



## Fishfriendly Innovative Technologies for Hydropower



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### Deliverable 5.1 Review of policy requirements and financing instruments

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## Executive Summary

This report has been prepared as part of work package 5 (WP5) of the FIThydro project, in specific Task 5.1 which aims at investigating the regulatory landscape influencing actions relevant to environmental improvements in the context of planning and operating hydropower plants. Emphasis is given to the requirements of the EU Water Framework Directive (WFD), nature protection policies and policies on renewable energy and climate change adaptation, thereby outlining opportunities, barriers and challenges in reaching multiple environmental objectives.

In addition to reviewing the regulatory landscape, this report also looks at the use of financing instruments especially in the countries where FIThydro test sites are located. These instruments are considered essential in providing the necessary support to promote and sustain ecologically compatible hydropower production.

### European policies

Several EU policies set ecological/environmental requirements on hydropower plants. Examples are EU policy requirements for environmental impact assessment as well as nature protection requirements of the Habitats Directive. Additionally, the further use and development of hydropower should consider the environmental objectives of the WFD, which aims at the achievement of good ecological status (GES) in European waters. Especially the hydromorphology and fish fauna of water stretches affected by hydropower are adversely impacted. In order to reconcile climate protection, water protection and nature protection objectives, hydropower should be generated in such a manner as to maintain the ecological functions of the affected water stretches.

### National legislation

The review of national policies concentrated on eight European countries in the four regions (Scandinavia, Alpine, Iberian peninsula and France/Belgium) where FIThydro test sites are located. These eight countries are also characterised by an important hydropower sector within these four regions. The review of national legislation focused on legislation which is relevant to ecological improvements in water ecosystems (with repercussions in hydropower production) to renewable energy production.

Important recent amendments to the key legislation have been highlighted because of their relevance to the operation of existing HPP or the authorisation of new HPP.

### Strategic planning instruments

The majority of the reviewed countries have strategic planning instruments in place for new hydropower use and development. These strategic planning instruments are developed mostly for the national and regional level. They are part of or related to other planning processes, especially hydropower sector planning (AT, CH, DE, FR, NO), national renewable energy action plans (ES, FR, NO) or river basin management planning (NO, AT, FR, ES).

The kind of strategic planning instruments identified include the formulation of legal requirements on where development of hydropower is allowed or not, national/regional master plans or strategies to guide hydropower development, decision support systems to guide decision-making (e.g. criteria catalogues for hydropower development) as well as studies on the potential for hydropower.

Although these strategic planning instruments are not related to simplification of authorisation processes for HPP, they can give a signal to operators about hydropower projects which are more likely to be rejected or accepted in the authorisation procedure (at specific sites).

In addition, most countries also have strategic planning instruments for restoring continuity. These take the form of lists of water courses where it is necessary to ensure migration of fish and sediment transport (FR), national strategies for river restoration (ES), prioritisation of the revision of hydropower concessions with restoration of continuity as a key measure considered (NO), connectivity studies and strategies delineating migratory routes (DE).

### **Environmental requirements in the context of authorising hydropower plants**

Prior to the strengthening of environmental legislation in the second half of the 20th century, many countries offered unlimited concessions (AT, DE, SE) or particularly long concessions to HPP (up to 99 years in ES). However, based on recent changes in environmental legislation and social pressure, permit duration for HPP has been in general reduced. Still, there remains a large number of unlimited permits on old HPP (e.g. in SE, up to 90% of hydropower concessions active today) which are complex to revise due to the administrative difficulty of doing so.

Criteria defining the duration of permits usually include the size of HPP, the specific situation especially in terms of hydrology, flow and associated water uses (e.g. water supply) and whether the HPP was built before or after the passing of recent legislation which changed conditions for permit duration.

Time-limited concessions are longer for large HPP (e.g. 50-90 years) and shorter for small HPP (e.g. 15-35 years). The duration of concessions aims at recovering costs of the investment.

Furthermore, in most of the reviewed countries (NO, AT, DE, FR, ES, PT), the duration of concessions generally differs between new and existing HPP, usually due to the changing of legislation in recent decades. In specific, the WFD and revisions of national policy related to the WFD have been strong drivers for modifying authorisation procedures for new HPP as well as for revising permits of existing hydropower. According to this review, authorisations for existing hydropower are being adapted or are expected to be adapted to meet the requirements of the WFD in most of the eight countries examined.

In case the permit of an operating HPP runs out, in all reviewed countries, the same conditions as for new authorisations apply in the process of permit renewal (except for SE where permits are indefinite). This means that mitigation measures may be required for existing HPP, even where none were required before.

#### *Mitigation measure requirements for HPP*

The type of mitigation measures required for new and existing HPP have been reviewed, focusing on the following key domains of environmental improvements at HPP: upstream/downstream fish migration, flow conditions, hydropeaking, gravel transport, habitat enhancement, as well as fish stocking provisions. The report distinguishes between mitigation requirements which are based on legislation, requirements which are based on a recommendation (e.g. a guideline or technical standard), requirements which are defined in individual cases or situations where there is no requirement in place for a certain type of mitigation.

Requirements for mitigation of the impacts of disrupted upstream fish migration and modified flow conditions are the ones most commonly based on legislation.

In some countries, there is a lack of relevant requirements for mitigation related to gravel/sediment transport, hydropeaking impacts and downstream fish migration, mainly due to

still open questions which need clarification through further research or pilot studies. For these type of impacts and for similar reasons, several countries follow a case-by-case approach when defining mitigation requirements.

In general, mitigation requirements for new and for existing HPP do not differ substantially, if there is an option to revise existing permits. In case permits run out and need to be renewed, similar requirements as for new HPP are usually applied.

Cost proportionality and balancing is also taken into account during authorization procedures, as well as the needs of other water uses such as flood protection, recreation, tourism, landscape and heritage aspects, etc.

Some degree of monitoring of mitigation measures, which have been set within HPP authorisations, is required across all countries reviewed. Effects of measures on fish migration, such as fish passes, appear to be the most commonly monitored (e.g. in AT, CH, DE, PT, SE, and NO).

### **Financing instruments**

In order to support the implementation of multiple environmental objectives (especially renewable energy production and protection of water ecosystems), financing and support instruments for hydropower development should be linked to ecological criteria for the protection of the water environment.

Results from the eight reviewed countries indicate that the instruments primarily being used in most countries are financial support schemes for the modernisation of existing plants (AT, CH, DE, ES, NO), followed by feed-in tariffs (CH, DE, ES, FR) and green power labels (AT, CH, DE, SE).

Compensation options to reduce energy production losses due to mitigation measures or monetary compensation are not widely applied.

In one of the countries reviewed (Portugal), there is at present no financial or other type of instrument aiming at boosting the hydropower sector, independently or cumulatively with the improvement of the status of water bodies.

### **Challenges and opportunities for hydropower planning and operation**

The present review has identified a number of challenges as well as opportunities related either to the legislation and regime of authorisations or the financing tools for environmentally-friendly hydropower.

In general, challenges are related to uncertainties of the interpretation of the legal framework (e.g. of the WFD requirements for the objectives of heavily modified water bodies) or lack of specification of a time-frame for implementing mitigation in existing HPP.

In some countries (e.g. FR, SE), there are ongoing reviews (or have been until recently) of the legislative framework and/or permit regime, which create uncertainty for the sector but also opportunities for new developments with appropriate mitigation of impacts.

The adequate financing to support necessary mitigation measures at hydropower stations still is a major bottleneck, despite several examples of innovative support schemes that have been in place.

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## List of Abbreviations

AT	Austria
CH	Switzerland
CIS	Common Implementation Strategy
DE	Germany
HPP	Hydropower Plant
EEG	Renewable Energy Sources Act (Germany)
EIA	Environmental Impact Assessment
ES	Spain
FR	France
GES	Good Ecological Status
GEP	Good Ecological Potential
HMWB	Heavily Modified Water Body
KWh	Kilowatt hours
MW	Megawatts
MSFD	Marine Strategy Framework Directive
NO	Norway
NREAP	National Renewable Energy Action Plan
PT	Portugal
RBMP	River Basin Management Plan
RBD	River Basin District
SE	Sweden
SEA	Strategic Environmental Assessment
WFD	Water Framework Directive
WHG	Federal Water Act (Germany)

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## 1. Introduction

This report has been prepared as part of work package 5 (WP5) of the FIThydro project, in specific Task 5.1 which aims at investigating the regulatory landscape influencing actions relevant to environmental improvements in the context of planning and operating hydropower plants. Emphasis is given to the requirements of the EU Water Framework Directive (WFD), nature protection policies and policies on renewable energy and climate change adaptation, thereby outlining opportunities, barriers and challenges in reaching multiple environmental objectives.

At first, the report outlines the key relevant European-level policies. Subsequently, the report focuses on selected European countries where test sites of the FIThydro project are located. On this national level of analysis, the report outlines the key legal requirements for environmental improvements related to existing and new hydropower plants, as well as relevant aspects in the permitting process.

In addition to reviewing the regulatory landscape, this report also looks at the use of financing instruments especially in the countries where FIThydro test sites are located. These instruments are considered essential in providing the necessary support to promote and sustain ecologically compatible hydropower production.

### 1.1 Background and objectives

FIThydro (Fishfriendly Innovative Technologies for Hydropower: <http://www.fithydro.eu>) is a 4-year EU research and innovation action (funded under Horizon 2020; duration 2016-2020) which aims to support decisions on commissioning and operating hydropower plants (HPP) by use of existing and innovative technologies. It concentrates on mitigation measures to develop cost-effective environmental solutions and strategies to avoid individual fish damage and to support the development of self-sustainable fish populations.

FIThydro brings together 26 partners from 10 countries, involving several of the leading companies in the renewable and hydropower energy sector in Europe. The project examines 17 test cases in four European regions (Scandinavia, France/Belgium, the Alps and the Iberian Peninsula). Scenario modeling in the four different geographic, climatic and topographic regions will allow the quantification of effects, resulting costs and comparisons of the test case regions to draw conclusions about future hydropower production mitigation options in Europe.

Ecologic Institute leads task 5.1 of FIThydro which aims at identifying opportunities, barriers and challenges related to policies and financing instruments for the planning, development and operation of HPP.

The specific objectives in the development of this report have been to:

- 1) Review relevant European policies concentrating on the Water Framework Directive, the EU climate and energy policy framework, Nature Directives, Environmental Impact Assessment Directive and the Eel Regulation.
- 2) Review relevant policies in selected European countries of the four key regions of the FIThydro project. The aim has been to capture the key legal requirements for environmental improvements related to existing and new hydropower plants, and relevant aspects that are taken into consideration in the permit process when commissioning or extending the operation of existing hydropower works. The review placed emphasis on requirements relevant to the main environmental impacts and mitigation options which are at the core of scientific work in FIThydro, i.e. fish passage, flow conditions, sediment management and habitat enhancement.

- 3) Collect up-to-date information on the use of instruments for financing mitigation measures and environmental improvements at hydropower plants.

## 1.2 Methodology

The report builds on a policy review carried out at European level on the one hand and at the national level on the other:

- The review of relevant EU-level policies was based on a desk review of existing studies and documents on hydropower relevant policies, which have been published by or on behalf of European and national institutions.
- The review of national policies involved collecting information via a questionnaire (FIThydro country template on policy) in order to gain further insight into policies and financing instruments at the national and regional levels. The questionnaires have been filled in by the FIThydro partners, active in the four regions of the project, using the following sources: published literature, online information, previous questionnaire surveys submitted by national authorities as well as interviews and personal communications with key policy actors.

A number of topics were explored in the questionnaire (see Table 1).

*Table 1 - Topics explored in the FIThydro country template on policy and financing instruments*

Category	Dimensions	Specific topics
Policy requirements	Relevant national / regional laws	Key elements for green hydropower
	Strategic planning instruments	Promoting new HPP
		Restoring continuity
	Procedural instruments at the level of hydropower plants	On new hydropower (duration of concessions, mitigation measures, WFD requirements)
		On existing hydropower (permit revisions, mitigation measures)
		On new and existing HPP (monitoring requirements, regulatory agencies, decision flow chart)
Financing instruments	Feed-in tariffs, green power labels, monetary compensation, support schemes	Type of HPP targeted, criteria used for ecological improvement, source of funding

The review of national policies concentrated on eight European countries in the four regions (Scandinavia, Alpine, Iberian Peninsula and France/Belgium) where FIThydro test sites are located. These eight countries are also characterised by an important hydropower sector within these four regions (see Table 2). A policy review for all European countries has not been possible due to resource constraints and the regional focus of the FIThydro project.

Table 2 - European countries and regions covered in the review of policies and financing instruments at national level

Country	% of total electricity output from renewable energy sources	% of total electricity production from hydropower
FIThydro region Scandinavia:		
Norway (NO)	97.69% (1)	95.8% (2)
Sweden (SE)	55.84% (1)	46.1% (2)
FIThydro region Alpine:		
Germany (DE)	29% (3)	3.2% (3)
Austria (AT)	81.13% (1)	59.95% (2)
Switzerland (CH)	64.2% (6)	59.9% (6)
FIThydro region northwest Europe:		
France (FR)	19.1% (7)	12% (7)
FIThydro region Iberian peninsula:		
Spain (ES)	38.9% (4)	13.8% (4)
Portugal (PT)	52% (5)	23% (5)

Sources:

1) Data from the World Bank (reference year 2014), available at: [https://data.worldbank.org/indicator/EG.ELC.RNEW.ZS?name\\_desc=false](https://data.worldbank.org/indicator/EG.ELC.RNEW.ZS?name_desc=false).

2) Data from the World Bank (reference year 2014), available at: [https://data.worldbank.org/indicator/EG.ELC.HYRO.ZS?name\\_desc=false](https://data.worldbank.org/indicator/EG.ELC.HYRO.ZS?name_desc=false).

3) Data on Germany from Bundesministerium für Wirtschaft und Energie (reference year 2016), available at: <https://www.bmwi.de/Redaktion/DE/Dossier/erneuerbare-energien.html>, accessed on 11.12.2017.

4) Data on Spain from RED ELÉCTRICA DE ESPAÑA (reference year 2016), Renewable energy in the Spanish electricity system 2016, available at: [http://www.ree.es/sites/default/files/11\\_PUBLICACIONES/Documentos/Renewable-2016.pdf](http://www.ree.es/sites/default/files/11_PUBLICACIONES/Documentos/Renewable-2016.pdf).

5) Average conditions in the period 2010-2015, Pordata: <https://www.pordata.pt/Portugal/Produ%C3%A7%C3%A3o+de+energia+el%C3%A9ctrica+total+e+a+parti+r+de+fontes+renov%C3%A1veis-1127>.

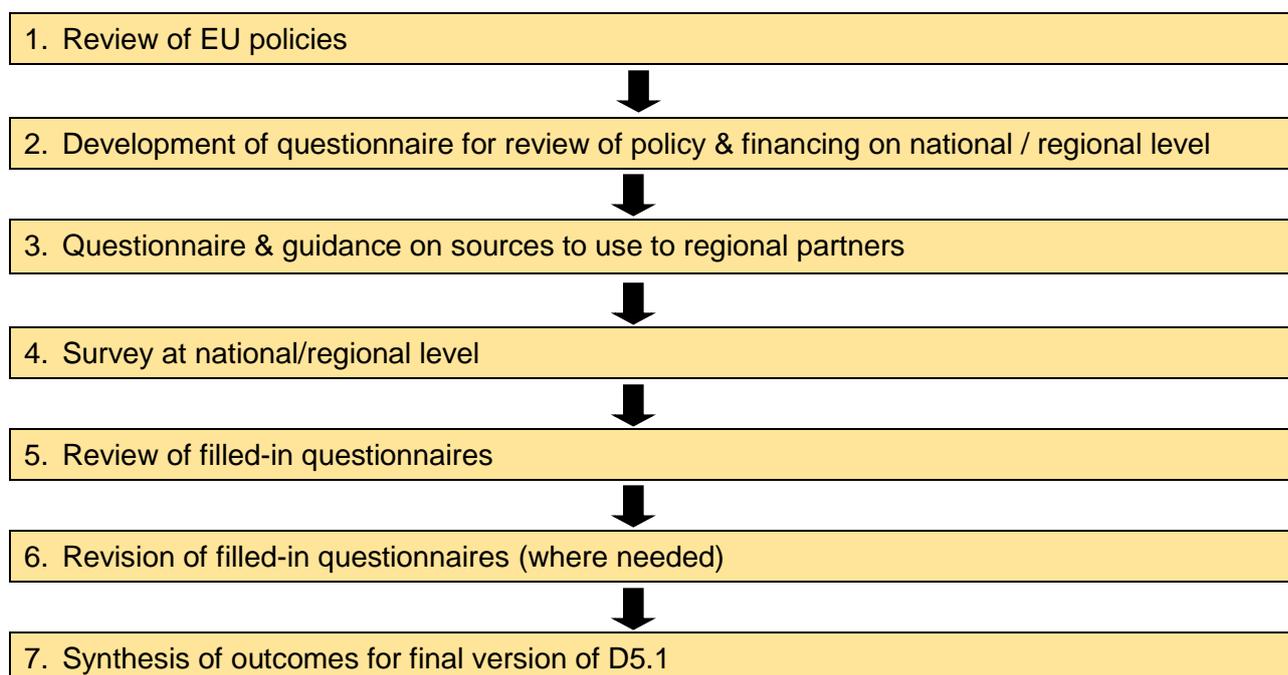
6) Data on Switzerland (reference year 2015) from Eidgenössisches Departement für Umwelt, Verkehr, Energie und Kommunikation UVEK, 2017. Faktenblatt «Energieversorgung der Schweiz und internationale Entwicklung», 21. März 2017.

7) 2016 data from RTE France, Bilan électrique français 2016 - Synthèse presse : [http://www.rte-france.com/sites/default/files/2016\\_bilan\\_electrique\\_synthese.pdf](http://www.rte-france.com/sites/default/files/2016_bilan_electrique_synthese.pdf).

In the case of countries with a federal system, e.g. Germany, or where regional legislation is significantly different from the national regulatory framework, respondents were asked to fill in an additional section outlining these distinctions. The aim of this was not to obtain a comprehensive overview of the country's regulations, but rather to concentrate on the regions where FIThydro case studies are located.

The questionnaire (FIThydro country template on policy) was sent to the relevant FIThydro partners in April 2017, and partners collected relevant information by August 2017. Ecologic Institute reviewed the country policy templates and synthesised the results and outcomes of the questionnaires into the present report (Deliverable D5.1 of FIThydro) (see Figure 1).

*Figure 1 - Work steps taken for the review of European and national policies and financing tools*



### **1.3 Structure of the report**

The report is structured as follows:

- Chapter 2 reviews key European-level policies which are potentially relevant for the planning and operation of hydropower in the EU.
- Chapter 3 gives an overview of key national legislation in 8 European countries, which is relevant to ecological improvements in water ecosystems and renewable energy production.
- Chapter 4 presents strategic planning instruments for hydropower and possible environmental improvements at national and regional level.
- In chapter 5, we present the results of this review on the way environmental requirements especially for mitigation measures are set for hydropower plants (HPP). The chapter looks especially at the authorisation procedures for hydropower plants (duration of concessions/permits and options for their revision) and mitigation measure requirements.
- Chapter 6 briefly outlines the key regulatory agencies involved in HPP authorisation in 8 European countries.

- Chapter 7 discusses financing instruments incentivising environmentally-friendly hydropower in the reviewed eight countries.
- Finally, chapter 8 outlines certain challenges to the hydropower sector and relevant environmental improvements, which result from the regulatory and authorisation regimes in the reviewed countries, but also opportunities for further development of environmentally-friendly hydropower sector.

The Annex to this report includes the full FIThydro policy templates, filled-in for the eight European countries reviewed in detail. *Please note that the sources of information and references used for specific countries are given in the policy templates in the Annex; these detailed sources and references have not been repeated inside the main report.*

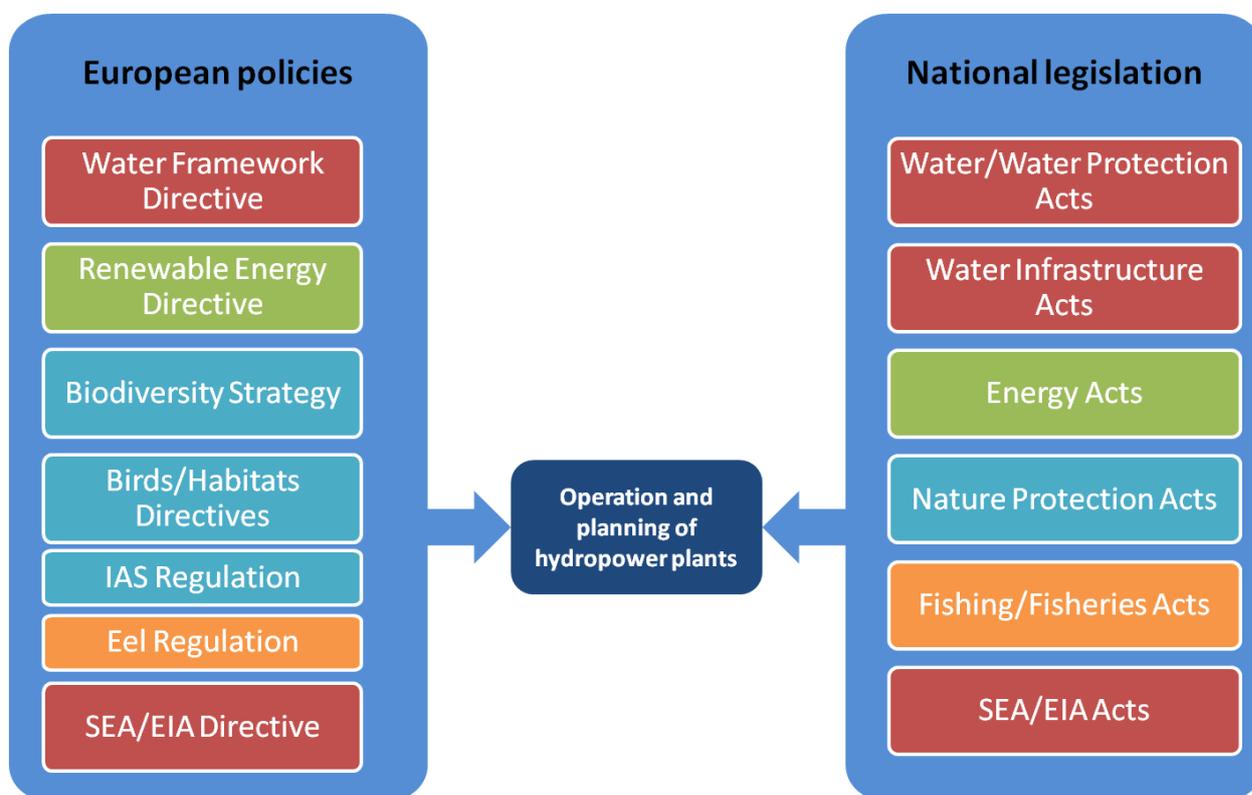
## 2. European policies

In this chapter, we review key European-level policies which are potentially relevant for the planning and operation of hydropower in the EU. Specific emphasis is given to the following:

- Policy framework on renewable energy and climate change adaptation
- Requirements of the Water Framework Directive (WFD)
- Nature / biodiversity protection policies
- Environmental Impact Assessment Directive
- Eel Regulation (due to its relevance to fisheries)
- Invasive Alien Species (IAS) regulation

Although the policies are treated one-by-one in separate sections, we also outline opportunities and challenges in reaching multiple environmental objectives.

*Figure 2 Key policies relevant for the planning and operation of hydropower in the EU*



Overall, hydropower is considered to be a reliable and cost effective renewable energy source. As it is described in detail in following sections, hydropower production can make an important contribution to the reduction of CO<sub>2</sub> emissions in Europe within current climate protection and renewable energy policy.

At the same time, the construction and operation of hydropower plants is generally linked to impacts on the water bodies and the adjacent wetlands. The major impacts of hydropower plants in river basins are the barrier function together with damage and mortality of fish species, modified flows and habitat conditions, the changes in nutrient and physico-chemical conditions, and changed sediment patterns (Devoldere et al. 2011).

Therefore, besides the advantage of almost emissions-free energy production through hydropower, there is a need to optimise hydropower facilities to strike a balance with the ecological needs of the affected water systems, adjacent land ecosystems and wetlands. Several EU policies set ecological/environmental requirements on hydropower plants. Examples are EU policy requirements for environmental impact assessment as well as nature protection requirements of the Habitats Directive. Additionally, the further use and development of hydropower should consider the environmental objectives of the WFD, which aims at the achievement of good ecological status (GES) in European waters. Especially the hydromorphology and fish fauna of water stretches affected by hydropower are adversely impacted. In order to reconcile climate protection, water protection and nature protection objectives, hydropower should be generated in such a manner as to maintain the ecological functions of the affected water stretches. These are important considerations when planning or revising/renewing concessions for hydropower plants.

## **2.1 Climate and energy policy framework**

To secure energy supply and tackle climate change, the European Union has developed a policy of renewable energy sources. A key development in this respect was the adoption of an ambitious and far-reaching 'climate and energy package' in 2009 to make the European economy less dependent on imported energy sources and to reduce greenhouse gas emissions.

The so-called 20-20-20 targets, to be met by 2020, include a reduction in EU greenhouse gas emissions of at least 20% below 1990 levels, 20% of EU energy consumption to come from renewable energy and a 20% reduction in primary energy use compared with projected levels, to be achieved by improving energy efficiency. This policy responds to the fact that energy related emissions account for almost 80% of the EU's total greenhouse gas emissions.

Directive 2009/28/EC on the promotion of the use of energy from renewable sources (Renewable Energy Directive) established a common EU framework in this respect. The Directive for the first time sets for each member state a mandatory national target for the overall share of energy from renewable sources in gross final consumption of energy, taking account of countries' different starting points. The main purpose of mandatory national targets is to provide certainty for investors and to encourage technological development allowing for energy production from all types of renewable sources. To ensure that the mandatory national targets are achieved, member states have to follow an indicative trajectory towards the achievement of their target (Devoldere et al., 2011).

Under the terms of the Directive, Member States were required to prepare National Renewable Energy Action Plans (NREAPs) to demonstrate how they intend to increase the share of energy from renewable sources in their final energy consumption by 20%. Countries were free to choose their own mix of renewable energy sources (e.g. hydropower, wind or solar power, geothermal energy or biomass).

The Member States were required to send their NREAPs to the European Commission by 2010.<sup>1</sup> However, the existing strategy is currently unlikely to achieve all the 2020 targets. A recent review of progress made on the NREAPs states that "In 11 countries, renewable energy consumption in 2013 was below what was expected in their NREAPs. Almost half of all countries will need to increase their growth rate post-2013 to reach the expectations for 2020." In 2013,

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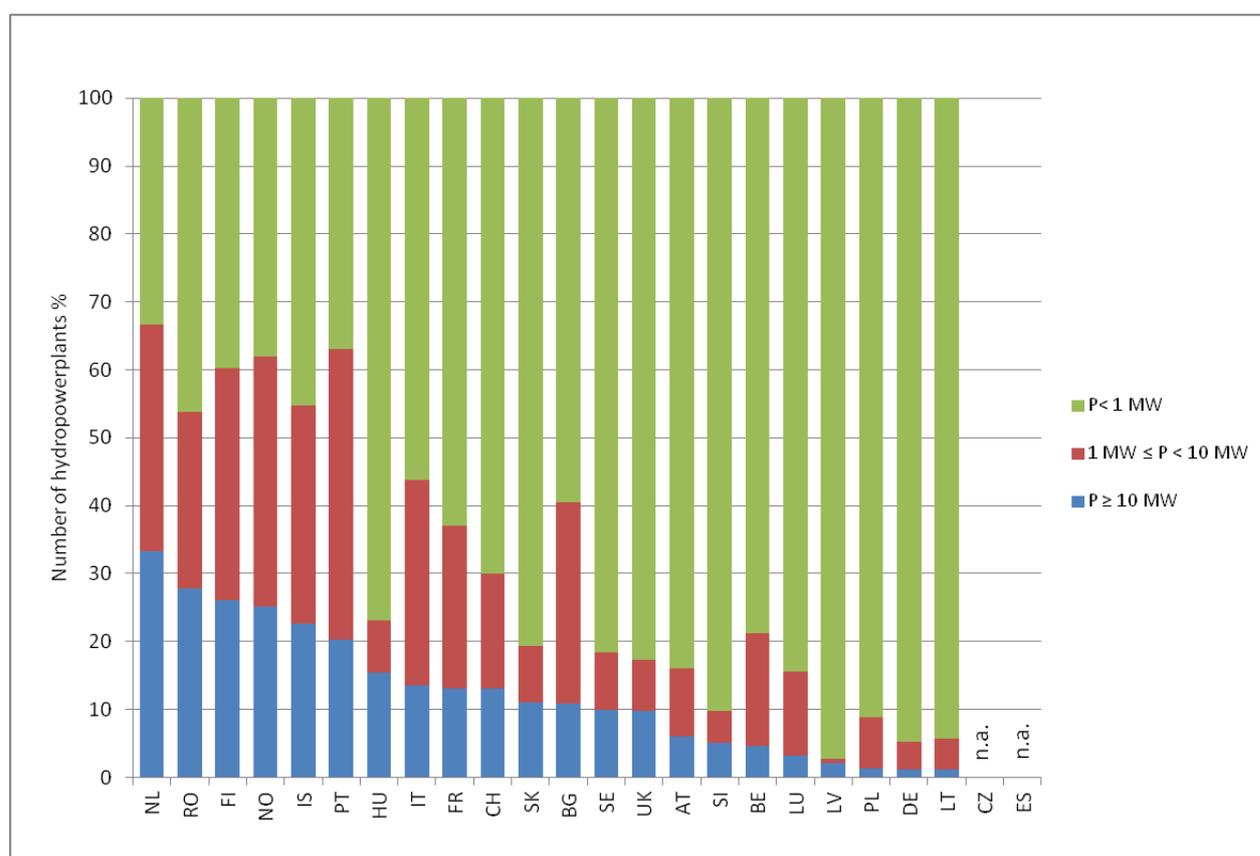
<sup>1</sup> See <https://ec.europa.eu/energy/en/topics/renewable-energy/national-action-plans>.

the largest contribution to renewable energy was from hydro, at 42%. However, hydropower also had the lowest growth rate, at 0% between 2005 and 2013 (EEA, 2016).

There are significant differences between EU countries in terms of the extent to which hydropower is used in their energy mix. This is highly influenced by geographic conditions, climate, precipitation patterns, the availability of affordable energy supply alternatives, as well as institutional capacities and technical competences.

Hydropower is currently Europe's largest renewable energy resource with about 361,000 GWh generated (net electricity generation) in Europe in 2012<sup>2</sup> Around 23.000 hydropower installations have been recorded in the European Union in 2011, the vast majority (91%) are small (less than 10 MW) and generate around 13% of the total production. Large hydropower plants ( $\geq 10$  MW), on the other hand, represent only 9% of all hydropower facilities but generate about 87% of the total production (Devoldere et al., 2011). See also Figure 3 for an overview of share of different hydropower plant sizes across European countries.

Figure 3 Percentage of number of existing hydropower plants for different plant sizes (%)



Source: Dataset from Kampa et al. 2011 (figures are from 2010 or earlier reference years), which has been updated for the purpose of this report with data for CH (missing in the original graph). Information for CH has been provided by the Swiss FIThydro partner ETHZ.

<sup>2</sup>See <http://ec.europa.eu/eurostat/web/environmental-data-centre-on-natural-resources-old/natural-resources/energy-resources/hydropower>.

The NREAPs point to an increase in hydropower production in 2010-2020 of around 8% (25 TWh) although the increase in pumping hydropower by 2020 is expected to be higher, by around 35% (8.6 TWh). Part of this increase will come from the refurbishment of old installations (EC, 2016).

Furthermore, the National Renewable Energy Action Plans agreed on in 2010 set an installed capacity target of 15.92 GW for small and medium hydropower facilities by 2020 (excluding pumping). The interim target for 2015 was set at 14.39 GW (EC, n.d.).

However, the growth of other renewables could see the overall contribution of hydropower to renewable electricity production fall. Certain countries plan an increase in electricity production from hydropower by 2020 (PT, FR, AT, DE, FI, IT, SI, SK, PL, BE, LU) whereas other countries may see the electricity production from hydropower drop by 2020 (SE, RO, CZ, LV) (EC, 2016).<sup>3</sup>

The largest remaining potential in Europe lies in low head plants (<15m) and in the refurbishment of existing facilities. About 65% of small hydropower plants located in Western Europe and 50% in Eastern Europe are more than 40 years old (Devoldere et al., 2011).

Energy production that has an impact on water (e.g. hydropower) will continue to play a key role in helping the EU meet its energy needs and climate mitigation targets beyond 2020. EU countries have agreed on a new renewable energy target of at least 27% of final energy consumption in the EU as a whole by 2030 as part of the EU's energy and climate goals for 2030.<sup>4</sup> The 2030 climate and energy framework for a competitive, secure and low-carbon EU economy also calls for:

- A binding target to reduce EU domestic greenhouse gas emissions by at least 40% below the 1990 level by 2030;
- A share of renewable sources in final energy consumption of at least 27% in 2030. This target will be binding at EU level;

The indicative energy efficiency target of 27% is to be reviewed in 2020 having 30% in mind.

