASA)	Kammarkollegiet
The Swedish Environmental Protection Agency (SEPA)	Naturvårdsverket

Terms

Concession change trial	Prövning för ändringstillstånd
Concession review	Omprövning
Environmental Quality Standard	Miljökvalitetsnorm
Environmental Quality Objective (EQO)	Miljömål
Extensive examination	Fullständig prövning
Good Ecological Status (GES)	God Ekologisk Status
Good Ecological Potential (GEP)	God Ekologisk Potential
Highly Modified Water (HMW)	Kraftigt Modifierat Vatten
Limited examination	Begränsad prövning
Renewable Energy Directive (RES)	Förnybarhetsdirektivet
Swedish Environmental Code	Miljöbalken
Water Framework Directive (WFD)	Vattendirektivet

SUMMARY

In 2008 hydropower produced almost half of the total electricity consumed in Sweden, which makes it the most important source of renewable electricity in Sweden. Storage hydropower – which provides over 97 per cent of the electricity produced – also has the additional advantage of being a dispatchable energy source which can be used to balance the electric grid. At the same time, storage hydropower production leads to the fragmentation of rivers, creation of artificial dams and highly altered flow regimes with serious and well documented negative effects on the ecosystems of the affected rivers and their surroundings. As a result, hydropower has the potential of becoming a political issue in connection with the implementation of the Renewable Energy Directive (RES) and the Water Framework Directive (WFD), since the implementation processes could lead to potentially contradictory demands on hydropower production. This report provides a review of the status of implementation of the RES and WFD directives to date in Sweden and an analysis of how the current national hydropower concession system directs future implementation of the two directives. The report also discusses the degree of policy coherence of the present and foreseeable outcomes of the two directives in Sweden in relation to hydropower. The final part offers suggestions of feasible policy alternatives for a more effective and synergetic implementation of the goals of the directives, which would enable an increase in both renewable energy production and an improved aquatic environment.

The main results indicate that the actions and strategies of both operators and authorities within the current judicial and administrative setup have led to a situation of high distrust and conflict between the actors involved. The main implication of this is that the Swedish concession system is currently working in such a way that neither the full potential of efficiency gains from hydropower refurbishments to reach the RES targets is attained, nor is it likely that the concession system will be able to accommodate significant changes to hydropower stations and dams that could be required from the implementation of the WFD within the set timeframe.

The following conclusions and policy suggestions are put forward:

- There is an important window of opportunity for win-win solutions thanks to the extensive refurbishment that is currently taking place in Swedish hydropower facilities.

- Without a change to the incentives of the actors in the current concession system this opportunity for win-win solutions could be lost.

- It is possible to create a more efficient and competition-neutral system by creating an environmental compensation scheme that would cover the cost of biodiversity and water status improvement measures in connection to hydropower plants. Such a scheme would significantly improve the possibilities of reaching win-win solutions and take a more holistic approach in concession trial processes.

SAMMANFATTNING

Vattenkraft producerade närmare hälften av all slutanvänd el i Sverige 2008 och är därmed landets viktigaste källan till förnybar elektricitet. Dammkraftverk – som producerar över 97% av elen – kan snabbt generera elektricitet och därmed balansera ojämnheter i den nationella energitillgången. Kraftverksdammar leder dock till fragmentering av floder, skapar artificiella vattenmagasin och förändrar flodernas naturliga flödesregim. Den negativa påverkan på ekosystem i vattendragen och närliggande områden är omfattande och väldokumenterad. På grund av dessa egenskaper är det möjligt att vattenkraften blir en politisk fråga under förverkligandet av Förnybarhetsdirektivet (RES) och Vattendirektivet (WFD), eftersom direktiven potentiellt har motsägelsefulla krav på vattenkraften. Denna rapport är en granskning av den pågående implementeringen av dessa två direktiv och analyserar hur det svenska koncessionssystemet påverkar fullföljningen av direktiven. Rapporten diskuterar också i vilken utsträckning de två direktiven är samordnade med hänsyn till nuvarande och troliga framtida utfall i relation till vattenkraften. Rapportens sista del för fram möjliga policy alternativ för att möjliggöra ett effektivare och mer enhetligt genomförande av direktivens mål. Vidare diskuteras möjligheterna för win-win lösningar som skulle kunna leda till både ökad produktion av förnybar elektricitet och förbättrad vattenstatus.

De viktigaste resultaten vittnar om att operatörers och myndigheters agerande och strategier inom vattenkraftens nuvarande administrativa system leder till en situation av konflikt och misstro mellan aktörerna. Ett resultat av det svenska koncessionssystemet blir därmed att den potentiella effektivitetsökningen som är möjlig att uppnå vid förnyelse och renovering av äldre vattenkraftverk inte alltid nås. Vattenkraftens andel av produktionsökningen av förnybar elektricitet som är nödvändig för genomförandet av RES begränsas därmed. Det är inte heller troligt att systemet kommer att klara av att genomföra några större förändringar av vattenkraftstationer och dammar som skulle kunna krävas under genomförandet av WFD inom den utsatta tidsramen.

De viktigaste slutsatserna och policy alternativen som förs fram är:

- Den finns för närvarande ett unikt tillfälle för win-win lösningar tack vare den omfattande renovering som pågår av den svenska vattenkraften

- Utan en förändring i aktörernas incitament i det gällande koncessionssystemet kommer denna win-win möjlighet troligen inte uppfyllas

- Det är möjligt att skapa ett effektivare och marknadsneutralt system genom att upprätta ett miljökompensationssystem som täcker kostnaderna för miljö- och vattenstatusförbättrande åtgärder i vattenkraftsverk och dammar. Ett sådant system skulle avsevärt förbättra möjligheterna att nå win-win lösningar och främja ett mer holistiskt tillvägagångssätt i tillståndsprövningarna

INTRODUCTION

The main purpose of the present study is to analyze the implementation and interaction of the WFD and RES with regard to the hydropower sector in Sweden. Special attention is given to how the directives are implemented with regard to the hydropower governance system which is centered on a highly judicial concession granting and review system. The strategies and actions of the public authorities and operators active in the review process are discussed and analyzed together with their implications for the possibility of achieving the goals of the WFD and RES within the set timeframe. Some of the perceived conflicts, in terms of policy coherence in the implementation of the two directives, are also discussed.

Sweden is a country with an unusual energy mix when it comes to electricity production in an EU perspective. In 2008, nuclear and hydropower energy together accounted for almost 90 per cent of the total production of electricity, and there is virtually no electricity produced from oil and carbon (SEA, 2009b). In the same year, hydropower alone provided roughly 47 per cent of the total electricity produced which makes it the most important source of renewable electricity in Sweden. Bioenergy and wind power electricity production are growing but are still relatively limited (ibid). Hydropower is therefore essential for reaching the Swedish RES targets for 2020. At the same time production from storage hydropower leads to the fragmentation of rivers, creation of artificial dams and highly altered flow regimes with serious and well documented negative effects on the ecosystems of the affected rivers (Rosenberg *et al*., 1997; Vorosmarty *et al*., Abell, 2002). The high level of hydropower production in Sweden means that roughly three quarters of the major and medium-size rivers in the country are partially or highly affected by hydropower and dams (Dynesius and Nilsson, 1994). It is therefore possible that changes to existing hydropower stations and limitations to the construction of new hydropower stations will be required in order to achieve the requirement of the WFD. Such changes and limitations could lead to a loss of actual and potential renewable electricity production. The implementation, interaction and impact of the RES and WFD on hydropower is therefore a highly relevant subject for investigation in Sweden since the implementation of the directives could influence the hydropower sector significantly in the years to come.

Research focus, aim and method

This research aims to review the status of implementation of the RES and WFD in Sweden with special focus on the hydropower sector. These EU policies will be implemented largely through a national concession system which means that an analysis of the history and functioning of the Swedish concession system is needed in order to understand the possible effects of these policies and to what extent they are coordinated. This analysis will also provide a basis on which to make policy suggestions on how to achieve a more effective implementation of energy and environmental objectives in Sweden. This paper will thus be divided into the following sections:

- a review of the status of implementation of the RES and WFD directives;
- an analysis of the current Swedish concession system regulating hydropower in light of the goals and implementation of the directives;
- a discussion of the degree of policy coherence of the present and foreseeable outcomes of the directives; and
- suggestions of feasible policy alternatives for a more effective and synergetic implementation of the directives.

In order to understand the main challenges in the hydropower sector relating to the implementation of the WFD and RES, an extensive literature review was carried out of reports and research from relevant public authorities, hydropower companies and trade organizations in Sweden. Based on this review an interview guide was created and used in interviews with 10 interviewees from different relevant organizations. The full interview guide and information about the interviewees can be found in appendix 1.

Delimitation

The RES deals with renewable energy production and consumption in all parts of the energy sector, including electricity, transport and heating. In this paper, the focus is on the interaction of the RES and WFD in relation to hydropower stations producing electricity. The main part of the paper will therefore focus on renewable electricity production even though the introduction of renewable energy into the

heating and transport sector and energy efficiency and saving in general are equally or more important in order to achieve the overall goals of the RES.

BACKGROUND TO EU DIRECTIVES

Since the publication of the first Intergovernmental Panel on Climate Change (IPCC) report in 1990, results from scientific research and observations of climate change have increasingly validated the climate change thesis. In a global perspective we are now at a point where there is unequivocal evidence of warming of the climate system and we are certain that this warming is very likely due to the observed increase in anthropogenic Greenhouse Gas concentrations (IPCC, 2007a). This realization has led to a number of policy responses at both an international and local level. At EU level one of the more ambitious initiatives is the climate and energy package that provides legislation to help reach the 20-20-20 EU targets by 2020. In essence the aim is for the EU to reduce its greenhouse gas emissions to at least a level of 20 per cent below the 1990 levels. In addition it is stipulated that 20 per cent of EU energy consumption should come from renewable resources and that there should be a 20 per cent reduction in primary energy use compared to projected levels due to increased energy efficiency (EU, 2010a). There are a number of pieces of EU legislation that are related to this goal such as those setting up the Emissions Trading System (EC, 2003/87) and binding national targets for renewable energy (EC, 2009/28). There is also an Energy Efficiency Directive (EC, 2006/32) and an Energy Efficiency Action Plan (EU, 2010b).