## **2.2 Water Framework Directive**

The EU Water Framework Directive (Directive 2000/60/EC of the European Parliament and of the Council establishing a framework for the Community action in the field of water policy) which was adopted in 2000, established a comprehensive and ambitious legislation that holistically covers EU water policy.

Already in the 1<sup>st</sup> implementation report of the European Commission on the WFD (European Commission, 2007b), hydropower and dams were identified among the main pressures leading to hydromorphological alterations, loss of continuity and significant impacts on the ability of survival of fish populations in water ecosystems.

### Environmental objectives

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<sup>3</sup> Certain countries, such as Austria, plan to expand their large-scale hydroelectric power stations, though the review notes that these plans existed prior to renewable energy targets – which are now used to facilitate implementation. The Czech Republic's Action Plan also notes an increase in hydroelectric plants, specifically stating estimates for plants up to 1MW and between 1-10MW (Green Energy Foundation, 2010).

<sup>4</sup> See [http://ec.europa.eu/clima/policies/strategies/2030/index\\_en.htm](http://ec.europa.eu/clima/policies/strategies/2030/index_en.htm) and <https://ec.europa.eu/energy/en/topics/energy-strategy-and-energy-union/2030-energy-strategy>

The legal requirements of the WFD concerning hydropower are mostly contained in Article 4 concerning the environmental objectives of the Directive.

The Directive's main aim is to achieve 'good status' of all EU waters, including surface and groundwater, by 2015 through coordinated action (Article 4(1)).

'Good status' is a concept that on the one hand ensures protection of all water bodies in a holistic way, and on the other hand integrates quality objectives for specific bodies of water derived from other legislation (e.g. the Drinking Water Directive). For surface water bodies, the Directive distinguishes between good ecological and good chemical status.

The basic idea of "good status" is that a water body may be used, but only in so much as its ecological functions are not fundamentally affected. The general concept of "good status" is specified for different waters in the extensive Annex V of the Directive. It is above all characteristic biological groups of aquatic flora, invertebrates and fish fauna that are assessed. Ecological status is "good" when the values for biological quality components of surface waters indicate anthropogenic influences, but deviate to only a negligible extent from values normally recorded in the absence of disturbing influences. For the use of hydropower it is important that morphological changes – for example, disruption of water passage, water bed or flow characteristics – also influence the classification of waters, in so far as aquatic communities are affected as a result (Bunge et al., 2003). In specific, hydromorphological and physico-chemical parameters are supporting elements to the biological quality elements for classifying the status of water bodies.

Although the targets of the WFD should have been met by 2015, the Directive permits time delays in achieving "good status" (Article 4(4)) as well as, in exceptional cases, the setting of less stringent objectives (Article 4(5)). There are the so-called possible exemptions from the objectives of the WFD.

Furthermore, Article 4(3) of the WFD has specific relevance to hydropower affected stretches because it allows the designation of surface waters as heavily modified (HMWB), when particular water uses and public interests stand in the way of extensive restoration of the water body in question. The environmental objective of HMWB is good ecological potential instead of good ecological status. In the 1<sup>st</sup> RBMPs, ca. 35% of all HMWB in Member States were designated due to hydropower (Kampa et al., 2011).

A general challenge results from the fact that the environmental goals of the WFD for HMWBs are not clearly defined (contrary to natural water bodies). In fact, the definition and interpretation of "good ecological potential" (GEP) is still an item of ongoing discussions among European countries. At present, there is a dedicated activity within the Common Implementation Strategy (CIS) of the WFD<sup>5</sup> to develop further technical guidance for the definition of GEP for HMWB.

Additional exemptions for building new infrastructure projects are possible under Article 4(7), if certain strict conditions are met and an assessment is done according to these conditions. This can relate to new projects (e.g. new specific hydropower dams) or to modifications to existing projects. The conditions for exemptions under Article 4(7) include amongst others that there are no significantly better environmental options, the benefits of the new infrastructure outweigh the benefits of achieving the WFD environmental objectives and all practicable mitigation measures

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<sup>5</sup> In order to address the challenges of the WFD in a co-operative and coordinated way, the Member States, Norway and the Commission agreed on a Common Implementation Strategy (CIS) for the Water Framework Directive shortly after the adoption of the Directive.

are taken to address the adverse impact of the status of the water body. In general, for new developments, there is a need firstly to prevent deterioration of 'status' in a water body. Where this is not possible, mitigation measures should be applied.

In the 1<sup>st</sup> planning cycle of the WFD (2009-2015), only few plans have made use of the Art 4(7) exemption and new infrastructure dams have often not been mentioned by the reporting Member States.

At present, further guidance is being developed on the interpretation and requirements of Article 4(7) of the WFD within the CIS.

#### River basin management planning and programme of measures

In order to establish a comprehensive and consistent concept for achieving "good status", a river basin management plan (RBMP) has to be established for each river basin district (Article 13). With these RBMPs, measures are co-ordinated between participating administrative authorities, and the substance of all water management activities communicated externally to the public and the Commission. The public is also to be involved in drawing up the RBMPs (Article 14), which should lead to greater transparency and acceptance (Bunge et al., 2003).

The Directive envisages a cyclical process where RBMPs are prepared, implemented and reviewed every six years. There are four distinct elements to the river basin planning cycle:

- Characterisation and assessment of impacts on river basin districts;
- Environmental monitoring;
- Setting of environmental objectives; and
- Design and implementation of a cost-effective programme of measures needed to achieve these objectives.

According to Article 11, Member States are further obliged to establish a programme of measures. In the case of hydropower affected stretches, measures are needed to address mainly physical modifications to the water bodies. Actions should first be considered to restore the water body with the aim to achieve 'good ecological status' (restoration). Where restoration is not possible, mitigation measures should be investigated with the aim to meet 'good ecological potential' (GEP) for heavily modified water bodies.

At a CIS workshop on WFD and Hydropower in 2007, and when discussing "Technical approaches for good practice in hydropower use", it was stated that "Standardisation at European level is desirable, but solutions for mitigation measures will have to be largely site-specific. Exchange of information should be promoted on standards that have been developed by different countries or organisations (e.g. for continuity)."

At a later CIS workshop on Water management, WFD and Hydropower in 2011, good practice recommendations for mitigation measures included providing (Kampa et al., 2011):

- An ecologically optimised river flow reflecting ecologically important components of the natural flow regime, including a relatively constant base flow and more dynamic/variable flows.
- Where relevant, effective provision for upstream and downstream migration of fish including sufficient flows.
- Dampening of hydro peaking by, for example, gentle ramping or discharging tailrace flows into a retention basin.

### 2.3 Nature and biodiversity protection policy

In addition to water resource protection, halting the loss of EU's biodiversity is high on the policy agenda. In 2010, the EU Heads of State and Government set themselves the ambitious target of halting, and reversing, the loss of biodiversity in Europe by 2020. In 2011, the European Commission adopted a new EU Biodiversity Strategy to 2020<sup>6</sup> which sets out a policy framework for achieving this. The EU 2020 Biodiversity Strategy aims to implement the Strategic Plan for Biodiversity 2011–2020 and the Aichi Biodiversity Targets<sup>7</sup>. The strategy identifies six targets that cover the main factors driving biodiversity loss and aim to reduce existing pressures on nature:

- Target 1: conserving and restoring nature through better application of the Birds and Habitats Directives with the goal of halting biodiversity loss and restoring biodiversity by 2020.
- Target 2: maintaining, enhancing and restoring (15% as minimum by 2020) ecosystems and their services, by integrating green infrastructure into land-use planning.
- Target 3: ensuring the sustainability of agriculture and forestry through enabling existing funding mechanisms to assist in the application of biodiversity protection measures.
- Target 4: ensuring sustainable use of fisheries resources by 2015 with the goal of achieving MSFD targets by 2020.
- Target 5: combating invasive alien species.
- Target 6: addressing the global biodiversity crisis and meeting international biodiversity protection obligations.

Moving forward towards 2020 it will be important to transparently measure progress towards the new European and global 2020 biodiversity targets. The SEBI indicators (Streamlining European Biodiversity Indicators) aim to contribute to this. In fact, one of the indicators currently in preparation is SEBI 014 on the "Fragmentation of river systems".<sup>8</sup>

The Birds Directive (78/409/EEC13) and the Habitats Directive (92/43/EEC12) are the cornerstones of the EU's nature and biodiversity policy. They enable all 28 EU Member States to work together, within a common legislative framework, to conserve Europe's most endangered and valuable species and habitats across their entire natural range within the EU, irrespective of political or administrative boundaries.

The overall objective of the two nature Directives is to ensure that the species and habitat types they protect are maintained and restored to a favourable conservation status throughout their natural range within the EU. This target is defined in positive terms, oriented towards a favourable situation which needs to be reached and maintained. It therefore goes beyond the basic requirement of avoiding deterioration (European Commission, 2016).

#### **Natura 2000 site protection**

In addition, according to Article 3(1) of the Habitats Directive, a coherent European ecological network of special areas of conservation will be set up under the title "Natura 2000". This network, comprising sites hosting the natural habitat types listed in Annex I and habitats of the species listed in Annex II of the Directive, should enable the natural habitat types and the

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<sup>6</sup> See <http://ec.europa.eu/environment/nature/biodiversity/comm2006/2020.htm>

<sup>7</sup> See <https://www.cbd.int/sp/targets/>

<sup>8</sup> See <http://biodiversity.europa.eu/topics/sebi-indicators>

habitats of species concerned to be maintained or, where appropriate, restored at a favourable conservation status in their natural range.

Although not obligatory, the Habitats Directive strongly recommends the use of Natura 2000 management plans as a means of setting conservation objectives and identifying measures for Natura 2000 sites in an open and transparent manner.

Lake and river ecosystems cover around 4% of the total surface area of Natura 2000. These sites have been designated for some 19 freshwater habitat types, 128 bird species and 236 other species that are listed in the two nature Directives (EC, 2016).

Article 6(3) of the Habitats Directive concerns the assessment procedure for any plan or project that could affect one or more Natura 2000 site. In essence, the assessment procedure requires that any plan or project that is likely to have a significant effect on a Natura 2000 site undergoes an appropriate assessment to study these effects in detail.

In exceptional circumstances, a derogation (Article 6(4)) may be invoked to approve a plan or project having an adverse effect on the integrity of a Natura 2000 site if it can be demonstrated that there is an absence of less damaging alternatives and the plan or project is considered to be necessary for imperative reasons of overriding public interest. In such cases, adequate compensation measures will need to be put in place beforehand to ensure that the overall coherence of the Natura 2000 network is protected.

As regards the scope of the provisions of Article 6(3), the term "plan" or a "project" also concerns projects that aim to upgrade or modernize an existing hydropower if it is deemed this might have a significant effect on a Natura 2000 site. Furthermore, the provisions are not restricted to plans and projects carried out exclusively in a Natura 2000 site; they also target developments situated outside Natura 2000 sites but which are likely to have a significant effect on these sites. For instance a project located upstream of a Natura 2000 site may still cause negative effects to the site located downstream as a result of water flow disruptions or barriers to species migration. In such cases, the project would still need to be assessed according to the Article 6(3) procedure (EC, 2016).

### **Species protection**

The second set of provisions of the nature Directives concerns the protection of certain species across their entire natural range within the EU, i.e. also outside Natura 2000 sites. These provisions also need to be taken into account for hydropower plants, especially on rivers harbouring migratory species, such as the European sea sturgeon *Acipenser sturio* or the apron Zingel *asper* both of which are listed in Annex IV of the Habitats Directive (EC, 2016).

The species protection measures apply to species listed in Annex IV of the Habitats Directive as well as all wild bird species in the EU. The exact terms are laid down in Article 5 of the Birds Directive and Article 12 (for animals) and Article 13 (for plants) of the Habitats Directive.

## **2.4 Eel Regulation**

The EU eel regulation (Council Regulation (EC) No 1100/2007) aims to establish measures for the recovery of the stock of the European eel. The eel regulation is a legally binding regulation to protect this species within and beyond the Natura 2000 network. The European eel is a catadromous species and is critically endangered; eels reproduce in seawater and juvenile eels migrate from the sea upstream. Adult eels migrate back to the sea to reproduce. Populations of long distance migratory fish can only survive if a distinct percentage of the downstream migrating abundance survives; for example, it was assessed that an eel population will only survive, if 50% of the natural number of eels reaches the sea (CIS, 2006).

According to the EU eel regulation, Member States are obliged to identify and define eel river basins and to set up Eel Management Plans aiming to reduce anthropogenic mortalities so as to permit with high probability the escapement to the sea of at least 40 % of the silver eel biomass relative to the best estimate of escapement that would have existed if no anthropogenic influences had impacted the stock. Article 2 of the regulation explicitly requests that “in the Eel Management Plan, each Member State shall implement appropriate measures as soon as possible to reduce the eel mortality caused by factors outside the fishery, including hydroelectric turbines, pumps or predators, unless this is not necessary to attain the objective of the plan.”

## **2.5 Strategic environmental assessment and environmental impact assessment**

### SEA Directive

The Strategic Environmental Assessment (SEA) Directive (2001/42/EC) concerns the assessment of the effects of certain plans and programmes on the environment. The Directive aims to provide for a high level of protection of the environment by ensuring that the environmental consequences of certain plans and programmes are identified, assessed and taken into account during their preparation and before their adoption.

An SEA (strategic environmental assessment) is mandatory for a variety of plans and programmes which set the framework for future development consent of projects listed in the EIA Directive. It is also mandatory for any plans or programmes, which, in view of the likely significant effect on sites, have been determined to require an assessment pursuant to Article 6(3) of the Habitats Directive.

An SEA is carried out for the river basin management plans (RBMPs) prepared for implementing the WFD.

### EIA Directive

While the SEA process operates at the level of plans and programmes, the EIA Directive operates at the level of individual public and private projects. The EIA Directive 2011/92/EU was amended by Directive 2014/52/EU, but it was initially adopted in 1985 by Council Directive 85/337/EEC.

The development consent for projects which are likely to have significant effects on the environment should be granted only after an assessment of its likely environmental effects has been carried out. The EIA Directive distinguishes between projects requiring a mandatory EIA ("Annex I projects") and those where Member State authorities must determine, in a procedure called "screening", if projects are likely to have significant effects, taking into account criteria in Annex III of the Directive ("Annex II projects").

With regard to hydropower:

- Annex I projects include those for “dams and other installations designed for the holding back or permanent storage of water, where a new or additional amount of water held back or stored exceeds 10 million cubic meters’.
- Most installations for hydropower production are Annex II projects. For Annex II projects, the obligation to carry out EIA depends on thresholds and criteria laid down by Member States, or on a case-by-case examination on the basis of the new Annex III. It still applies, that whole project categories may not be excluded from EIA obligation. "Installations for hydroelectric energy production" are mentioned in Annex II of the amending Directive, under 3. "Energy industry" (h). Annex II also includes measures in the area of surface waters, under point 10. Infrastructure projects, (f), are "construction of

inland-waterways (so far as they are not listed in Annex I), canalisation and flood-relief works", and (g) "Dams and other installations designed to hold water or store it on a long-term basis (projects not included in Annex I)" (Bunge et al, 2003).

It becomes obvious that hydropower is subject to a number of environment assessment procedures stemming from different policy streams and directives on EU level. In order to streamline these various procedures and at the same time ensure the maximum level of environmental protection in accordance with EU law, the European Commission has issued a Guidance document for energy infrastructure, in particular for Projects of Community Interest (PCIs) under the Ten-T Regulation (European Commission, 2013).

This guidance documents includes several recommendations, which, although designed with PCIs in mind, are also relevant for all energy plans or projects, including hydropower developments (EC, 2016). The recommendations focus among others on early planning, "roadmapping" and scoping of assessments; early and effective integration of environmental assessments; data collection, sharing and quality control; as well as effective public participation.

## **2.6 Invasive Alien Species regulation**

EU regulation (1143/2014) on Invasive Alien Species (IAS) addresses plants and animals that can have negative consequences when introduced (intentionally or accidentally) to new, non-native environments. The IAS regulation fits into the EU Biodiversity Strategy, and entered into force in 2015, outlining a set of measures to be taken with regards to alien species on a list of "Invasive Alien Species of Union concern." These measures are grouped into: prevention, early detection and rapid eradication, and management.

In the context of hydropower, the development of hydropower installations can create new connections between river systems, leading to the spread and dispersal of various aquatic organisms. These can be difficult to identify and prevent, as they often involve the movement of small organisms through flowing water. In implementing the requirements of the IAS regulation, Member States can, for example, include requirements in their authorization procedures related to preventing the spread of alien species. Furthermore, requirements related to fish restocking may be adapted so that the fish used are from local populations (Norwegian Ministry of the Environment, 2007).

### 3. National legislation

The review of policies within FIThydro included a review of key national legislation in 8 European countries. The review of legislation focused on legislation which is relevant to ecological improvements in water ecosystems and which may have repercussions in hydropower production. In addition, key national legislation which is relevant to renewable energy production, including hydropower, has been examined.

Table 3 gives an overview of the range of relevant legislation, which has been reviewed for the purpose of this report, and their relevance for broader policy fields such as water protection, nature protection, fisheries or renewable energy. The table also gives an indication how long some of this legislation dates back to. Although most of the environmental legislation has been adopted (or substantially amended) since the 1990s, there are some pieces of legislation relevant to hydropower operation dating back to early to mid-1900, e.g. on fisheries and water course regulation.

Table 3 - Summary of national reviewed policies

Country	Water protection	Nature protection	Fisheries	Environmental impact assessment	Energy/renewable energy	Water infrastructure	Name of laws and dates
<b>NO</b>	X	X	X	X	X	X	The Watercourse Regulation Act (1917) The Water Resources Act (2001) The Plan and Building Act (2010) The Biodiversity Act (2016) The Salmon and inland fisheries Act (2016) The Energy Act (1991)
<b>SE</b>	X		X		X		Ordinance on Water Quality Management (2004) Environmental Code (1999) Water Law (1918) Ordinance concerning EQS for fish and mussels (2001) Electricity Preparedness Act (1997)
<b>DE</b>	X	X		X	X	X	Federal Water Act (2009) Federal Nature Conservation Act (2010), Federal Emission Control Act (2013), Law on Environmental Impact Assessment Act (2010) Renewable Energy Sources Act (2012), Environmental Damage Act (2007)
<b>AT</b>	X			X	X		National Water Act (1959) EIA Act (2000) Green Electricity Act (2012)
<b>CH</b>	X		X	X	X	X	Federal Act on the Protection of Waters (1991) Federal Act on Fisheries (1991) Environmental Protection Act (1983)

							Energy Act (1998) Federal Hydropower Act (1918) Federal Act on Hydraulic Engineering (1991)
<b>FR</b>	X	X	X	X	X	X	Law on fish and fisheries (1865) Law n°64-1245 on water regime and distribution and pollution control (1964) Law n°76-629 on nature protection (1976) Law n°84-512 on freshwater fishing and the management of fish resources (1984) Law n°92-3 on water (1992) Law n°2006-1772 on water and aquatic environments Law n° 2009-967 for the implementation of the "Grenelle de l'environnement" Ministerial circular on waterworks Law on the use of hydraulic energy (1919) Law n°80-531 on economies of energy and heat utilisation Law n°2000-108 on the modernization and development of the public electricity service Law n°2005-781 setting the energy policy guidelines (POPE) Law n°2015-992 on the energy transition for green growth
<b>ES</b>	X	X	X	X	X	X	Water Act (2001) Natural Heritage and Biodiversity Act (2007) Rivers Fishing Act (1942) Environmental Impact Assessment Act (2013) Electric Sector Act (2013)
<b>PT</b>	X	X	X	X	X	X	Water Law (2005) National network of nature protected areas (2008) Freshwater Fisheries Law (2015) Legislation on environmental impact assessment (2013) Water Resources Utilization Regime (2007) Legal Framework of Activities Developed under the National Electric System (2012)

The following tables briefly describe the main aspects of each law which are relevant for environmental improvements in water ecosystems, environmental conditions related to hydropower schemes or the production of hydropower itself. For example, in case of a water protection law, relevant aspects may include specific provisions for the restoration of watercourses, the implementation of restoration measures and the mitigation of adverse effects of hydropower.

Important recent amendments to the key legislation are also highlighted because of their relevance to the operation of existing HPP or the authorisation of new HPP.

For example, in AT, the National Water Act was revised in 2011 and made several mitigation measures such as upstream continuity measures and ecological minimum flow an obligatory requirement. Also in Switzerland, new developments and environmental requirements are driven by the most recent amendment of the Waters Protection Act in 2011.

Some of the country policy templates, which are all available in the Annex to this report, also include some information on regional legislation, especially in case of federal systems or countries where the regional legislation is significantly different from the national regulatory framework. The intention was not to get the full picture of regulations in all regions in the countries reviewed, but mainly to concentrate on the regions where FIThydro case studies are located. In specific, information on regional legislation is given in the policy templates of DE (especially for Bavaria and Baden-Wurtemberg), CH and ES.

### **Energy/renewable policy**

In addition to the review of key legislation on energy and renewable policy (see table 4), all of the countries reviewed have targets in place for electricity production from renewable sources, with an indication of changes expected on the level of hydropower production. These targets are mainly related to 2020 objectives of the Renewable Energy Directive as set in the National Renewable Energy Action Plan. In the case of Portugal, the targets for electricity from renewable sources are not specific for hydropower.

In NO and SE, a common certificate market was set up in 2012 and, as a result, the two countries aim to build 28.4 TWh of new renewable energy by 2020 (13.2 TWh in NO, 15.2 TWh in SE). Norway's commitment to the EU Renewable Energy Directive states that it will reach a renewable energy share of 67.5% by 2020. In Norway, hydropower and wind power will probably be the main sources for new production. The National Renewable Energy Action Plan in SE projects that it will increase its share of renewables from 39.7% in 2005 to 50.2% by 2020; however, hydropower's contribution to Swedish electricity supply is expected to decrease, although this is mainly due to the fact that the reference year (2005) was a wet year resulting in unusually high levels of hydropower production.

In DE, between 2010 and 2020, an increase of 2000 GWh/year from hydropower is expected. The realistic development potential (after 2020) is approximately 5000 GWh/year of electricity production. However, there is no general consensus amongst the different actors whether these targets are realistic, taking into account the strict environmental regulations and land use related restrictions in Germany.

In AT, the Energy Strategy 2010 clearly sets that besides other renewable sources, hydropower generation has to be extended by 3.500 GWh to reach the goals in 2020 set by the Renewable Energy Directive.

As it is not a member of the EU, CH is not tied to the requirements of the Renewable Energy Directive; however, legislation in place aims to increase the average annual electricity generation from hydropower plants from its level in the year 2000 by at least 2000 GWh by 2030. Other goals state that the increase by 2035 should be 1100 GWh relative to 2015.

In FR, there is only a slight increase of hydropower planned between 2018 and 2023 of 500-750 MW.

In ES, it is planned to increase hydropower production from the current level of 18600 MW to 26950 MW, but this is still an ongoing debate due to the environmental effects of hydropower on rivers.

Table 4 - Energy/renewable energy policies by country

Energy/renewable energy		
Country	Name of law	Relevant aspects
NO	Energy Act	<p>The Act shall ensure that the generation, conversion, transmission, trading, distribution and use of energy are conducted in a way that efficiently promotes the interests of society, which includes taking into consideration any public and private interests that will be affected.</p> <p>In this Act, electrical installation is defined as: a generic term for electrical equipment and associated building structures for the generation, conversion, transmission and distribution of electrical energy. In this Act, district heating plant is defined as: a term for technical equipment and associated building structures for the generation, transmission and distribution of hot water or some other heating medium to external consumers.</p>
SE	Electricity Preparedness Act (1997)	If owner of a power plant is about to do changes, e.g. mitigations, that will have an impact on the ability to produce energy the owner must give notice to TSO (Svenska Kraftnät). This applies on HPP's with significant importance.
DE	Renewable Energy Sources Act (EEG)	The Act is complementary to the Energiewende and provides for support schemes and conditions for renewable energy sources in Germany. It provides for economic incentives for the use of watercourses for hydropower, but also includes efficiency improvement requirements that must be reached in order for hydropower installations to benefit from the scheme. Due to the EEG incentives, sites of HPPs that are technically unprofitable from a business point of view might become attractive, regardless of their environmental impacts. This not only holds true for newly built HPPs, but also for the repowering of already existing plants.
AT	Green Electricity Act	The Green Electricity Act 2012 (amended in 2013) provides for the expansion plans of renewable technologies as well as associated support schemes.
CH	Energy Act, Federal Hydropower Act	<p>A 2009 revision to the Federal Energy Act contains a package of measures aimed at promoting renewable energies and energy efficiency in the electricity sector, the mainstay of which is the cost-covering remuneration scheme for electricity generated from renewable energies. The maximum surcharge of 0.6 centimes per kilowatt-hour may only be levied once the registered plants with a positive decision have been certified, are feeding electricity into the grid, and are already receiving the cost-covering remuneration. The Federal Office of Energy decided that the 2010 surcharge is to remain at 0.45 centimes per kilowatt-hour. Since the latest revision of the Act in summer 2011, there is also the possibility to use the surcharge for renaturation of rivers impacted by hydropower (Dworak, 2011). There will be another revision of the Act coming into force on January 1, 2018.</p> <p>According to the Energy Act of 1998, the national high-tension grid operator Swissgrid reimburses operators of existing HPP for the costs of mitigation measures as required by the Water Protection Act and the Federal Law on Fisheries (BAFU 2016).</p>

		The Federal Hydropower Act lays down the procedure for granting concessions.
FR	<p>Law n°2000-108 on the modernization and development of the public electricity service (10/02/2000)</p> <p>Law n°2005-781 setting the energy policy guidelines (13/07/2005)</p> <p>Law n°2015-992 on the energy transition for green growth</p> <p>Law n°80-531 on economies of energy and heat utilisation</p>	<p>"Before 31 December 2002, a law will set out the energy policy guidelines for multiannual production investment planning. The Minister for Energy make public the multiannual production investment program which sets out the objectives for the allocation of production capacity by primary energy source and, where appropriate, by production technology and geographical area." (Article 6)</p> <p>Possibility of using call for tenders when production capacity does not meet the objectives of multiannual investment planning (Article 8).</p> <p>Creation of the obligation for EDF to buy, if requested by the producers concerned, the electricity produced by HPP using renewable energies, whose installed capacity per production site does not exceed 12 megawatts [...]. (Article 10).</p> <p>Objective of production of renewable electricity of 21% of consumption in 2010 (compared with 14% in 2005) (Article 4).</p> <p>Possibility to turbine whole or part of the reserved flow (articles 35 and 46).</p> <p>Possibility to increase the power of an authorized or conceded plant by a maximum of 20% per declaration (Article 44).</p> <p>Target of 23% of renewable energy by 2020 and 32% by 2030 (Article 1)</p> <p>At that time, the law sets the target of producing 40% of electricity from renewable sources (Article 1)</p> <p>Allow the gathering of several hydroelectric concessions, linked hydraulically (Article 116)</p> <p>Creation of "reserved rivers": rivers or portions of rivers, designated by decree, on which no authorization or concession is given for new hydraulic scheme</p> <p>Establishment of "reserved flow": minimum flow to be maintained in the natural bed of the river between the water intake and the restitution of a hydroelectric power station</p> <p>(Article 25 that modify the article 2 of the Law on the use of hydraulic energy [16/10/1919]).</p>
ES	Electric Sector Act (2013)	This Act, and many more that develop it, declares the general framework of production, transport, distribution, and trading of energy, and the relationships among companies, Governments and consumers.
PT	Legal Framework of the Activities Developed under National Electric System	Besides completing the transposition of European Directives into the Portuguese legal tissue, this decree-law clarifies the framework of the energy production based on renewable energies by private entities – the so-called special regime, which is the more relevant one in the scope of the FITHydro project. Regarding this regime, along with the previous guaranteed selling price system, a market selling price system can also be applied. However, the additional legislation that was supposed to follow up this decree-law in order to support the option for one of the previous selling systems was never published which definitely compromised and even stopped the development of the private energy production sector.