The Renewable Energy Directive (RES) (EC, 2009/28) establishes a common framework for the promotion of energy from renewable sources. The targets are set for the share of gross final consumption of energy and for the share of energy from renewable sources in transport. The RES constitutes an important part of the package of measures needed to reduce greenhouse gas emissions and comply with the Kyoto Protocol to the United Nations Framework Convention on Climate Change and with the EU commitment of a 20 per cent greenhouse gas emission reduction by 2020. The RES amends and repeals the Renewable Electricity Directive (RES-E) (EC, 2001/77) which set national indicative targets for the contribution of renewable electricity to gross national electricity consumption by 2010 (Lafferty and Ruud, 2008). The RES goal is expressed as a percentage of gross final consumption of energy, which means it can be reached by increasing production from renewable energy, decreasing production from non-renewable energy or a mix of both. The EU-wide target of a 20 per cent share of renewable energy is translated into national overall targets where Sweden is expected to go from a 39.8 per cent share in 2005 to a 49 per cent share of renewable energy in 2020. All member states also have the common goal of achieving a 10 per cent share of energy from renewable sources in transport, and it is also stated that increased energy efficiency, particularly in the transport sector, is vital for achieving the target.

With increasing population growth, water usage and pollution from agriculture and industry, the pressure on our fresh water resources and ecosystems has been mounting during the last century (Hassan, 2005). On a global scale we are facing a situation where problems due to water scarcity and decreasing water quality are reaching critical levels. The strained situation of our water resources will most likely become even worse in many parts of the world due to population growth, increasing economic activity and the effects of climate change (Postel, 2008; Jackson *et al*., 2001; Bates *et al*., 2008). In Europe many of these pressures are being felt and between 1973 and 2000 the EU responded to some of these concerns by developing policy in the water sector by means of five environmental action programs (Chave, 2001). These programs treated a number of issues related to water pollution and improving the quality of natural waters in the EU. This work resulted in a number of separate directives dealing with issues such as urban waste-water treatment (EEC, 1991/271), quality standards of drinking water (ECC, 1980/778) and protection of natural habitats (ECC, 1992/43).

The directives dealing with the water sector had however been developed to deal with specific problems and there were concerns that a comprehensive protection of our water resources was missing and some crucial issues, such as groundwater protection and water quality, were not sufficiently addressed. This led to the start of negotiations for a framework directive providing more comprehensive protection of EU water resources (Chave, 2001). The ensuing Water Framework Directive (WFD) (EC, 2000/60) establishes a framework for the protection of inland surface waters, transitional waters, coastal waters and groundwater, which prevents further deterioration and protects and enhances the status of aquatic ecosystems, terrestrial ecosystems – with regard to their water needs – and wetlands that depend directly on aquatic ecosystems. The WFD also promotes sustainable water use based on a long-term protection of available water resources and aims at enhanced protection and improvement of the aquatic environment. The overarching goal is for all water bodies to achieve

good chemical and ecological status by 2015 with the possibility of extension in reaching these targets by 2027. The passing of the Water Framework Directive in 2000 is unique since it combines and coordinates the diverse water legislation that had been in force up until then and creates one instrument that covers the water sector as a whole (Chave, 2001).

IMPLEMENTATION OF THE RES IN SWEDEN

Sweden has a relatively long history of using policy instruments to decrease carbon dioxide emissions. The first carbon dioxide tax, which is still in force, was introduced in 1991, and is levied on emissions from all fuels except bio-fuels and peat (SEA, 2008a). Sweden also participates in the EU emission allowance trading scheme, which is a climate policy instrument within the EU's ECCP climate change program that aims to achieve the emission reduction commitments of the Kyoto Protocol. In Sweden about 35 per cent of greenhouse gas emissions are covered by the emission allowance trading scheme (ibid). A third policy instrument is the Renewable Electricity Certificate System, which is a market-based support system to incentivize the expansion of renewable energy production in Sweden. The Renewable Electricity Certificate System was introduced in 2003 and is one of the most important tools for reaching Sweden's commitment towards the RES of a 49 per cent share of renewable energy by 2020 (SEA, 2009a).

The law that introduced the Renewable Electricity Certificate System (SFS, 2003:113) and the ensuing regulations from the SEA (STEMFS, 2009:3) specify

The Swedish electricity sector

The Swedish electricity sector was deregulated in 1996 from a planned to a market-based system. The framework conditions for the electricity market are set by regulations but the actual commercialization of electricity takes place on the Nord Pool Spot exchange. Nord Pool Spot is a market place for producers, energy companies and large consumers on which they can buy or sell electrical energy. Norway, Sweden, Finland, Denmark and Estonia participate in the Nord Pool Spot exchange and in 2009 the marketplace had a turnover of 288 TWh representing more than 70 per cent of the total consumption of electricity in the Nordic countries (Nordpool 2010).

The Swedish Energy Agency (SEA) is the central government agency for national energy policy issues and is the agency responsible for the emissions trading scheme, the Renewable Electricity Certificate System and climate research in connection with energy policy. The Renewable Electricity Certificate System is a market-based support system to increase the production of electricity from renewable sources and peat. It is one of the main mechanisms for reaching Sweden's commitment towards the RES.

The Swedish National Grid (SNG) is the transmission system operator and is responsible for securing electricity supply in the Swedish grid and ensuring that the balance of supply and demand is kept constant in the grid.

The main sources of electricity production in Sweden are specified in Figure 1.

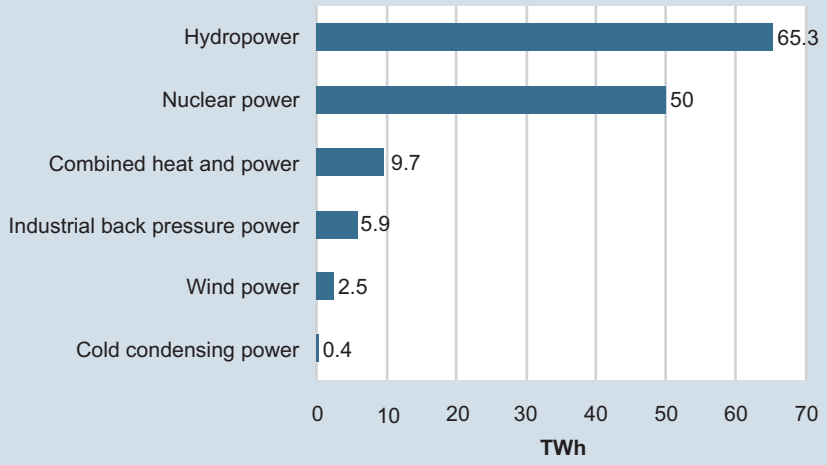

Figure 1: Sources of electricity production in Sweden in 2009 in TWh (out of a total of 133.8 TWh) (SEA 2009b)

the conditions and type of facilities that can receive renewable electricity certificates. The system is currently set to run until 2030 and all electricity suppliers are required to buy certificates corresponding to the particular portion of their total electricity sale which creates demand. The quota should reach a maximum of 17 per cent of total electricity sales and decrease to 4 per cent in 2030. The aim is to produce 25 TWh more renewable energy by 2020 compared to 2002. Apart from peat, which is not a renewable energy source, there are a number of renewable energy sources that are entitled to certificates such as wind, solar, wave and geothermal energy and biofuels. Only certain hydropower production facilities are allowed to participate in the certificate scheme. These are: small-scale hydropower facilities with a maximum installed capacity of 1.5 kW per pro¬duction unit; new plants; plants that have resumed operation; the share of increased production capacity from existing plants; and plants that are no longer economically feasible due to injunctions from authorities or extensive rebuilding (SEA, 2009a). Between 2003 and 2008 there was an increase in renewable energy production of 8.5 TWh. In terms of energy production capacity, the most important increase occurred in biofuel production with an increase of one GW. During the same time wind power production capacity increased by 0.4 GW while hydropower increased by 0.29 GW (Eurostat, 2010).

There have also been several policy initiatives coming from the RES in the government's Climate and Energy Bill (Govt. bill, 2008/09:163). The bill specifies a plan of action for renewable energy which includes a revision of the production goal level of the renewable electricity certificates to 25 TWh and a national planning frame for wind power development of 30 TWh. There have also been additional bills with the aim of both facilitating the net connection of new renewable energy production units (Govt. bill 2009/10:51) and simplifying the concession process for new wind power facilities (Govt. bill, 2008/09: 146). Overall the government aims to create a third major source of electricity production, apart from hydropower and nuclear power, from combined heat and power production, wind power and other renewable sources in order to increase the security of supply. This is clearly stated in the government bill: "To reduce the vulnerability and increase supply security, a third leg for electricity supply should be developed and hence reduce the dependence on nuclear and hydropower. To achieve this, combined heat and power production, wind power and other renewable energy production have to supply a significant part of electricity production" (Govt. bill, 2008/09:163).

IS THERE A ROLE FOR HYDROPOWER IN THE FULFILLMENT OF THE RES?

Between 1918 and 1975 Sweden experienced a significant and rapid expansion of hydropower production. In 1975, a final target for hydropower production of 66 TWh a year to be achieved by 1985 was set by the government. This was a clear signal of the level of hydropower production that was politically desirable. The target was given ample support by the Swedish Parliament and was on several occasions confirmed by the Parliament in the following decade. The last general hydropower plan in 1984, for example, refers to this 66 TWh target (Govt. bill, 1983/84:160) and it was also included in the Energy Policy Bill of 1985 (Govt. bill, 1984/85: 120). By 1987 the protection of rivers also started to become institutionalized with the law that specified rivers and tributaries that should be protected from hydropower production (SFS, 1987:12). The number of protected rivers and tributaries has since increased and at present four of the major unexploited rivers and many of the remaining unexploited rivers and tributaries are explicitly protected according to the Swedish Environmental Code. In practice Sweden reached the 66TWh production target in the 1980s which, in combination with low electricity prices and the increasing judicial protection of rivers, has led to a halt in new hydropower development of major importance in Sweden during the last few decades.

At present there are mixed signals coming from the Swedish government relating to the role of hydropower in the fulfillment of the RES. Hydropower is not specified as a source of increased energy production in the 2009 Climate and Energy Bill and the focus of the bill is rather on reducing the dependence of Swedish electricity production on nuclear and hydropower production (Govt. bill, 2008/09:163). At the same time, the law and regulations that govern the renewable electricity certificate system, which is one of the main tools for the fulfillment of the RES, grants subsidies for hydropower production plants. This duality of aims is also present in the directive from the Ministry of the Environment to the public commission of inquiry on water operations (SOU, 2009:42). The directive asks for a review of changes to the Environmental Code that will benefit a high production capacity of hydropower without undermining other significant environmental and fishing interests.

There are a number of actors – mainly Swedenergy (SE) which is the stakeholder organization for the companies producing, distributing and trading electricity in Sweden – that are pushing for a review of this de facto halt in significant hydropower

development in Sweden (SE, 2009). Swedenergy is also the initiator of a private inquiry with the instruction to propose measures to maintain the current production capacity of hydropower and render future development of hydropower possible. Other actors defending fishing and environmental interests, mainly the NGOs Riversavers, the Swedish Society for Nature Conservation and the Swedish Sport Fishing Association, are working for the continuation of the status quo and to ensure that any possible increase in hydropower production is to come from refurbishments of existing plants and not from new plants.

Most of the current Swedish hydropower facilities are old and in need of refurbishment. It is estimated that the rate of refurbishment will be in the order of 2.5 billion SEK/year in the coming decade (Elforsk, 2010). At present it therefore appears most likely that the main increase in hydropower production will come from increased efficiency through refurbishment of existing power plants. There are calculations that point towards a potential of a 5 per cent increase in electricity production from such refurbishments although there are several examples of much higher efficiency gains that could come from such refurbishments (Bernhoff *et al*., 2003). A marginal increase in production could also come from the construction of new small-scale hydropower plants although such development is contested (SSFA, 2010).

IMPLEMENTATION OF THE WFD IN SWEDEN

As a result of the passing of the WFD, five River Basin District Authorities (RBAs) were set up in Sweden in 2004. The new RBA administrative borders were set in accordance with the five main river basins in the country. The new authorities were located in connection to already existing county administrative boards. There are also advanced plans for a new national Sea and Water Agency that will take over the responsibilities relating to the sea and water from the Swedish Board of Fisheries (SBF) and the Swedish Environmental Protection Agency (SEPA). This includes overall responsibility for national coordination of the RBAs and national activities resulting from the WFD and other relevant EU directives concerning the water environment (SOU, 2010:8).

The overarching goal of the WFD is that no water body should experience a decrease in water quality and that all water bodies should achieve a good status by 2015, with the possibility of extension to 2027. A national monitoring program has been set up to classify the status of each water body according to a five-class scale. The best status that is given to a water body is "high quality" while decreasing water quality is given the status "good", "moderate", "poor" and "bad". The initial results of the monitoring program that are set up provide a baseline from which to track the effectiveness of measures to improve water quality. The status of surface water is measured in terms of biological, chemical and hydromorphological characteristics and the overall status of the water is

Main actors and agencies governing Swedish hydropower

Swedish hydropower is governed through a judicial system in which concessions are granted that specify the conditions under which operations can take place. The concessions have legal force since they are granted by environmental courts and in addition to this have no time limit.

There are five regional environmental courts in Sweden which constitute the first instance of hearing and decision regarding new and revised concessions. Their rulings may be appealed to the Environmental Court of Appeal and in the final instance to the Supreme Court after which the sentence becomes legally binding. Between 1918 and 1999 the first instance consisted of special water courts.

The main consultation bodies that can provide input and consider proposed new or revised concessions are the relevant municipalities and individuals at the local level and the relevant county administrative boards at the regional level. At the national level the main referral agencies are the Legal, Financial and Administrative Services Agency (LFASA), SEPA, and SBF. In the process of revising and granting new hydropower concessions the LFASA works to ensure that the general rules of consideration of the Environmental Code are fulfilled and represent general environmental interests in concession trials. The current or future operator of the hydropower station participates as the initiator of the proceedings for new concessions and either as the respondent or initiator in proceedings for a revision of an existing concession. Operators, municipalities, county administrative boards, the LFASA and SEPA can initiate proceedings for a review of an existing concession. There are also several stakeholder organizations that are active in the debate and governance of Swedish hydropower such as the trade organizations Swedenergy and the Confederation of Swedish Enterprises and the NGOs Riversavers, the Swedish Society for Nature Conservation and the Swedish Sport Fishing Association.

The county administrative boards are the main supervising agencies of hydropower plants and can inspect the facilities and issue injunctions and prohibitions on the operators to ensure that the concession and the Swedish Environmental Code is followed. Such injunctions and prohibitions cannot however restrict the original autonomy granted to the operator in the existing concession.

River Basin Authorities (RBAs) were created in conjunction with the implementation of the WFD in Sweden. They function as regulatory agencies and mainly have an indirect effect on the hydropower sector by applying environmental quality standards and creating programs of measures. These documents are binding only on public authorities, such as county administrative boards and municipalities, who are responsible for their implementation.

generally determined by the indicators that show the most negative value. This means that a water body with good chemical status but poor biological status will be classified as having overall poor status. At the end of 2009, the RBA produced the first set of River Basin Management Plans including programs of measures, which specifies the measures that are needed within each water basin to reach the overarching goal of good water. This management process is adaptive in that it follows a six-year cycle whereby progress is evaluated and the river basin water management plans reviewed.

The programs of measures specify a number of tasks that should be completed during the first management round by 2015. Most of them relate to more research and information that different government agencies have to carry out and provide. County administrative boards are for example required to establish a plan of measures prioritizing water bodies that are at a risk of not reaching good ecological status (GES) and assist the LFASA in investigating and setting strategies to attend to bypass barriers and other physical alterations affecting water bodies. The WFD also introduces a number of instruments designed to reduce potential conflicts with other sectors and societal goals when trying to reach GES in all waters. There is also the possibility to designate water bodies as heavily modified (HMW) or artificial, where the water quality requirement becomes "good ecological potential" (GEP) instead of "good ecological status" (GES). GEP is defined as the water quality that is achieved "after all appropriate improvement measures have been taken to improve the ecological status in the water body, without causing significant adverse effects on the environment generally or on the activity for which the modification of the water body has been made. 'Appropriate improvement measures' are understood to be measures that have a significant ecological effect" (Bothnian Sea, 2009). This designation could be given to infrastructure such as hydropower stations and harbors where the aquatic environment is already heavily modified and measures to achieve GES would have significant adverse effects on the activity for which the modification has been created or would entail a disproportionate cost.

In the initial round of river basin management in Sweden all water bodies connected to large hydropower stations with more than a 10 MW potential have been given the status HMW (Bothnian Sea, 2009). The 10 MW limit is only a rule of thumb and in relation to medium and small hydropower, with less than a 10 MW potential, the first step of the RBA is to make a more thorough inventory to investigate which water bodies adjacent to hydropower stations should be designated as HMW. This rule of thumb is based on the assessment by the SEA that the load balance potential that large hydropower stations provide to the electric grid is crucial and provides an additional value to the renewable energy produced (SEA, 2008c). The protection of load balancing potential has been deemed more critical than that of renewable energy production in general. Large-scale hydropower production has consequently been given priority for the designation as HMW since it is the largest hydropower dams – around 10 per cent of the total amount – that supply roughly 97 per cent of hydropower production (SEA, 2008c).

Although the quality requirements for GEP are less stringent than those of GES, quality-improving measures will be needed in HMW as well. The designation of HMW and the improvement measures that are needed are currently being discussed at both EU level (EI, 2009) and national level in Sweden. The general starting point of the RBA in the first management round is that most HMWs at present have moderate ecological potential which means that there are improvements that should be made to achieve GEP (Bothnian Sea, 2009). From interviews with one of the RBAs it appears that the measures that are being discussed in Sweden in relation to hydropower are to create bypass channels for fish, increase or create minimum flows of water and some measures implemented in hydropower dams are to improve the conditions for beach and river bottom vegetation. A more detailed investigation on a case-by-case basis is necessary to decide on specific and appropriate measures for each HMW. The Bothnian Sea RBA has despite this specified that they expect that restoration of water bodies will result in the construction of at least 55 new bypass channels in relation to hydropower dams and lake regulation dams in their district (Bothnian Sea, 2009).

Hydromorphological changes, among other things due to hydropower production, are specified as one of the main problems in all of the RBAs and particularly in the two most northern water districts of Sweden. The programs also specify some general costs that the implementation of the programs will incur. These costs are very rough and only an estimate on the part of the RBAs but they do give an indication of the extent of activities contemplated during the first management round. There is a spread among the different RBAs of costs of between approximately six MSEK and 18 MSEK per year for measures completely or partially related to hydropower dams, which indicates the level of activity planned in order to reach GES and GEP in the water bodies affected by hydropower production (for a complete list see appendix 2).

Environmental "quality objectives" vs "quality standards"

The **Swedish Environmental Quality Objectives** form the overarching framework for Swedish environmental policy. They are political goals that are non-binding in nature. They consist of a total of 16 environmental objectives, the majority of which are intended to be reached by 2020. These goals range from "natural acidification only", "a good built environment" to "sustainable forests". The general idea is that the environmental quality objectives are to be reached through voluntary initiatives, economic and informative instruments and only in the final instance through legislation. There is however no direct mechanism that specifies how this is to be done, nor a mentioning of the environmental quality objectives in the Swedish Environmental Code (Dalhammar 2008). The implementation of the environmental quality objectives is therefore rather unclear and incomplete. This can be seen by the fact that currently only one objective is expected to be met in the set timeframe while six will require additional efforts and nine will be very difficult or impossible to reach (EQO 2010). Objective number eight "flourishing lakes and streams" is of special relevance for hydropower. It is however only a selection of rivers and streams, roughly 700, of high conservation value, that are directly affected by the environmental quality objectives.