## Water protection

Table 5 - Water protection policies by country

Water protection		
Country	Name of law	Relevant aspects
NO	Water Resources Act (2001)	The Water Resources Act is a law that aims to ensure a socially sound use and management of watercourses and groundwater. The Act regulates waterway installations, which are defined as building or construction in or over watercourses, and other measures in the river basin which, by their nature, are suitable for influencing water flow, water level, river bed or flow direction and velocity or physical and chemical water quality in other ways than by pollution (which is covered by a separate law). Furthermore, the Act provides the regulation in the rights to use of groundwater, groundwater drilling, concessions for hydropower development and expropriation for hydropower production.
SE	Ordinance on Water Quality Management (2004), Environmental Code (1999), Water Law (1918)	<p>The WFD was transposed into Swedish law, and specifically the Environmental Code, in 2004 through the Ordinance on Water Quality Management (Ordinance 2004:660). The Environmental Code was adopted as new environmental legislation in 1999. In 1999, the Swedish Parliament also decided on 15 (later 16) national Environmental Quality Objectives. The Environmental Quality Objectives are divided into subcategories, each with different sets of indicators. The most immediately relevant to hydropower impacts is Objective 8, “Flourishing lakes and streams”, which has 11 indicators. These are (freely translated): Good ecological and chemical status; unexploited water courses; quality of surface waters; ecosystem services; structures and water flow; preservation and genetic variation; threatened species and restored habitats; invasive species and genome types; genetically modified organisms; preservation of natural and cultural values; and outdoor life. The Swedish Agency for Water and Marine Management (SwAM) is responsible agency overseeing the “Flourishing lakes and streams” objective.</p> <p>Several of the Environmental Quality Objectives are highly relevant for hydropower generation, beyond “Flourishing lakes and streams”. The Water Law of 1918 was designed largely to enable rapid development of hydropower generation to meet burgeoning demand and still regulates most of the current hydropower capacity in the country (including on key issues such as water diversion from rivers and reservoir impoundment).</p>
DE	Federal Water Act (2009)	<p>The Federal Water Act is the key act concerning the assessment of the permissibility and approval of the construction and operation of HPP. For the assessment of permissibility of the HPP (i.e. for construction/reactivation/operation), the Act considers the intended use, whether the development of a water body is involved, whether the reactivation of a station with prior approval is involved, and whether the construction of a new station is involved. Basically speaking, the intended use of waters requires a permit/license, whereas the development of a water body requires a planning approval procedure. However, while some general uses of waters require no approval, such as insignificant public uses, hydroelectricity power plants always require approval. Regarding the construction of HPPs, the following uses can be relevant: impoundage by a weir, diversions of water (e.g. through a turbine), extraction of solid matter through inlet screens, lowering of the water body through deepening and the diversion of water through widening the water bed.</p> <p>The WHG (§§33 to 35) requires ecological measures to be undertaken at HPPs according to the WFD. As a strategic element concerning HP, it demands as well (§35) the examination of unused weirs and dams as locations for hydropower production. The federal states incorporated the WHG into their legislation (Federal State Water Acts (Landeswassergesetze) and Federal State Fishery Acts</p>

		<p>(Landesfischereigesetze)). The Water Act outlines the requirements related to minimum river stream flow and river continuity. A specific requirement for hydropower is that appropriate measures are taken to protect the fish population. Existing installations have to comply with this requirement within a reasonable time.</p> <p>The WHG is the central law for assessing the lawfulness of the establishment and the operation of hydropower facilities. It contains provisions for water management, use of hydropower, permit authorisation and minimum water flow conditions with respect to the EU Water Framework Directive.</p>
<b>AT</b>	National Water Act (1959)	<p>The Austrian Water Act (1959, last updated in 2014) is the main piece of legislation regarding water management and the provisions for projects having a potential impact on the watercourse. The 2010 ordinance on the quality objectives for ecological quality elements in rivers and lakes is based on the EU WFD and complements the Austrian river basin management plan of 2009.</p>
<b>CH</b>	Federal Act on the Protection of Waters (1991)	<p>The 1991 Federal Act on the Protection of Waters included, among other aspects, important provisions for defining minimum flow. The Waters Protection Ordinance takes up the provisions of the Act and sets them out in greater detail. According to Annex 1 of the Waters Protection Ordinance of 1998, the hydrodynamics (unit bed load discharge and water level and flow regime) and the morphology should correspond to the natural conditions. Other objectives were defined for the biocoenosis of the flora and fauna of surface waters, the environment under their influence and the space requirement of the watercourses (FOEN, SFOE, ARE (eds), 2011, Recommendations for developing cantonal conservation and exploitation strategies for small hydropower plants, Bern). The Federal Act on the Protection of Waters was amended in 2011; this amendment is a milestone of water resources protection in Switzerland.</p> <p>Hydropower plants are the source of 59% of the electricity that is produced in Switzerland. In addition, as of 2016 (BFE, 2017) 54% of this supply is produced in storage power plants mainly located in the Swiss Alps, where water is retained in reservoirs in order to meet demand during peak consumption. This intermittent operation gives rise to unnaturally strong fluctuations in the levels of water in streams and rivers below the power plant (“hydropoaking”), and this in turn has a negative impact on aquatic life. When turbines operate at full speed, the maximum outflow can be up to 40 times greater than the water level in the basin (Issue paper Workshop WFD and Hydropower, 2011). Seasonal reservoirs further allow to shift water from snow and glacier melt in spring and summer to the low-flow winter season when energy generation from run-of-river plants (mainly located on the Swiss Plateau) is below average, but electricity demand is highest. This seasonal storage has effects on the hydrographical flow regimes, damping natural flows during the high-flow season, while increasing base flow during the low-flow season.</p> <p>Thanks to the 2011 revision of the Water Protection Act, it is possible to significantly lessen most of these negative impacts by 2030 through the introduction of structural measures, without restricting the level of electricity production. Also, a legal basis has been created for maintaining natural conditions in streams and rivers below hydropower plants (Issue paper Workshop WFD and Hydropower, 2011).</p> <p>The new provisions adopted in the amended Act envisage specifically (Restoring waters to a more natural state: Amended Waters Protection Act in force from January 2011. Press release):</p> <ul style="list-style-type: none"> <li>• Space provided for waters: The Act obliges the cantons to specify and safeguard the space needed to maintain the natural functions of waters and ensure flood protection. Areas used in this space are eligible as ecological compensation areas for farmers. 20 million francs will be made available each year as remuneration for the services provided by those managing these areas.</li> <li>• Rehabilitation: The Act imposes a new obligation on the cantons to conduct the strategic planning and implementation of rehabilitation measures. This ensures the long-term maintenance and restoration of semi-natural watercourses and</li> </ul>

		<p>lakeshores. The Swiss Confederation will provide 40 million Swiss francs per year in co-financing for rehabilitation planning and implementation.</p> <ul style="list-style-type: none"> <li>Mitigating the adverse effects of hydropower generation: The cantons are obliged to eliminate impairments caused by hydropeaking operation and to plan the requisite remedial action. The Act envisages that the measures taken in order to meet this obligation should only be engineering measures (such as holding reservoirs) that do not impair electricity generation compared to operational measures. However, the hydropower operator can also select other measures such as adapting its power operation to fulfil the ecological requirements. Furthermore, impairments of the bedload regime must be remediated. The costs of such measures, and of those taken to restore fish passability in accordance with the Fisheries Act, are financed by levying a surcharge of at most 0.1 centimes per kilowatt-hour on the transmission costs of the high-voltage networks.</li> </ul> <p>The timeline set in the amended Act is for the mitigation of hydropeaking, bed load transport and fish migration to take place until 2030 (power plants and Cantons) for the river revitalisations and improvement of the morphology until 2090 (Cantons) (Schweizer, 2017).</p> <p>As regards hydropeaking and bedload regime, the Swiss Waters Protection Ordinance determines which impairments are to be considered serious and for which hydropower plants remedial measures must be considered. It further sets out the procedure to be taken when planning and implementing such measures. The requirements concerning restoration of free fish migration are set out in an amendment to the Ordinance to the Swiss Fisheries Act (Restoring waters to a more natural state: Amended Waters Protection Act in force from January 2011. Press release).</p>
<b>FR</b>	<p>Law n°92-3 on water (1992)</p> <p>Law n°2006-1772 on water and aquatic environments (2006)</p> <p>Law n°64-1245 on water Regime and distribution and pollution control (1964)</p>	<p>Water is part of the common heritage of the nation. Its protection, its development and the development of the usable resource, while respecting the natural balances, are of general interest. (Article 1)</p> <p>Strengthens the imperative of protecting the quality and quantity of water resources (Articles 2 and 8)</p> <p>Establishment of new tools for water management: in river basin district, the general plan on development and water management (SDAGE) (Article 3 and 4) and more locally the plan on development and water management (SAGE) (Article 5).</p> <p>regulation of installations, works and activities ("IOTA" nomenclature) having an impact on water and aquatic environments: in order to be authorized by the administrative authority, these projects must be subject to an authorization procedure or declaration on the basis of an impact statement (Impact Assessment)</p> <p>Should allow achieving the objectives of the European Water Framework Directive (WFD), in particular the restoration of good ecological status by 2015.</p> <p>Revision of rivers classifications (Article L214-17 of the environment code) with the creation of 2 lists:</p> <ul style="list-style-type: none"> <li>List 1: list of rivers, parts of rivers or canals, among those that are in very good ecological state, or identified by the general plan on development and water management (SDAGE) as a biological reservoir necessary to maintain or restore the good ecological status of rivers in a watershed, or in which complete protection of migratory fish living alternately in fresh and salt water is required, in which no authorization or concession can be granted for the construction of new project if they constitute an obstacle to ecological continuity.</li> </ul> <p>➔ Obligation that apply when the list is published.</p> <ul style="list-style-type: none"> <li>List 2: list of rivers, parts of rivers or canals in which it is necessary to ensure adequate transport of sediments and the circulation of migratory fish. All</li> </ul>

		<p>projects must be managed, maintained and equipped according to rules defined by the administrative authority, in consultation with the owner or the operator.</p> <p>→ Obligation that applies at the end of a period of five years after the publication of the lists, to the existing facilities regularly installed.</p> <p>→ Publication of lists by 1 January 2014 at the latest. Lists published in 2012 and 2013 by river basin district.</p> <p>Revision of the reserved minimum flow values and their implementation time:</p> <ul style="list-style-type: none"> <li>• 1/10 (10%) of the mean annual discharge in general</li> <li>• 1/20 (5%) of the mean annual discharge for projects located on a watercourse with a mean annual discharge greater than 80 m<sup>3</sup>/s.</li> <li>• 1/20 (5%) of the mean annual discharge for HPP which, by their modulation capacity, contribute to the production of electricity during periods of peak consumption (list fixed by decree).</li> <li>• Possible lower values on non-typical rivers.</li> </ul> <p>→ Possibility of setting different minimum flow values depending on the time of year, provided that the annual average of these values is not less than the minimum flows set. The lowest value shall be greater than half the annual minimum value.</p> <p>→ Possibility of derogation during exceptional natural low flow.</p> <p>→ Implementation by 1 January 2014 at the latest.</p> <p>Organization of decentralized water management by major river basin (6 basins), in a concerted manner and with financial incentives</p> <p>Creation of basin committees (consultative structure) and water agencies (executive body) (Articles 13 and 14)</p> <p>Establishment of the National Water Committee (Article 15)</p> <p>For installations that aim to regulate the river flow or increase the flow during low flow period, other than hydroelectric power stations, their authorization can determine a minimum flow to maintain in the river downstream of the intake, called "reserved flow", during different periods of the year, in order to safeguard the general interests and satisfy the needs of other authorized diversion beneficiaries and those of local residents (Article 26).</p>
<b>ES</b>	Water Act (2001)	<p>This act defines and treats the legal regime of both private and public waters, and their use and protection. In relation to river connectivity, it declares rivers and their public domain and of public interest, for instance: the general protection of water bodies and the treatment of damages as an exception, even though it leaves connectivity to further development of the Act.</p>
<b>PT</b>	Water Law (2005)	<p>The Water Law (WFD (Law n.º 58/2005, 29 of December and posterior updates Rectification n.º 11-A/2006, Decrees-Law n.º 60/2012 and n.º 130/2012 and Law n.º 42/2016) transposes the WFD to the Portuguese legislation. It is the main legislation on the protection of the Portuguese water resources and bodies. It establishes the need to implement measures to attain a good ecological status (or potential) in all water bodies, namely rivers, the need for the new water uses to comply with those objectives, and the cases where exceptions to the requirement to prevent further deterioration or to achieve good status under are allowed (unforeseen or exceptional circumstances, or for reasons of overriding public interest or new modifications to the physical characteristics of a surface water body, provided that all practicable steps are taken to mitigate the adverse impact on the status of the body of water).</p>

## Water infrastructure

Table 6 - Water infrastructure policies by country

Water infrastructures		
Country	Name of law	Relevant aspects
<b>NO</b>	Watercourse Regulation Act (1917)	This Act applies to all types of regulations or introduction of installations of watercourses that aim at changing the water flow. Regulations of watercourses are understood to be installations or other measures for regulating a watercourse's rate of flow, including expanding or altering older regulating installations. Installations or works intended to increase the rate of flow by diverting water and pumping water to a reservoir located at a higher elevation are likewise to be regarded as regulations of watercourses.
<b>FR</b>	Law on the use of hydraulic energy (1919) Ministerial circular on waterworks (1851)	"No person may dispose of the energy of tides, lakes and watercourses, irrespective of their classification, without a concession or authorization from the State" (Article 1)  Organization of the development regime according to their maximum power (maximum falling height * maximum derived flow) (Article 2): <ul style="list-style-type: none"> <li>• <math>P &gt; 4.5 \text{ MW} \rightarrow</math> Concession</li> <li>• <math>P \leq 4.5 \text{ MW} \rightarrow</math> Authorization</li> </ul> Maximum duration of a concession fixed at 75 years; Renewable in increments of 30 years.  Maximum duration of an authorization fixed at 75 years; renewable.  A standard water regulation must be complied with for waterworks located on public watercourses  One of the provisions of the water regulation is the construction of fish ladders
<b>ES</b>	Water Act (2001)	This act defines and treats the legal regime of both private and public waters, and their use and protection. In relation to river connectivity, it declares rivers and their public domain and of public interest, for instance: the general protection of water bodies and the treatment of damages as an exception, even though it leaves connectivity to further development of the Act.
<b>PT</b>	Water Resources Utilization Regime (2007)	This legislation details the aspects related to the issuing of water use permits. Hydropower production is one of the water uses requiring a water permit (concession), including the water use for energy production and the build of water infrastructures. The Decree-Law establishes the procedures needed for someone (usually a private entity) to require a water use permit, the maximum concession period (maximum 75 years, and variable according to the investment required; concession periods may vary from 50-75 years for an installed capacity $> 50 \text{ MW}$ , from 35-50 years for an installed capacity 30-50 MW and from 15-35 years for an installed capacity $< 30 \text{ MW}$ ). It also establishes some of the users obligations, such as the need to monitor the water use and its impacts (ecological state), as well as the situations where the cessation of the water use can be enforced.

## Nature protection

Table 7 - Nature protection policies by country

Nature protection		
Cou ntry	Name of law	Relevant aspects
<b>NNO</b>	Plan and Building Act (2010)	<p>The Act shall promote sustainable development in the best interests of individuals, society and future generations. Planning pursuant to this Act shall facilitate the coordination of central government, regional and municipal functions and provide a basis for administrative decisions regarding the use and conservation of resources. The processing of building applications pursuant to this Act shall ensure that projects are carried out in compliance with statutes, regulations and planning decisions. Individual projects shall be carried out in a proper manner. Planning and administrative decisions shall ensure transparency, predictability and public participation for all affected interests and authorities. There shall be emphasis on long-term solutions, and environmental and social impacts shall be described. With respect to hydropower development, this The Norwegian directorate for Water and Energy Resources (NVE) is the responsible authority, which specifies the Environmental Impact Assessment (EIA) program and also controls the fulfilment of the EIA.</p>
<b>DSE</b>	Federal Nature Conservation Act (2010)	<p>The construction and operation of HPPs is relevant for the Federal Nature Conservation Act in terms of the potential interference with nature and landscape ecosystems. Article 15 of the act stipulates that interference with nature is not allowed when the effects are neither avoided nor sufficiently compensated, and that the interests of nature protection and landscape conservation shall be given priority over all other interests.</p> <p>The construction, enlargement or conversion of an HPP can be classified as an interference with nature (according to the Act's definition). However, this is only in the case for stations located in the outer zone ("Aussenbereich") (i.e. outside local development plans, outside unplanned inner zones of settlements, or inside the planning area of a not yet finalized local development plan). According to the Building Code, HPPs in the outer zone have several undeniable ecological and hydromorphological impacts, and therefore interfere with nature.</p> <p>The Act details the protection of valuable species, habitats and landscapes. The act also stipulates restrictions on the construction and structural alteration of HPPs located in officially protected areas and states that damage or modification to nature protection areas or component parts is prohibited. The construction or enlargement of HPPs inevitably modifies a natural area, according to the definition of modification in the Act.</p> <p>The aspects on habitats protection and the coherence of the N2000 network are the most important in the context of commissioning and operating HPPs. The coherence aspect is especially relevant, as it ensures both upstream and downstream connectivity.</p>
<b>FFR</b>	<p>Law n°76-629 on nature protection (1976)</p> <p>Law n° 2009-967 for the implementatio</p>	<p>Obligation to carry out an impact assessment on the natural environment prior to the works and development projects (Article 2).</p> <ul style="list-style-type: none"> <li>• Definition of the minimum content of the impact assessment, including the measures envisaged to eliminate, reduce and if possible compensate for the harmful consequences on the environment (ERC sequence) (Article 2).</li> <li>• Creation of the status of protected species (Articles 3 and 4)</li> <li>• Creation of nature reserves (Article 16 and following)</li> </ul>

	n of the "Grenelle de l'environnement (2009)	<p>Commitment to increase the proportion of renewable energies to at least 23% of the final energy consumption by 2020 (Article 2).</p> <ul style="list-style-type: none"> <li>Objective of achieving good ecological status for at least 2/3 of the watercourses (Article 27).</li> <li>Aim to create a "green and blue network", which will help to preserve and restore the ecological continuity of the environment by, in particular, studying the most problematic obstacles to fish migration (Article 24, 26 and 29)</li> </ul>
<b>EES</b>	Natural Heritage and Biodiversity Act (2007)	It protects the wild flora and fauna of Spain and their habitats, according to the EU Law. It declares the types of legal protection and the naturally protected areas of Spain, both terrestrial and marine ones, and the treatment of the use of species and territories.
<b>PPT</b>	National network of nature protected (2008)	The first Decree-Law establishes and structures the national network of nature protected areas, including Natura 2000 sites and other protected areas. The second Decree-Law transposes the Habitats Directive, which aims to protect/maintain habitats, animal and plant species endangered in the European Union territory. Several of the listed habitats and species are aquatic and riparian, thus closely linked to rivers. Iberian habitats and species are listed in the Directive Annexes and in the Portuguese legislation.

## Fisheries

Table 8 - Fisheries policies by country

<b>Fisheries</b>		
<b>Country</b>	<b>Name of law</b>	<b>Relevant aspects</b>
<b>CH</b>	Federal Act on Fisheries (1991)	The Federal Act on Fisheries requires taking necessary measures for free fish migration at existing HPP. These measures have to be taken until 2030.
<b>SE</b>	Ordinance concerning EQS for fish and mussels (2001)	No specific provisions which relate to environmental improvements for fish in HP schemes
<b>FR</b>	<p>Law n°84-512 on freshwater fishing and the management of fish resources (1984)</p> <p>Law on fish and fisheries (1865)</p>	<p>"The preservation of aquatic environments and the protection of the fish population are of general interest" (Article 2).</p> <p>- Confirmation of the obligation to maintain a minimum flow ("reserved flow") downstream of the project, which permanently guarantee the life, circulation and reproduction of the species (Article 4)</p> <p>The facilities and works likely to destroy the spawning grounds, the feeding and the growing areas of the fish are subject to authorization (article 408)</p> <p>Minimum value set for the reserved flow (Article 4):</p> <ul style="list-style-type: none"> <li>1/10 (10%) of the average annual flow for any new project, and for existing project when renewing their authorization or concession.</li> <li>1/20 (5%) for any new project located on a watercourse with a mean annual discharge greater than 80 m<sup>3</sup>/s and for existing project when renewing their authorization or concession.</li> <li>1/40 (2.5%) for project already existing on the date of publication of the law, within 3 years from that date.</li> <li>Creation of classifications of rivers or parts of rivers on which the circulation</li> </ul>

		<p>of migratory fish must be ensured (Article 4):</p> <ul style="list-style-type: none"> <li>• In rivers or parts of rivers and canals, listed by decree, any project shall include devices to ensure the circulation of migratory fish. The operator shall be responsible for the operation and maintenance of these devices.</li> <li>• Existing projects shall comply, without compensation, with these obligations within five years from the publication of a list of migratory species.</li> </ul> <p>Possibility of installing fish ladders on the dams of hydraulic plants following an inquiry learned by the conservators of Waters and Forests</p>
<b>ES</b>	Rivers Fishing Act (1942)	<p>This old act fosters fishing and some protection of relevant species, such as salmon, sturgeon and trout, by imposing limits to catching and by promoting restocking. This act has been widely overcome by regional acts. In Castilla and León region, the 9/013 Act of Fishing does not include any matter on rivers connectivity for the general jurisdiction in water works on the Duero river basin depends on the State, as the Constitutional Courts has sentenced.</p>
<b>PT</b>	Freshwater Fisheries Law (2015)	<p>This recent legislation replaces older legal documents (dating from 1959 and 1962) and aims to protect freshwater fisheries by means of sustainable management. It includes several articles related to the mitigation of impacts resulting from new hydraulic projects, namely by imposing the owners or users of water infrastructures to release environmental flows allowing the maintenance of good ecological status (Article n.º 12) and related to river connectivity (if deemed necessary, existing projects that block fish passage could be forced to install fish passes, Article n.º 13).</p>

### Environmental impact assessment

Table 9 - Environmental Impact Assessment policies by country

Environmental Impact Assessment		
Country	Name of law	Relevant aspects
<b>DE</b>	Law on Environmental Impact Assessment Act (EIA Act) (2010)	<p>The EIA act regulates environmental impact assessments for projects with a potential impact on the environment. ] The EIA Act (UVPG) aims to ensure effective precautionary protection through two main approaches. Firstly, it requires that impacts on the environment are comprehensively investigated, described and assessed in good time, and secondly, that findings of an environmental impact assessment are taken into account as early as possible in all decisions on permissibility (Article 1).</p> <p>The projects that shall be subject to an EIA are listed in Annex 1, of which the construction of a new HPP is mentioned under number 13.14 and the repowering of a station is included under number 13.18 . Thus, a general pre-examination of the individual case is required. Whether a full EIA is required, or not, depends on the intensity of the impact on the environment. In this regard, the involved authorities have a certain margin of discretion.</p> <p>The EIA act also sets standards on how public interest parties (“Träger öffentlicher Belange”) such as Nature NGOs can participate in the EIA procedure. Often the EIA is the only way for public interest parties to actively participate in the planning process. The EIA act also regulates the strategic assessment of public plans or programmes on the basis of Directive 2001/42/EC (known as 'Strategic Environmental Assessment' – SEA Directive).</p>

<b>AT</b>	EIA Act (2000)	<p>The EIA Act 2000 (last updated in 2013) gives provisions for environmental planning instruments, development control plans, procedures and certification.</p> <p>The EIA act 2000 provides that with regard to hydropower planning, an environmental impact assessment is mandatory for hydropower plants with a bottleneck output of 15 MW or more as well as several subcategories of hydropower facilities.</p>
<b>ES</b>	Environmental Impact Assessment Act (2013)	<p>In relation to the EU law, it describes those projects and plans subject to EIA, the administrative procedure and the value of the final decision taken before a project or plan is approved. Some regional law declares the submitting of EIA on certain water works, generally on small water infrastructures, but the procedure on national basins must be carried out by the regional government.</p>
<b>PT</b>	Legislation on environmental impact assessment (2013)	<p>The legislation transposes the European Directive 2011/92/UE, on the assessment of the effects of certain public and private projects on the environment. Hydropower projects are subjected to an environmental impact assessment (EIA) for installed capacities <math>\geq 20</math> MW, in any area, or <math>\geq 1</math> MW, if in a Nature protected area, including Natura 2000 sites. Projects with less than 1 MW but that promote changes in the hydrologic regime or require the construction of weirs are also subjected to EIAs if located in Nature protected areas. Projects not subjected to EIA are nonetheless subjected to a similar study, albeit somewhat less detailed, named "Estudo de Incidências Ambientais". The EIA assesses compatibility of the project with other legislation, including on water protection. Therefore, it is at this stage that the impacts of the project are evaluated as to their compatibility with the WFD environmental objectives. It is also at this stage that matters such as environmental flows and fish passages are discussed.</p>

## 4. Strategic planning instruments

In addition to legislative instruments, the review of national policies examined the use and role of “strategic planning” for hydropower and possible environmental improvements at national and regional level. Emphasis has been placed on strategic planning instruments developed to guide a) new hydropower use and development taking into account water and environmental protection objectives, and b) the implementation of measures for restoring continuity.

### 4.1 Strategic instruments for new hydropower use and development

The review examined whether countries established strategic planning instruments for new hydropower use and development. This may include for example definition of locations suitable for hydropower in terms of water protection and economic benefits, as well as definitions of areas of high ecological value where hydropower development is not allowed.

The majority of the reviewed countries have such strategic planning instruments in place (AT, CH, DE, ES, FR, NO) with the aim of balancing multiple objectives and impacts of HPP (e.g. ecological value of river vs. energy management vs. water management objectives). These strategic planning instruments are developed mostly for the national and regional level. They are part of or related to other planning processes, especially hydropower sector planning (AT, CH, DE, FR, NO), national renewable energy action plans (ES, FR, NO) or river basin management planning (NO, AT, FR, ES).

Table 10 - Strategic planning instruments by administrative level and planning process

Country	Name of instrument	Administrative level				Overall Planning Process			
		National	River Basin District	Regional	Federal state	River Basin Management Plans National	Renewable Energy Action	Hydropower sector planning	Regional planning procedures
NO	Master plan for Hydropower development (Samlet Plan)	X				X	X	X	
	Regional small scale hydropower master planning			X			X	X	X
SE	National strategy for hydropower (SEA & SwAM)								
DE	Hydropower potential studies	X		X	X			X	
AT	Criteria catalogue for hydropower as a basis for further regional planning	X				X		X	
	Alpine region - Common Guidelines for the use of small hydropower in the alpine region			X					
	Designation of appropriate/not appropriate sites - Vorarlberg			X					
	Hydropower potential studies	X		X					
CH	Recommendations for developing cantonal conservation and exploitation strategies for small hydropower plants	X			X			X	
FR	Classification of rivers (list 1)		X			X			X
	Regional climate, air and energy scheme (SRCAE)			X			X	X	X
	Calls for submission	X		X			X	X	X
ES	Hydrological Plans of Water Districts		X			X			
	National Plan of Renewable Energy 2011-2020	X					X		

Strategic planning instruments being used include:

- **Legal requirements** defining where development of hydropower is allowed or not. For instance, in France, hydropower development is not allowed in streams (or parts of stream) classified as “list 1”, even with devices installed for upstream and downstream migration and sediment transport, as these devices are never fully efficient.
- **National and regional master plans or strategies** to guide hydropower development. In Norway for example, the Samlet Plan, in place since the 1980s (but phased out since 2016), classified water courses for development or protection and prioritised hydropower projects based on the degree of conflict in relation to different user interests (e.g. environment, fishing, biodiversity, recreation, etc.) and power plant economics. This is complemented with regional small-scale hydropower master plans which map the hydropower resources and the characteristics of these resources. The resources are typically assessed with respect to biodiversity, areas without landscape qualities, prior encroachments, fish and game fishing, historical/cultural sites, recreation, tourism and domesticated reindeer.  
In Sweden, a national strategy for hydropower is being developed to determine the respective energy and environmental values of Swedish river basins and provide a framework for their prioritization in terms of hydropower development.
- **Decision support systems to guide decision-making.** In Austria, a criteria catalogue for new hydropower development has been developed at national level to guide regional planning. It includes criteria assessing the ecological value of river stretches, criteria for the assessment of specific hydropower projects taking into account ecological, energy management and water management aspects in case of expected status deterioration. In Switzerland, there are recommendations for developing cantonal conservation and exploitation strategies for small hydropower plants; these offer the cantons a guide on how to handle the sometimes conflicting objectives, especially between energy and water policies. They indicate where hydropower exploitation is possible and where conservation should be the priority.
- **Studies examining the potential for hydropower.** In Germany for example, the federal government and some Länder with a higher unused hydropower potential have prepared or are preparing such studies to identify optimal locations for new hydropower. In those studies, environmental exclusion criteria are used. This for example requires that no installation of new HPP occurs in natural free-flowing river stretches or that new HPP at existing transverse structures need to allow minimum flow conditions.  
In France, studies of the potential for development of hydroelectricity (new sites and equipment of existing weirs or dams) have been conducted at the hydrographic district level. In 2013, a synthesis of these studies was made to identify the potential for hydropower development at national level, indicating that most part of this potential (roughly 70%) is on rivers classified in “list 1” (where no new hydropower development is allowed).

In PT, no strategic planning instrument is in place. However, there have been experiences with such instrument in the past (e.g. the “National Program for Dams with High Hydroelectric Potential”, which identified 25 areas suitable for new hydropower projects).

Although these strategic planning instruments are not related to simplification of authorisation processes for HPP, they can give a signal to operators about hydropower projects which are more likely to be rejected or accepted in the authorisation procedure (at specific sites).

Table 11 - Summary of strategic planning instruments for hydropower

Country	Name of strategic planning instrument	Relevant aspects
NO	Master plan for Hydropower development (Samlet Plan)	Samlet plan is an old planning instrument going back to 1984-85 with the aim to classify all watercourses for development or protection. This national master plan is based on a systematic verifiable prioritisation of hydropower projects, based on the degree of conflict in relation to different user interests (environment, fishing, biodiversity, recreation, etc.) and power plant economics. From 2016, Samlet Plan was actually formally phased out as a planning instrument.
	Regional small scale hydropower master planning	The purpose of the regional small-scale hydropower plans is to map the hydropower resources and the characteristics of these resources. The resources are typically assessed with respect to biodiversity, areas without landscape qualities, prior encroachments, fish and game fishing, historical/cultural sites, recreation, tourism and domesticated reindeer. The regional plans and guidelines will be an important basis for the total assessment made for the individual project and should not replace today's licensing.
SE	National strategy for hydropower (SEA & SwAM)	Balanced approach between WFD and EU energy directives Provide a framework for prioritization in regulating Swedish river basins, based on a system designed to determine the respective energy and environmental values of major Swedish river basins
DE	Hydropower potential studies	<p>Apart from the requirements of the WFD, there are no explicit strategic environmental agendas imposed by federal authorities, given the limited unused potential for new HPPs. The main challenge is to deal with the environmental impacts of existing hydropower. Some states in possession of higher unused hydropower potentials have carried out surveys to identify optimal locations for installing new HPPs. However, these studies mainly focus on the technical aspects such as the hydropower capacity of river systems.</p> <p>Another new provision in the Water Act with strategic relevance refers to existing dams, weirs, or barriers in a river (S. 35(3)). In cases where the removal of weirs and barriers is not necessary in order to achieve the Act's water management objectives, authorities are required to assess whether they are structures suitable for hydropower, and to make the corresponding assessment publicly available. This is intended to provide new motivation for an environmentally sound expansion of hydropower</p> <p>There are some planning instruments on the administrative level (national, federal). Examples include the studies on the hydropower potential for Germany as a whole and the sub-basins such as the one for Neckar River. At the level of the federal states, water authorities check if hydropower use is possible on non-replaceable transverse structures. (WHG §35 (3)" [1] In addition, some federal states also issue capacity studies, summarising regional studies and filling gaps (e.g. Potentialstudie Erneubare Energien NRW 2017)</p> <p>As a basis for the German hydropower development strategy, the Federal Ministry of Environment, Nature Conservation and Nuclear Safety (BMU) has commissioned further research to determine the additional usable potential of hydropower throughout Germany, using a consistent method of line potential calculations (Environmental exclusion criteria are, for example, that no installation of new HPP in</p>

		natural free-flowing river stretches is allowed and new HPP at existing transverse structures need to allow minimum flow conditions. Criteria for the approval of hydropower use could be, for instance, if the deconstruction of a weir isn't possible due to other reasons (e.g. regulation of the ground-water table), if water discharge to assure minimum flow conditions is guaranteed and if no conflicts with flood defence measures will happen.
<b>AT</b>	Criteria catalogue for hydropower as a basis for further regional planning	The "Criteria Catalogue for new hydropower development" (Österreichischer Wasserkatalog: Wasser schützen – Wasser nutzen. Kriterien zur Beurteilung einer nachhaltigen Wasserkraftnutzung) is a decision support system as basis for regional planning. In a first step the catalogue was published as a national ordinance which needs to be made more explicit by the Austrian provinces in a second step. The national criteria catalogue includes criteria assessing the ecological value of river stretches, criteria for the assessment of specific hydropower projects taking into account ecological, energy management and water management aspects in case of an expected status deterioration.  Preplanning for new hydropower development based on the national criteria catalogue (published by the Ministry in 2012) was already implemented in 3 provinces and is still undergoing in at least one province.
	Alpine region - Common Guidelines for the use of small hydropower in the alpine region	-
	Designation of appropriate/not appropriate sites - Vorarlberg	-
	Hydropower potential studies	-
<b>CH</b>	Recommendations for developing cantonal conservation and exploitation strategies for small hydropower plants	These recommendations offer the cantons a guide on how to handle the sometimes conflicting legal objectives, especially between the Energy Act and the Waters Protection Ordinance. They offer the stakeholders a guide to decision making with the aim of balancing the different claims to the watercourses against each other. They indicate where rational and reasonable hydropower exploitation is possible and where conservation has priority.  A list of the main criteria is proposed and can be extended by the cantons as necessary. A list of this type is used to evaluate and objectively assess the different conservation and exploitation interests and weigh them against each other transparently if conflicts arise. This means that projects are evaluated nationally under comparable criteria. The planning security for applicants is also increased. Coordinated over large areas, the recommendations can also be used by the cantons to designate the locations suitable for hydropower exploitation and include them as mandatory in their spatial planning instruments.
<b>FR</b>	Classification of rivers (list 1)	On stream or part of streams classified "list 1" according to the article L.214-17 of the environment code (see the description of the law

		<p>n°2006-1772 on water and aquatic environments published on December 30, 2006), it is not allowed to build new scheme which constitute an obstacle to the ecological continuity (the notion of obstacle to the ecological continuity is defined by law). Even equipped with devices for upstream and downstream migration and sediment transport, as these devices are never fully efficient, it is considered up to now that it is not possible to build a new intake for hydropower on these streams.</p> <p>As of 2009, following the “Grenelle de l’environnement” Law, which calls for qualitative and quantitative targets to be reached by geographical areas for the development of renewable energy potential by 2020 and 2050 (SRCAE), studies of the potential for development of hydroelectricity (new sites and equipment of existing weirs or dams) were conducted at the hydrographic district level. In 2013, a synthesis of these studies was made by the ministry of energy and by hydroelectric companies (UFE; ufe-electricite.fr) to identify the potential for hydropower development at national level. However, most part of this potential (roughly 70%) is on river classified in list 1. The remaining potential is only around 3 TWh.</p>
	Regional climate, air and energy scheme (SRCAE)	<p>There are not high objectives to developed hydroelectricity as explained above.</p> <p>The Regional climate, air and energy schemes identify more precisely within each region new sites and existing weirs where equipment are possible.</p>
	Calls for submission	Contribute to the achievement of 23% of renewable energy by 2020 by developing hydroelectricity
<b>ES</b>	Hydrological Plans of Water Districts	The hydrological water districts plans foresee areas in which further development of water works are either not permitted or under serious restrictions
	National Plan of Renewable Energy 2011-2020	Mainly, to reduce CO2 levels and the import of petrol and gas.

#### 4.2 Strategic instruments to restore continuity

The policy review examined whether countries established planning instruments to reduce the impact of existing hydropower on river continuity. This may include for example strategies for the landscape scale restoration of connectivity, prioritised action on particularly valuable water bodies, etc.

The majority of the reviewed countries have strategic planning instruments for restoring continuity in place. In PT, a relevant instrument is under development; the RBMPs currently in force have called for a specific plan for the restoration of river connectivity, riparian vegetation and the revision of environmental flows. According to the RBMPs, this plan should be available between 2017 and 2019 and put in force thereafter. In SE and NO, there is no relevant strategic instrument to restore continuity, but in NO, there are other relevant processes promoting restored continuity (see below).

Especially, the WFD environmental objectives are a very strong instrument to restore continuity for migrating species in regulated rivers. To reach WFD objectives, problems of barriers and river fragmentation need to be tackled. Many countries have included measures in their RBMPs to restore continuity and mitigate the impact of barriers through for example fish ladders,

ensuring environmental flows, etc. In Austria, a specific strategic plan for continuity restoration does not exist, but the RBMP 2009 included a general strategy to ensure connectivity from downstream to upstream and from “large into small rivers” and to start with rivers ( - stretches) which are historically the habitats for medium distance migrators (which are the most threatened fish species in Austria).