Figure 2: All Environmental Quality Objectives and status forecast in 2007 (EOC 2007)

Environmental quality standards are a type of legally binding policy instrument introduced by the Swedish Environmental Code of 1999. An environmental quality standard may, for example, lay down the maximum permitted concentration of a substance in air, soil or water. Since they are a binding policy instrument, there are various avenues for ensuring their implementation. New enterprises can for example be denied concessions if they contribute to the contravention of an environmental quality standard. The WFD has been implemented in Swedish law in the form of *environmental quality standards* where it is required to reach the environmental quality standard "good ecological status" or "good ecological potential" in all water bodies by 2027. The judicial significance of the WFD environmental quality standards is however unclear since the government submitted a bill that differentiates between "limit value" and "other" environmental quality standards where only "limit value" environmental standards allow for the most forceful compliance tools (Govt. bill 2009/10:184).

The water quality standards of the WFD have been implemented into Swedish legislation as "environmental quality standards". According to the present environmental code, new concessions should not be given to new enterprises that contribute to the contravention of an environmental quality standard unless compensating action is taken that increases the chances of fulfilling the norm.[1] This is referred to as the "stop rule" since it gives grounds for preventing new polluting enterprises from being established when an environmental quality norm is not realized. This implementation of the WFD has been criticized by many business organizations as overly strict and the government has responded with a new bill that specifies that the more stringent rule only applies to environmental quality standards that are "limit values" (Govt. bill, 2009/10:184). The environmental quality standards of the WFD are referred to as "other demands on the quality of the environment emanating from EU membership"[2], which means that the stricter rules do not apply to them. The judicial status of the environmental quality standards and their application is despite this still rather unclear (SEPA 2010; Kruse 2010). Partially this is due to the fact that the EU environmental quality standards appear to have different judicial strength in the WFD. In an interview with a representative from the SEPA it became clear that the chemical status objectives and the non-deterioration rule are two such environmental quality standards that come close to being limit value environmental quality standards. In the WFD text there are for example only two exemptions mentioned to the non-deterioration requirement: for reasons of overriding public interest and when new sustainable human development activities are the reason for deterioration from high to good water status.[3]

There are therefore some interesting results from the first management round of the RBAs that indicate how the implementation of the WFD will affect the Swedish hydropower sector. Hydromorphological changes, which are an effect of hydropower production, are specified as one of the main problems in all RBAs. A spending level of between six and 18 MSEK a year has been set in the various programs of measures for restoration of water bodies that have been damaged, among other things, due to hydropower production. The Bothnian Sea RBA has even specified that they expect at least 55 new bypass channels to be constructed in hydropower and lake regulation dams in the coming years. The designation of all hydropower stations of more than 10 MW potential as HMW also shows that larger hydropower stations will have the less strict quality standard GEP as their requirement while smaller hydropower stations can in many cases be expected to reach the stricter quality standard of GES. With regard to new small hydropower production facilities it is also questionable to what extent they can influence the water environment negatively without breaching the non-deterioration requirement which is a strict requirement in the WFD. There are however many issues that are still under examination by the RBA at present such as the extent of HMW in Sweden and the degree of quality improvement measures that will be required to reach GES and GEP. The status and strength of the environmental quality standards of the WFD are also unclear and could influence the implementation significantly. How and to what extent the implementation of the WFD will affect hydropower production is therefore still in many ways not settled and should unfold during the coming years.

1 Article 16:5 Swedish Environmental Code

2 Article 5:2:4 Swedish Environmental Code

3 Preamble 32 and Article 4:7 WFD

THE PRESENT SYSTEM DIRECTS FUTURE IMPLEMENTATION

The main tool for ensuring that the environmental quality standards are reached is through the program of measures that have been drawn up by the RBAs. These programs of measures are targeted at public authorities and have no direct effect on private entities and persons. Private companies and persons are affected by the programs of measures in the same way and with the same tools as before the implementation of the WFD, for example by supervision and review of concessions and general regulations (SEPA, 2010). This means that the present judicial and administrative system regulating hydropower is the primary tool with which the environmental quality standards are to be fulfilled in Sweden. A closer look at the history of hydropower and how the judicial and administrative system is constructed and functions is therefore needed to understand what the effects of the RES and WFD could be in Sweden.

The water law of 1918 can in many ways be seen as the backbone of the current Swedish judicial and administrative system regulating hydropower. In many ways it was a law that favored the rapid expansion of hydropower production in the country (Vedung and Brandel, 2001). One of the main changes it introduced was that it gave landowners owning the majority of land along a river the right to expropriate the land of the remaining landowners when constructing hydropower plants. The law also shifted the discretion of hydropower concessions from local to national level by creating special national water courts. The creation of water courts was also meant to make the process of concession treatment judicial and technical rather than political in nature. Vedung and Brandel note that during the first half of the 20th century, unlike many other major issues in Sweden, there was in essence complete agreement among the political parties regarding the necessity and desirability of hydropower expansion (2001). The water courts were therefore constructed in such a way as to be able to grant concessions for hydropower production without political involvement in the majority of cases. The judicial nature of concession treatment also means that the concessions have a binding effect that would normally require judicial proceedings to be altered.

In the 1918 water law there were few general limitations on the amount of water that could be diverted for hydropower production. It was possible to grant concessions which allowed for full appropriation of the water flow for electricity production. The main exception referred to limited sections of 58 specific rivers, referred to as "Royal Arteries" ("*Kungsådror*"), where important shipping, fishing and timber transportation activities were carried out. Up to a third of the natural water flow could be required for preservation without compensation in these cases (Strömberg, 1983). Hydropower concessions were also granted with no time limit so proceedings for a review had to be initiated either by the company in possession of the concession or one of the public authorities with the right to bring an action to the water court.

The water law of 1918 was in force in Sweden until 1983 when a new water law entered into force. The new water law introduced important changes such as general limitations on the compensation that owners of water power rights were entitled to when part of the water flow was diverted for shipping, fishing and timber transportation interests. General environmental interests were also included as a legitimate interest for which the same limitation on compensation would be applied. The general rule was that hydropower producers should accept a loss of between 5 and 20 per cent of the production value without compensation. The main limitation however came from the transitional rules that limited the uncompensated loss to 5 per cent of production value in all reviews of concessions given according to the old water law of 1918 (Strömberg, 1983). In 1999 the Swedish Environmental Code came into force which gathered together a range of existing environmental legislation. The water law was included and the water courts changed their name to environmental courts. The limitations on compensation were not changed with the passing of the Environmental Code.

When the new water law of 1983 was introduced, the vast majority of hydropower plants and dams currently in use had been constructed. Of a total of 3,727 hydropower station and dam concessions that have been considered by the water and environmental courts, 3,393 have been considered according to the 1918 law or older legislation, 261 according to the 1983 water law and 73 according to the Environmental Code. There are also a total of 78 concessions that have been reviewed in accordance with the Environmental Code (SOU, 2009:42). These figures are presented in Figure 3.

Some of the more important features of the Swedish concession system are therefore that the vast majority of concessions in place today have been granted according to the 1918 water law where full appropriation of the water flow of parts of rivers for power production was

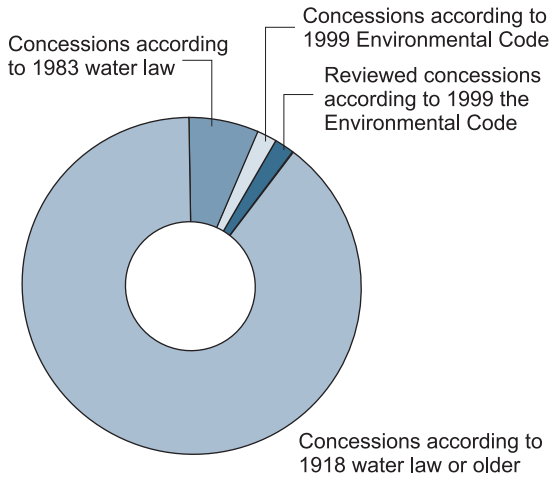

Figure 3: Status of concessions of hydropower plants and dams in Sweden in 2009
(Source SOU 2009:42 p. 95)

not uncommon. The concessions that are granted have no time limit and are binding in nature which means they need to be reviewed in an environmental court of law to be modified. With the new water law of 1983 general environmental concerns became a legitimate interest for limiting the appropriation of water flow for hydropower production. A general limit on compensation for loss of power production was also set at between 5 per cent and 20 per cent of the production value for new hydropower stations. For reviews of concessions given according to the 1918 water law the hydropower owners only need to accept a loss of a maximum of 5 per cent of the production value without compensation when their concession is up for review.

JUDICIAL CONCESSION TRIALS

Considering the binding nature of hydropower concessions in Sweden, a judicial concession trial is usually the only way to carry out any significant changes that deviate from the original concession. The claimant that initiates the proceedings is responsible for carrying out the necessary trials and investigations and has to pay the cost of the proceedings. It is normally the proprietor of the plant that has to carry out and finance any changes to the hydropower plant resulting from a change to the concession. During the last few decades there have been three main issues that have instigated judicial concession trials. Concession change trials have usually been initiated by the operators to increase dam safety and for refurbishments leading to increased efficiency and power production of existing hydropower plants. The LFASA has been the most active public authority and has, with the assistance of the SBF, mainly initiated reviews of concessions for fishing and general environmental interests.

The process of a judicial concession trial is often very complex. There are a number of issues that can complicate and protract the process. There are various dams that were constructed prior to 1918 and run according to prescription from time immemorial. It is in these cases unclear what part of the water activity is regulated or not. When a concession has been given, at times crucial information about the concession is missing since parts of the original concession documentation might have been lost. When there is a change to a hydropower station or dam, for example through refurbishment, which requires a change to the concession, there is often disagreement regarding the extent of examination that is necessary in the concession trial. The burden of evidence for the claimant can also be very high and when providing evidence of for example the biological effects of a change, there are significant uncertainties in the results that can be hard to eliminate. It can also take years before the verdict becomes legally binding, since the verdict from the Environmental Court can be appealed to the Environmental Court of Appeal and in the final instance to the Supreme Court. For the judicial concession trial, and in particular a review process, to be efficient it is therefore vital to have some sort of prior agreement between the responsible authority and operator before judicial deliberations begin (LFASA, 2005; Bothnian Sea, 2008). When there is disagreement between the initiator and the respondent, the nature of the judicial concession process opens up the possibility of a wide range of strategies that can be used to prolong the process if it is in the interest of either of the actors. Consequently, the administrative resources necessary to carry through a review to improve the water status are considerable, and it is estimated that currently 2/3 of the total resources spent on restoration projects are dedicated to administrative tasks (Bothnian Sea, 2008). One of the most protracted processes in Sweden occurred due to litigation resulting from the damage caused to fish stocks from the construction of Stornorrfors hydropower station. The litigation process lasted 45 years, between 1962 and 2007, until the parties finally agreed on appropriate compensatory measures in the form of a settlement out of court. This is an extreme example, but it is not rare for a concession process to be very complicated, resource-intensive and to require many years in cases when the appellant and defendant are in complete disagreement.

A typical hydropower judicial concession trial process

The concession process follows the same rules of procedure as a normal court case following the Court Matters Act (1996:242) and the verdict is based on the considerations laid down in the Swedish Environmental Code (1998:808), the Water Operations Ordinance (1998:1388) and the Act Containing Special Provisions concerning Water Operations (1998:812). One of the main principles that should guide rulings, according to the Environmental Code, is a cost-benefit analysis of the proposed project.

Changes to the water environment required to build and run hydropower stations – or important changes to current hydropower stations – are considered water operations that will have *significant environmental impact*. Water operations with a significant environmental impact require a judicial concession trial process in an environmental court according to the Environmental Code.

The initiator of proceedings has to provide a written application to the court with the necessary background information to be able to consider the request. In the case of new projects, an Environmental Impact Assessment (EIA), as laid down in chapter six of the Environmental Code, is required, which includes consultation with relevant authorities, organizations and stakeholders that could be affected by the change. In concession reviews there is no requirement for an EIA, but it is recommended that the consultations and documentation provided should have depth and quality similar to that of an EIA (SEPA 2007).

A public notice is made of the request and the full application documentation is sent to the relevant authorities and stakeholders for consideration. These bodies and individuals are allowed to send written replies arguing for their standpoints to the court. The initiator is allowed to reply to these standpoints after which the main hearing is scheduled. During the main hearing, the parties concerned can present and argue for their positions. If deemed unnecessary, the court can choose not to summon a main hearing and take a decision on the case based on the written documentation provided by the parties. In important and contentious cases the court can obtain a decision from the government before a verdict is given. The normal time for a complete concession process ranges between four months to several years depending upon the complexity of the case and the level of agreements between the parties concerned. The ruling can be appealed to the Environmental Court of Appeal and in the final instance to the Supreme Court after which the ruling becomes legally binding.

Apart from the passing of the Environmental code in 1999, there have been several political statements in favor of improving the biodiversity of the regulated water ways in Sweden. One of the most important is the Swedish environmental quality objective "Flourishing lakes and streams" (Environmental Objectives, 2010). In 2004 a motion was passed in parliament which states the intention to the government to prescribe that bypass channels for fish be constructed in all regulated water ways (Motion 2005). Despite this, there has been an extremely slow process of review of concessions in Sweden, which can be seen in the number of concessions that have been reviewed according to the Environmental Code between 1999 and 2009 (Figure 3). Only 78 concessions, out of a total of 3,727, were reviewed during this time. Considering that 3,393 of the concessions now in force have been granted according to the 1918 water law or older, it is unlikely that this limited activity is due to a lack of cases in which a review would be granted in light of the requirements of the Environmental Code.

When trying to understand this slow pace, one important clue is the history and setup of the Swedish concession system and the diverging interests of the actors, which often prevents the achievement of even minimum agreement prior to reviews. In practice the reviews that have occurred have usually led to a water spill that translates to five per cent production loss for bypass channels for fish and other biodiversity interests in the revised concession (SOU, 2009:42). This loss has to be accepted by the operator according to the Environmental Code and is not compensated for by the State. By entering into a review process, the hydropower owner can therefore be certain that the result will be a loss of revenue if they are in possession of a concession granting water spill that translates into less than 5 per cent of production value. In these cases, it is in the interest of operators to try to limit the amount of reviews that are initiated and when they occur, to try to slow the process down as much as possible. This issue was explained by the representative of Riversavers when referring to a failed process of reaching an agreement that included various

Overview of the current status of concessions for water operations

Knowledge of the current status of concessions for water operations in Sweden is only partial and very fragmented. Information on concession rulings is stored in paper form in the five environmental courts of Sweden. There is no common and accessible database where the information is stored - nor are there general overviews available that provide an overview of the status of the current concessions in force in Sweden.

As part of the research for the current report the SBF, LFASA and directors of the five RBAs in Sweden were contacted in order to get an overview of the amount of hydropower concessions that allow for 0 per cent water spill in Sweden. A concession that grants 0 per cent water spill gives the operator the right to channel all the water flow of the river through turbines and in many cases leaves stretches of the river completely dry as the water is diverted through tunnels that can stretch up to several kilometers.

Both the SBF and LFASA did not have the required overview to provide an answer. Three RBAs were able to give an expert judgment on the amount of concessions granting full appropriation of water in their district.

Bothnian Sea – Roughly 80 per cent of 100 of hydropower dams in the district.
Northern Baltic Sea – Roughly 10 per cent of 169 hydropower dams in the district.
Western Sea – Roughly 20 per cent of 45 large-scale hydropower dams (> 10 MW) and around 7-10 per cent of smaller hydropower dams in the district.

power stations in Ljusnan prior to reviews: "They have delayed the process for ten years by 'conducting a dialogue', so to speak. It is strategically brilliant; every year you can sit and talk in conferences without having to spill 5 per cent, but only investigate what would happen if you spilled 5 per cent you in fact earn those 5 per cent in profit". (Respondent G)

The LFASA is the public authority that initiates most of the reviews in connection with fishing and environmental interests. It has a limited budget for reviews with only 3-4 members of staff working with these issues and at present resources for initiating 5-10 review processes per year (SEPA, 2009). There are therefore only a very limited number of concessions that the LFASA can bring up for review with the current resources at their disposal. If a review is initiated without prior agreement with the operator, substantial administrative resources are in addition necessary due to the nature of the process. Due to these limitations, and as a result of their interpretation of the demands emanating from the Environmental Code, the LFASA - apart from initiating reviews – seems to be following a strategy of petitioning for an extensive examination in court when an operator initiates a concession change trial. "As soon as we need to change a concession, the LFASA appears… and with them the demand that we need to review the whole concession." (Respondent H). As laid down in chapter 25 of the Environmental Code, the initiator of a concession trial process is responsible for the costs of the process, for producing the necessary background material and usually has to pay the costs of the other involved parties. If the petition for an extensive examination is successful, the operator will, as the initiator of the process, pay the costs of the process, those of the involved parties and for producing the necessary background materials. Such a strategy could greatly increase the amount of concessions in force that have been granted according to the Environmental Code, since the financial burden, and any extra costs resulting from delays in the process, would fall on the operators.

During the last few years, petitions of this sort have been standard both for concession change trials for safety-increasing measures and extended refurbishments. In the case of safety-increasing measures, the Environmental Court and higher instances have ruled consistently against the LFASA, arguing that a limited examination is sufficient for safety improvements.[4] When it comes to concession change trials for refurbishments, there are no clear and final verdicts that specify at what level of refurbishment a concession change requires a limited or extensive examination of the concession. Because of this, there are examples where measures to increase the productivity of hydropower stations have not been implemented in order to avoid the risk of an extensive examination: "We initiated some measures for increased dam security; we could also have raised the dam level 0.2 m and have raised the productivity a fair bit, but then we received these petitions [of extensive examination] and did not follow it through. We do not want this process" (Respondent H).

4 Ruling of the Environmental Court of Appeal of 7 May 2009 in case M 5367-08

The judicial battle of the extent of examination in concession change trials

During the last few years, and continuing up to the present, one of the most important judicial battles taking place between operators and authorities in concession trials has been the question of establishing common practice regarding the extent of examination when operators request changes to their original concession. The main interest of operators in changing the original concession is to implement safety-increasing measures and extended refurbishments of the plants. The initiator of a judicial concession trial has to pay the costs of all the involved parties, the court process and the necessary background material to the court.

If the changes are examined and approved through a **limited examination**, the original concession stays intact and the court only examines the effects and legality of the proposed changes to the hydropower station.

If the changes require **an extensive examination**, the water operations in question is evaluated and changed in light of the current demands emanating from the Environmental Code and other legislation that did not exist at the time of the original concession process. This usually results in requirements for minimum levels of flow and other measures to ensure that the operations are in line with modern environmental and safety requirements.

The extent of examination that is required is of strategic importance since it determines the extent of biodiversity improvement measures that will result and determines whether operators should bear the cost of a concession review or not. Practice would appear to have been set with the ruling of the Environmental Court of Appeal in 2009 with the effect that a limited examination is sufficient to bring about safety improvement measures. Regarding extended refurbishments to increase the production of hydropower plants, there is no clear practice as yet, although there are several cases currently in court dealing with this issue.