A variety of additional mechanisms to restore continuity have been established in other countries:

- France has identified a list of watercourses, called “list 2”, where it is necessary to ensure the circulation of migratory fish and sediment transport. The list was established for each RBD in 2012 or 2013. This obligation applies at the end of a period of five years after the publication of the lists (2017 or 2018). The compliance period has recently been extended by 5 years.
- In addition, France has issued a Regional Ecological Coherence Scheme which involves:
  - i) a diagnosis of the regional territory and a presentation of the stakes related to the reservation and the restoration of environmental continuity at the regional scale,
  - ii) a presentation of the ecological continuities selected to constitute the Regional “trame verte et bleue” and identifying the biodiversity reservoirs and the corridors they include,
  - iii) a strategic action plan,
  - iv) a cartographic atlas, and
  - v) a monitoring and evaluation system.

The strategy does not create new regulatory tools; instead it ensures the coherence of the existing policies and complements them with a network approach.
- In Spain, there is a national strategy of river restoration, aiming at restoring river connectivity and riparian and flooding areas in relation to civil protection and environmental purposes.
- Norway has published a national report on the “revision of concessions”. It gives an indication about the measures that are needed in order to improve the environmental status at HPP. More detailed studies in the individual cases are needed to specify the most cost-efficient measures, but restoring of continuity is considered being the most important measure in many rivers together with increased releases of water in bypass sections. The "revision of concessions" (only revision of the environmental terms, not the concession itself) have identified those objects that will be prioritized (given higher environmental requirements/standards), and migration is one of the key ecological processes to be restored/mitigated. In addition, it is possible to apply for financial support from the Norwegian Environment Agency to build and restore fish ladders.
- Germany has published a number of connectivity studies and strategies at the basin and sub-basin levels delineating migratory routes with special importance for the conservation and repopulation of diadromous and potamodromous species, indicating fish passability, hydromorphological status and restoration potential of habitats. A connectivity concept and a biotope network for the federal waterways are being developed. Connectivity concepts also exist for certain target species, such as salmon and eel, delineating priority water bodies for connectivity measures at Länder level.

Table 12 - Relevant aspects of strategic planning instruments to restore continuity

Country	Name of strategic planning instrument	Relevant aspects
NO	Revision of concessions report	<p>The "Revision of concessions"-report (2013) was a national exercise of those approx. 400 hydropower concessions that can undergo a revision of terms (environmental requirements) the coming 6-7 years. The national authorities screened these 400 objects in order to make a prioritised list of concessions where environmental improvements are prioritised and concessions which will be "saved" (no losses of power production accepted), as they were considered very important for the provision of energy and regulated power. In order to do such an assessment, a set of environmental and energy-related criteria were established, as the basis for the prioritised list.</p> <p>This is a national report and must be considered only giving indications about the measures that are needed in order to improve the environmental status. More detailed studies in the individual cases are needed to specify the most cost-efficient measures, but restoring of continuity is considered being the most important measure in many rivers together with increased releases of water in bypass sections.</p>
DE	Continuity strategies for fish fauna	<p>There are several strategic planning instruments on the basin and sub-basin level (i.e. connectivity studies for potamodromous and diadromous fish species). Connectivity strategy for the fish fauna (LAWA Strategiepapier Fischdurchgängigkeit): delineation of migratory routes with special importance for the conservation and repopulation of diadromous and potamodromous species (content: Identification of target species, setting up information systems on transversal structures in rivers including an assessment of fish passability, hydromorphological status and restoration potential of habitats.) The connectivity strategies of the national river basin associations can indirectly be used to designate appropriate river stretches for hydropower usage. At the moment a connectivity concept and a biotope network for the federal waterways in Germany are being developed (Bundesweites Fachkonzept "Biotopverbund Gewässer und Auen".) Connectivity concepts also exist for certain target species, such as salmon and eel, delineating priority water bodies for connectivity measures ("Zielarten Gewässer(-strecken)") (e.g. Migratory Fish Species Pro-gramme Northrhein-Westfalia).</p>
AT	River Basin Management Plan 2009	<p>A specific strategic plan for continuity restoration does not exist. But the RBMP 2009 included the general strategy to restore river continuity from downstream to upstream and from "large into small rivers" and to start with rivers(-stretches) which are historically the habitats for medium distance migrators (medium distance migrators are the most endangered fish species in Austria). River continuity includes that also a base flow is provided to guarantee passability for fish. The prioritisation approach for continuity restoration applied in the RBMP is combining these ecological criteria with administrative criteria (like number of obstacles which have to be restored) because not only hydropower plants have to restore continuity but also any other obstacles (mostly due to flood protection) within the "priority river stretch) also has to restore continuity. Another criterion for selecting the priority area for restoration is the ecological effectiveness that means that some river stretches might be postponed as there are too many obstacles in the (downstream) part of the river.</p>
CH	Restoration of fish migration – strategic	-

	planning	
	Protection of habitats of aquatic animals	This enforcement guide indicates a procedure which is appropriate for fulfilling the requirements of water protection and fisheries legislation in terms of re-establishing fish migration.
FR	Classification of rivers (list 2)	There is a list of stream or part of streams (called “list 2”), where it’s necessary to ensure the sediment transport and the circulation of migratory fishes (see the description of the law n°2006-1772 on water and aquatic environments published on December 30, 2006). These lists were established for each River basin District and published in 2012 or 2013. This obligation applies at the end of a period of five years after the publication of the lists (2017 or 2018). The compliance period has recently been extended by 5 years (law n°2016-1087 published on August 08, 2016).
	Regional ecological coherence scheme (SRCE)	<p>The SRCE includes:</p> <ul style="list-style-type: none"> <li>- a diagnosis of the regional territory and a presentation of the stakes related to the reservation and the restoration of environmental continuity at the regional scale</li> <li>- a presentation of the ecological continuities selected to constitute the Regional “trame verte et bleue” and identifying the biodiversity reservoirs and the corridors they include</li> <li>- a strategic action plan</li> <li>- a cartographic atlas</li> <li>- a monitoring and evaluation system</li> </ul> <p>The SRCE do not create new regulatory tools. It ensures the coherence of the existing devices and complements them with its network approach.  <a href="http://www.trameverteetbleue.fr/vie-tvb/avancement-srce">http://www.trameverteetbleue.fr/vie-tvb/avancement-srce</a></p>
ES	National Strategy of River Restoration	To restore rivers connectivity and riparian and flooding areas in relation to civil protection and environmental purposes.
	Basin Water Plans (minimum flows and river restoration)	-
PT	Plan for the restoration of river connectivity and of the riparian vegetation and for the revision of the environmental flows	To improve the hydromorphological conditions of water bodies. The preparation of this plan recognises that the alteration of the river regime is one of the major anthropogenic pressures upon rivers. It also states that there are some barriers (dams and weirs) no longer used but that represent barriers for fish. Although the river basin management plans foresee the implementation of this plan at each river basin district, the national water plan recognized that a national plan would allow a more detailed and coordinated analysis of this question, including different authorities (water authorities, nature protection authorities and energy authorities) and operators (e.g. hydropower plant owners). The results of the plan should secure the efficiency of the environmental flows in force accounting for the environmental objectives settled for the water bodies bellow dams and weirs.

Table 13 - Administrative level and planning process of strategic planning instruments to restore continuity

Country	Name of strategic	Administrative level	Overall Planning Process
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	planning instrument	National	RBD	Regional	Federal State	RBMP	Eel Management Plans	Other
NO	EU Water Framework Directive		X			X		X
	Revision of concessions report	X				X		X
DE	Continuity strategies for fish fauna	X	X	X	X	X	X	X
AT	River Basin Management Plan 2009	X				X		
CH	Restoration of fish migration – strategic planning (Wiederherstellung der Fischwanderung – strategische Planung)	X						
	Protection of habitats of aquatic animals							X
FR	Classification of rivers (list 2)		X				X	
	Regional ecological coherence scheme (SRCE)			X				
ES	National Strategy of River Restoration	X				X		
	Basin Water Plans (minimum flows and river restoration)		X					
PT	Plan for the restoration of river connectivity and of the riparian vegetation and for the revision of the environmental flows	X	X			X		X

## 5. Environmental requirements in the context of authorising hydropower plants

As part of the review of national policies in the FIThydro project, we examined how environmental requirements especially for mitigation measures are set for hydropower plants. This mainly takes place in the context of the authorisation procedures for HPP (new authorisation procedures, or revision or renewal of valid authorisations). In the following, the regulatory framework has been reviewed in terms of i) the duration of concessions/permits and options for their revision, ii) mitigation measure requirements for HPP and iii) monitoring requirements for mitigation measures.

### 5.1 Duration of permits/concessions

Three key elements were reviewed with regards to the duration of hydropower permits (or concessions, authorizations). Firstly, the “typical” duration of concessions in each country was identified. The assessment also determined if permit duration is the same for all HPP and if not, the criteria that define the duration were investigated (size, location, year on which permit was issued etc). Finally, differences in the duration of concessions between new and existing HPP were examined. This could be the case, e.g. if the legislation on permit durations has recently changed.

Prior to the strengthening of environmental legislation in the second half of the 20<sup>th</sup> century, many countries offered unlimited concessions (AT, DE, SE) or particularly long concessions to HPP (up to 99 years in ES). For example, up to 90% of HPP in Sweden are under unlimited old concessions regulated under the Water Law of 1918, which was designed largely to enable rapid development of hydropower generation and still regulates most of the current hydropower capacity in the country. As a consequence, many measures which can promote ecological sustainability – such as fauna passages and minimum flow rates – are not common among the active concessions.

Overall, permit duration is not the same for all HPP in any of the countries reviewed, with the exception of Sweden. In addition, based on recent changes in environmental legislation and social pressure, permit duration for HPP has been in general reduced. The following can be noted for the countries reviewed, with further details provided in Table 14.

- In Austria, previous unlimited permits were changed to a limitation of 90 years for large HPP and up to 40 years for small HPP in case of permit renewal. Existing very old small HPP have time-unlimited permits, although permits can be renewed in case of severe changes in water use. Nowadays, new small HPP has typically concessions of 30-40 years while new large HPP has concessions of 60-90 years.
- In Switzerland, permit duration varies between 40-80 years.
- In Germany, the recommended length of concession for new HPP is 30 years. Older HPP have longer or indefinite concessions, so-called ‘ancient rights’.
- In Spain, permit duration varies between 25-75 years.
- In France, it varies between 20-50 years.
- In Portugal, permit duration varies between 50 and 75 years for HPP>50 MW, between 35 and 50 years for HPP between 30-50 MW; and 15-35 years for HPP<30 MW.
- In Norway, small hydropower permits (<10 MW) usually have unlimited duration. There is also a distinction between public and privately owned HPP; two thirds are publicly owned HPP with unlimited permits, while the remaining privately owned plants have 60 year permits. Generally, permit duration nowadays is somewhere between 30 and 80 years.

There is also a revision of the environmental terms of licenses planned after 50 years, and after 30 years for the larger HPP built after 1992.

- In Sweden, permits of HPP are of indefinite time; time-limited permits still remain only a recommendation in the Environmental Code.

In most of the reviewed countries (NO, AT, DE, FR, ES, PT), the duration of concessions generally differs between new and existing HPP, usually due to the changing of legislation in recent decades. For example, in DE, new HPP are usually granted permits up to 30 years. Older HPP have ancient rights (often indefinite concessions), which are permits that were granted to operators or installations when the Water Act first came into force in 1960. Many hydropower installations have been able to rely on the special status provided to them by the Water Act ever since. The permit conditions under ancient rights are often environmentally inadequate from today's perspective and it is difficult for authorities to compel these operators to modernize. However, water rights can be revoked under certain conditions and more stringent regulations can be stipulated subsequently (WHG §13, §20).

In NO, it is not the duration per se that is different, but the time frame for revising the environmental terms in licenses is different for HPP built after 1992.

Criteria defining the duration of permits usually include the size of HPP, the specific situation especially in terms of hydrology, flow and associated water uses (e.g. water supply) and whether the HPP was built before or after the passing of recent legislation which changed conditions for permit duration. The duration of concessions usually also aims at recovering costs of the investment. In DE, the actual duration is a provision of the negotiations between the hydropower planner/operator and the competent authorities.

Table 14 - Summary of durations of concessions

Country	Duration of permits (or concessions, authorisations) for HPP	Is the permit duration for all hydropower plants the same?		Are there differences in the duration of concessions between new and existing HPP?	
		Yes/No	If no, which criteria define the duration of a permit?	Yes/No	If yes, see details below
<b>NO</b>	Publicly owned (2/3) and small hydropower (< 10MW) permits usually have unlimited duration. Privately owned hydropower permits have limited duration (60 years)	No	Revisions of licencing conditions (environmental terms) after 50 years, then 30 years (after 1992) for the larger hydropower plants.	Yes	After 1992 the environmental terms specified in the concession are revised after 30 years.
<b>SE</b>	<p>Unlimited time duration.</p> <p>About 90% of hydropower concessions active today in Sweden were granted long before modern environmental legislation with implications for hydropower generation was enacted. The Water Law of 1918, which was designed largely to enable rapid development of hydropower generation to meet burgeoning demand, regulates most of the current hydropower capacity in the country (including on key issues such as water diversion from rivers and reservoir impoundment).</p> <p>Permits granted prior to the introduction of the Environmental Code in 1999 are essentially open-ended and have legal force for all parties. As a consequence, many measures incorporated in modern hydropower practice designed to promote ecological sustainability – such as fauna passages and minimum flow rates – are not common among the active concessions. The Water Activity Review of 2014, which was a governmental inquiry on new and changed legal frameworks for water activities running from 2012 to 2014, recommended that all hydropower plants (including old ones) acquire permits in accordance with the Environmental Code. Another key</p>	Yes		No	

	recommendation was that hydropower concessions should be time-limited rather than practically open-ended, as is currently the case.				
<b>AT</b>	1) Existing very old small hydropower plants: without limitation, but permit needs to be renewed in case of severe changes of water use. 2) New large hydropower plants: usually 60-90 years maximum. 3) New small hydropower plants: usually 30-40 years taking into account the local situation in relation to flow and water existing uses. 4) The unlimited permits where changed to a limitation of up to 90 years (large HP) or up to 40 years (small HP) in case of renewal of the permit	No	Size of hydropower plant and situation (hydrology-flow-existing use)	Yes	See first column of this table
<b>DE</b>	Nowadays, it is recommended that a permit for new HPP is granted for a maximum of 30 years. Older HPP have longer or indefinite concessions 'ancient rights'. Ancient rights are permits that were granted to operators or installations when the Water Act first came into force in 1960. Many hydropower installations have been able to rely on the special status provided to them by the Water Act ever since. The permit conditions under ancient rights are often environmentally inadequate from today's perspective and it is difficult for authorities to compel these operators to modernize. However, water rights can be revoked under certain conditions and more stringent regulations can be stipulated subsequently. (WHG §13, §20).	No	According to the Water Resources Act, the permit is granted for a reasonable time that cannot exceed 30 years. The actual duration is a provision of the negotiations between the hydropower planner/operator and the competent authorities. Under certain conditions, the duration of a permit can be adjusted.	Yes	See first column of this table
<b>CH</b>	between 40 and 80 years	No	Duration is typically dependent on the capacity of the HPP; it is granted by the respective canton except for HPP on binational rivers	No	

			where the Swiss permit is issued by the Federal Office (SFOE)		
<b>FR</b>	For concessions and authorizations, the maximal duration is 75 years (articles L521-4 for conceded HPP et L531-2 for authorized HPP of energy code). Formerly, for new concessions and authorizations, maximal duration was generally adopted. Nowadays, durations adopted for new or renewed concessions and authorizations are generally lower, between 20 and 50 years, as the amount of investments is generally much lower (for renewed). The levels of taxes and of investments for new facilities (including mitigation measures) are taken into account.	No	See first column of this table	Yes	See first column of this table
<b>ES</b>	Currently up to 75 years. Newly-issued permits from 25 up to 50 years. The national water law defines a maximum concession period of up to 75 years. River basin plans can define different or additional requirements, for example shorter permit durations, within the boundaries of the national law. Until 1985 the duration was up to 99 years in some cases.	No	It depends on the year in which water permits were issued. Mainly the number of MW and if the permits was issued before the new Water Law of 2001.	Yes	Due to new regulation on the environmental aspects of hydropower and social pressure.
<b>PT</b>	In the past there were some expected licensing/concession periods that no longer apply (35 years for the small private hydropower schemes). Nowadays the duration of the licensing/concession periods is case-dependent and can vary according to several factors, including the installed capacity of the hydropower plant (for very large dams it can go up to 75 years). Theoretically, it should allow recovering the investment and, therefore, larger hydropower schemes should have larger licensing/concession periods. Regardless the framework of the energy production when based on private small hydropower schemes (ordinary regime or special regime), the licensing/concession contract should specify the duration of the licensing/concession period. Because there were no such contracts issued in the last years (due to the non-existence of legislation regarding the energy selling price system that should be applied) the sector does not know what to expect. Desirably, 20 to 25 years should be the lower limit of the licensing/concession period.	No	Duration is for HPP with an installed capacity >50 MW between 50 and 75 years; with an installed capacity 30-50 MW between 35 and 50 years; and with an installed capacity <30 between 15 and 35 years. Complementary, the specific legal framework that	Yes	For small hydropower schemes until a few years ago the expected duration of the license/concession was and equal to 35 years. Now it depends on several issues and is specified in each license/contract. For large schemes the maximum period is presently 75 years.

		<p>applies to the energy productions based on small hydropower schemes establishes that the duration of the licensing/concession should be the one specified in each contract.</p>		
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## 5.2 Revision of permits for existing HPP

The possibility to carry out revisions to permits can help ensure that HPP remain environmentally sound and that state-of-the-art mitigation measures are implemented at existing HPP. However, in many cases, HPP were built prior to modern environmental laws with inadequate environmental requirements based on current knowledge of state-of-the-art and no mechanisms to revise them.

Nevertheless, since 2000, the EU WFD and revisions of national policy related to the WFD have been strong drivers for modifying authorisation procedures for new HPP and for revising permits of existing hydropower. According to this review, authorisations for existing hydropower are being adapted or are expected to be adapted to meet the requirements of the WFD in most of the eight European countries examined.

Concrete time limits to ensure existing HPP is retrofitted or modernised have been set in recent legislation in AT, CH ES, and NO. In AT, a change of permits can be done according to the measures set in the national action plan. According to this, the National Water Act was revised in 2011. For example in the frame of regional restoration programmes - which have the character/form of an ordinance by the regional authorities – restoration measures like restoring continuity and ensuring an ecological minimum flow can be required.

CH requires setting of mitigation measures for hydropeaking, bed load transport and fish migration by 2030, while NO reviews the environmental terms of its licensing conditions after 50 years (and after 30 years for larger HPP built after 1992). The environmental terms of licenses in NO that are revised in this context are typically minimum flow, requirements about physical habitat improvements, continuity, and qualities that can be important for use (recreation, fishing, etc.).

### Box 1 Revision of concessions report in Norway

The "Revision of concessions" report (2013) was a national exercise in Norway of those approx. 400 hydropower concessions that can undergo a revision of terms (environmental requirements) the coming 6-7 years. The national authorities screened these 400 objects in order to make a prioritised list of concessions where environmental improvements are prioritised and concessions which will be "saved" (no losses of power production accepted), as they were considered very important for the provision of energy and regulated power. In order to do such an assessment, a set of environmental and energy-related criteria were established, as the basis for the prioritised list.

In ES, an adaptation of existing authorisations depends on the specific permit regime, the water plan of the district and jurisprudence related to determined cases. Overall, though, changing existing permits is complicated and bound to produce legal proceedings if existing rights of concessionaires are affected.

In DE, FR, PT, and SE, there is no time period set in legislation for modernizing existing HPP. However, there may be requirements to do so within "a reasonable timeframe" – as is the case in DE.

In FR, minimum flow had to be implemented by 1<sup>st</sup> January 2014 at the latest. Furthermore, if an existing plant ( $P \leq 12$  MW) wants to benefit from a feed-in tariff for the purchase of its production, it must carry out an investment program to modernize the plant within a defined period. In addition, if an existing HPP is located on a stream classified in “list 2”, it has to ensure sediment transport and circulation of migratory fish, during the compliance period (initial period of 5 years after the publication of this list in 2012; extended by 5 years). Overall, though the authorisation procedures in FR have not directly been adapted to the WFD, the definition of mitigation measures is now more ambitious to preserve or restore the good ecological status of streams.

In PT and SE, authorisations for existing hydropower are not yet required to be adapted to WFD requirements. In specific, SE has investigated approaches to review existing licenses, with the suggestion that existing HPP be brought up to modern environmental standards in 20 years (see box below).

### **Box 2 Proposal for review of HPP permits in Sweden**

In 2015, the Swedish Energy Agency (SEA) and the Swedish Agency for Marine and Water Management (SwAM) published a document that suggests how review processes for hydropower operating licences can be harmonized with modern environmental requirements (SEA and SwAM, 2015). The suggested timeframe for when all Swedish hydropower should be brought up to modern environmental standards, in line with EU standards and with regular check-ups at the end of each six-year cycle of WFD implementation, is 20 years.

The document proposes that individual reviews should be carried out that reflect the specific water-using activity (e.g. hydropower plant) and local conditions. It also recommends that although existing permits can be subject to complete reassessment, it would be most efficient only to review their conditions, not the permit as a whole. However, specific conditions must be added – if they do not already exist – that would allow for the hydropower plant to be decommissioned if found necessary. It also recommends that the scope of the review should not be determined solely by the applicant (i.e. power plant operator), but that the supervisory authority, or at least some other relevant stakeholder, should be able to influence it.

In contrast to the Water Activity Review (which was a governmental inquiry on new and changed legal frameworks for water activities running from 2012 to 2014), however – which recommended that reviews should generally lead to termination of existing permits and the award (or denial) of a new permit – the SwAM-SEA proposal recommends that it should be possible for new environmental requirements to be added to existing permits, except in areas covered by a new review, where they would be superseded or complemented by new permits.

Table 15 - Time period for retrofitting/modernising existing HPP

Country	Time period set in legislation, within which existing HPP (without mitigation measures in place) need to be retrofitted / modernised	
	Yes/No	Description
NO	Yes	Revisions of licensing conditions (environmental terms) after 50 years, then 30 years (after 1992) for the larger hydropower plants.
SE	No	There is no time period set. However, if changes to existing permits are made, they depend on the limit for economical feasibility of the plant which is judged case by case. If mitigation measures require more water than 20 % of the production value for plants built after 1983 (very few plants), the State has to compensate the plant owner. Older plants (the majority) the same limit is set to 5 %. The praxis is however normally below 5%.
DE	No	Water rights can always be revoked under certain conditions and more stringent regulations can be stipulated retroactively (WHG §13, §20). However, there is no time period set in the legislation to comply with new legal requirements (§ 35). WHG states that fish population measures need to be implemented “within a reasonable time” for existing installations.
AT	Yes	In former times, a change of the existing permit was only in case of a significant change in hydrological situations. But according to the WFD a change of permits can be done according to the measures set in the National action plan. According to this, the National Water Act was revised in 2011. For example in the frame of regional restoration programmes - which have the character/form of an ordinance by the regional authorities – restoration measures like restoring continuity by building a fish passes, guaranteeing an ecological minimum flow can be required - a deadline can be set by which the owner of a permit has to submit a restoration project to the authorization body.
CH	Yes	Mitigation of hydropreaking, bed load transport and fish migration to take place until 2030
FR	No	However, if an existing plant ( $P \leq 12$ MW) wants to benefit from a feed-in tariff for the purchase of its production, it must carry out an investment program to modernize the plant within a defined period. Minimum flow had also to be implemented by the January the 1st 2014 at the latest (law n°2006-1772 on water and aquatic environments (30/12/2006)).
ES	Yes	Mainly in some water planning instruments and the regulation of some protected areas.
PT	No	

Type of action needed to initiate a permit revision in the case of indefinite concessions

In most of the countries reviewed, there are no indefinite concessions except for SE.

In SE, both the operator and a public authority (county government; “the legal, financial and administrative service agency”) can initiate permit revisions through a concession modification hearing. When this happens, a process in the court is initiated, which is managed by lawyers. Permit revisions can end with concessions being reviewed or denied depending on whether there is any damage occurring and if all EU obligations are being met.

In NO, although the concessions are usually unlimited for publicly owned entities, the environmental terms are revised at regular intervals.

In DE, a permit revision is needed normally only if the turbine power is subject to enlargement. However, water authorities have been getting stricter recently and asking for mitigation measures. This is also in the case of indefinite concessions, especially when the specific rivers are priority water courses for fish conservation (e.g. Programmgewässer Lachs).

In ES, there are some rare cases of indefinite concessions, according to exceptional historic rules, recognized under certain XIXth century Supreme Court case law.

*What happens when the authorization of an existing HPP runs out*

In case the permit of an operating HPP runs out, in all reviewed countries, the same conditions as for new authorisations apply in the process of permit renewal (except for SE where permits are indefinite). This means that mitigation measures may be required for existing HPP, even where none were required before.

*Table 16 - Conditions when authorisations of existing HPP run out*

<b>Country</b>	<b>Conditions which apply when the authorisation for an existing HPP is running out (link to mitigation measures)</b>
<b>NO</b>	The concession itself is not running out, but the environmental terms can be revised as part of the revisions of a concession.
<b>SE</b>	Not relevant as permits are indefinite
<b>DE</b>	When the authorisation for an existing HPP is running out, the hydropower plant has to fully comply with the WHG in order to get a new concession. If no mitigation measures have been required in the past and the ecological requirements of the WHG (e.g. minimum flow conditions, fish protection etc.) are not fulfilled, mitigation measures will be stipulated.
<b>AT</b>	In general, if an operator applies for a new hydropower permit or needs a new permit (because the existing permit has expired or they want to change the water use and therefore have to apply for a new permit), it is possible to a permit, if the application follows state of the art technologies, which that the HPP has a fish pass and ecological flow.
<b>CH</b>	When an existing concession is running out, a clear definition of residual flow conditions is applied, as for new HPP projects. The above-mentioned topics further apply (if applicable), i.e. mitigation of hydropeaking, reestablishment of fish migration and of bed load continuity
<b>FR</b>	The concession or authorisation for an existing HPP, which runs out, can be renewed (vast majority of cases) or not (rarely). If not, the scheme has to be removed. In case of renewal of a concession or authorization, mitigation measures are taken into account and renegotiated.
<b>ES</b>	The main rule is that the works on public domain should be demolished and the place restored at the permittee's expenses, unless a new permit is issued under all the environmental provisions.
<b>PT</b>	After the end of the licensing/concession period and according to the legislation, the HPP becomes propriety of the State. It could be relicensed to the same or to another operator/owner. The issuing of a new water permit requires the evaluation of the compliance with the WFD objectives and other environmental laws, which could depend upon the implementation of mitigation measures.

### Permit revision if turbines are repowered and upgraded

Permit revision is usually not required if the upgrade of a HPP does not affect the environmental terms of the permit, its capacity and the extent of the water use by the hydropower operation.

For example in CH, a permit revision is needed only if the capacity increases significantly; this typically applies if the turbine flow is increased, but not from increased turbine efficiency alone.

Also in DE, a permit revision is not needed, unless the turbine power is subject to enlargement.

In AT, a permit from the water authority is not needed, if changing the turbine or upgrading does not change the “extent of the water use” (permitted amount of water abstraction, operation mode, effects on water ecology etc).

In NO, refurbishments of existing machinery, reduction of head losses in tunnels, pressure shafts, etc will normally not lead to revision of terms. Extensions such as transfer of water into the system, increase of reservoir capacity, increased power production capacity (installed capacity), re-building/new power plant, etc will normally lead to revision of terms.

In ES, permits are not generally subject to revision, if turbines are repowered and upgraded. It depends on the permit granted and the state of the works.

In PT, in theory, any change in the layout of a HPP could lead to a revision of the licensing/concession contract.

### **5.3 Mitigation measure requirements for HPP**

In the following, an overview is provided on the eight reviewed countries regarding the type of mitigation measures required for new and existing HPP. We distinguish between mitigation requirements which are based on legislation, requirements which are based on a recommendation (e.g. a guideline or technical standard), requirements which are defined in individual cases or situations where there is no requirement in place for a certain type of mitigation.

The following overview of mitigation requirements is related to the following key domains of environmental improvements at HPP: upstream/downstream fish migration, flow conditions, hydropeaking, gravel transport, habitat enhancement, as well as fish stocking provisions.

In general, mitigation requirements for new and for existing HPP do not differ substantially, if there is an option to revise existing permits. In case permits run out and need to be renewed, similar requirements as for new HPP are usually applied. For example, in FR, there is no difference between new permits and renewal of existing permits. However, if an existing HPP already applies mitigations measures which are considered satisfactory for fish, nothing additional will be imposed.

Furthermore, legislation relevant to HPP authorisation may outline aspects which should be considered in addition to environmental conditions, when setting mitigation requirements. Consideration of cost (dis-)proportionality, cost balancing and limits on the economic feasibility of the HPP are the most commonly additional aspects taken into account in authorization procedures (CH, DE, SE, FR, and NO). Therefore, the extent of mitigation measures is usually not decided only upon ecological criteria.

A further element that may be considered when setting mitigation requirements are other important water uses such as recreational fishing, canoeing, aesthetics, flood and drought protection, navigation, etc, which are linked to the hydropower operation. For example, in CH, the selection of mitigation measures should take into account flood protection and energy policy targets for renewable energy, while in NO recreation, tourism, other local industry or commerce, and landscape aspects are considered. Also in FR, authorizations and concessions of HPP must take into account all others waters uses, and vice versa, even if this is not precisely defined. For example, schemes with storage capacity are frequently used to release water during drought periods. At the same time, schemes that create an artificial lake are used for recreational activities and, in such cases, a minimal level of the lake must generally be maintained during summer.

Table 17 Overview of mitigation measure requirements in reviewed countries

Requirements for mitigation		Based on legislation	Based on recommendation	Defined in individual cases	No requirement for this type of mitigation
Upstream fish migration	<b>New HPP</b>	NO, DE, AT, CH, FR <sup>(1)</sup> , ES, PT (7)		FR <sup>(2)</sup> , PT (2)	SE (1)
	<b>Existing HPP</b>	NO, DE, AT, CH, FR <sup>(1)</sup> , ES, PT (7)		FR <sup>(2)</sup> , PT (2)	SE (1)
Downstream fish migration	<b>New HPP</b>	DE, CH, FR <sup>(1)</sup> , ES (4)	DE (1)	NO, AT, FR <sup>(2)</sup> , PT (4)	SE (1)
	<b>Existing HPP</b>	DE, CH, FR <sup>(1)</sup> , ES (4)	DE (1)	NO, FR <sup>(2)</sup> , PT (3)	SE, AT (2)
Flow conditions	<b>New HPP</b>	NO, DE, AT, CH, FR, ES, PT (7)	PT (1)	SE, DE (2)	
	<b>Existing HPP</b>	NO, DE, AT, CH, FR, ES, PT (7)	PT (1)	SE, DE (2)	
Hydro-peaking	<b>New HPP</b>	DE, AT, CH, ES (4)		NO, SE, DE, FR, PT (5)	SE (1)
	<b>Existing HPP</b>	DE, CH, ES (3)		NO, SE, DE, FR, PT (5)	SE, AT (2)
Gravel transport (sediment)	<b>New HPP</b>	AT, CH, FR <sup>(1)</sup> , ES (4)		DE, FR <sup>(2)</sup> , PT (3)	NO, SE (2)
	<b>Existing HPP</b>	CH, FR <sup>(1)</sup> , ES (3)		DE, FR <sup>(2)</sup> , PT (3)	NO, SE, AT (3)
Habitat enhancement	<b>New HPP</b>	DE, CH, FR, ES (4)	NO (1)	AT, PT (2)	
	<b>Existing HPP</b>	DE, CH, ES (3)	NO (1)	AT, FR, PT (3)	
Fish stocking provisions	<b>New HPP</b>	NO, DE, ES, PT (4)		FR (1)	
	<b>Existing HPP</b>	NO, DE, ES, PT (4)		FR (1)	

Notes: (1) In FR, the mitigation requirement for upstream/downstream fish migration and gravel transport (sediment) is based on legislation, if the stream in question is listed in „list 2“. (2) If the stream is not listed in “list 2”, then the mitigation requirements in these cases in FR are defined in individual cases (and are not based on legislation).

### Upstream fish migration

Upstream fish migration is required through legislation in AT, CH, DE, ES, FR (if the river is on “list 2”), PT and NO for both new and existing HPP. In practice, the type and design of mitigation measures are usually decided on a case-by-case basis. In DE, the federal States have specific technical and hydraulic requirements for upstream fish migration measures. From a technical perspective, small HPPs especially have difficulties constructing measures for upstream fish migration that work, due to the limited water discharge that is available for most of them.

In AT, ensuring ecological continuity is compulsory except outside of the natural fish zone and very near to natural existing barriers. The timeline for continuity restoration is outlined in the RBMP. In CH, HPP (new and existing ones) are required to mitigate interrupted fish migration by 2030.

In SE, there is no legislative requirement for mitigation related to fish migration, but a review has recommended that all hydropower plants (including existing ones) acquire permits in accordance with the Environmental Code, which implies the compulsory use of fish passes.