Generally speaking, it is not in the interest of the operator to initiate a judicial concession trial if the administrative costs of the process, the costs of building and maintaining the necessary installations and the water diversion for biodiversity run the risk of outweighing the additional efficiency gains that an extended refurbishment – which would require a change to the concession – provides. As a result of this risk, there seem to be cases where the operators limit the extent of refurbishment that is initiated in order to stay within the granted concession, which often means changing the turbines in the existing power stations. By doing this the full potential of efficiency gain from refurbishing a hydropower plant is not always reached. "If we put new equipment into an old power station, then we might get 5 per cent more production…if, on the other hand, we use a different technique, like constructing new waterways, maybe using more of the drop, then we can often get up to 20 per cent more production" (Respondent D)

Balancing biodiversity and renewable energy production objectives is often delicate and site-specific for the various hydropower stations. In theory, the Swedish concession system based on the decisions of environmental courts could be a good way to balance the objectives and implement the WFD and RES in the coming years. In practice, as we have seen, the legacy and construction of the concession system is such that the operators of hydropower plants often have an inherent and intrinsic interest in limiting the amount of reviews that are carried out. Due to the many unclear aspects of the present concessions and the judicial character of the process, there are ample possibilities to protract the process and limit the amount of concession reviews. At the same time the strategy of the LFASA to constantly push for an extensive examination of the water operations when an operator seeks a concession change trial also means that the full potential of efficiency gains that can be achieved through refurbishments is not always achieved. The actions of operators and regulators seem to have led to a partial breakdown in trust and cooperation which means that there are very few hydropower concessions that can be taken to the environmental court with at least minimal agreement between the parties. Comments from both sides illustrate this. A representative from the LFASA, during a presentation, responded to the question of whether preliminary voluntary agreements could be a way forward in concession trials: "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 interviews, at a different time, the hydropower manager of the company concerned also had strong feelings on the subject "My opinion is that what the LFASA is

doing…appears to be some sort of vendetta against the energy companies in cooperation with the Swedish sport fishing association" (Respondent D).

The Swedish concession system has an important task ahead, since almost 90 per cent of all concessions related to hydropower production in force today, 3,393 concessions, have been granted according to the 1918 water law or earlier. It can be suspected that the level of consideration given to the aquatic environment in many of these concessions is not sufficient to reach the environmental quality standards GES and GEP according to the WFD. It is likely that changes will be necessary to concessions in force today in many cases. The current concession system in Sweden with concessions that have legal force signifies that a judicial concession trial is necessary for any significant changes to a hydropower concession. A judicial trial process takes between four months and several years depending upon the complexity of the case and the level of agreement between the concerned parties. For the environmental courts in Sweden to have the slightest chance of addressing more than only a very limited part of the concessions in force up until 2027 – the final deadline of the WFD – a high level of agreement between the parties for quick trials is necessary. As we have seen, this is not the case, and at present the system is constructed in such a way that the operators have an inherent interest in limiting and protracting the concession review process since a reviewed concession usually leads to energy and revenue losses for the operator. The main public authority representing environmental issues at the same time has an intrinsic interest in pushing for an extensive examination every time an operator initiates a concession change trial process. The actions and strategies of both operators and public authorities have led to a situation of high distrust and conflict between them, which greatly decreases the effectiveness of the review process and makes it very unlikely that any substantial changes that could be required from the WFD will be implemented in Sweden at a sufficient pace. It also appears that the functioning of the system leads to refurbishments of hydropower stations that do not fulfill the full potential of possible efficiency gains, which at present limits the implementation of the RES as well.

DEGREE OF POLICY COHERENCE

Policy coherence is a relatively new focus of research which centers on the outputs, implementation and outcomes of different policies and the way they interact. When analyzing the policy coherence of environmental policy, it could be viewed as similar to the relatively well studied field of environmental policy integration. There are, however, some differences. Environmental policy integration focuses mainly on the integration of environmental protection into policies and activities with a view to promoting sustainable development. This should be carried out by inserting environmental requirements broadly into policy-making and policy implementation.[5] The focus is thus mainly on the process of policy-making, while policy coherence analyzes the measures used to implement various sets of policy objectives and their outcomes. A useful definition of the concept policy coherence is "the property of two or more sets of policy objectives, instruments and implementation practices being free from contradiction, having logical order, clarity and intelligibility" (Nilsson *et al*., 2010).

In interviews with the respondents, the perceived conflict between the objectives of the WFD and RES was often mentioned: "There is also a conflict between two environmental issues, the local biodiversity and [global] climate issues" (Respondent E). The main issue in the debate is that water used for improving biodiversity in the water ways, one of the objectives of the WFD, means losing water for renewable energy production, which conflicts with the objectives of the RES. As we have seen, the main policy instrument to fulfill the Swedish commitments in the RES is the renewable electricity certificate scheme where the goal is to produce an additional 25 TWh of renewable energy by 2020 compared to 2002. This expansion is meant to come primarily from combined heat and power production together with biofuels and wind power development and to some extent from increased efficiency in existing renewable energy power plants. A national planning frame of 30 TWh has also been set for wind power development for 2020. There are two important implications that come from these production goals.

The first relates to the balance between electricity production and consumption in Sweden. The consumption of electricity in Sweden has been relatively stable during the last three years and since 1987 it has, on average, only increased by 0.3 per cent each year (This is illustrated in Figure 4). There are no signs that the consumption pattern of electricity will change significantly by 2020. There are, however, forecasts of significant increases in electricity production during the same time due to the addition of new renewable production capacity and increased efficiency in the existing power plants. In the SEA's long-term prognosis it is calculated that Sweden will have a surplus in electricity production of 23 TWh in 2020 (SEA, 2008b). This is when we take into account an expansion of renewable energy production far below the target of 25 TWh. Wind power production is for example only estimated to increase by six TWh between 2002 and 2020. Sweden is therefore heading towards a significant energy surplus created almost exclusively from renewable sources. If realized there are many possible ways that this surplus could be used. The electricity surplus could be exported to other countries, provide the necessary capacity to dismantle nuclear power plants and/or to improve the biodiversity of our streams. This is ultimately a political decision, but the possible existence of surplus electricity production in the coming decade shows that in terms of total electricity production and consumption in Sweden, there is a limited overall contradiction between the implementation of the WFD and RES.

The second implication relates to plans for introducing relatively large quantities of wind power production into the electric grid. One of the main problems with wind power is that it is a variable energy source, which means that it cannot be regulated to produce in accordance with the fluctuating demand for electricity. There is therefore a need for additional power sources which can be regulated to balance the power grid. Storage hydropower is one of the most efficient regulated power sources since it both stores energy and can be turned on and off at very short notice. The high targets of wind power production set in Sweden have created a significant discussion relating to the ability of the electric grid, and electricity production in general, to accommodate production of this new variable power source. The SNG, the state utility responsible for the national electric grid, was in 2008 commissioned to investigate the effects of a large-scale introduction of wind power production into the Swedish electric grid (SNG, 2008). One of the main conclusions was the calculation that an expansion of wind power of 10 TWh would require an additional 1,400-1,800 MW of regulating capacity, while an expansion of 30

5 Definition taken from article 6 of the EC treaty

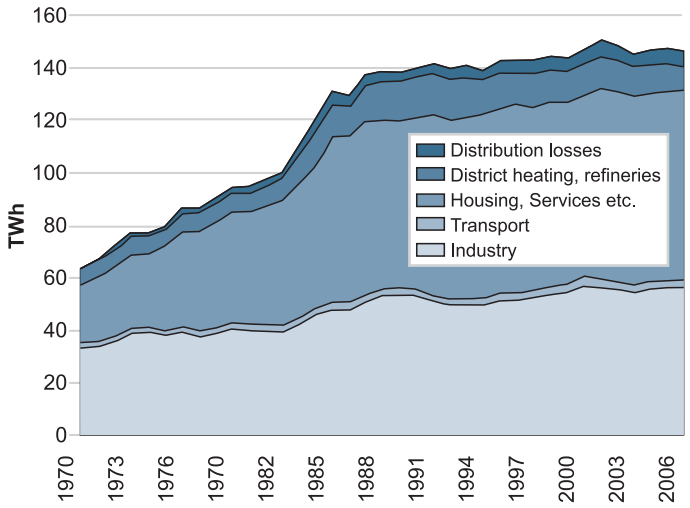

Figure 4: Sweden's electricity consumption in TWh divided into sectors for the years 1970-2006
(Source: SEA 2008a)

TWh would require an additional 4,300-5,300 MW of regulating capacity. This has been interpreted by some actors to mean that new regulated power sources would be needed for a large-scale introduction of wind power or, at a minimum level, no regulating capacity may be lost in Sweden to enable the large-scale introduction of wind power planned for the fulfillment of the RES (SE, 2010; SEA, 2008c). If this were true, there would be an implicit contradiction between the objectives of the WFD and RES since the necessary expansion of wind power to fulfill the RES objectives requires the preservation of the current levels of hydropower production capacity, which would not leave any scope for the environmental improvements required in the WFD since they could lead to loss of energy production and balancing capacity for the electric grid.

However, there are calculations that show that the estimated amount of balancing capacity necessary according to the SNG is overestimated (Holttinen *et al*., 2009) and the more important conclusion is that a need for additional balancing capacity due to the inclusion of wind power is not the same as a need for an expansion of dispatchable energy production capacity. The reason for this is that additional production from wind power means that reserve capacity opens up in the existing energy production facilities, in the Swedish case to a large extent from hydropower. During periods of high wind power production, hydropower stations that were previously needed for base load production in the electric grid will automatically be turned off and work as reserve and balancing power in cases where wind power production decreases. This means that adding wind power creates reserve power capacity in the existing energy system (Söder, 2010). A recent study has also calculated the effect of adding 30TWh of wind power production to a part of the electric grid and shows that the existing hydropower stations in northern Sweden, providing 80 per cent of the hydropower production, have sufficient regulating capacity to balance such an expansion (Amelin *et al*., 2009).

The Swedish power grid is connected to a larger Nordic electric grid – with plans to increase transfer capacity in the coming decades – where balancing services can be traded between countries. This means that Norwegian hydropower can be used to balance the grid in Sweden or that Danish grid operators could purchase Swedish hydropower electricity to balance their grid fluctuations. There are therefore many different factors that interplay both nationally and internationally and influence the level of balance capacity that would be desirable in Sweden. More research is necessary to more fully understand the balance capacity necessary to cater for the planned changes in the Nordic electric grid such as the construction of nuclear plants in Finland and the large-scale integration of wind power in Sweden. On a national scale, however, the Swedish hydropower capacity to balance the 30 TWh wind power production goal does not appear to be a limitation, nor would it create a situation of structural deficit in grid balance capacity nationally. Therefore, there do not seem to be any serious contradictions between the objectives of the RES and WFD in Sweden and the two policies have a high degree of coherence overall.