Table 18 - Upstream fish migration requirements

Upstream fish migration requirements	
Country	Relevant legislation or guidance and relevant requirements for new and existing HPP
NO	The mitigating measures are defined on case-by-case basis. For every new hydropower licence, terms will be set, such as minimum water flow, reservoir restrictions, rules of operation, habitat restoration, weirs, fish ladders etc. The requirements for existing HPP are similar to the requirements for new HPP.
SE	No requirement. The Water Activity Review of 2014 recommended that all hydropower plants (including old ones) acquire permits in accordance with the Environmental Code. The suggestions also imply compulsory use of fish ways, which currently only exist in about 10% of Swedish hydropower plants.
DE	New HPP: The WHG (§34) requires measures for ensuring upstream fish migration and upstream river continuity. Some Federal states have specified the technical and hydraulic requirements for these measures. From a technical perspective, small HPPs especially have difficulties constructing measures for upstream fish migration that work, due to the limited water discharge that is available for most of them. Existing HPP: The installation of fish passage facilities for upstream fish migration does not necessarily need to be part of the existing permits or authorizations. The competent water authorities can require the installation of a fish passage facility for upstream fish migration retroactively. (§ 20

	(2) WHG i.V.m. § 13 (2) WHG).
<b>AT</b>	<p>Providing river continuity is declared to be state of the Art (§ 12 a in the National Water Act, Revision 2011) and therefore obligatory – except outside of the natural fish zone and very near to natural existing barriers.</p> <p>As an outcome of the River Basin Management Plan it's obligatory to guarantee ecological continuity. That means for example that a fish pass is required for all hydropower plants which are situated in rivers where fish naturally used to live ("natürlicher Fischlebensraum"- that means that more or less areas in the very high alpine regions are excluded where natural fish habitats do not exist due to natural obstacles/ high slope).</p> <p>The requirement for providing river continuity is relevant for new and existing obstacles (incl. those due to hydropower).</p> <p>For existing obstacles the timeline/deadlines for continuity restoration are set in the National River Basin Management Plan NGP (the legal character of the plan is an "Verordnung" = Ordinance) taking into account criteria like ecological effectiveness, economic and administrative aspects (prioritisation!).</p> <p>Fish passes have to be built according the requirements of the "Leitfaden zum Bau von Fischaufstiegshilfen" which was published by the Ministry of Agriculture, Forestry, Environment and Water Management in 2012.</p>
<b>CH</b>	<p>New HPP:</p> <p>Amended Waters Protection Act / Fisheries Act required mitigation of interrupted fish migration by 2030.</p> <p>Every new HPP is required to have a fish pass which fulfils its function. The latter has to be proved by monitoring results which are prescribed by the authorities.</p> <p>Existing HPP:</p> <p>Federal Act on Fisheries requires from existing HPP to take necessary measures for free fish migration. These measures have to be taken until 2030.</p>
<b>FR</b>	<p>Article L 214-17 of environment code, created by the law n°2006-1772</p> <p>There is a list of stream or part of streams (called "list 2"), in which it is necessary to ensure adequate transport of sediments and the circulation of migratory fish. All projects must be managed, maintained and equipped according to rules defined by the administrative authority, in consultation with the owner or the operator.</p> <p>These lists were established for each River Basin District and published in 2012 or 2013. This obligation applies at the end of a period of five years after the publication of the lists (so 2017 or 2018). The compliance period has recently been extended by 5 years (law n°2016-1087 published on August 08, 2016).</p> <p>Owners or operators of obstacle have an obligation of results, not an obligation of means ("obligation de résultats, et non obligation de moyens").</p> <p>But in fact, all stakeholders try to agree on the design and dimensioning of the solution, given that a true assessment of solution efficiency after implementation is costly and consequently rare (see Q13 in 3.4.3). In most cases, a consensus is found. If not, a monitoring can be asked to the owner to prove that its solution is effective.</p> <p>There is no standard or norms for the design and dimensioning of devices for upstream and downstream migration. However, there are technical guides which are quite well respected. There is the place to discussion to adapt the implementation of criteria if this is justified by the constraints of each site. Technical guides can notably be found at the following links : <a href="http://www.onema.fr/node/1611">http://www.onema.fr/node/1611</a>; <a href="http://www.onema.fr/node/1570#pap">http://www.onema.fr/node/1570#pap</a></p> <p>Concerning the sediment transport, the law raise a question: what is an "adequate" sediment transport? From which point of view? In addition, we lack of methods and tools to assess the</p>

	<p>issues of transport. We also lack of criteria for the design and dimensioning of solutions.</p> <p>There is no difference between new permits and renewal of existing permits. If existing HPP have already mitigations measures which are considered satisfactory for fish, nothing additional will be imposed.</p>
<b>ES</b>	<p>New HPP:</p> <p>The Royal Decree of Public Hydraulic Domain reform of 2012 and some regional fishing and natures acts, such as the 2015 Act of Natural Heritage of Castilla and León, which promotes river connectivity, fish ladders and obstacles demolition, even though the jurisdiction to do it is State's.</p> <p>Existing HPP:</p> <p>The Royal Decree of Public Hydraulic Domain reform of 2012 and some regional fishing acts.</p>
<b>PT</b>	<p>New HPP:</p> <p>The obligation to maintain connectivity is settled in national legislation (e.g. Freshwater Fisheries Law and regulation). For new projects (or for the alteration of old ones), the Freshwater Fisheries Authority (ICNF) evaluates the need to install fish passes (or other ways of maintaining connectivity for fish). The need and configuration of the fish passes (or other methods/devices) in new projects is assessed on a case-by-case basis during environmental impact evaluation.</p> <p>Existing HPP:</p> <p>Similar to conditions for new HPP. There is no option to revise the conditions of existing HPP permits. However, for HPP permits which run out, a new licensing process is initiated with similar requirements to those for a new HPP.</p>

### Downstream fish migration

Downstream fish migration is required through legislation in CH, DE, ES, and FR (similar to upstream fish migration, only if the river is on “list 2”). In DE, some federal states indicate in specifications on fish protection (e.g. protection screens) in their federal laws.

Overall, there are more countries dealing with requirements for this issue on a case-by-case basis (NO, AT, PT, FR for rivers not on list 2) than for upstream migration. In AT, as there as is no proven state-of-art-technology to ensure downstream migration, there is no general requirement but only some pilot facilities to learn for the future and increase know-how.

Also in NO, requirements related to downstream migration have historically been an issue only to a limited extent, and have received less attention than upstream migration. However, there is growing concern that this is a key issue which also requires mitigation.

In PT, although the need to consider downstream migration can be assessed during environmental evaluation of new projects on a case-by-case basis, legislation on this issue remains unclear.

As for upstream mitigation, SE has no legislative requirement for downstream migration.

*Table 19 - Downstream fish migration requirements*

Downstream fish migration requirements	
Country	Relevant legislation or guidance and relevant requirements for new and existing HPP
NO	<p>The mitigating measures are defined on case-by-case basis. For every new hydropower licence, terms will be set, such as minimum water flow, reservoir restrictions, rules of operation, habitat restoration, weirs, fish ladders etc.</p> <p>Environmental requirements related to downstream migration have historically been an issue only to a limited extent, and have received less attention than upstream migration. However, there is growing concern that this is a key issue which also requires mitigation.</p> <p>The requirements for existing HPP are similar to the requirements for new HPP.</p>
SE	No requirement
DE	<p><b>New HPP:</b></p> <p>The Federal Water Act (WHG §35) requires measures for ensuring connectivity for downstream fish migration. Some Federal states have specified the technical and hydraulic requirements for these measures. More stringent requirements for fish protection for diadromous species (e.g. protection screens for eels: 15 mm clear width of bars, salmon: 10 mm) are introduced by the federal states in which those species are relevant for the achievement of the management objectives according to WHG §§27-31 and in which these requirements can be technically implemented. Some federal states indicate in their federal laws specifications on fish protection (e.g. protection screens: 15 mm clear width of bars) (CIS questionnaire, 2011).</p> <p><b>Existing HPP:</b></p> <p>The installation of a fish passage facility for downstream fish migration does not necessarily need to be part of the former permits or authorizations. The competent water authority can require exiting HPPs with “ancient rights” to implement state-of-the-art measures for fish protection and downstream fish migration (§ 20 (2) WHG i.V.m. § 13 (2) WHG).</p>
AT	<p><b>New HPP:</b></p> <p>National law states that all water uses have to respect the state-of-art-technology. In Austria, we naturally don't have long distance migrators like salmon or eel. Anyway downstream migration is seen as important for longitudinal continuity for fish species in general. But as there as is no proven state-of-art-technology to ensure downstream migration there is no general requirement but only some pilot facilities to learn for the future and increase know how.</p>
CH	<p><b>New HPP:</b></p> <p>Amended Waters Protection Act / Fisheries Act required mitigation of interrupted fish migration by 2030. Every new HPP is required to ensure downstream continuity. Monitoring is prescribed by the authorities to check for the proper functioning of the fish protection and guidance measure chosen.</p> <p><b>Existing HPP:</b></p> <p>Federal Act on Fisheries requires from existing HPP to take necessary measures for free fish migration. These measures have to be taken until 2030.</p>
FR	<p>Article L 214-17 of environment code, created by the law n°2006-1772. See description dealing with upstream migration which is common for downstream migration.</p> <p>There is no difference between new permits and renewal of existing permits. If existing HPP have already mitigations measures which are considered satisfactory for fish, nothing additional will be imposed.</p>

ES	<p>New HPP:</p> <p>The Royal Decree of Public Hydraulic Domain reform of 2012 and some regional fishing and nature acts, such as that of Castilla and León.</p> <p>Existing HPP:</p> <p>The Royal Decree of Public Hydraulic Domain reform of 2012 and some regional fishing acts. For existing plants only in some cases, the plant is required to ensure downstream continuity (CIS questionnaire on WFD &amp; HP, 2011).</p>
PT	<p>New HPP:</p> <p>Although there are not specific requirements, the need to consider downstream migration in new projects can be assessed during environmental evaluation on a case-by-case basis (including methods such as catch and carry/trap and truck). However, legislation is unclear concerning this mitigation measure.</p> <p>Existing HPP:</p> <p>Similar to conditions for new HPP. There is no option to revise the conditions of existing HPP permits. However, for HPP permits which run out, a new licensing process is initiated with similar requirements to those for a new HPP</p>

### Flow conditions

Mitigation measures on flow conditions are required in national legislation in all the reviewed countries except SE where they are defined on case-by-case basis during permit procedure (for new HPP) in the Environmental Court.

Requirements usually refer to minimum flow requirements and, in different countries, different methods are used for determining minimum flow.

In DE, the amount of minimum flow is aligned with management objectives according to the WFD (according to law WHG §§ 27-31).

In AT, provisions regarding watercourse residual flow protection were introduced in 1990 and further defined in 2010 based on the WFD. As in the case of continuity, restoration should be carried out according to a timeline set in the National RBMP. According to the 1st RBMP, watercourse residual flow is to be fully restored stepwise until 2027 in existing hydropower plants to comply with the WFD.

In CH, the 1991 Water Act required minimum flow conditions to be restored in the case of existing concessions by 2012; however only 50% of plants increased minimum flow. However, the 1991 Act could only be fully applied in the context of a renewal of concession; this problem was resolved via a special provision in the amended Water Protection Act (2011), which included a retrofitting requirement for all existing hydropower plants.

In FR, the maintenance of minimum flow is an obligation since 2006 with the requirement to implement minimum flow values by 2014.

In ES, minimum flows are going to be implemented in the new river basin management plans, generally before 2015, on a case by case basis. A basic legal framework for ecological flows exists and many licenses include requirements concerning minimum flows. Depending on specific conditions, new minimum flow requirements for existing plants may be determined on case by case.

Table 20 - Flow conditions requirements

<b>Flow conditions requirements</b>	
<b>Country</b>	<b>Relevant legislation or guidance and relevant requirements for new and existing HPP</b>
<b>NO</b>	<p>The use of the statistical value "common low flow" (allminnelig lavvannføring) has been a very common flow value set in bypass section as a minimum flow requirement. This is calculated by a defined statistical method, most likely only used in Norway. In many case, the common low flow value ends up in the same range as Q95, which is a very common flow value in other European countries.</p> <p>The requirements for existing HPP are similar to the requirements for new HPP.</p>
<b>SE</b>	<p><b>New HPP:</b></p> <p>Minimum flow requirements are set case by case during permit procedure in the Environmental Court. New plants have rarely minimum flow above 5 % of average flow which commonly is less than average minimum flow. In some cases, specific minimum flow requirements are set during fish migration periods (CIS questionnaire on WFD and hydropower (2011)). In practice, there are different views of what minimum requirements should be and there have been several cases where Land and Environmental Courts have been asked to rule. In general, the courts have seemingly argued for the maintenance of at least mean low flow (MLQ), though urging that minimum flow be kept as high as possible. Relevant rulings highlight that measures necessary for the movement of fish should be established without any reimbursement to the operator of related costs – except when the cost is disproportionately large compared to the expected environmental gain, in which case the operator can be freed from the specific responsibility. However, there are also cases where MLQ has not been assessed as a requirement due to limited impacts on the environment. The Water Activity Review of 2014 recommended that all hydropower plants (including old ones) acquire permits in accordance with the Environmental Code. This recommendation has often been interpreted as a demand for minimum flows of water in river systems and an attempt to reduce drastic variations of high and low water levels in water storage reservoirs.</p> <p><b>Existing HPP:</b></p> <p>In older permits from 1900 to 1930 some plants have minimum flow requirement equal to average minimum flow (CIS questionnaire on WFD and hydro-power (2011)).</p>
<b>DE</b>	<p><b>New HPP:</b></p> <p>The WHG (§33) provides regulations regarding minimum conditions. Some federally enacted decrees exist to specify technical and hydraulic requirements for minimum flow related measures. The amount of minimum flow is aligned with management objectives according to the WFD (WHG §§ 27-31). The federal state uses different methods for the determination of minimum flow conditions.</p> <p><b>Existing HPP:</b></p> <p>Measures to ensure minimum flow conditions do not necessarily need to be part of the former permits or authorizations. The competent water authority can require existing HPPs with "ancient rights" to implement state-of-the-art measures.</p>
<b>AT</b>	<p>Provisions regarding watercourse residual flow protection were introduced in the 1990 Water Management Law, and further defined in the 2010 ordinance on the quality objectives for ecological quality elements in rivers and lakes. The ordinance is based on the WFD.</p> <p>There is a requirement of an ecological minimum flow according to the National water Act (§ 13). This is valid for new plants and according to the National River Basin Management Plan also for existing hydropower plants (but restoration will be done stepwise as in the case of</p>

	<p>continuity).</p> <p>Like for river continuity the timeline/deadline for restoration is set in the National River Basin Management Plan. The Priority area for restoration is usually identical with the priority area set for river continuity restoration.</p> <p>Ecological minimum flow through fish passes is regulated in a national recommendation for fish passes “Leitfaden zum Bau von Fischaufstiegshilfen” which was published by the Ministry of Agriculture, Forestry, Environment and Water Management in 2012 - but the general requirement that fish passes have to guarantee functioning is a national legal requirement concerning state of the Art and Technology.</p>
<p><b>CH</b></p>	<p>New HPP:</p> <p>Until 1991, there was no clear definition of minimum flow.</p> <p>Since 1991, via the adoption of the Federal Act on the Protection of Waters, there is clear definition of residual flow conditions for all new HPP according to the following articles:</p> <ul style="list-style-type: none"> <li>• Art.31(1): Starting point is Q347 (5%-Percentile of Annual Flow)</li> <li>• Art. 31(2): Focus on aquatic species (preservation of typical species like fish (habitats and migration) and macroinvertebrates)</li> <li>• Art. 32: Possible reduction of residual flow when no fish occur or the ecological potential is not high</li> <li>• Art. 33: Possible increase of the residual flow with balancing of the interests for and against the water use (landscape, seasonal variation, energy Losses, net stability, energy strategy etc)</li> </ul> <p>Summary of residual flow for a new concession</p> <ul style="list-style-type: none"> <li>• Minimum flow requirements in winter</li> <li>• Seasonal increase</li> <li>• The dynamics of floods also have to be considered (sediment transport, morphological aspects, floodplains)</li> </ul> <p>Existing HPP:</p> <p>In case of existing (valid) concessions, the Water Act in 1991 asked for the «Restoration of minimum flow conditions» until 2012. However, for these cases, there was no clear definition of minimum flow conditions provided. Until now, only 50% have increased the minimum flow. In case an existing concession was running out, a clear definition of minimum flow was to be applied (similar as to new concessions since 1991).</p> <p>However, the fact that the 1991 Act could only be fully applied in the context of a renewal of the concessions, which typically run over 80 years, no major changes in operation could be expected before the year 2020.</p> <p>The problem that the authorities were unable to impose any new regulations on electricity companies during the period of validity of a license was solved in the form of a special provision in the amended Water Protection Act (2011) which stipulated a retrofitting requirement for all existing hydropower plants, regardless of the duration of the operating license. At the same time, the amended Act provided for the payment of full compensation to the operator for the required structural measures.</p>
<p><b>FR</b></p>	<p>Article L 214-18 of environment code, created by the law n°2006-1772. This article confirmed the obligation to maintain a minimum flow ("reserved flow") downstream of each project, which permanently guarantee the life, circulation and reproduction of the species that inhabit the waters. This is an objective (already present in the law n°84-512 on freshwater fishing and the management of fish resources (29/06/1984).</p> <p>This article also revised the minimum flow values :</p> <ul style="list-style-type: none"> <li>• 1/10 (10%) of the mean annual discharge in general</li> <li>• 1/20 (5%) of the mean annual discharge for projects located on a watercourse with a mean annual discharge greater than 80 m<sup>3</sup>/s.</li> </ul>

	<ul style="list-style-type: none"> <li>• 1/20 (5%) of the mean annual discharge for HPP which, by their modulation capacity, contribute to the production of electricity during periods of peak consumption (list fixed by decree).</li> </ul> <p>Possible lower values on non-typical rivers. It's possible to set several minimum flow values depending on the time of year, provided that the annual average of these values is not less than the annual minimum value set. The lowest value shall be greater than half of this annual minimum value. It's possible to derogate during exceptional natural low flow. These minimum values have to be implemented by 1 January 2014 at the latest. To comply with the objective (to permanently guarantee the life, circulation and reproduction of the species), it could be necessary to adopt minimum flow significantly higher than the minimum values. The minimum flow value is debated for each individual case, depending on the results of studies on the hydrology (characterisation of natural low flows notably) and the variations of hydro-morphological and habitat parameters in function of the flow. A circular published in July 5<sup>th</sup> 2011 described the procedure to implement the article L 214-18, and the different methods to determine the biological minimum flow.</p> <p>There is no difference between new permits and renewal of existing permits. If existing HPP have already mitigations measures which are considered satisfactory for fish, nothing additional will be imposed.</p>
ES	<p>New HPP:</p> <p>Regulation of Public Hydraulic Domain reform of 2012 and some regional fishing acts and hydrological planning, such as the Catalonian water plans. Minimum flows are going to be implemented in the new river basin management plans, generally before 2015, on a case by case basis. Minimum flows are defined following a consultation process in which users and affected parties participate.</p> <p>Existing HPP:</p> <p>Regulation of Public Hydraulic Domain reform of 2012 and some regional fishing acts and hydrological planning.</p> <p>A basic legal framework for ecological flows exists. Many licenses for the use of water resources include requirements concerning minimum flows. Depending on specific conditions, new minimum flow requirements for existing plants may be determined on a case by case basis (CIS questionnaire on WFD &amp; HP, 2011).</p>
PT	<p>New HPP:</p> <p>The obligation to maintain an environmental flow is settled in the national legislation (e.g. Freshwater Fisheries Law and regulation). There is a hydrologic method used by the water authority to propose an environmental flow during licensing. Operators can propose another environmental flow for each specific case based on other methodologies (e.g. IFIM).</p> <p>Existing HPP:</p> <p>Similar to conditions for new HPP. There is no option to revise the conditions of existing HPP permits. However, for HPP permits which run out, a new licensing process is initiated with similar requirements to those for a new HPP</p>

### Hydropeaking

Mitigation of hydropeaking is required through legislation in AT, CH, DE and ES.

In CH, hydropeaking needs to be mitigated by 2030. Structural or operational measures can be applied; structural measures do not affect electricity production and can be the construction of compensation basins or underground channels to a lower lake.

In AT, as compensation reservoirs cannot be built very often due to lack of suitable land, other mitigation measures are tested in the frame of a research project to find out the most effective way - without reducing peak load production in a significant manner. Due to still open questions on this issue, the implementation of mitigation measures was postponed to the WFD cycle after 2021. In the Austrian RBMP, it is explained that based on the results of the research studies, hydropower companies have to provide feasibility studies for their hydropeaking plants till 2021 on how hydropeaking can be mitigated effectively.

In NO, requirements on hydropeaking operations have been defined in only very few cases so far (but some producers have introduced voluntary restriction on such operations in some selected cases).

In DE, hydropeaking is normally only allowed in exceptional cases.

Hydropeaking mitigation is not a requirement in SE, but some plants have a downstream plant to reduce the water level effects from hydropeaking.

Table 21 - Hydropeaking requirements

Hydropeaking requirements	
Country	Relevant legislation or guidance and relevant requirements for new and existing HPP
NO	<p>The mitigating measures are defined on case-by-case basis. Requirements on hydropeaking operations have been defined in only very few cases so far (but some producers have introduced voluntary restriction on such operations in some selected cases). Recent research from CEDREN (research centre, not an authoritative body) has proposed guidelines to be used when restrictions on hydro-peaking operations are to be defined, but so far not used (to our knowledge).</p> <p>The requirements for existing HPP are similar to the requirements for new HPP.</p>
SE	<p>Existing HPP:</p> <p>Some plants have a downstream plant to reduce the water level effects from hydropeaking.</p>
DE	<p>Hydropeaking (e.g. specification of its extent and required provisions for minimizing its negative environmental impacts) is regulated by the right to use a body of water (WHG §9). In Germany, hydropeaking is normally only allowed in exceptional cases. In addition, the natural conditions in Germany normally don't allow for hydropeaking.</p>
AT	<p>New HPP:</p> <p>In the National Ordinance on Ecological status, it is stated that in small and middle size-rivers a surge / downsurge relation of &gt; 1: 3 ensures good status for biological elements with high confidence in case that at least 80% of the river which is covered by water during surge is also covered by water during at the lowest down surge. As compensation reservoirs cannot be built very often due to lack of suitable land, other mitigation measures are tested in the frame of a research project starting in 2010 to find out the most effective way - without reducing peak load production in a significant manner. In 2015, some issues had been clarified in between but there still existed some open questions; therefore the implementation of mitigation measures was postponed to WFD cycle after 2021. In the National RBMP, the following activity is included: Based on the results of the research studies hydropower companies have to provide feasibility studies for their hydropeaking plants till 2021 on how hydropeaking can be mitigated effectively. All measures have to be described whether they are ecologically effective, technical feasible, their economic and socioeconomic effects. This will be the basis for the water authority to delineate and define good ecological potential and the necessary mitigation measures to</p>

	achieve GEP. Those mitigation measures will have to be implemented after 2021.
<b>CH</b>	Waters Protection Act requires mitigation of hydropeaking by 2030. According to the Act, structural measures which in contrast to operational measures do not affect electricity production may be applied by the power plants. This can be the construction of compensation basins or underground channels to a lower lake. Operational measures can be applied only when owner of the power plant agrees.
<b>FR</b>	<p>Unless the disposition concerning the minimum flow (described above), there is no additional national disposition to regulate the hydropeaking management. The requirements are defined for each individual case at a local scale, depending on the results of studies on the biological impacts.</p> <p>However, the article L 214-4 indicate that :</p> <p>II : an authorization can be suppressed or modify without indemnity [...] : 3° In case of a major threat to the aquatic environment, and particularly when aquatic environments are subjected to critical hydraulic conditions incompatible with their preservation</p> <p>II bis : since January 1st 2014, on stream or part of streams listed in list 1 according to L 214-17, an authorization can be modify, if the operation of the facility does not comply with the preservation of migratory species alternately living in fresh and salt water (created by the law n°2006-1772). There is no difference between new permits and renewal of existing permits. If existing HPP have already mitigations measures which are considered satisfactory for fish, nothing additional will be imposed.</p>
<b>ES</b>	Regulation of Public Hydraulic Domain reform of 2012 and some regional fishing acts, and jurisprudence, which forbid hydropeaking in certain types of hydropower plants. The mitigation of hydropeaking effects was an issue to be implemented in new river basin management plans after 2015.
<b>PT</b>	<p>New HPP:</p> <p>Although there are not specific requirements, the need to consider hydropeaking mitigation measures in new projects can be assessed during environmental evaluation on a case-by-case basis.</p> <p>Existing HPP:</p> <p>Similar to conditions for new HPP. There is no option to revise the conditions of existing HPP permits. However, for HPP permits which run out, a new licensing process is initiated with similar requirements to those for a new HPP</p>

### Gravel transport (sediment)

Mitigation of gravel transport is required by law in AT, CH, ES, and FR (for “list 2” rivers).

In AT, a national ordinance (mainly applicable to new HPP) states that good ecological status can be achieved with high confidence if sediment dynamics is only modified within short river stretches.

As for hydropeaking, in CH, mitigation of gravel transport is required by 2030. Various measures can be applied to mitigate gravel transport depending on the site, including both structural adaptations and sediment replenishment.

In DE, PT, and FR (for streams not on list 2) the requirements for mitigating gravel transport are assessed on a case-by-case basis. In PT, although there are no specific requirements,

the need to consider mitigation measures for sediment transport can be assessed during environmental evaluation on a case-by-case basis.

In NO and SE, there are no requirements related to sediment and this issue has received limited attention.

Table 22 - Gravel transport (sediment) requirements

<b>Gravel transport (sediment) requirements</b>	
<b>Country</b>	<b>Relevant legislation or guidance and relevant requirements for new and existing HPP</b>
<b>NO</b>	The mitigating measures are defined on case-by-case basis. This specific problem has limited attention in Norway. The requirements for existing HPP are similar to the requirements for new HPP.
<b>SE</b>	No requirement
<b>DE</b>	Preventive measures for maintaining sediment transport and the handling of solids are regulated by the right to use a body of water and are HPP specific.
<b>AT</b>	New HPP: There is a general requirement for new plants to mitigate negative effects of any water use by national legislation, to ensure good ecological status/good ecological potential, no deterioration principle. In the National "Ordinance on Ecological Status", it is stated that good ecological status for biological elements can be achieved with high confidence in case that the sediment dynamics is only modified within short river stretches. Exemptions from the no deterioration principle can only be accepted in case that the requirements of Art. 4.7 WFD are met.
<b>CH</b>	Waters Protection Act requires mitigation of gravel transport by 2030. A number of measures can be applied, from structural adaptations via reservoir drawdown and flushing to sediment replenishment below dams, the selection being very site-specific.
<b>FR</b>	Article L 214-17 of environment code, created by the law n°2006-1772. See description dealing with upstream migration which is common for sediment transport. There is no difference between new permits and renewal of existing permits. If existing HPP have already mitigations measures which are considered satisfactory for fish, nothing additional will be imposed.
<b>ES</b>	Hydrological Planning Act, which foresees sediments as a requirement of minimum flows.
<b>PT</b>	New HPP: Although there are not specific requirements, the need to consider mitigation measures for sediment transport can be assessed during environmental evaluation on a case-by-case basis. Existing HPP: Similar to conditions for new HPP. There is no option to revise the conditions of existing HPP permits. However, for HPP permits which run out, a new licensing process is initiated with similar requirements to those for a new HPP

### Habitat enhancement

Measures related to habitat enhancement are required through legislation in CH, DE and ES. However, the strength of these requirements varies.

In CH, revitalization and improvement of morphology is required by 2090, however these measures are taken at the Cantonal (state) level and not by the HPP operators. In DE, habitat improvements are indirectly required with the requirements of the WFD.

AT, FR and PT, requirements for morphological mitigation are determined for each individual case.

In AT, there is a requirement to minimise impacts as far as possible for new plants and to achieve GES/GEP, which means that morphological mitigation measures have to be implemented. Existing HPP with impoundment are usually designated as HMWB and the definition of GEP includes morphological improvements.

In FR, projects must include measures to compensate for their significant residual impact, which may consist of actions and their funding, preferably in the hydromorphologically homogenous section of the watercourse.

In PT, although there are no specific requirements, the need to consider habitat enhancement as a mitigation measure or, more often, as a compensation measure can be assessed during environmental evaluation on a case-by-case basis.

In NO, habitat enhancement has historically been used to only a limited extent.

*Table 23 - Habitat enhancement requirements*

<b>Habitat enhancement requirements</b>	
<b>Country</b>	<b>Relevant legislation or guidance and relevant requirements for new and existing HPP</b>
<b>NO</b>	The mitigating measures are defined on case-by-case basis. Habitat enhancement seems to be more common as a measure, but has historically to only a limited extent been used. In the overview table above, it is indicated that habitat enhancement is "based on a recommendation" as habitat conditions and adequate conditions are standard in the terms of the concession.  The requirements for existing HPP are similar to the requirements for new HPP.
<b>SE</b>	n/a
<b>DE</b>	Habitat improvements are only indirectly required in order to comply with the objectives of the WFD. They are seen as an addition to the strictly necessary fish protection measures.

<b>AT</b>	<p>New HPP:</p> <p>There is a requirement to minimise impacts as far as possible for new plants and to achieve GES/GEP, which means that morphological mitigation measures have to be implemented. However, this is depending on the site specific situation.</p> <p>Existing HPP:</p> <p>Existing HPP with impoundment are usually designated as HMWB and the definition of GEP includes morphological improvements – mostly habitat restoration in the area of the beginning impoundment (Stauwurzel). In case of residual flow stretches it is not allowed just to change morphology (make the river narrower) so to minimise the ecological flow. Relevant morphological mitigation measures are listed in the “Catalogue of Measures” (open list) from which at least appropriate measures have to be selected for GEP or mitigating minimising impacts in case of new projects.</p>
<b>CH</b>	<p>Waters Protection Act requires river revitalisations and improvement of the morphology until 2090. However, these measures have to be taken by the Cantons, not the power plants.</p>
<b>FR</b>	<p>The article 8 of the order of September 11, 2015 (NOR: DEVL1413844A) indicate in its article 8 that:</p> <p>The project includes measures to compensate for their significant residual impact, including that related to the increase of the "staging effect" on the watercourse, the creation of a reservoir, the creation an obstacle to ecological continuity or the crea-tion of a bypassed section.</p> <p>These measures may consist of actions and fundings of actions, preferably in the hydromorphologically homogeneous section of the watercourse, aiming at the improvement of the functionalities of aquatic environments (removal of obstacles, restoration of alluvial annexes, mobility lateral, land-water transition, spawning grounds, etc.) or the ecological status of the body of water.</p> <p>There is no difference between new permits and renewal of existing permits. If existing HPP have already mitigations measures which are considered satisfactory for fish, nothing additional will be imposed.</p>
<b>ES</b>	<p>Hydrological planning and protected areas regulation under the Habitats Directive, such as protected areas from being developed.</p>
<b>PT</b>	<p>New HPP:</p> <p>Although there are not specific requirements, the need to consider habitat enhancement as a mitigation measure or, more often, as a compensation measure can be assessed during environmental evaluation on a case-by-case basis.</p> <p>Existing HPP:</p> <p>Similar to conditions for new HPP. There is no option to revise the conditions of existing HPP permits. However, for HPP permits which run out, a new licensing process is initiated with similar requirements to those for a new HPP</p>

### Fish stocking

There are relevant provisions on fish stocking based on legislation in NO, DE, ES, and PT.

In DE, the federal states’ fisheries acts can require financial compensation measures for fish losses which is then used to restock fish populations.

Legislation in PT details various aspects of fish stocking (species allowed, procedures for authorization), however this measure is only recommended in the event other mitigation measures have failed. Also in FR, fish stocking is nowadays not a measure implemented to mitigate or compensate the impacts of a HPP.

In NO, mitigation measures are defined on a case-by-case basis and fish stocking has historically been a very common measure to enhance the salmon and trout populations.

Table 24 - Fish stocking provisions

Fish stocking provisions	
Country	Relevant legislation or guidance and relevant requirements
<b>NO</b>	The mitigating measures are defined on case-by-case basis. This has historically been a very common measure to enhance the salmon and trout populations. This could be specified as a number of smolts, 1+, 0+, or more recently egg, that are to be stocked in a reservoir/lake or river every year. The requirements for existing HPP are similar to the requirements for new HPP.
<b>SE</b>	n/a
<b>DE</b>	The federal states' fisheries acts can require financial compensation measures for fish losses. This money will be subsequently used to restock the fish populations.
<b>AT</b>	n/a
<b>CH</b>	n/a
<b>FR</b>	Formerly, fish stocking was a compensation measure for the HPP. This could be replaced by a tax paid to the association for fishing and protection of rivers, or to the State. This tax was suppressed in 2014. Nowadays, to our knowledge, fish stocking is not a measure implemented to mitigate or compensate the impacts of an HPP. There is no difference between new permits and renewal of existing permits. If existing HPP have already mitigations measures which are considered satisfactory for fish, nothing additional will be imposed.
<b>ES</b>	Regional fishing acts: In Castilla and Leon region, the 9/013 Act of Fishing, which promotes the use of non-exotic species and avoids re-stocking with exotic species or genomics.
<b>PT</b>	New HPP: Freshwater Fisheries Law which details several aspects related with fish stocking (species allowed, procedures for authorisation. It is recommended that stocking is used only after the fail of other mitigation measures. Existing HPP: Similar to conditions for new HPP. There is no option to revise the conditions of existing HPP permits. However, for HPP permits which run out, a new licensing process is initiated with similar requirements to those for a new HPP

#### 5.4 Monitoring requirements for mitigation measures

Some degree of monitoring of mitigation measures, which have been set within HPP authorisations, is required across all countries reviewed. In AT and in FR, there seems to be a distinction between small and large HPP. In AT, monitoring is generally not required for small HPP and in FR, monitoring plans are reduced or not existing for small HPP (<4.5 MW).

Effects of measures on fish migration, such as fish passes, appear to be the most commonly monitored (e.g. in AT, CH, DE, PT, SE, and NO). In FR, monitoring the effect of flow conditions on fish populations is rather common and also in NO, monitoring of fish population must be applied by the HPP operator.

More details are given in the table below.

*Table 25 - Monitoring requirements in the authorization of HPP*

<b>Requirements for monitoring the effectiveness of required measures in authorisation procedures</b>		
<b>Country</b>	<b>Yes/No</b>	<b>Description of requirements</b>
<b>NO</b>	Yes	The authorization process usually requires monitoring of effect of measures. The power producer is often requested to monitor the fish population (e.g. number of smolts, juvenile fish densities, etc). In some controversial cases the authorities have defined a period (sometimes 5 years) where a specific operational regime (e.g. minimum flow) is tested and evaluated afterwards, based on the findings of the environmental impacts/effects.
<b>SE</b>	Yes	If there is an installation of fishway, the effect has to be monitored. Also in other types of actions, different kinds of parameters have to be monitored due to “ordinance of self-control”.
<b>DE</b>	Yes	The authorisation procedures for both new and existing HPP that need to renew their concessions may include objectives and methods for the monitoring of measures for upstream fish migration and fish protection.
<b>AT</b>	Yes/No	For small HPP plants, there are usually no monitoring requirements; for large HPP, there are requirements in most cases. Functioning of fish pass has to be monitored for large HPP in most cases.
<b>CH</b>	Yes	Fish passages (both up- and downstream) have to be monitored after implementation to check for their effectiveness. Control of the effectiveness of measures is generally required and financed.
<b>FR</b>	Yes	Yes in principle. In reality, it also depends on the financial capacity of the HPP, the biological stakes and the existence or not of a consensus on mitigation measures. Generally, monitoring plans are inexistent or reduced for authorised HPP (< 4.5 MW), and more ambitious for conceded HPP (> 4.5 MW). For example, the monitoring of the effectiveness of migration devices for fishes with telemetry studies is still rare (a few studies each year). Monitoring of effect of flow conditions on invertebrate and fish populations are more frequent.
<b>ES</b>	Yes	Government inspections and control systems
<b>PT</b>	Yes	Monitoring is made in new and recent HPP and also in HPP subject to relicensing, in any case aiming at assessing the effectiveness of the implemented measures. Monitoring targets specifically the ability of the environmental flows to maintain good ecological/potential status downstream dams and weirs. Monitoring includes fish, other biological elements, and hydromorphological and physico-chemical conditions (sensu WFD). The efficiency of other mitigation (or compensation) measures, namely fish passes, is determined at the environmental assessment phase (EIA)

## 6. Regulatory agencies involved in the authorisation of HPP

Administrative responsibility for the granting of HPP permits follows some trends between countries. Across the countries surveyed, various ministries and authorities are involved in the permitting process. Often in cases where permitting occurs at a lower level, the authorities remain informed by national ministries (AT, ES, PT, SE)

Many countries delegate responsibility for granting permits for small HPP to local authorities:

- In AT regional and district authorities handle facilities up to 500kW, with state authorities handling small HPP above 500 kW. Any facilities on the Danube River, or cross-border facilities, are handled by the national authority.
- Similarly, in ES, river basin authorities handle permits up to 5MW, with a national body handling plants above 5MW and those that impact autonomous communities.
- CH follows a similar structure, with cantonal authorities handling small plants, and federal authorities larger ones.
- Finally, FR also splits responsibilities between larger and smaller plants (the distinction here is “conceded” and “authorized” HPP), but also notes that there is “public consultation” of a commission including representatives of local authorities, consumer associations, and associations of fisheries and environmental protection.

In contrast, local authorities in DE have significant power in granting permits for all types of plants. As such, it has sometimes been difficult for operators to obtain permits despite meeting all environmental criteria.

In NO, licensing is the responsibility of the Water Resources and Energy Directorate. The Environment Agency defines the environmental terms in rivers with anadromous fish while the county governor defines those in rivers with only inland fish.

*Table 26 - Regulatory agencies involved in the authorisation procedures*

Country	Regulatory agencies involved in the authorisation procedure (and their role)
<b>NO</b>	NVE is the main licencing authority in Norway, i.e. in handling operational aspect of the process. The ministry defines the framework for licencing, and is the appealing authority. Please note that small (< 10 MW) and large hydro are handled differently, i.e. a simplified regime for small hydro. The Norwegian Environment Agency (Directorate) is a very important hearing partner, and the authority that defines the environmental terms (in rivers with anadromous fish). In rivers with inland fish, the county governor (Fylkesmannen in Norwegian) is the authoritative body that defined the terms.
<b>SE</b>	Mostly county government and often with the role of supervision.
<b>DE</b>	Local authorities in Germany have strong discretionary powers in terms of granting permits for all types of hydropower projects (with some legal exceptions). For this reason, it has been somewhat difficult for a number of operators to obtain permits even in instances where projects comply with all the applicable environmental criteria. There are two types of authorisation procedures: planning assessment (“Planfeststellung”) and planning approval (“Plangenehmigung”). Both types require the involvement of different regulatory agencies with different roles. The following regulatory agencies are normally involved: Water authorities (lead role), Building authorities (participation role), land use and regional planning authorities (participation role), Fisheries authorities (participation role), nature conservation authorities

	(participation role).
<b>AT</b>	<p>The Federal Minister of Agriculture, Forestry, Environment and Water management is responsible for setting an environmental protection provision and coordinating the local, State, and federal authorities. It is responsible for updating and applying the Austrian Water Act.</p> <p>The Austrian Reservoir Commission is appointed by the Federal Minister of Agriculture to support water authorities on technical issues and safety monitoring in or outside of water rights procedures. Since 1964, it has published guidance and opinions on monitoring and reservoir safety.</p> <p>The local authorities are responsible for water monitoring and water rights procedures. There are three levels:</p> <ul style="list-style-type: none"> <li>- First, the regional government and district authorities are responsible for water management and the licensing for most hydropower facilities (&lt;500 kW).</li> <li>- Second, federal State authorities are responsible for the authorisation of small hydropower with a capacity higher than 500 kW.</li> <li>- Last, the national authority is responsible for hydropower facilities on the Danube as well as cross-border facilities. The authorities can be assisted in their tasks by the Austrian Reservoir Commission.</li> </ul>
<b>CH</b>	Typically water right and environmental authorities on a cantonal level are involved. Depending on the size of the HPP scheme, federal authorities are also involved (e.g. dam safety section of the SFOE).
<b>FR</b>	<p>For authorized HPP, the instructor service is the Departmental Directorate of Territories ("Direction Départementale des Territoires"; DDT)</p> <p>For conceded HPP, the instructor service is the regional directorate for the environment, planning and housing ("Direction Regionale de l'Environnement, de l'Aménagement et du Logement" ; DREAL).</p> <p>Others public organisms are consulted by the instructor service to issue a technical notice, notably:</p> <ol style="list-style-type: none"> <li>1. national agency for biodiversity ("Agence Française pour la Biodiversite" [AFB], which replace the "Office National de l'Eau et des Milieux Aquatiques" [ONEMA] since the beginning 2017).</li> <li>2. regional health agency ("Agence Régionale de Santé" [ARS]).</li> </ol> <p>There is also a public consultation ("enquête publique") and the consultation of a commission including representatives of local authorities, consumer associations, and associations of fisheries and environmental protection ("Conseil Départemental de l'Environnement et des Risques Sanitaires et Technologiques").</p>
<b>ES</b>	<p>Water basin authorities that issue the water permit and environmental agencies that inform them.</p> <p>The River Basin Authorities are competent for granting concessions for hydroelectric projects of less than 5 MW, and the General Directorate of Water through the Ministry of Agriculture, Food and the Environment, for hydroelectric power plants greater than 5 MW or affecting several autonomous communities</p>
<b>PT</b>	Environmental Authority (responsible for the EIA process), Water Authority (responsible for licensing the water use), Freshwater Fisheries Authority (responsible for assessing the need for fish passes or other means of increasing connectivity), Energy Authority, and Directorate General for Energy and Geology (responsible for licensing electricity production). Presently, the Environmental Authority and the Water Authority belong to the same institution, namely the Portuguese Environment Agency (APA)/Agência Portuguesa do Ambiente (APA). The river basin authorities (Administração da Região Hidrográfica –

	<p>ARH) are also implicated.</p> <p>Other regulatory agencies participate during the EIA process, namely the Directorate General for Cultural Heritage/Direção-Geral do Património Cultural and the Directorate General for Territory/Direção-Geral do Território</p>
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## 7. Financing instruments

In order to support the implementation of multiple environmental objectives (especially renewable energy production and protection of water ecosystems), financing and support instruments for hydropower development should also be linked to ecological criteria for the protection of the water environment.

In the following sections, information is first provided on key EU initiatives and tools to support and finance hydropower. Second, information is given on the use of financing instruments in the eight European countries reviewed for this report.

### 7.1 EU support instruments

The financing of renewable energy in the EU is largely in the hands of the Member States. Nevertheless, even national support schemes often partly depend on EU funding, especially the Structural Funds and the Cohesion Fund. After 2006 and in the context of reforms of the European cohesion policy, assistance from the Cohesion Fund also covered projects in the fields of energy efficiency and renewable energy (Council Regulation (EC) No 1084/2006). According to its Renewable Energy Road Map of 2007, the EC intended to exploit fully the possibilities offered by the Community's financial instruments – notably the Structural and Cohesion funds - to support the development of renewable energy sources in the EU.<sup>9</sup> In 2011, the European Commission updated the 2007 document with the “Energy Roadmap 2050” as a first step in developing a post-2020 energy strategy.<sup>10</sup>

In 2014, a report was published by the European Court of Auditors examining the success of Cohesion Funds in support of renewable energy generation. It concluded that, while many of the audited renewable generation projects delivered outputs as planned, the overall value for money of the funds was limited in helping achieve 2020 targets. This is due to the lack of consideration of cost-effectiveness as a guiding principle in planning and implementing renewable generation projects, and the cohesion policy funds having a limited EU added value. There has been no detailed analysis specifically for hydropower projects, while the list of 24 audited projects did not include hydropower (European Court of Auditors, 2014).

Other types of support of renewable energy (including hydropower) on the EU level relate to efforts to promote the facilitation/simplification of authorisation procedures for renewable energy generators, to facilitate grid access and access to the energy market for renewable (overcoming barriers of feeding renewable energy into the market and of market competition with conventional energy sources).

In general, the European Commission encourages optimal use of existing financial instruments, which except for the Structural and Cohesion Funds, include instruments that focus on supporting research and disseminating technology, such as the Strategic Energy Technology Plan<sup>11</sup> and the EU's Horizon 2020 programme.

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<sup>9</sup> See <http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=LEGISSUM:I27065>.

<sup>10</sup> See <http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52011DC0885&from=EN>.

<sup>11</sup> See <http://ec.europa.eu/energy/en/topics/technology-and-innovation/strategic-energy-technology-plan>

## 7.2 Financing instruments at country level

On the national level, there are more possibilities and options available to financially support electricity production from hydropower and, at the same time, to also support the mitigation of environmental impacts. The specific instruments investigated in the context of the country reviews carried out for this reported included the following:

1. feed-in tariffs, whereby a fixed price is paid for renewable electricity which has been fed into the public grid
2. green power labels/certifications, which usually define minimum standards for electricity production
3. support schemes (direct financing, grants, loans) for the modernisation of existing plants or for mitigation measures in new plants
4. compensation options to reduce energy production losses due to mitigation measures (these may include e.g. increase of flow at the hydropower facility, increase of the headwater level or deepening of the tailwater)
5. monetary compensation to give up a concession at a particular location.

For each of these instruments, our review examined whether they are in place, what type of hydropower is targeted (e.g. size of plant, operation mode), whether the instrument applies equally to new or existing hydropower, the criteria used for ecological improvement and source of funding (e.g. national or regional government, energy consumers, hydropower companies).

Results from the eight reviewed countries indicate that the instruments primarily being used in most countries are financial support schemes for the modernisation of existing plants (AT, CH, DE, ES, NO), followed by feed-in tariffs (CH, DE, ES, FR) and green power labels (AT, CH, DE, SE).

Compensation options to reduce energy production losses due to mitigation measures or monetary compensation are not widely applied.

In Portugal, at present, there is no financial or other type of instrument aiming at boosting the hydropower sector, independently or cumulatively with the improvement of the status of water bodies. As described in previous sections, the hydropower sector in Portugal is presently on hold because it is waiting for new legislation (partly on the energy selling price system) which can enhance or, on the contrary, hinder the sector.

*Table 27 - Overview of financial instruments in the reviewed countries*

Country	Feed-in tariffs	Green power labels	Compensation options (to reduce energy production losses due to mitigation measures)	Monetary compensation to give up a concession at a particular location	Support schemes for modernization of existing plants	Support schemes for mitigation measures in new plants
NO					X	
SE		X			X	
DE	X	X			X	X
AT		X			X	
CH	X	X			X	
FR	X					
ES	X		(X)	X	X	X

PT						
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### 7.2.1 Feed-in tariffs

Most feed-in tariffs in place are unfortunately decoupled from ecological improvements. However, there are some feed-in tariffs which are tied to the hydropower operators' undertaking specific ecological measures. Part of the financial burden involved in measures, e.g. for protecting migrating fish, can be balanced through the higher tariffs.

Feed-in tariffs are currently in place in CH, DE, FR and ES, but as noted above, not all of these are related to criteria for ecological improvement. In CH, these apply to HPP up to 10 MW on new HPP and extensions of existing HPP, while ES offers tariffs for plants up to 50 MW on both new and existing HPP. DE has a very detailed breakdown of its feed-in tariffs by HPP size (according to the Renewable Energy Sources Act), which are applied to both new and existing HPP. In general, the feed-in tariffs in DE are much higher for smaller HPP than for large.

Each of these countries sets a different level of criteria for ecological improvement associated with the feed-in tariffs. In CH, the criteria in the Water Protection Act must be fulfilled; similarly in FR, HPPs must comply with environmental laws in place. Furthermore, FR notes that the construction of devices to ensure migration of migratory fish make up part of the investments selected (renovation works) to benefit from purchase obligations (until 2015) or supplementary remuneration (from 2017). In contrast, there are no criteria for ecological improvement in ES and DE; the older version of the Renewable Energy Source Act (EEG) in DE stipulated ecological improvements linked to feed-in tariffs but this is no longer the case.

With regards to the source of the funding, the consumers are responsible for the cost in CH, DE, and FR, whereas in ES the feed-in tariffs are publicly funded.

Table 28 - Feed-in tariffs in the reviewed countries

Feed-in tariffs		
Country	Name of the instrument	Characteristics (type of HPP targeted, criteria for ecological improvement, source of funding)
DE	Hydropower feed-in rates according to the Renewable Energy Law	<p>Type of hydropower targeted:</p> <p>The revised <u>Renewable Energy Sources Act</u> (RESA of 2017) allows for hydropower feed-in tariffs. However, is not bound anymore to the proof that the use of hydropower either achieves good ecological water status or substantially improves it. In Germany, small RES-E plants of sizes up to 100 kW are eligible for feed-in tariff as set out in the EEG 2017 (§ 19 par. 1 no. 2. And § 21 EEG 2017). The eligibility is coupled to the obligation of the plant operator to feed the electricity into the grid in the months for which they raise the claim for receiving financial support. Regardless of the size, plants in exceptional cases are eligible for a feed-in tariff reduced by 20% (Ausfallvergütung). However, this can happen for no longer than 3 consecutive months and no more than 6 months in total within a calendar year (§ 21 par. 1 no 2 EEG 2017).</p> <p>In general, all technologies used to generate electricity from renewable sources are eligible for feed-in tariffs (§ 19 par. 1 EEG 2017). Eligibility also applies to electricity that was temporarily stored prior to being fed into the grid (§ 19 par. 3 EEG 2017).</p> <p>Feed-in tariffs are granted only for electricity actually taken over by the grid</p>

		<p>operator (§ 21 par. 1 EEG 2017). The electricity may not be consumed in the direct surroundings of the power plant and needs to be transmitted through the grid (§ 21 par. 2 no 1 EEG 2017). Additionally, the plant is not allowed to participate in the electricity balancing market (§ 21 par. 2 no 2 EEG 2017). The level of the feed-in tariff is defined by law and varies according to specificities of the technologies (§§ 40 – 49 EEG 2017). For hydropower, 3.47 – 12.40€ct per kWh are paid depending on plant size and date of commissioning, (§ 40 par. 1-4 EEG 2015) minus 0.2 €ct per kWh (§ 53 no. 1 EEG 2017):</p> <p>HPP ≤500 Kilowatt 12.40 Cent per kWh  HPP ≤2 Megawatt 8.17 Cent per kWh  HPP ≤5 Megawatt 6.25 Cent per kWh  HPP ≤10 Megawatt 5.48 Cent per kWh  HPP ≤20 Megawatt 5.29 Cent per kWh  HPP ≤50 Megawatt 4.24 Cent per kWh  HPP &gt;50 Megawatt 3.47 Cent per kWh</p> <p>A HPP operator is entitled to receiving a feed-in tariff according to the subsequent provisions of the law (§ 19 par. 1 EEG 2014) for the amount of energy fed into the grid. The tariff levels will decrease in regular periods of time. New plants will receive the tariff level applicable on the day they are put into operation. This tariff level will apply for the entire payment period, i.e. for 20 years (§§ 25 EEG). For hydropower, the percentages by which the tariff levels will decrease are set by law. The digression rate is 0.5% every year (§ 27 par. 1 no. 1 EEG 2017). The tariff payment period is 20 years from the day of commissioning. For plants receiving a feed-in tariff, the period may be expanded until December 31<sup>st</sup> of the 20th year (§25 EEG 2017).</p> <p>Application to new or existing HPP: It applies to new and existing HPP, however, some specifications differ.</p> <p>Criteria for ecological improvement: None specifically, just the ones that are already in place, such as the WHG. Older versions of the EEG also stipulated ecological improvements, but this is no longer the case.</p> <p>Source of funding: The costs of the feed-in tariff scheme are borne by the final consumers.</p>
<b>CH</b>	<p>Cost-covering feed-in tariff ("Kostendeckende Einspeisevergütung" (KEV))</p>	<p>Type of hydropower targeted: Small HPP with a capacity between 1 MW and 10 MW; HPP in combination with drinking water supply or wastewater sewage schemes with a capacity below 10 MW.</p> <p>New HPP and extension of existing HPP</p> <p>Criteria for ecological improvement: The criteria set in the Water Protection Act have to be fulfilled</p> <p>Source of funding: Energy consumer (surcharge on the grid tariff)</p>
<b>FR</b>	<p>(1) Purchase obligation contracts and (2) Supplementarily</p>	<p>In France, a public support system known as the "purchase obligation" introduced in 1946 is designed to promote renewable energy development, including hydroelectricity. Its principle is to guarantee for private producers of renewable energy, over a period of 15 or 20 years, a price for the purchase of the electricity produced that exceeds the price of the market, in order to ensure the profitability of the investments made for the production of renewable energies. The terms of the energy feed-in tariffs are set by</p>

	remuneration	<p>decrees of the Ministry in charge of energy and submitted to the Energy Regulatory Commission for opinion. Electricité De France company is entrusted with the task of purchasing the electricity produced by renewable electricity generation facilities.</p> <p>Reformed in the form of a public service by the law n°2000-108 published in 10/02/2000 on the modernization of the public electricity service, this support system was revised in depth by Law 2015-992 on the energy transition published in 18/08/2015. This revision follows a review by the European Commission of the framework for granting aid which Member States can provide to renewable energy producers. This Law 2015-992 introduces a new so-called "supplementary remuneration" system, which is intended to partially replace the obligation to purchase. The additional remuneration is a premium paid to producers in addition to the income they earn from direct sales in the electricity market.</p> <p>Otherwise, HPP benefiting from rates of purchase (in the form of purchase obligation or supplementary remuneration) can no longer collect other public subsidies.</p> <p>Type of hydropower targeted:</p> <p>Until 2015, to qualify for the purchase obligation, new or retrofitted HPP must have an installed capacity less than or equal to 12 MW (decree No. 2000-1196 published on December 6, 2000).</p> <p>From 2017 (decree published on December 13, 2016), only new HPP with an installed capacity less than or equal to 499 kW can benefit from the purchase obligation. New HPP with an installed capacity between 500 and 999 kW can benefit from the supplementary remuneration. Existing HPP can only benefit from the supplementary remuneration, subject to the realization of an investment program.</p> <p>Application to new or existing HPP:</p> <p>Until 2015, new and existing HPPs can benefit from purchase obligations contracts. It is possible for existing HPP since only 2001 (decree No. 2001-410 published on 2001 May 10), if they make significant investment for their renovation. The amount and nature of such investments are set by ministerial orders.</p> <p>From 2017, new HPP can benefit from purchase obligation or supplementary remuneration according to their production capacity (cf. above). Existing HPP can only benefit from supplementary remuneration, subject to the realization of an investment program.</p> <p>Criteria for ecological improvement:</p> <p>There is no strict reference to environmental criteria, but in order to benefit from purchase obligations or supplementary remuneration, HPPs must comply with the environmental laws in effect.</p> <p>For existing power stations, the construction of device who ensure circulation of migratory fish is part of the investments selected (renovation works) to benefit from purchase obligations (until 2015) or supplementary remuneration (from 2017).</p> <p>Source of funding:</p> <p>The additional cost of purchasing these support schemes, that is to say the</p>
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		difference between the remuneration paid to producers and the value of the energy sold, constitutes an expense attributable to this public service remit, a contribution due from final consumers, contribution to the public electricity utility (CSPE).
<b>ES</b>	Register of specific tariff regime (Registro de régimen retributivo específico)	Type of hydropower targeted: Up to 50MW It is applied to new and existing HPP Criteria for ecological improvement: None Source of funding: National

### 7.2.2 Green power labels

Ecolabels are instruments recognising environmental efforts beyond existing environmental legislation. The ecolabel approach is voluntary for both suppliers and the consumers. One of the key issues is the selection of criteria and the standards that have to be met in order to justify a specific label. Initiatives for labelling electricity from hydropower in the European countries are being developed. These take ecological improvements into account, including environmental flows, sediment flushing, fish passages and wetland restoration. However, none of these criteria are so far agreed at EU level.

Green power labels are in place in CH, DE, SE and AT. In AT, these do not play an important role and, similarly, the different green power labels existing in DE are of minor importance due to the tariffs of the Renewable Energy Sources Act.

SE has two types of ecolabelling in place for hydropower: the NGO labelling (“Bra Miljoval”) with ecological criteria related to minimum flow requirements, and the “Good Environmental Choice” labelling by the Swedish Society for Nature Conservation (SSNC). The hydropower included in the electricity labelled with Good Environmental Choice should complete a yearly provision to an environmental fund equivalent to 1500 SEK/GWh hydropower in the electricity sold as being environmentally labelled. The environmental fund provision can be used in projects undertaken by the licensee’s own operations or placed in SSNC’s central environmental fund. All projects financed by the environmental fund should be approved by the Swedish Society for Nature Conservation. Furthermore, only electricity from hydropower plants built before 1996 can be approved for licensing for electricity labelled with Good Environmental Choice.

In CH, the “Naturemade” labelling scheme is in place, applying to new HPP as well as HPP extensions. More details on the scheme can be found in the box below.

#### Box 3 Switzerland – Naturemade labelling scheme

“Naturemade” is the quality mark for ecologically produced energy (Naturemade star) and energy from renewable sources (Naturemade basic). The label is awarded after thorough inspection by the Association to Promote Environmentally Friendly Electricity (VUE). Naturemade covers a broad range of electricity production methods, including bioenergy, solar, wind, and hydropower. In the case of hydropower, all existing plants are awarded the basic level of certification, while low-impact plants can be awarded Naturemade star for meeting additional environmental criteria (Wustenhagen et al., 2003).

A certification procedure for hydropower facilities (called greenhydro) has been designed for implementation as part of the ecolabel Naturemade.

New power plants and power plant extensions can be awarded naturemade star certification if the impact of construction works and operation does not impair additional natural or near-natural habitats, populations or landscapes (prohibition of deterioration) or brings about an improvement.

The more stringent requirements for new plants do not apply where existing water utilization is renewed after 1.1.2001 at the previous or a smaller scale. Old plants which are in the process of being environmentally upgraded to earn VUE Naturemade star certification can only be awarded the Naturemade basic quality seal until the upgrade is complete. Under certain conditions, which must be agreed in writing with VUE, operators may, however, communicate that they are seeking certification as a “green power plant”.

Hydropower plants have to fulfil a set of basic requirements, which have been formulated in a general way. The basic requirements ensure that all certified power plants reach a comparable ecological standard. Under the basic requirements, environmental domains to be considered include (1) hydrological character, (2) connectivity of river systems, (3) solids load and morphology of the river, (4) landscape and biotopes and (5) biocenosis and protected species along and in the river.

Management domains considered include: (i) regulations on residual flow, (ii) regulations on hydropeaking regime, (iii) regulations on reservoir management, (iv) guidelines on bed load management and (v) guidelines on an environmentally compatible power plant design.

Second, power plants commit to carrying out measures for the ecological improvement of their immediate surroundings and for the protection of the impacted river. Such measures are financed by an income generated by a fixed surcharge per kWh of green electricity sold (eco-investments). The eco-investments are specifically adapted to the ecological situation of the power plant at hand. These so called eco-investments will be used to restore, protect or upgrade the environment in the catchment area of the plant at hand (EAWAG, 2005). In principle, the facility invests a fixed monetary contribution per sold kWh of green electricity in the restoration, protection or ecological improvement of the affected catchment. These green electricity contributions guarantee a targeted, local ecological evaluation of the scheme requirements and allow credible communication with the green electricity customers (Ecologic Institute, 2007).

With regard to eco-investments, for instance, it was decided that an amount of 0.1 centimes (about 0.09 €ct) has to be paid for every kilowatt-hour (kWh) produced in a greenhydro power plant. An additional 0.9 centimes/kWh (0.80 €ct/kWh) has to be paid for the electricity sold to end consumers under a naturemade star product. As a matter of fact, a fund for financing eco-investment, will receive a total of 1 centimes (0.9 €ct) for every kWh sold as green electricity.

### **7.2.3 Support schemes for modernization of existing plants**

Support schemes for the modernisation of existing plants are related to the use of subsidies (direct financing), grants and loans to encourage green investments. They are the most frequently used type of financial instrument to support ecologically compatible hydropower and is being used in AT, CH, DE, ES, NO and SE (in SE, such scheme is about to be made

operational). In CH, DE, ES, SE and NO, the support schemes apply to any size or type of HPP. In AT, the scheme is specifically targeted to small and medium sized plants. Similarly, some of the schemes identified apply to both new and existing plants (DE, ES, NO) while others are more strictly linked to existing plants (e.g. CH, AT).

A variety of criteria for ecological improvement are set in these schemes. In CH, operators qualify if they carry out mitigation measures on hydropeaking, bed load transport, and fish migration. In AT, some regional support schemes combine ecological improvement and technical modernisation. In DE, there are no ecological criteria, while in ES, the support instrument (via the Renewable Energy Plan 2011-2020 of Spain) is related to improvements with respect to greenhouse gases only.

The source of funding for modernisation schemes varies across countries. In DE, the funding comes from the national government. Costs are passed to the consumer in CH (electricity surcharge) and NO (energy tax attached to bill). In CH, there is further funding at the national and regional level; more details on the Swiss program can be found in the box below.

#### **Switzerland - Financing of measures for ecological mitigation at existing HPP**

Operators of existing HPP which carry out mitigation measures on hydropeaking, bed load transport and fish migration, receive reimbursement of all costs of the measures by Swissgrid (national high voltage grid company) if mitigation is done by 2030.

For the prioritisation and selection of the mitigation measures, the Water Protection Act asks to consider the interests of flood protection, energy policy targets for the promotion of renewable energy and the proportionality of the investment. Therefore, the extent of the measures is not decided only upon ecological criteria. A balanced cost-benefit ratio should be aimed for. The mitigation measures should also be cost-effective (BAFU, 2016).

In addition, if measures are not fully functional, they can be adapted (adaptive management) and still be financed.

Compensation is independent of the type of concession, whether it is still valid or is expiring and needs to be renewed. This way, mitigation is independent of the situation with the concession of single HPP.

The funding of around 1 billion Swiss francs which will be required by 2030 for the construction of compensation basins, bypass watercourses, fish ramps and other structures is to be financed via an electricity surcharge of 0.1 centimes per kilowatt-hour. Thus in keeping with the “user pays” principle, the costs of these measures are to be borne by the consumer (Kampa et al., 2011).

River revitalisations and improvement of the morphology (by 2090) are paid by the Cantons / State of Switzerland (Schweizer, 2017).

#### **7.2.4 Support schemes for mitigation measures in new plants**

DE (favorable credits from the KfW Bank) and ES (different kinds of measures) have support schemes for mitigation measures in new plants. In both cases, they apply to all sizes and types of plants. However, while there are no criteria for ecological improvement in DE, in ES these measures are linked to improvements in terms of river connectivity and flows.

In Norway, all new power production (independent of size, mode, etc) can apply for certificates (financial support) within the green electricity market with Sweden. Electricity certificates are an aid scheme for power produced from renewable energy sources. The electricity customers finance the system of electricity bills by the fact that power suppliers add the energy tax cost to the electricity price. No criteria for ecological improvement in new HPP have been mentioned as part of this scheme.