In the RES there are articles dealing with statistical transfers of renewable energy and joint projects between member states dealing with the fulfillment of the requirements in the RES . In the government bill on the implementation of the RES, there is also an argument that the Swedish state should look into the possibilities of using these mechanisms to aid other EU countries in achieving their RES targets (Govt. bill 2009/10:128). The production and export of renewable energy from Sweden could in theory reduce CO_2 emissions in other EU countries with more carbon-intense electricity production. Since climate change is a global problem, this would be in the interest of Sweden as it does not matter where in the world CO_2 emissions are released. This issue also surfaced in one way or another during the interviews where it was mentioned that the Swedish Environmental Code and politicians put much weight on local conservation issues while not giving enough importance to global climate problems: "Local politicians do not take responsibility for global issues in the same way [as local issues] - that is a problem" (Respondent D). In an EU perspective, some contradiction could therefore exist between the RES and WFD since renewable energy production loss in Sweden in theory could lead to increased CO_2 emissions in other EU countries, as they would not be able to import as much renewable energy from Sweden. Considering climate change to be a global environmental problem that is more urgent than local biodiversity loss, it could be argued that Sweden should use all its renewable energy resources to the maximum and export the surplus energy – and provide balancing services to the electric grid of neighboring countries – to limit climate change as far as possible. With an increasing interconnection of power grids and the Nord Pool electricity exchange, it could be envisaged that the possibilities of exporting renewable electricity and balancing services will increase in the coming decades.

The biodiversity loss that is occurring simultaneously on a global scale is however adding up to a significant global environmental problem in the same way as local CO_2 emissions are causing global climate change (Rockstrom *et al*. 2009; Reid *et al*. 2005; SBD 2010). During the global Millennium Ecosystem Assessment, researchers found evidence that 60 per cent of studied ecosystem services globally are being degraded or used unsustainably due to ecosystem and biodiversity degradation (Reid *et al*., 2005). We are also at present reaching extinction rates of species that are one thousand times higher than the average historic rates, creating significant risks for human well-being and monetary loss (TEEB, 2010). Habitat destruction and fragmentation is one of the major drivers of this biodiversity loss, which is precisely one of the main effects of hydropower production. The global biodiversity outlook argues that biodiversity loss and climate change are twin challenges that must be addressed with equal priority and in close coordination (SBD, 2010). There is even research that suggests that biodiversity loss at present is occurring at a rate that is even more alarming than the pace of climate change (Rockstrom *et al*., 2009). We are therefore in essence dealing with two important global environmental problems, which means that reduction of CO_2 emissions without regard to biodiversity loss does not appear to be a viable alternative.

Overall there therefore seem to be few serious contradictions between the implementation of the WFD and the RES in Sweden. In relation to new small-scale hydropower production, there are however some contradictory signals. The certificate system, which is part of the implementation of the RES, provides encouragement for new small-scale hydropower developments since all stations with a production capacity of less than 1.5 MW receive support from the certificate system. In a recent review by the sport fishing association, a number of new and planned hydropower projects in Sweden were identified (SSFA, 2010). Most of these projects are hydropower stations in existing dams and some completely new projects. It could be expected that some water flow into existing small hydropower dams would be required to reach good ecological status and that the creation of completely new hydropower dams could be restricted due to the non-deterioration requirement in the WFD. It is therefore questionable to what extent the policies are coordinated in this regard since part of the RES implementation fuels an expansion of small hydropower plants which could be hard to combine with the requirements of the WFD.

POLICY IMPLICATIONS AND SUGGESTIONS

In interviews with both operators and authorities there was often agreement that it would be desirable to work with a concession system that allowed for a balance between measures for biodiversity in some rivers with a high environmental potential while being able to increase the production of hydropower energy in other rivers for example by means of more extended refurbishments of existing plants. This often common desire for a smoothly functioning and effective concession system capable of making balanced case-to-case decisions within a broader drainage basin and national context is far from the way the Swedish concession system works at present. Part of the reason for this is that there is no comprehensive overview of the current status and extent of water works and hydropower concessions in Sweden. One of the main tasks of the RBAs is to deal with this lack of coherent information at a national scale so it is likely that knowledge of the hydropower sector and its current concessions will improve within the following years. A more significant barrier to an effective and timely implementation and balancing of the objectives in WFD and RES is the set-up and functioning of the Swedish concession system. Operators normally lose energy production and revenue from a review of their concession. This means that there is an inherent interest on the part of the operators to limit the extent of concession reviews since each additional year with the old concession means an additional year with higher revenues. A review initiated for general environmental and fishing interests is therefore often initiated without prior agreement. This means that the judicial review process is usually slow and protracted. At the same time, the strategy adopted by the LFASA to push for a an extensive examination when an operator initiates a concession change trial for hydropower refurbishments has also led to extended judicial processes concerning how comprehensive the concession trial should be when a hydropower station is refurbished. There are examples of operators limiting the extent of refurbishment, and thereby limiting the amount of increased efficiency that is gained from the refurbishment, in order to stay within the existing concession and avoid the risk of a judicial concession trial.

Considering the way the current system functions and the restraints and interests of the concerned actors, these actions and strategies are logical but lead to a breakdown of trust and cooperation between the actors and decrease the efficiency of the current concession system. Important resources are invested in complex and prolonged judicial processes with limited positive results. With its current performance the concessions trial system is working at a speed that is insufficient for the implementation of the WFD – in cases where any substantial changes to the Swedish hydropower stations are required – and in addition it limits the share of hydropower in the implementation of the RES. A personal reflection of a representative of an RBA on the slow process of concession reviews is that a general regulation breaking through the legal force of the existing concessions would most likely be necessary to reach the requirements of the WFD within the set time limit. Such regulations could contain a minimum level of flow and could possibly include bypass channels as a standard with the possibility of exemption from this requirement in special cases. A general rule of a 5 per cent flow, for example, that should be conserved for biodiversity, would in some cases not be sufficient to improve the biodiversity of the river, and in other cases less flow could be sufficient to reach critical volumes of water for biological processes and to reach GES or GEP of the water body concerned. A general regulation would therefore not always be the best way of reaching a reasonable balance between biodiversity and renewable energy interests in the hydropower sector.

It is however possible to remove the most significant barrier identified for the effective functioning of the current concession trial system. This can be done by changing the incentives of the involved actors to improve their cooperation in the review process. This would be achieved by creating a general environmental compensation scheme from which the necessary resources would be taken to fully compensate the operator concerned for changes emanating from a reviewed concession. Operators would in this case not risk losing revenue from an updated concession and would not have an incentive to protract the judicial process nor limit the amount of concession reviews that are carried out. The review process would with such a change be able to proceed much more efficiently and balance biodiversity and renewable electricity production objectives on a case-to-case basis. The available resources created by the general compensation scheme could also be used much more flexibly based on where the greatest biodiversity gains could be achieved. The size of such a scheme would, of course, be a political decision, but could have as a reference point the 5 per cent of the production value that operators are required to bear without compensation in a review process according to the Environmental Code. With such a change the

current system would be able to take a more holistic approach since agreements between operators and authorities, covering several hydropower stations in a river, prior to actual concession reviews would be much more likely. So far this has only happened in one case, Harmangersån, and was attempted but failed in Ljusnan. This would greatly improve the possibilities of working on a river basin scale and increase the effectiveness of the review process.

This possibility has been discussed in the Swedish Government Official Report "Water Activities" the conclusion of which was that they could not propose such a change since a more effective concession trial system would lead to hydropower production losses due to increased reviews in the interests of biodiversity. This would not be in accordance with the initial guidelines of the inquiry that focused on measures that would promote a high hydropower production capacity (SOU, 2009:42). A relative, or even actual, increase in hydropower production could however be a possible result of such a change. With more efficient functioning of the concession system – and with the operators fully compensated for any production losses for biodiversity interests with updated concessions – operators would be more inclined to realize extended refurbishments, requiring changes to the concessions, which would yield higher efficiency gains in the refurbished hydropower plants and increased renewable electricity production. An significant part of the energy loss that results from diverting water for biodiversity requirements to achieve good ecological potential 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 at a significantly lower level than what could be expected from the water spill necessary for the improvement of the ecological status and potential of the Swedish water bodies. As we have seen, there are calculations of a 5 per cent potential increase in production from basic refurbishments – such as replacing existing turbines and generators – while extended refurbishments, in which the water intake capacity of the station and drop is increased, could lead to even higher efficiency gains. It is for example projected that the refurbishment of Blankaström, Knislinge, and Rundbacken will lead to electricity production increases of 50 per cent, 75 per cent and 114 per cent respectively (E.ON 2011). There is therefore an important potential for win-win projects where the increased efficiency of the refurbished hydropower plants would provide scope for both biodiversity improvements and increased energy production. In Norway there are examples of such win-win projects that have been successfully carried out (Thaulow, *et al*. 2008). The creation of a common environmental compensation scheme would greatly increase the possibilities of the present system to implement the objectives of the WFD in time and ensure that the full potential for the hydropower sector to contribute to the fulfillment of the RES through extended refurbishment of its current plants is realized. The overall effect could even be an increase in both renewable electricity production from hydropower and an improved aquatic environment.