Table 29 - Support schemes for modernization of existing HPP

Support schemes for modernization of existing plants		
Country	Name of the instrument	Characteristics (type of HPP targeted, criteria for ecological improvement, source of funding)
NO	Green electricity market with Sweden	<p>Type of hydropower targeted: Independent of size, mode, etc.</p> <p>All new power production can apply for certificates (financial support). For existing plants, only the extra power production qualifies for support.</p> <p>Criteria for ecological improvement: -</p> <p>Source of funding: Electricity certificates are an aid scheme for power produced from renewable energy sources. The electricity customers finance the system of electricity bills by the fact that power suppliers add the energy tax cost to the electricity price.</p>
SE	Vattenkraftens Miljöfond (Environmental Fund for Hydropower)	<p>Type of hydropower targeted:</p> <p>Vattenkraftens Miljöfond is available for all water operations that are conducted adjacent to the generation of hydropower electricity, or which had the aim of such generation when they commenced. Such operations will receive compensation for both review costs and those costs for environmental improvement measures (including any demolition costs) and loss of generation costs that are required to achieve modern environmental conditions according to the national review plan that is proposed to be included in the Swedish legal system.</p> <p>Application to new or existing HPP:</p> <p>Unclear, but it seems it is mainly relevant to existing permits.</p> <p>Criteria for ecological improvement:</p> <p>Decisions on financing for operators will be made on the basis of objective criteria that are set in advance and reconciled with certain conditions set in advance.</p> <p>Establishing modern environmental conditions in Swedish hydropower will require about 1.800 projects to be implemented over a period of 20 years.</p> <p>Source of funding:</p> <p>The work of setting up a financing function under the name of Vattenkraftens Miljöfond is currently in progress between representatives for the major hydropower companies, referred to below as the Financiers. The idea is that all operators shall be able to receive compensation for costs for environmental measures with the aim of achieving modern environmental conditions in hydropower in accordance with a national legally binding review plan, prioritising environmental measures in rivers where the benefits are substantially higher than the benefits of hydropower generation and vice versa prioritising hydropower production in rivers where the hydropower production is of big importance for the society. A cap for a maximum impact on hydropower production is needed in the</p>

		<p>plan.</p> <p>Vattenkraftens Miljöfond's establishment is based on meeting certain prerequisites, among which are:</p> <ul style="list-style-type: none"> <li>- A national review plan for the implementation of environmental measures that balance the environmental interest and the energy interest against each other at a national level is incorporated in the legal system. The aim of the plan is for the update to modern environmental conditions to deliver the greatest possible benefit for the aquatic environment and the minimum possible negative impact in relation to effective national access to hydroelectric power. It has been presupposed that it is possible to limit the total impact on Swedish hydropower generation to a maximum of 2.3 per cent of a normal year's generation or 1.5 terawatt hours. This is in accordance with the National Strategy presented by the Swedish Energy Agency and the Swedish Agency for Marine and Water Management in 2014.</li> <li>- The update to modern environmental conditions for hydropower is assumed to take place through rational and effective reviews of the conditions in the existing permits of hydropower electricity operations.</li> <li>- To achieve a good level of effectiveness, the operators shall themselves be responsible for a proportion of the financing. An operator shall thus be responsible for a) 15 per cent of the costs for environmental measures including the court trial process and b) loss of generation up to 5 percent of normal annual generation.</li> </ul> <p>A project to prepare for the setting up of Vattenkraftens Miljöfond AB has been underway since March 2017 with the ambition to be operational in the first half of 2018. The definitive decision on the setting up of the fund will be taken after the Swedish Parliament has decided on the new regulations, which might be in November 2017.</p>
<b>DE</b>	Favorable credits from the KfW Bank	<p>Type of hydropower targeted: All</p> <p>Application to new or existing HPP: Both</p> <p>Criteria for ecological improvement: None</p> <p>Source of funding: national government</p>
<b>AT</b>	National regional support schemes and	<p>Type of hydropower targeted: The national support scheme targets for small and medium size hydropower.</p> <p>The schemes target existing HPP.</p> <p>Criteria for ecological improvement:</p> <p>National support scheme: There is no difference between those which improve status and those which do not; However, any HPP needs to have already a permit by the water authority which means that a fish pass and ecological minimum flow is obligatory.</p> <p>Regional support schemes: There are support schemes by some regional governments which combine ecological improvement and technical modernisation.</p> <p>Source of funding: National and regional governments</p>
<b>CH</b>	Financing measures of ecological	<p>According to the amended Water Protection Act (2011), operators get the full costs for the mitigation of hydropeaking, fishpasses (up and down) and</p>

	mitigation at existing HPP	<p>bed load transport reimbursed.</p> <p>Type of hydropower targeted: Compensation is independent of the type of concession, whether it is still valid or is expiring and needs to be renewed. This way, mitigation is independent of the situation with the concession of single HPP.</p> <p>The scheme only applies to existing HPP</p> <p>Criteria for ecological improvement:</p> <p>Operators of existing HPP which carry out mitigation measures on hydropeaking, bed load transport and fish migration, receive reimbursement of all costs of the measures by Swissgrid (national high voltage grid company) if mitigation is done by 2030. For the prioritisation and selection of the mitigation measures, the Water Protection Act asks to consider the interests of flood protection, energy policy targets for the promotion of renewable energy and the proportionality of the investment. Therefore the extent of the measures is not decided only upon ecological criteria. A balanced cost-benefit ratio should be aimed for. The mitigation measures should also be cost-effective.</p> <p>In addition, if measures are not fully functional, they can be adapted (adaptive management) and still be financed.</p> <p>Source of funding:</p> <p>The funding of around 1 billion Swiss francs which will be required by 2030 for the construction of compensation basins, bypass watercourses, fish ramps and other structures is to be financed via an electricity surcharge of 0.1 centimes per kilowatt-hour. Thus in keeping with the “user pays” principle, the costs of these measures are to be borne by the consumer. River revitalisations and improvement of the morphology (by 2090) are paid by the Cantons / State of Switzerland.</p>
<b>ES</b>	Renewable Energy Plan 2011-2020	<p>Type of hydropower targeted: All (including both new and existing HPP)</p> <p>Criteria for ecological improvement: Greenhouse gases</p> <p>Source of funding: European, national and regional</p>

## 8. Challenges and opportunities for hydropower planning and operation

### 8.1 Related to the legislative framework and authorisation procedures

1. A general challenge comes from the fact that the **environmental goals of the WFD** for HMWBs **are not clearly defined** (contrary to natural water bodies) and neither is the level at which the costs of measures are considered disproportionate.  
For example, the Norwegian context, there are still open questions related to how the WFD affects and will affect the authorisation process for HPP. A number of hydropower projects have been granted the last 10-15 year, which gives precedent for how environmental terms are set, but according to hydropower producers with ideas for new projects, the WFD poses uncertainty to this process.
2. In some countries, the **judicial system** also **seems to play a key role** for the interpretation of environmental requirements outlined in policy and “translating” them into concession-linked requirements for HPP.  
For example, in Sweden, the judicial system could help to shape the updated rules for hydropower generation (in Sweden, a process in the court is initiated for permit revisions). How the courts interpret the Swedish Environmental Code and the WFD for licensing purposes and internalize new knowledge is fundamental to what changes will eventually be implemented at the national level.
3. In cases where **legislation has not specified by when existing HPP need to be modernised**, the planning and implementation of mitigation measures is uncertain.  
For example, in Germany, legislation is not specific enough regarding the time period within which all existing HPP without mitigation measures in place need to be upgraded.
4. When permits run out, a **permit renewal process** can be initiated. However, the outcome of this process is not guaranteed, therefore placing uncertainty on the hydropower operators.  
As an example, in Switzerland, at concession end, the respective canton may decide not to grant the water concession right to third parties any more, but to use the water by itself. A HPP owner thus does not necessarily know in advance if the concession will be renewed, even if all legislative requirements are fulfilled.
5. In some countries, there are **ongoing review processes** (or have been until recently) of the legislative framework and/or permit regime for hydropower operation, which create uncertainty and challenges in the sectoral planning and the implementation of mitigation measures.  
In France, the procedure of renewal of hydropower concessions has been in stand-by since 2010, which has not been favourable to new development and measure implementation for the concerned facilities. Legal provisions to implement the renewal of concessions opened to competition have now been completed by a law on the energy transition for green growth in 2015. Also, the procedure of environmental authorisation has been recently reformed to be simpler and faster and should therefore facilitate the development of new plants.  
In Portugal, the legislation expected to follow up from a Decree-law in 2007 on the national electric system (to clarify the selling system) has not been published; this has compromised and put on hold the development of the private energy production sector.

In Sweden, there is an ongoing review process of the policy framework and permit review for hydropower generation. The so-called Water Activity Review (2014) recommendations are under review by the Ministry for the Environment and Energy and a proposition for new legislation is expected during 2017.

6. Changes expected in the legislative framework in the near future may also change the setting for development of potentially new hydropower. E.g. in Switzerland, the new Energy law (entering into force as from 01.01.2018) will potentially enable new large HPP schemes even in protected areas if they are of overarching national interest.

## 8.2 Related to financing instruments

1. In the countries reviewed, there is usually one or more financing instruments in place to promote hydropower generation and in the same time improve the status of water bodies. An exception is **Portugal**, where **currently there is no such instrument**. There were feed-in tariffs in place for small HPP (< 10MW) which ended in 2012. From 2012 onwards, a new legal framework was required but the corresponding legislation has not yet been produced. In **Sweden**, an Environmental Fund for Hydropower, whereby the operators will be responsible for part of the financing, is in preparation with the ambition to be operational in 2018.
2. Overall, having sufficient financing to support the necessary mitigation measures at hydropower stations remains a key bottleneck in European countries. For instance, in **Switzerland**, there is a good scheme in place to **finance measures for ecological mitigation** at existing HPP (financed via an **electricity surcharge**). It is estimated that 1 billion Swiss francs will be needed for all the mitigation measures at HPP by 2030. Nevertheless, according to today's knowledge, it is estimated that this amount will by far not be sufficient to cover the extent of mitigation needed.
3. In some cases, **recent policy developments have led to a weakening of support for environmental improvements** related to hydropower. For instance, in Germany, the new Renewable Energy Act (EEG) (2014/2017) no longer links to the ecological requirements of the Water Act (§33-35 WHG). In comparison to the older versions of the Renewable Energy Act, this has led to a situation in which environmental aspects have been weakened and the focus is now mainly on the required 10% increase in energy efficiency. In general, the system of feed-in tariffs is under some criticism. For large HPP >10 MW, the prices of the energy stock exchange are more important than the tariffs of the Renewable Energy Act. At the same time, there are hardly any new small HPP <100KW because, despite the Renewable Energy Act, this economic activity does not pay off. In some federal states (Bavaria, North Rhine-Westfalia, Baden-Württemberg), there have been ideas to partly bridge the existing funding gap for small HPP.
4. In **Norway**, the financial support given by the **green certificate market** with Sweden stimulates the building of new hydropower (and wind power). However, this green electricity market with Sweden will be phased out in 2020, and there is an on-going discussion if it should be extended/replaced by a new arrangement (still pending). This represents a risk to power producers considering developing new hydropower projects.

5. Also, in Switzerland, with the new energy law coming into force as of 1<sup>st</sup> January 2018, it has been decided to give favourable capital investment grants to companies investing in large HPP (> 10 MW).<sup>12</sup>
6. In **France**, there are two recent processes that should drive new developments in the hydropower sector: firstly, the public support system known as the "**purchase obligation contracts**" (similar to feed-in tariffs) was recently revised in 2015 and sets a new framework mainly for new HPP and for existing HPP subject to the realization of an investment program. In order to benefit from purchase obligations, HPPs must comply with the environmental laws in effect. Secondly, in April 2016 and May 2017, two calls for submissions for the construction and operation of hydroelectric installations were published by the Ministry for the Environment. Their objective is to contribute to the achievement of 23% of renewable energy by 2020 by developing hydroelectricity. Projects must propose the best possible integration of environmental issues in order to be able to succeed and be authorized.

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<sup>12</sup> See <http://www.bfe.admin.ch/energie/00588/00589/00644/index.html?lang=de&msg-id=68637>.

## 9. References

- BAFU, 2016, Ökologische Sanierung bestehender Wasserkraftanlagen (WKA).
- Biodiversity Information System for Europe, SEBI, n.d. – Streamlining European Biodiversity Indicators (<http://biodiversity.europa.eu/topics/sebi-indicators>).
- Bunge, T., et al, 2003, Hydroelectric Power Plants as a Source of Renewable Energy – legal and ecological aspects, For the German Federal Environmental Agency.
- Convention on Biological Diversity, n.d., Aichi Biodiversity Targets (<https://www.cbd.int/sp/targets/>)
- Council Regulation (EC) No 1084/2006 of 11 July 2006 establishing a Cohesion Fund and repealing Regulation (EC) No 1164/94.
- Council Regulation No 1100/2007 of 18 September 2007 establishing measures for the recovery of the stock of European eel. (<http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32007R1100&from=EN>)
- Devoldere, K., Adriaensens, V., Redeker, M., Dumont, U., Anderer, P., 2011 Hydropower Generation in the context of the EU WFD, Report to EC DG Environment, Contract no 070307/2010/574390.
- Dworak, T., 2011, Green Hydropower in Switzerland, report to the European Commission, grant agreement no. 265213.
- EAWAG, 2005. Development of ecological standards for hydropower. WP 2.1 report from the CLEAN-E project. A report prepared as part of the EIE project „Clean Energy Network for Europe (CLEAN-E)”. Available online: [https://ec.europa.eu/energy/intelligent/projects/sites/iee-projects/files/projects/documents/clean-e\\_development\\_of\\_ecological\\_standards\\_for\\_hydropower.pdf](https://ec.europa.eu/energy/intelligent/projects/sites/iee-projects/files/projects/documents/clean-e_development_of_ecological_standards_for_hydropower.pdf)
- Ecologic Institute, 2007, Water Framework Directive & Hydropower: Issues Paper, For Common Implementation Strategy Workshop, Berlin, 4-5 June 2007.
- European Commission, 2007b, First report on the implementation of the Water Framework Directive 2000/60/EC, Commission Staff Working Document (SEC(2007) 362 final).
- European Commission, 2011, Energy Roadmap 2050 (<http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52011DC0885&from=EN>) accessed 11 April 2017.
- European Commission, 2016, Hydropower and Natura 2000: good practice guide, Revised Draft for the European Commission, September 2016.
- European Commission, n.d., Hydropower Technology Information Sheet ([https://setis.ec.europa.eu/system/files/Technology\\_Information\\_Sheet\\_Hydropower.pdf](https://setis.ec.europa.eu/system/files/Technology_Information_Sheet_Hydropower.pdf)) accessed 11 April 2017.
- European Commission, n.d., 2030 Energy Strategy, accessed 11 April 2017.
- European Commission, 2013, Guidance Document "Streamlining environmental assessment procedures for energy infrastructure 'Projects of Common Interest' (PCIs)". Available: [http://ec.europa.eu/environment/eia/pdf/PCI\\_guidance.pdf](http://ec.europa.eu/environment/eia/pdf/PCI_guidance.pdf)
- European Court of Auditors, 2014, Cohesion policy funds support to renewable energy generation – has it achieved good results? ([http://www.eca.europa.eu/Lists/ECADocuments/SR14\\_06/SR14\\_06\\_EN.pdf](http://www.eca.europa.eu/Lists/ECADocuments/SR14_06/SR14_06_EN.pdf)) accessed 11 April 2017.
- EEA, European Environment Agency, 2016, Renewable Energy in Europe 2016: Recent Growth and knock-on effects (<http://www.eea.europa.eu/publications/renewable-energy-in-europe-2016>) accessed 11 April 2017.
- Green Energy Foundation, 2010, *27 National Action Plans = 1 European Energy Policy?*, ([http://gef.eu/wp-content/uploads/2017/01/GEF-10-06\\_NREAP\\_EN\\_web\\_final.pdf](http://gef.eu/wp-content/uploads/2017/01/GEF-10-06_NREAP_EN_web_final.pdf)) accessed 11 April 2017.

- International Hydropower Association, 2016, What will the Paris Agreement mean for hydropower development? (<https://www.hydropower.org/blog/what-will-the-paris-agreement-mean-for-hydropower-development>) accessed 14 December 2017.
- Kampa, E., et al, 2011, Issues Paper for the CIS Workshop on Water management, Water Framework Directive & Hydropower. Brussels, 13-14 September 2011.
- Norwegian Ministry of the Environment, 2007, Strategy on Invasive Alien Species. ([https://www.regjeringen.no/globalassets/upload/MD/Vedlegg/Planer/T-1460\\_eng.pdf](https://www.regjeringen.no/globalassets/upload/MD/Vedlegg/Planer/T-1460_eng.pdf)) accessed 14 December 2017.
- Schweizer, S. (2017). Mitigation of Hydropeaking in the Hasliaare –Selection of Measure(s) – echnical Aspects – Monitoring. Presentation at the CIS Workshop on GEP inter-comparison case studies on water storage, 13 -14 February 2017, Vienna.
- Schweizerischer Wasserwirtschaftsverband (2017). Der Wasserzins – die bedeutendste Abgabe auf der Wasserkraft. *Faktenblatt*, [https://www.swv.ch/Dokumente/Faktenblaetter-SWV-28Download-Ordner29/Faktenblatt-Wasserzins\\_SWV.pdf](https://www.swv.ch/Dokumente/Faktenblaetter-SWV-28Download-Ordner29/Faktenblatt-Wasserzins_SWV.pdf)
- SEA and SwAM, 2015, A Proposal for Review of Hydropower Generation
- Common Implementation Strategy, CIS, 2006, Technical Good Practice Paper, CIS activity on WFD & Hydromorphology, 11/2006.
- Wustenhagen, R. et al., 2003, Diffusion of green power products in Switzerland, *Energy Policy* 31, pp 626-627

*Additional online sources consulted for this report:*

<https://ec.europa.eu/energy/en/topics/renewable-energy/national-action-plans>

<http://ec.europa.eu/eurostat/web/environmental-data-centre-on-natural-resources-old/natural-resources/energy-resources/hydropower>

[http://ec.europa.eu/clima/policies/strategies/2030/index\\_en.htm](http://ec.europa.eu/clima/policies/strategies/2030/index_en.htm)

<https://ec.europa.eu/energy/en/topics/energy-strategy-and-energy-union/2030-energy-strategy>

<http://ec.europa.eu/environment/nature/biodiversity/comm2006/2020.htm>

[http://ec.europa.eu/environment/nature/natura2000/management/index\\_en.htm](http://ec.europa.eu/environment/nature/natura2000/management/index_en.htm)

[http://ec.europa.eu/environment/nature/invasivealien/index\\_en.htm](http://ec.europa.eu/environment/nature/invasivealien/index_en.htm)

[http://www.un.org/depts/los/convention\\_agreements/convention\\_overview\\_fish\\_stocks.htm](http://www.un.org/depts/los/convention_agreements/convention_overview_fish_stocks.htm)

*Please note that the sources of information and references used for specific countries are given in the policy templates in the Annex; these detailed sources and references have not been repeated inside the main report. For these, you should refer to the Annex.*



## Fishfriendly Innovative Technologies for Hydropower



Funded by the Horizon 2020 Framework Programme of the European Union

### Deliverable 5.1 Review of policy requirements and financing instruments - ANNEX

Project Acronym	FIThydro
Project ID	727830
Work package	Work package 5
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# 1 Austria

Prepared by Ecologic Institute.

## 1.1 Key national policies

The table below presents the key national legislation relevant to ecological improvements in water ecosystems and which may have repercussions in hydropower production.

Policy area	Name of law	Date
<b>Water protection</b>	National Water Act	1959 (last update 2014)
<b>Environmental impact assessment</b>	EIA Act	2000
<b>Energy/renewable energy</b>	Green Electricity Act	2012

The Table below presents, for each legislation, the relevant aspects for environmental improvements in water ecosystems, environmental conditions related to hydropower schemes or the production of hydropower itself.

Law	Description
<b>National Water Act 1959</b>	The Austrian Water Act (1959, last updated in 2014) is the main piece of legislation regarding water management and the provisions for projects having a potential impact on the watercourse. The 2010 ordinance on the quality objectives for ecological quality elements in rivers and lakes is based on the EU WFD and complements the Austrian river basin management plan of 2009.
<b>Environmental Impact Assessment Act 2000</b>	The EIA Act 2000 (last updated in 2013) gives provisions for environmental planning instruments, development control plans, procedures and certification. The EIA act 2000 provides that with regard to hydropower planning, an environmental impact assessment is mandatory for hydropower plants with a bottleneck output of 15 MW or more as well as several subcategories of hydropower facilities.
<b>Green Electricity Act 2012</b>	The Green Electricity Act 2012 (amended in 2013) provides for the expansion plans of renewable technologies as well as associated support schemes.

### 1.1.1 Targets set under the Renewable Energy Directive

In AT, the Energy Strategy 2010 clearly sets that besides other renewable, hydropower generation has to be extended by 3.500 GWh to reach the goals in 2020 set by the RES-Directive (this was also included in the National Renewable Energy Action Plan).

Sources of information: Glachant et al., 2015,<sup>1</sup> Kampa et al., 2011<sup>2</sup>

<sup>1</sup> Glachant, J., Saguean, M., Rioux, V., Douguet, S. Regimes for granting the right to use hydro-power in Europe (19 October 2015) European University Institute.

<sup>2</sup> Kampa et al. 2011, Water management, Water Framework Directive & Hydropower, Issue Paper (draft 2) for Common Implementation Strategy Workshop, Brussels, 13-14 September 2011.

## 1.2 Strategic planning instruments

### 1.2.1 Strategic instruments for new hydropower use and development

#### 1.2.1.1 Instruments

There are strategic planning instruments in place for new hydropower use and development at different administrative levels:

- Criteria catalogue for hydropower as a basis for further regional planning (Ministry for Agriculture, Forestry, Environment & Water Management) (national level)
- Alpine region -Common Guidelines for the use of small hydropower in the alpine region (regional)
- Designation of appropriate/ not appropriate sites – Vorarlberg (regional)
- Hydropower potential studies (national and regional level)

The Table below presents, for the National Criteria Catalogue, the relevant aspects for environmental improvements in water ecosystems, environmental conditions related to hydropower schemes or the production of hydropower itself.

Law	Description
<b>Criteria catalogue for hydropower as a basis for further regional planning</b>	The “Criteria Catalogue for new hydropower development” (Österreichischer Wasserkatalog: Wasser schützen – Wasser nutzen. Kriterien zur Beurteilung einer nachhaltigen Wasserkraftnutzung) is a decision support system as basis for regional planning. In a first step the catalogue was published as a national ordinance which needs to be made more explicit by the Austrian provinces in a second step. The national criteria catalogue includes criteria assessing the ecological value of river stretches, criteria for the assessment of specific hydropower projects taking into account ecological, energy management and water management aspects in case of a expected status deterioration. Pre-planning for new hydropower development based on the national criteria catalogue (published by the Ministry in 2012) was already implemented in 3 provinces and is still undergoing in at least one province.

Source of information: CIS questionnaire on WFD and hydropower (2011)

#### 1.2.1.2 Administrative levels and linked planning process

The table below presents the strategic planning instruments in place for new hydropower use and development and the administrative level at which they act.

Name	National	RBD	Regional	Federal State	Other
<b>Criteria catalogue for hydropower as a basis for further regional planning</b>	Yes				
<b>Alpine region -Common Guidelines for the use of small hydropower in the alpine region</b>			Yes		
<b>Designation of appropriate/ not appropriate sites - Vorarlberg</b>			Yes		
<b>Hydropower potential studies</b>	Yes		Yes		

The table below presents the planning process which the relevant strategic instrument is part of.

Planning process	Criteria catalogue for hydropower as a basis for further regional planning
River Basin Management Planning	Yes
Hydropower Sector planning	Yes

### 1.2.1.3 Linking with financing instruments and/or regulatory procedures

If strategic planning instruments are used to identify “suitable” locations for hydropower development, are such areas:	
Targets of financial support schemes for hydropower development?	Subject to more simplified and faster authorisation processes?
No	No. In “Abwägungsstrecken” an EIA might still be needed and it depends on the concrete project design to prove that there is no deterioration of WFD objectives. In other cases like the “Rahmenplan Tiroler Oberland”, for those stretches which are designated for hydropower use, there are no simplified/faster processes either due to the same reasons, but in reality if the project will lead to a deterioration of status there will be a very important argument in the weighing process of balancing public interests, which might speed up the process a little bit.

## 1.2.2 Strategic planning instruments to restore continuity

A specific strategic plan for continuity restoration does not exist. But the national River Basin Management Plan (2009) included the general strategy to restore river continuity from downstream to upstream and from “large into small rivers” and to start with rivers(-stretches) which are historically the habitats for medium distance migrators (medium distance migrators are the most endangered fish species in Austria).

River continuity includes that also a base flow is provided to guarantee passability for fish. The prioritisation approach for continuity restoration applied in the RBMP is combining these ecological criteria with administrative criteria (like number of obstacles which have to be restored) because not only hydropower plants have to restore continuity but also any other obstacles (mostly due to flood protection) within the “priority river stretch) also has to restore continuity. Another criterion for selecting the priority area for restoration is the ecological effectiveness that means that some river stretches might be postponed as there are too many obstacles in the (downstream) part of the river.

Source of information: pers. Comm BMLFUW (Bundesministerium für Land- und Forstwirtschaft, Umwelt und Wasserwirtschaft)

## 1.3 Procedural instruments at the level of hydropower plants

### 1.3.1 Duration of concessions

Typical duration of concessions
Existing very old small hydropower plants: without limitation, but permit needs to be renewed in case of severe changes of water use.
New large hydropower plants: usually 60-90 years maximum.
New small hydropower plants: usually 30-40 years taking into account the local situation in relation to flow and water existing uses.

The unlimited permits were changed to a limitation of up to 90 years (large hp) or up to 40 years (small hp) in case of renewal of the permit.
<b>Is the permit duration for all hydropower plants the same?</b>
No
<b>If the permit duration varies, which criteria define the duration of a permit? (e.g. size of hydropower plant)</b>
Size of hydropower plant and situation (hydrology-flow-existing use)
<b>Are there differences in the duration of concessions between new and existing HPP?</b>
Yes, see above.

Source of information: CIS questionnaire on WFD and hydropower (2011)

### 1.3.2 Authorisation conditions for new hydropower plants

#### 1.3.2.1 Mitigation measures required

The table below presents the mitigation measures related to fish required to fulfil the conditions for authorizing a new hydropower plant.

Types of mitigation	Requirement based on legislation?	If no relevant legislation, is requirement based on a recommendation?	If no relevant legislation or recommendation, is requirement defined in individual cases?	Is there no requirement at all for this type of mitigation?
<b>Upstream fish migration</b>	Yes			
	Providing river continuity is declared to be state of the Art (§ 12 a in the National Water Act, Revision 2011) and therefore obligatory – except outside of the natural fish zone and very near to natural existing barriers. As an outcome of the River Basin Management Plan it's obligatory to guarantee ecological continuity. That means for example that a fish pass is required for all hydropower plants which are situated in rivers where fish naturally used to live ("natürlicher Fischlebensraum"- that means that more or less areas in the very high alpine regions are excluded where natural fish habitats do not exist due to natural obstacles/ high slope). The requirement for providing river continuity is relevant for new and existing obstacles (incl. those due to hydropower). Fish passes have to be built according the requirements of the "Leitfaden zum Bau von Fischaufstiegshilfen" which was published by the Ministry of Agriculture, Forestry, Environment and Water Management in 2012.			
<b>Downstream fish migration</b>			Yes	
	National law states that all water uses have to respect the state of Art & Technology. In Austrian we naturally don't have long distance migrators like salmon or eel. Anyway downstream migration is seen as important for longitudinal continuity for fish species in general. But as there as is no proven state of technology to ensure downstream migration there is no general requirement but only some pilot facilities to learn for the future and increase know how.			
<b>Flow conditions</b>	Yes			
	There is a requirement of an ecological minimum flow according to the National water Act (§ 13). This is valid for new plants and according to the National River Basin Management Plan also for existing hydropower plants (but restoration will be			

Types of mitigation	Requirement based on legislation?	If no relevant legislation, is requirement based on a recommendation?	If no relevant legislation or recommendation, is requirement defined in individual cases?	Is there no requirement at all for this type of mitigation?
	done stepwise as in the case of continuity). Ecol. Min. Flow through fish passes is regulated in a national recommendation for fish passes "Leitfaden zum Bau von Fischaufstiegshilfen" which was published by the Ministry of Agriculture, Forestry, Environment and Water Management in 2012 - but the general requirement that fish passes have to guarantee functioning is a national legal requirement concerning state of the Art and Technology.			
<b>Hydropeaking</b>	Yes			
	<p>In the National Ordinance on Ecological status, it is stated that in small and middle size-rivers a surge /downsurge relation of &gt; 1: 3 ensures good status for biological elements with high confidence in case that at least 80% of the river which is covered by water during surge is also covered by water during at the lowest down surge. As compensation reservoirs cannot be built very often due to lack of suitable land, other mitigation measures are tested in the frame of a research project starting in 2010 to find out the most effective way - without reducing peak load production in a significant manner. In 2015, some issues had been clarified in between but there still existed some open questions; therefore the implementation of mitigation measures was postponed to WFD cycle after 2021.</p> <p>In the National RBMP, the following activity is included: Based on the results of the research studies hydropower companies have to provide feasibility studies for their hydropeaking plants till 2021 on how hydropeaking can be mitigated effectively. All measures have to be described whether they are ecologically effective, technical feasible, their economic and socioeconomic effects. This will be the basis for the water authority to delineate and define good ecological potential and the necessary mitigation measures to achieve GEP. Those mitigation measures will have to be implemented after 2021.</p>			
<b>Gravel transport (sediment)</b>	Yes			
	There is a general requirement for new plants to mitigate negative effects of any water use by national legislation, to ensure good ecological status/good ecol. potential, no deterioration principle. In the National "Ordinance on Ecological Status", it is stated that good ecological status for biological elements can be achieved with high confidence in case that the sediment dynamics is only modified within short river stretches. Exemptions from no deterioration principle can only be accepted in case that the requirements of Art. 4/7 WFD are met.			
<b>Habitat enhancement</b>			Yes	
	<p>There is a requirement to minimise impacts as far as possible for new plants and to achieve GES/GEP, that means that morphological mitigation measures have to be implemented. But which is depending on the site specific. Existing hp with impoundment are usually designated as HMWB and the definition of GEP includes morphological improvements – mostly habitat restoration in the area of the beginning impoundment (Stauwurzel).</p> <p>In case of residual flow stretches it is not allowed just to change morphology (make the river narrower) so to minimise the ecological flow. Relevant morphological mitigation measures are listed in the "Catalogue of Measures" (open list) from which at least appropriate measures have to be selected for GEP or mitigating minimising impacts in case of new projects.</p>			

Sources of information: pers. comm BMLFUW, CIS questionnaire on WFD and hydropower (2011)

### 1.3.2.2 Link to WFD requirements

Authorisation procedures for new hydropower have been adapted to the requirements of the WFD. In Austria, mitigation measures to reduce negative impacts on water status are a precondition to get a permit/license for a new hydropower plant. Ecological continuity as well as an ecological minimum flow are obligatory mitigation measures for new plants in natural water bodies as well as in heavily modified water bodies (when defining the ecological minimum flow in HMWBs the altered flow and/or bed structures have to be taken into account). Other mitigation measures which are technically feasible depend on the actual situation.

Source of information: Kampa et al. 2011.

### 1.3.3 Authorisation conditions for existing hydropower plants

#### 1.3.3.1 Permit revisions

<p><b>Time period to upgrade, retrofit or modernize existing hydropower plants</b></p> <p>In former times, a change of the existing permit was only in case of a significant change in hydrological situations. But according to the WFD a change of permits can be done according to the measures set in the National action plan. According to this, the National Water Act was revised in 2011. For example in the frame of regional restoration programmes - which have the character/form of an Ordinance by the regional authorities – restoration measures like restoring continuity by building a fish passes, guaranteeing an ecological minimum flow - a deadline can be set by which the owner of a permit has to submit a restoration project to the authorization body.</p>
<p><b>Adaptation of existing concessions to WFD requirements</b></p> <p>There has been an adaptation of existing concessions to WFD requirements (see previous response).</p>
<p><b>Conditions when the authorization of an existing HPP is running out</b></p> <p>In general, if you apply for a new hydropower permit or if you need a new permit (because the existing permit has expired or you want to change the water use and therefore have to apply for a new permit) you only can get a permit, if your application follows “State of the Art &amp; Technologies, that it means that it has a fish pass, ecological flow.</p>
<p><b>Indefinite concessions and permit revisions</b></p> <p>The unlimited permits were changed to a limitation of up to 90 years (large hp) or up to 40 years (small hp) in case of renewal of the permit.</p>
<p><b>Turbine upgrades and permit revisions</b></p> <p>Turbine upgrades don't need a permit from the water authority if changing the turbine or upgrading does not change the “Maß der Wasserbenutzung” (the permitted amount of water abstraction, operation mode, effect on water ecology)</p>

Sources of information: CIS questionnaire on WFD and hydropower (2011), Glachant et al. 2015, pers. comm. BMLFUW

#### 1.3.3.2 Mitigation measures required

The table below presents the mitigation measures related to fish required when revising the conditions of existing hydropower plants permits.

Types of mitigation	Requirement based on legislation?	If no relevant legislation, is requirement based on a recommendation (e.g. guideline, technical standard)?	If no relevant legislation or recommendation, is requirement defined in individual cases?	Is there no requirement at all for this type of mitigation?
<b>Upstream fish migration</b>	Yes			
	<p>Providing river continuity is declared to be state of the Art (§ 12 a in the National Water Act, Revision 2011) and therefore obligatory – except outside of the natural fish zone and very near to natural existing barriers. As an outcome of the River Basin Management Plan it's obligatory to guarantee ecological continuity. That means for example that a fish pass is required for all hydropower plants which are situated in rivers where fish naturally used to live ("natürlicher Fischlebensraum"- that means that more or less areas in the very high alpine regions are excluded where natural fish habitats do not exist due to natural obstacles/ high slope).</p> <p>The requirement for providing river continuity is relevant for new and existing obstacles (incl. those due to hydropower). For existing obstacles the timeline/deadlines for continuity restoration are set in the National River Basin Management Plan NGP (the legal character of the plan is an "Verordnung" = Ordinance) taking into account criteria like ecological effectiveness, economic and administrative aspects (prioritisation!).</p>			
<b>Downstream fish migration</b>				Yes
<b>Flow conditions</b>	Yes			
	<p>Provisions regarding watercourse residual flow protection were introduced in the 1990 Water Management Law, and further defined in the 2010 ordinance on the quality objectives for ecological quality elements in rivers and lakes. The ordinance is based on the EU Water framework directive. There is a specific requirement of an ecological minimum flow according to the National water Act (§ 13). This is valid for new plants and according to the National River Basin Management Plan also for existing hydropower plants (but restoration will be done stepwise as in the case of continuity). Like for river continuity the timeline/deadline for restoration is set in the National River Basin Management Plan. The Priority area for restoration is usually identical with the priority area set for river continuity restoration. According to the 1<sup>st</sup> RBMP, watercourse residual flow is to be fully restored stepwise until 2027 in existing hydropower plants to comply with the WFD.</p>			
<b>Hydropeaking</b>				Yes
<b>Gravel transport (sediment)</b>				Yes
<b>Habitat enhancement</b>			Yes	
	<p>Existing hp with impoundment are usually designated as HMWB and the definition of GEP includes morphological improvements – mostly habitat restoration in the area of the beginning impoundment (Stauwurzel). In case of residual flow stretches it is not allowed just to change morphology (make the river narrower) so to minimise the ecological flow. Relevant morphological mitigation measures are listed in the "Catalogue of Measures" (open list) from which at least appropriate measures have to be selected for GEP or mitigating minimising impacts in case of new projects.</p>			

Sources of information: CIS questionnaire on WFD and hydropower (2011), Glachant et al. 2015, pers. comm. BMLFUW

### 1.3.4 Authorisation aspects relevant to new and existing hydropower plants

#### 1.3.4.1 Requirements for monitoring effectiveness

No monitoring requirements usually exist for small hp plants. For large, in most cases. Functioning of fish pass has to be monitored for large hp in most cases.