There is also an additional source of finance possible for the additional costs that the operators have to bear from the review of concessions which comes from renewable electricity certificates. The overarching goal of the renewable electricity certificate is to "establish a more ecologically sustainable energy system in Sweden" (SEA, 2009a). At present this seems to focus solely on reducing CO_2 emissions but with only slight changes it could also work in favor of the biodiversity conservation dimension required for an ecologically sustainable energy system. The regulations from the Swedish Energy Agency (STEMFS, 2009:3) set out the conditions that hydropower plants have to fulfill in order to be granted certificates. "New plants" are entitled to certificate assignment for their full production and are defined as new solely on the basis of changes to the physical structure and production equipment of the power plant. There have been reports of operators tearing down existing hydropower plants and building new ones in order to receive certificates for the whole electricity production and thereby receiving up to three times the initial investment in renewable certificate subsidies (Uppdrag Granskning 2010). There are signs that there will be a change to the regulations to avoid this type of situation in the future (SEA 2010). These "new plants" are however working with old concessions and the same applies to many smaller production units of up to 1.5 MW that are also automatically entitled to renewable electricity certificates for full production. In both these cases a basic requirement could be that the hydropower plant needs to possess a reviewed concession according to the Environmental Code and WFD requirements to be entitled to support from the renewable electricity certificates scheme. Such a modification would increase the coordination between the WFD and RES in relation to small hydropower production facilities identified earlier and work towards the fulfillment of the twin environmental objectives of CO_2 reduction and biodiversity conservation necessary for a more ecologically sustainable energy system.

CONCLUSIONS

Since 2001, with the passing of the RES-E and its successor the RES in 2009, Sweden has launched important policy instruments to encourage the expansion of renewable energy production in Sweden. The introduction of the renewable electricity certificate system is the clearest example of this policy and has been instrumental in the expansion of renewable energy production in Sweden of 8.5 TWh between 2003 and 2008. Due to this successful expansion, the government goal of 25 TWh additional renewable energy production by 2020, compared to 2002, does seem to be within reach. The main part of this expansion has taken place – and the rest is expected to take place – through combined heat and power production and wind power. Hydropower is not identified as an important source of growth for renewable energy production since the increases are mainly envisaged to originate from increased efficiency of current hydropower plants.

The implementation of the WFD is underway in Sweden and the River Basin District Authorities have started working on identifying the necessary changes in order to achieve GES and GEP in all identified Swedish water bodies. It appears that adjustments will be required in hydropower stations and dams in order to improve the hydromorphological status of the rivers affected by hydropower production. The extent of water quality improvement necessary is however still rather unclear since the final designation of HMW and the requirements for reaching GES and GEP are not established. The judicial strength of the environmental quality standards established from the implementation of the WFD will also have to be tested before a better understanding of their impact on hydropower production can be discerned. Either way, the implementation of the WFD in Sweden creates few changes to the administrative and judicial system governing hydropower at present. The programs of measures created by the RBAs have no direct effect on operators but are intended to be implemented by public authorities using the same tools that existed prior to the implementation of the WFD. The main tools available to the public authorities are general regulations and supervision and review of concessions.

In many cases the required way of implementing the changes necessary to achieve GES and GEP will most likely be through concession reviews since general regulations, at present, are not allowed to infringe on the rights granted the operator in the original concession. Many concessions in force in Sweden also grant ample rights to the operator to use the water flow, allowing for up to full appropriation of the water flow of the river for energy production. In these cases supervision of the given concession will presumably not be sufficient to reach GES or GEP. The process of granting and reviewing concessions is very centralized and judicial with a process that is conducted according to the Environmental Code and in one of five regional environmental courts. Concerned authorities and actors from local to national level intervene in the process principally by considering the proposed changes and submitting their opinions to the Environmental Court, which pronounces the final verdict.

The complexities of the judicial concession trial system and often incomplete information and overview regarding the current status of concessions mean that for the process to function effectively it is vital to have some sort of agreement between operator and supervising authority prior to judicial deliberations. This is usually not the case since a review of a concession usually means loss of energy and revenue for the operator compared to present conditions. Operators therefore normally have an intrinsic interest in limiting the amount of concessions that are reviewed and prolonging the process of reviews when it is initiated for biodiversity and fishing interests. One of the clearest indications of the slow functioning of the concession review system is that only just over 2 per cent of all hydropower concessions were reviewed according to the Environmental Code between 1999 and 2009. This is despite the fact that 89 per cent of all hydropower station and dam concessions now in force have been granted according to the Swedish 1918 water law or older legislation where, in a number of cases, a review would most likely be granted today. With the current functioning and speed of the concession review process, necessary changes to hydropower concessions to reach good ecological status and potential will only have been implemented in a fraction of all the hydropower stations and adjacent water bodies in Sweden by 2027, the final deadline for achieving the objectives in the WFD.

There are also clear signs that the full potential of hydropower of fulfilling the RES is not always reached from refurbishments of existing hydropower stations. The main reason for this is that extended refurbishments – which would lead to higher efficiency gains – require a judicial concession trial. Operators filing for a concession change trial risk having to embark on an extensive examination of its water operations due to the LFASA's strategy of always pushing for a full

examination in concession change trails. The LFASA has adopted this strategy due to their interpretation of the requirements emanating from the Environmental Code and to maximize the amount of concessions in force that have been granted according to the Environmental Code. However, it also has the effect of making operators try to make changes that stay within the current concessions since they risk higher costs for biodiversity restoration with an updated concession than what is gained from the added efficiency of an extended refurbishment.

By changing the incentives of the actors involved in the concession system it would be possible to ensure a more effective fulfillment and implementation of the RES and WFD in the hydropower sector. This could be done by creating a general environmental compensation scheme from which resources would be taken to finance energy and revenue loss for water improvement measures from specific concession reviews. This scheme could consist of an established part of the production value from hydropower that all operators are required to contribute. With this change the main incentive to protract the review process – the risk of revenue loss for operators from concession reviews – would be eliminated and the review process would be able to proceed more effectively with implementing and coordinating both the WFD and RES objectives in Sweden. There is even the potential for win-win projects where the increased efficiency of refurbished hydropower plants would create scope for both biodiversity gains and increased energy production. The renewable electricity certificates could also work as an incentive and resource for necessary changes to fulfill the WFD requirements if one of the basic obligations for a hydropower plant to receive support would be to possess a reviewed concession according to the Environmental Code.

Measures to increase the renewable energy production and biodiversity conservation and restoration often appear to be in conflict since the flowing water of a river cannot be used for both purposes at the same time. An effective and smoothly functioning concession review system that manages to implement the WFD objectives could, for this reason, potentially make it more difficult for renewable energy production to expand to the extent required in the RES. In the case of Sweden, a closer look, however, shows that the two policies are surprisingly coherent. The main reason for this is that hydropower is only expected to contribute marginally to the fulfillment of the RES, mainly through increased efficiency of existing plants that are refurbished. The main bulk of expansion of renewable electricity production in Sweden is planned to come from combined heat and power production with biofuels and wind power. Even concerns regarding the inclusion of large amounts of variable wind power into the Swedish electrical system also appear to be overstated. The significant expansion of renewable energy planned also means that Sweden is projected to face a surplus in production of 23 TWh of electricity by 2020, which among other things could be used to improve the water environment. In the debate it is often argued that the projected surplus of renewable energy – and balancing potential of hydropower production – should be used as far as possible for export and to decrease CO_2-emitting electricity production in neighboring countries. Mitigating the global environmental problem of climate change should, according to this argument, be given higher priority than that given to what is perceived as local biodiversity issues. However, international research indicates that global biodiversity loss, to a large extent due to habitat destruction and fragmentation, is turning into an environmental crisis that is just as important, urgent and global as climate change, which leaves us with little option but to tackle the two problems simultaneously.

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APPENDIX 1: INTERVIEW GUIDE

Interviews of roughly one hour were conducted with a total of ten interviewees with insight into the implementation of the RES and WFD and the judicial and administrative system regulating hydropower production in Sweden. The interviews were conducted between the 6 March and 27 May 2010. The interviewees were from the Bothnian Sea RBA, E.ON, SEA, Fortum, SEPA, Statkraft, Vattenfall and Riversavers.

An interview was requested but not granted with the LFASA. The author did however have the possibility to assist with a presentation given by the LFASA entitled "Review of water operations" on 15 April 2010, which was directly related to the issues investigated.

Since the questions were directed to different authorities with different responsibilities, the questions were slightly modified to suit the interviewees. There was however an overall interview guide that was emailed to the participants prior to the interview.

- What are the most important areas, in your opinion, where the implementation of the RES and WFD could influence each other negatively or positively?
- What are or could be the most important effects of the implementation of the WFD in relation to hydropower?
- What role do you see hydropower having in the implementation of the RES in Sweden?
- What avenues exist in relation to the current judicial and administrative system for the regulation of hydropower to:
  - Implement programs of measures from the RBA to improve water quality in relation to the hydropower stations?
  - Implement measures to improve the efficiency of current hydropower stations?
  - Is the system suited for its purpose and how could if from your point of view be improved?

There was also additional communication by email and phone regarding specific questions with a representative from the SBF, a representative of an Environmental Court and the directors of four RBAs.

APPENDIX 2: SPENDING FOR IMPROVED HYDROMORPHOLOGY

Specified costs for measures to improve the hydromorphology of the water bodies of the five River Basin District Authorities of Sweden as specified in the program of measures.

A direct comparison is not possible since the different RBAs have presented the costs in different ways and it is at times unclear what is included in the terms. Costs that are related to hydropower production have been included and the figures give an indication of the extent of improvements contemplated.

Bothnian Bay program of measures (p. 78)	**Thousand SEK/year**	**Thousand SEK total**
Attend to bypass barriers, unspecified	1,857	32,118
Build bypass channels for fish	58	1,000
Build smolt diverter	5,783	10,000
Reviews of concessions	2,417	14,500
Bothnian Sea program of measures (p. 80)		
Measures in relation to dams	7,950	137,500
Review of concessions	5,500	27,500
Northern Baltic Sea program of measures (p. 78)		
Dams that are now bypass barriers	15,000	Not specified
Increased minimum flow	1,000	Not specified
Southern Baltic Sea program of measures (p. 93)		
Measures for bypass barriers,		
Minimum flow energy sector	8,200 - 19,200	Not specified
Reviews of concessions	4,300	Not specified
Western Sea program of measures (p. 86)		
Bypass channels		
Attend to culverts		
Demolition of dam	5,740	Not specified
Minimum flow		
Changed short-time water regulation	780	Not specified

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