Source of information: pers.comm BMLFUW

#### 1.3.4.2 Further aspects to be considered when setting mitigation requirements

N/an/a

#### 1.3.4.3 Regulatory agencies involved in the authorization procedure

The Federal Minister of Agriculture, Forestry, Environment and Water management is responsible for setting an environmental protection provision and coordinating the local, State, and federal authorities. It is responsible for updating and applying the Austrian Water Act.

The Austrian Reservoir Commission is appointed by the Federal Minister of Agriculture to support water authorities on technical issues and safety monitoring in or outside of water rights procedures. Since 1964, it has published guidance and opinions on monitoring and reservoir safety.

The local authorities are responsible for water monitoring and water rights procedures. There are three levels:

- First, the regional government and district authorities are responsible for water management and the licensing for most hydropower facilities (<500 kW).
- Second, federal State authorities are responsible for the authorisation of small hydropower with a capacity higher than 500 kW.
- Last, the national authority is responsible for hydropower facilities on the Danube as well as cross-border facilities. The authorities can be assisted in their tasks by the Austrian Reservoir Commission.

Source of information: Glachant et al. 2015

#### 1.3.4.4 Flow-chart on the key steps of the authorization procedure for new hydropower plants / existing hydropower plants

## 1.4 N/a Challenges with regards to policy requirements

<b>Uncertainty in the planning, development and operation of HPP linked to the regulatory framework (national, regional)</b>
N/a
<b>Uncertainty in the planning, development and operation of HPP linked to authorisation procedures</b>
N/a
<b>Recent changes to the regulatory framework</b>
The National Water Act was revised in 2011 and made several mitigation measures such as upstream

continuity measures and ecological minimum flow an obligatory requirement.
<b>Foreseeable changes to the regulatory framework</b>
N/a

## 1.5 Financing instruments

The following financing instruments promoting *at the same time* hydropower generation and improvement in water status are implemented:

- Green power labels. However they do not play an important role for hydropower.
- Support schemes for modernization of existing plants

### 1.5.1 Support schemes for modernization of existing plants

<b>Name of instrument</b>
A National support scheme for modernisation exists for small and medium size hydropower - but there is no difference between those which improve status and those which do not;  However, any HPP needs to have already a permit by the water authority which means that a fish pass and ecological minimum flow is obligatory. There are support schemes by some regional governments which combine ecological improvement and technical modernisation.
<b>Type of hydropower targeted</b>
<b>Criteria for ecological improvement</b>
<b>Source of funding</b>
<b>Source of information</b>
CIS questionnaire on WFD and hydropower (2011)

## 1.6 Challenges with regards to financing instruments

<b>Design or implementation dimensions to be improved</b>
N/a
<b>Recent changes driving developments in the hydropower sector</b>
N/a
<b>Foreseeable changes that may drive new developments in the hydropower sector</b>
N/a

## 2 Germany

Prepared by Ecologic Institute.

### 2.1 Key national policies

The table below presents the key national legislation relevant to ecological improvements in water ecosystems and which may have repercussions in hydropower production.

Policy area	Name of law	Date
<b>Water protection, Water infra-structures</b>	Federal Water Act (WHG)	2009
<b>Nature protection</b>	Federal Nature Conservation Act (BNatSchG)	2010
<b>Environmental protection</b>	Federal Immission Control Act - BImSchG)	2013
<b>Environmental impact assessment</b>	Law on Environmental Impact Assessment Act (UVPG)	2010
<b>Energy/renewable energy</b>	Renewable Energy Sources Act (EEG)	2012
<b>Environmental Liability</b>	Environmental Damage Act (USchadG)	2007

The table below presents, for each law, the relevant aspects for environmental improvements in water ecosystems, environmental conditions related to hydropower schemes or the production of hydropower itself.

Law	Description
<b>Federal Water Act, Wasserhaushaltsgesetz (WHG)</b>	<p>The Federal Water Act is the key act concerning the assessment of the permissibility and approval of the construction and operation of HPP. For the assessment of permissibility of the HPP (i.e. for construction/reactivation/operation), the Act considers the intended use, whether the development of a water body is involved, whether the reactivation of a station with prior approval is involved, and whether the construction of a new station is involved. Basically speaking, the intended use of waters requires a permit/license, whereas the development of a water body requires a planning approval procedure. However, while some general uses of waters require no approval, such as insignificant public uses, hydroelectricity power plants always require approval. Regarding the construction of HPPs, the following uses can be relevant: impoundage by a weir, diversions of water (e.g. through a turbine), extraction of solid matter through inlet screens, lowering of the water body through deepening and the diversion of water through widening the water bed (Bunge et al, 2003).<sup>3</sup></p> <p>The WHG (§§33 to 35) requires ecological measures to be undertaken at HPPs according to the WFD. As a strategic element concerning HP, it demands as well (§35) the examination of unused weirs and dams as locations for hydropower production. The federal states incorporated the WHG into their legislation (Federal State Water Acts (Landeswassergesetze) and Federal State Fishery Acts (Landesfischereigesetze)). The Water Act outlines the requirements related to minimum river stream flow and river continuity. A specific requirement for hydropower is that appropriate measures</p>

<sup>3</sup> Bunge, T., et al, 2003, Hydroelectric Power Plants as a Source of Renewable Energy – legal and ecological aspects, For the German Federal Environmental Agency.

	<p>are taken to protect the fish population. Existing installations have to comply with this requirement within a reasonable time (Desbarats et al, 2010).<sup>4</sup></p> <p>The WHG is the central law for assessing the lawfulness of the establishment and the operation of hydropower facilities. It contains provisions for water management, use of hydropower, permit authorisation and minimum water flow conditions with respect to the EU Water Framework Directive (Glachant et al, 2015).</p>
<p><b>Federal Nature Conservation Act</b></p>	<p>The construction and operation of HPPs is relevant for the Federal Nature Conservation Act in terms of the potential interference with nature and landscape ecosystems. Article 15 of the act stipulates that interference with nature is not allowed when the effects are neither avoided nor sufficiently compensated, and that the interests of nature protection and landscape conservation shall be given priority over all other interests.</p> <p>The construction, enlargement or conversion of an HPP can be classified as an interference with nature (according to the Act's definition). However, this is only in the case for stations located in the outer zone ("Aussenbereich") (i.e. outside local development plans, outside unplanned inner zones of settlements, or inside the planning area of a not yet finalized local development plan). According to the Building Code, HPPs in the outer zone have several undeniable ecological and hydromorphological impacts, and therefore interfere with nature.</p> <p>The Act details the protection of valuable species, habitats and landscapes. The act also stipulates restrictions on the construction and structural alteration of HPPs located in officially protected areas and states that damage or modification to nature protection areas or component parts is prohibited. The construction or enlargement of HPPs inevitably modifies a natural area, according to the definition of modification in the Act (Bunge et al, 2003).</p> <p>The aspects on habitats protection and the coherence of the N2000 network are the most important in the context of commissioning and operating HPPs. The coherence aspect is especially relevant, as it ensures both upstream and downstream connectivity (Interview with Fisheries Association Bavaria : 22.06.2017).</p>
<p><b>Law on Environmental Impact Assessment Act (EIA Act)</b></p>	<p>The EIA act regulates environmental impact assessments for projects with a potential impact on the environment (Glachant et al, 2015). The EIA Act (UVPG) aims to ensure effective precautionary protection through two main approaches. Firstly, it requires that impacts on the environment are comprehensively investigated, described and assessed in good time, and secondly, that findings of an environmental impact assessment are taken into account as early as possible in all decisions on permissibility (Article 1) (Bunge et al, 2003).</p> <p>The projects that shall be subject to an EIA are listed in Annex 1, of which the construction of a new HPP is mentioned under number 13.14 and the re-powering of a station is included under number 13.18 . Thus, a general pre-examination of the individual case is required. Whether a full EIA is required, or not, depends on the intensity of the impact on the environment. In this regard the involved authorities have a certain margin of discretion.</p> <p>The EIA act also sets standards on how public interest parties ("Träger öffentlicher Belange") such as Nature NGOs can participate in the EIA procedure. Often the EIA is the only way for public interest parties to actively participate in the planning process (Interview with Fisheries Association Bavaria : 22.06.2017). The EIA act also regulates the strategic assessment of public plans or programmes on the basis of Directive 2001/42/EC (known as 'Strategic Environmental Assessment' – SEA Directive).</p>

<sup>4</sup> Desbarats et al, 2010. Regulation of small-scale hydropower: case studies of Denmark, France and Germany, Report of the IEEP and Ecologic Institute

<b>Renewable Energy Sources Act (EEG)</b>	The Act is complementary to the Energiewende and provides for support schemes and conditions for renewable energy sources in Germany. It provides for economic incentives for the use of watercourses for hydropower, but also includes efficiency improvement requirements that must be reached in order for hydropower installations to benefit from the scheme (Bunge et al, 2003). Due to the EEG incentives, sites of HPPs that are technically unprofitable from a business point of view might become attractive, regardless of their environmental impacts. This not only holds true for newly built HPPs, but also for the repowering of already existing plants. <sup>5</sup>
<b>Environmental Damage Act (USchadG)</b>	The Environmental Damage Act (USchadG) is based on the Directive 2004/35/EC on environmental liability and aims for the prevention and remediation of environmental damage. The Environmental Damage Act concerns specifically water damage, which is any damage that adversely affects the ecological, chemical and/or quantitative status and/or ecological potential of water, as long as the adverse effects are 'significant'. <sup>6</sup>

### 2.1.1 Targets set under the Renewable Energy Directive

The installed hydropower capacity expected in Germany by 2020 is 4309 MW and the total amount of electricity production from hydropower is expected to be 20000 GWh. Between 2010 and 2020, an increase of 2000 GWh/a is expected. The gross power production capacity of the plants relates to the entire gross power production in Germany. The realistic development potential (after 2020) in Germany is approximately 5000 GWh/a of electricity production.<sup>7 8</sup>

There is no general consensus amongst the different actors whether these targets are realistic, taking into account the strict environmental regulations and land use related restrictions in Germany. Some regional hydropower capacity plans (e.g. in Bavaria) are available. Some of them are solely based on data from the hydropower industry (Example: [energieatlas.bayern.de/thema\\_wasser/potenzial/modernisierung.html](http://energieatlas.bayern.de/thema_wasser/potenzial/modernisierung.html)). Nature NGOs in Germany tend to be more conservative regarding which future scenario they find realistic and/or acceptable for hydropower energy production.

## 2.2 Key regional policies

The table below presents the key regional legislation relevant to ecological improvements in water ecosystems and which may have repercussions in hydropower production.

Policy area	Name of law	Date
<b>Water protection</b>	Federal State Water Acts (e.g. Bayerisches Wassergesetz (BayWG))	2010
<b>Nature protection</b>	Federal State Conservation Acts (e.g. Baden-Württemberg, n/a in Bavaria)	n/a

<sup>5</sup> ibid.

<sup>6</sup> ibid.

<sup>7</sup> Bundesrepublik Deutschland (2010): Nationaler Aktionsplan für erneuerbare Energie gemäß der Richtlinie 2009/28/EG zur Förderung der Nutzung von Energie aus erneuerbaren Quellen. ([http://www.erneuerbareenergien.de/files/pdfs/allgemein/application/pdf/nationaler\\_aktionsplan\\_ee.pdf](http://www.erneuerbareenergien.de/files/pdfs/allgemein/application/pdf/nationaler_aktionsplan_ee.pdf))

<sup>8</sup> Bundesministerium für Umwelt, Naturschutz und Reaktorsicherheit (BMU) (2010): Potentialermittlung für den Ausbau der Wasserkraftnutzung in Deutschland als Grundlage für die Entwicklung einer geeigneten Ausbaustrategie. BMU (Auftraggeber). Ingenieurbüro Floecksmühle, Institut für Strömungsmechanik und Hydraulische Strömungsmaschinen der Universität Stuttgart (IHS), Hydrotec Ing.-Ges. für Wasser und Umwelt mbH, Fichtner GmbH & Co. KG (Bearbeiter).

[https://www.dnr.de/fileadmin/Positionen/2014\\_03\\_12\\_Stellungnahme\\_EEG\\_Novelle\\_Anlagenregistrierung.pdf](https://www.dnr.de/fileadmin/Positionen/2014_03_12_Stellungnahme_EEG_Novelle_Anlagenregistrierung.pdf). See also: [nabu-stellungnahme\\_referentenentwurf\\_eeg\\_2016.pdf](#)

<b>Fisheries</b>	Federal State Fisheries Acts (e.g. Bayerisches Fischereigesetz (BayFiG))	2008
<b>Fisheries</b>	Federal State Fisheries regulations (e.g. Verordnung zur Ausführung des Bayerischen Fischereigesetzes (AVBayFiG))	2004
<b>Biodiversity</b>	Federal State Biodiversity Strategies	2008

The Table below presents, for each law, the relevant aspects for environmental improvements in water ecosystems, environmental conditions related to hydropower schemes or the production of hydropower itself.

Law	Description
<b>Federal State Water Acts (e.g. Wassergesetz für Baden-Württemberg (WG), Bayerisches Wassergesetz)</b>	<p>The Water Acts in the Federal States closely follow the federal WHG. In Bavaria, the Water Act closely follows and transposes of the federal WHG. Besides this, the administrative regulation for the Bavarian water act (Verordnung zum Bayrischen Wasserrecht (VV WAS) regulates which authorities have to be involved in the water legislation procedure (Glachant et al, 2015).</p> <p>In Baden Württemberg, the Water Act provides for a water use charge that is applied for the use of hydropower with more than 1 MW capacity. The rate of the fee is relative to the average available capacity of the plant. It is calculated from the useable quantity of water and the gross head. The fee is due to the owner of the river bed (Interview with Fisheries Association Bavaria : 22.06.2017).</p>
<b>Federal State Conservation Acts</b>	<p>Conservation Acts of the Federal States may closely follow and transpose the Federal Conservation Act. Bavaria has no Nature Conservation Act that transposes the German Conservation Act. Some years ago the Bavarian State Ministry for the Environment initiated a working group on “environmentally friendly hydropower”. This process involved all relevant stakeholders (hydropower associations, nature NGOs) with the objective to work jointly on an approval procedure for new HPPs. From the political side this stakeholder process was aimed at underlining the public interest for Hydropower energy production. In the end, all nature NGOs left this process as soon as they realized that this procedure would weaken the conservation status of the N2000 network (Interview with Fisheries Association Bavaria : 22.06.2017).</p>
<b>Federal State Fisheries Acts (e.g. Bayerisches Fischereigesetz (BayFiG))</b>	<p>The Bavarian Fisheries Act dates back to the beginning of the 20th century. Article 67 states that the competent district authorities can require fish protection measures for hydropower turbines, however, this regulation had hardly ever been applied before the recent WHG (§35) came into force in the year 2010 (Interview with Fisheries Association Bavaria : 22.06.2017).</p>

## 2.3 Strategic planning instruments

### 2.3.1 Strategic instruments for new hydropower use and development

#### 2.3.1.1 Instruments

Apart from the requirements of the WFD, there are no explicit strategic environmental agendas imposed by federal authorities, given the limited unused potential for new HPPs. The main challenge is to deal with the environmental impacts of existing hydropower. Some states in possession of higher unused hydropower potentials have carried out sur-

veys to identify optimal locations for installing new HPPs. However, these studies mainly focus on the technical aspects such as the hydropower capacity of river systems.

Another new provision in the Water Act with strategic relevance refers to existing dams, weirs, or barriers in a river (S. 35(3)). In cases where the removal of weirs and barriers is not necessary in order to achieve the Act's water management objectives, authorities are required to assess whether they are structures suitable for hydropower, and to make the corresponding assessment publicly available. This is intended to provide new motivation for an environmentally sound expansion of hydropower (Desbarats et al, 2010).

There are some planning instruments on the administrative level (national, federal). Examples include the studies on the hydropower potential for Germany as a whole and the sub-basins such as the one for Neckar River. At the level of the federal states, water authorities check if hydropower use is possible on non-replaceable transverse structures (WHG §35 (3)“ (CIS questionnaire on WFD and HP (2011)). In addition, some federal states also issue capacity studies, summarising regional studies and filling gaps (e.g. Potentialstudie Erneubare Energien NRW 2017)

As a basis for the **German hydropower development strategy**, the Federal Ministry of Environment, Nature Conservation and Nuclear Safety (BMU) has commissioned further research to determine the additional usable potential of hydropower throughout Germany, using a consistent method of line potential calculations (Environmental exclusion criteria are, for example, that no installation of new HPP in natural free-flowing river stretches is allowed and new HPP at existing transverse structures need to allow minimum flow conditions. Criteria for the approval of hydropower use could be, for instance, if the deconstruction of a weir isn't possible due to other reasons (e.g. regulation of the ground-water table), if water discharge to assure minimum flow conditions is guaranteed and if no conflicts with flood defence measures will happen (CIS questionnaire on WFD and HP (2011), Anderer et al, 2010).<sup>9</sup>

An **interdisciplinary study on the Neckar River** investigated the hydropower potential from technical, economic and environmental perspective at existing plants and for additional hydropower utilization at thus far unused transversal structures for the Neckar River basin (CIS questionnaire on WFD and HP (2011)).

**A study on the potential for hydropower in Bavaria (2013)** was issued by the Hydropower associations and only covers large HPPs. The study also highlights that the focus for future hydropower development lies on modernisation. New HPPs should be only considered, if synergies with other uses (e.g. flood protection) are given. In Bavaria, the regional development plans don't delineate priority areas for hydropower (Interview with Fisheries Association Bavaria : 22.06.2017).

The **individual RBMPs** might cover hydropower development aspects, however, the RBMPs tend to be rather vague on this subject and often just refer to §35 WHG.

### 2.3.1.2 Administrative levels and linked planning process

The above studies have been prepared at different levels, including national (Federal) and regional (State or Lander).

Name	National	RBD	Regional	Federal State	Other
Hydropower Potential Studies	Yes		Yes	Yes	

<sup>9</sup> Pia Anderer, Ulrich Dumont, Stephan Heimerl, Albert Ruprecht und Ulrich Wolf-Schumann (2010): Das Wasserkraftpotenzial in Deutschland. Wasserwirtschaft 9: 12-16.

The above studies are linked to several planning processes.

Planning process	Hydropower potential studies
<b>Hydropower Sector planning</b>	Yes (e.g. hydropower potential study of Bavaria, Neckar)
<b>German hydropower development strategy</b>	Yes (e.g. hydropower potential study of Germany)
<b>Federal States' Renewable Energy Action Plans</b>	Yes (e.g. hydropower potential study of Northrhine-Westfalia)
<b>Environmental information platforms on (renewable) energy</b>	Yes (e.g. energieatlasnrw.de Hydropower Atlas Bavaria)

### 2.3.1.3 Linking with financing instruments and/or regulatory procedures

If strategic planning instruments are used to identify “suitable” locations for hydropower development, are such areas:	
Targets of financial support schemes for hydropower development?	Subject to more simplified and faster authorisation processes?
No	No

## 2.3.2 Strategic planning instruments to restore continuity

### 2.3.2.1 Instruments

There are several strategic planning instruments on the basin and sub-basin level (i.e. connectivity studies for potamodromous and diadromous fish species).

Connectivity strategy for the fish fauna (LAWA Strategiepapier Fischdurchgängigkeit): delineation of migratory routes with special importance for the conservation and repopulation of diadromous and potamodromous species (content: Identification of target species, setting up information systems on transversal structures in rivers including an assessment of fish passability, hydromorphological status and restoration potential of habitats (CIS questionnaire on WFD and HP (2011)). The connectivity strategies of the national river basin associations can indirectly be used to designate appropriate river stretches for hydropower usage.

At the moment a connectivity concept and a biotope network for the federal waterways in Germany are being developed (Bundesweites Fachkonzept “Biotopverbund Gewässer und Auen”). Connectivity concepts also exist for certain target species, such as salmon and eel, delineating priority water bodies for connectivity measures (“Zielarten Gewässer(-strecken)”) (e.g. Migratory Fish Species Programme Northrhine-Westfalia).<sup>10 11</sup>

### 2.3.2.2 Administrative level and linked planning processes

The above planning instruments act at multiple level, including national (Federal level), regional (State/Lander) and river basin levels.

Name	National	RBD	Regional	Federal	Other

<sup>10</sup> [http://www.flussgebiete.nrw.de/index.php/Pr%C3%BCfkulisse\\_Zielartengew%C3%A4sser](http://www.flussgebiete.nrw.de/index.php/Pr%C3%BCfkulisse_Zielartengew%C3%A4sser)

<sup>11</sup> <https://www.lanuv.nrw.de/natur/fischereioekologie/wanderfischprogramm/>

				State	
Continuity strategies for fish fauna	Yes	Yes	Yes	Yes	

The strategies are aligned to the RBMP process and the Eel Management Plans.

Planning process	Continuity strategies for fish fauna
River Basin Management Planning	Yes
Eel Management Plans	Yes

## 2.4 Procedural instruments at the level of hydropower plants

### 2.4.1 Duration of concessions

Typical duration of concessions
<p>The authorisation permit or 'Bewilligung' is the strongest type of permit in terms of rights granted to the permit holder. It can be revoked only under very narrow conditions and must be time-restricted. Third parties are prevented from restricting the use of permits or from bringing claims against the permit holder on the basis of nuisance, loss and damage associated with a permitted project. Therefore the procedure for issuing an authorisation must include the possibility for third parties and authorities to submit objections at the onset of the permitting process. Stakeholders can challenge development after the project has been implemented only through the local or district authority, who can, in turn, make decisions on the basis of stakeholder complaints. Nowadays, it is recommended that a permit for new HPP is granted for a maximum of 30 years. Older HPP have longer or indefinite concessions ( 'ancient rights'). Ancient rights are permits that were granted to operators or installations when the Water Act first came into force in 1960. Many hydropower installations have been able to rely on the special status provided to them by the Water Act ever since. The permit conditions under ancient rights are often environmentally inadequate from today's perspective and it is difficult for authorities to compel these operators to modernize. However, water rights can be revoked under certain conditions and more stringent regulations can be stipulated subsequently. (WHG §13, §20),</p>
Is the permit duration for all hydropower plants the same?
No
If the permit duration varies, which criteria define the duration of a permit? (e.g. size of hydropower plant)
According to the Water Resources Act, the permit is granted for a reasonable time that cannot exceed 30 years. The actual duration is a provision of the negotiations between the hydropower planner/operator and the competent authorities. Under certain conditions, the duration of a permit can be adjusted.
Are there differences in the duration of concessions between new and existing HPP?
Yes (see above). Nowadays, it is recommended that a permit for new HPP is granted for a maximum of 30 years. Older HPP have longer or indefinite concessions ('ancient rights'). The legislative changes on permit duration have not had any effect on existing permits.

Source of Information: Desbarats et al, 2010. Regulation of small-scale hydropower: case studies of Denmark, France and Germany, Report of the IEEP and Ecologic Institute.

## 2.4.2 Authorisation conditions for new hydropower plants

### 2.4.2.1 Mitigation measures required

The table below presents the mitigation measures related to fish required to fulfill the conditions for authorizing a new hydropower plant.

Types of mitigation	Requirement based on legislation?	If no relevant legislation, is requirement based on a recommendation?	If no relevant legislation or recommendation, is requirement defined in individual cases?	Is there no requirement at all for this type of mitigation?
<b>Upstream fish migration</b>	Yes			
	The WHG (§34) requires measures for ensuring upstream fish migration and upstream river continuity. Some Federal states have specified the technical and hydraulic requirements for these measures. (CIS questionnaire, 2011) From a technical perspective, small HPPs especially have difficulties constructing measures for upstream fish migration that work, due to the limited water discharge that is available for most of them (Interview with Fisheries Association Bavaria: 22.06.2017)			
<b>Downstream fish migration</b>	Yes	Yes		
	The Federal Water Act (WHG §35) requires measures for ensuring connectivity for downstream fish migration. Some Federal states have specified the technical and hydraulic requirements for these measures. More stringent requirements for fish protection for diadromous species (e.g. protection screens for eels: 15 mm clear width of bars, salmon: 10 mm) are introduced by the federal states in which those species are relevant for the achievement of the management objectives according to WHG §§27-31 and in which these requirements can be technically implemented. Some federal states indicate in their federal laws specifications on fish protection (e.g. protection screens: 15 mm clear width of bars) (CIS questionnaire, 2011)			
<b>Flow conditions</b>	Yes		Yes	
	The WHG (§33) provides regulations regarding minimum conditions. Some federally enacted decrees exist to specify technical and hydraulic requirements for minimum flow related measures. The amount of minimum flow is aligned with management objectives according to the WFD (WHG §§ 27-31). The federal state uses different methods for the determination of minimum flow conditions. (CIS questionnaire, 2011)			
<b>Hydropeaking</b>	Yes		Yes	
	Hydropeaking (e.g. specification of its extent and required provisions for minimizing its negative environmental impacts) is regulated by the right to use a body of water (WHG §9). In Germany, hydropeaking is normally only allowed in exceptional cases. In addition, the natural conditions in Germany normally don't allow for hydropeaking. (CIS questionnaire, 2011)			
<b>Gravel transport (sediment)</b>			Yes	
	Preventive measures for maintaining sediment transport and the handling of solids are regulated by the right to use a body of water and are HPP specific. (CIS questionnaire, 2011)			
<b>Habitat enhancement</b>	Yes			
	Habitat improvements are only indirectly required in order to comply with the objectives of the WFD. They are seen as an addition to the strictly necessary fish protection			

Types of mitigation	Requirement based on legislation?	If no relevant legislation, is requirement based on a recommendation?	If no relevant legislation or recommendation, is requirement defined in individual cases?	Is there no requirement at all for this type of mitigation?
	tion measures.(Interview with Floecksmühle Energietechnik GmbH) (July 27,2017)			
<b>Fish stocking</b>	Yes		Yes	
	The federal states' fisheries acts can require financial compensation measures for fish losses. This money will be subsequently used to restock the fish populations. (Interview with Floecksmühle Energietechnik GmbH) (July 27,2017)			

### 2.4.2.2 Link to WFD requirements

Authorisation procedures for new hydropower have been adapted to the requirements of the WFD. New Hydropower plants need to fully comply with WHG 33-35 and also §27 WHG.

### 2.4.3 Authorisation conditions for existing hydropower plants

#### 2.4.3.1 Permit revisions

Time period to upgrade, retrofit or modernize existing hydropower plants
The German Water Act outlines the requirements related to minimum river stream flow and river continuity. A specific requirement for hydropower is that appropriate measures are taken to protect fish populations. Existing installations have to comply with this requirement within a reasonable time. Water rights can always be revoked under certain conditions and more stringent regulations can be stipulated retroactively (WHG §13, §20). However, there is no time period set in the legislation to comply with new legal requirements. § 35 (2) WHG states that fish population measures need to be implemented “within a reasonable time”.
Adaptation of existing concessions to WFD requirements
Existing concessions can be adapted to fit WFD requirements (see above).
Conditions when the authorization of an existing HPP is running out
When the authorisation for an existing HPP is running out, the hydropower plant has to fully comply with the WHG in order to get a new concession. If no mitigation measures have been required in the past and the ecological requirements of the WHG (e.g. minimum flow conditions, fish protection etc.) are not fulfilled, mitigation measures will be stipulated.
Indefinite concessions and permit revisions
Normally, only if the turbine power is subject to enlargement a permit revision is needed. However, water authorities have been getting stricter recently and asking for mitigation measures. This is also in the case of <b>indefinite concessions</b> , especially when the specific rivers are priority water courses for fish conservation (e.g. Programmgewässer Lachs).
Turbine upgrades and permit revisions
N/a

Sources of information: Desbarats et al, 2010. Regulation of small-scale hydropower: case studies of Denmark, France and Germany, Report of the IEEP and Ecologic Institute

[https://www.energieatlas.bayern.de/thema\\_wasser/genehmigung.html](https://www.energieatlas.bayern.de/thema_wasser/genehmigung.html), Interview with Floecksmühle Energietechnik GmbH) (July 27,2017)

### 2.4.3.2 Mitigation measures required

The table below presents the mitigation measures related to fish required when revising the conditions of existing hydropower plants permits.

Types of mitigation	Requirement based on legislation?	If no relevant legislation, is requirement based on a recommendation (e.g. guideline, technical standard)?	If no relevant legislation or recommendation, is requirement defined in individual cases?	Is there no requirement at all for this type of mitigation?
<b>Upstream fish migration</b>	Yes			
	The installation of fish passage facilities for upstream fish migration does not necessarily need to be part of the existing permits or authorizations. The competent water authorities can require the installation of a fish passage facility for upstream fish migration retroactively. (§ 20 (2) WHG i.V.m. § 13 (2) WHG). (CIS questionnaire, 2011)			
<b>Downstream fish migration</b>	Yes	Yes		
	The installation of a fish passage facility for downstream fish migration does not necessarily need to be part of the former permits or authorizations. The competent water authority can require exiting HPPs with “ancient rights” to implement state-of-the-art measures for fish protection and downstream fish migration (§ 20 (2) WHG i.V.m. § 13 (2) WHG) (CIS questionnaire, 2011)			
<b>Flow conditions</b>	Yes		Yes	
	Measures to ensure minimum flow conditions do not necessarily need to be part of the former permits or authorizations. The competent water authority can require existing HPPs with “ancient rights” to implement state-of-the-art measures for fish protection and downstream fish migration (§ 20 (2) WHG in combination with § 13 (2) WHG)). (CIS questionnaire, 2011)			
<b>Hydropeaking</b>	Yes		Yes	
	Hydropeaking (e.g. specification of its extent and required provisions for minimizing its negative environmental impacts) is regulated by the right to use a body of water (WHG §9). In Germany, hydropeaking is normally only allowed in exceptional cases. In addition, the natural conditions in Germany normally don't allow for hydropeaking.			
<b>Gravel transport (sediment)</b>			Yes	
	Preventive measures for maintaining sediment transport and the handling of solids are regulated by the right to use a body of water and are HPP specific.			
<b>Habitat enhancement</b>	Yes			
	Habitat improvements are only indirectly required in order to comply with the objectives of the WFD. They are seen as an addition to the strictly necessary fish protection measures. Interview with Floecksmühle Energietechnik GmbH) (July 27,2017)			
<b>Fish stocking</b>	Yes		Yes	
	The federal states fisheries acts can require financial compensation measures for			

Types of mitigation	Requirement based on legislation?	If no relevant legislation, is requirement based on a recommendation (e.g. guideline, technical standard)?	If no relevant legislation or recommendation, is requirement defined in individual cases?	Is there no requirement at all for this type of mitigation?
	fish losses. This money will be subsequently used to restock the fish populations. Interview with Floecksmühle Energietechnik GmbH) (July 27,2017)			

## 2.4.4 Authorisation aspects relevant to new and existing hydropower plants

### 2.4.4.1 Requirements for monitoring effectiveness

Yes. The authorisation procedures for both new and existing HPP that need to renew their concessions may include objectives and methods for the monitoring of measures for upstream fish migration and fish protection.

Source of information: Schmalz, Wolfgang; Falko Wagner und Damien Sonny (2015): Arbeitshilfe zur standörtlichen Evaluierung des Fischschutzes und Fischabstiegs, 215 p.

### 2.4.4.2 Further aspects to be considered when setting mitigation requirements

Cost proportionality of fish protection measures is a relevant aspect of the WHG that competent water authorities need to take into account. It is known that small HPPs are often not in the financial situation to fully comply with WHG 33-35 due to the disproportionate costs of mitigation measures.

Source of information: Ingenieurbüro Floecksmühle et al. (2014): Vorbereitung und Begleitung der Erstellung des Erfahrungsberichts 2014 gemäß § 65 EEG. im Auftrag des Bundesministeriums für Wirtschaft und Energie, p. 253.

### 2.4.4.3 Regulatory agencies involved in the authorization procedure

Local authorities in Germany have strong discretionary powers in terms of granting permits for all types of hydropower projects (with some legal exceptions). For this reason, it has been somewhat difficult for a number of operators to obtain permits even in instances where projects comply with all the applicable environmental criteria. There are two types of authorisation procedures: planning assessment ("Planfeststellung") and planning approval ("Plangenehmigung"). Both types require the involvement of different regulatory agencies with different roles. The following regulatory agencies are normally involved: Water authorities (lead role), Building authorities (participation role), land use and regional planning authorities (participation role), Fisheries authorities (participation role), nature conservation authorities (participation role).

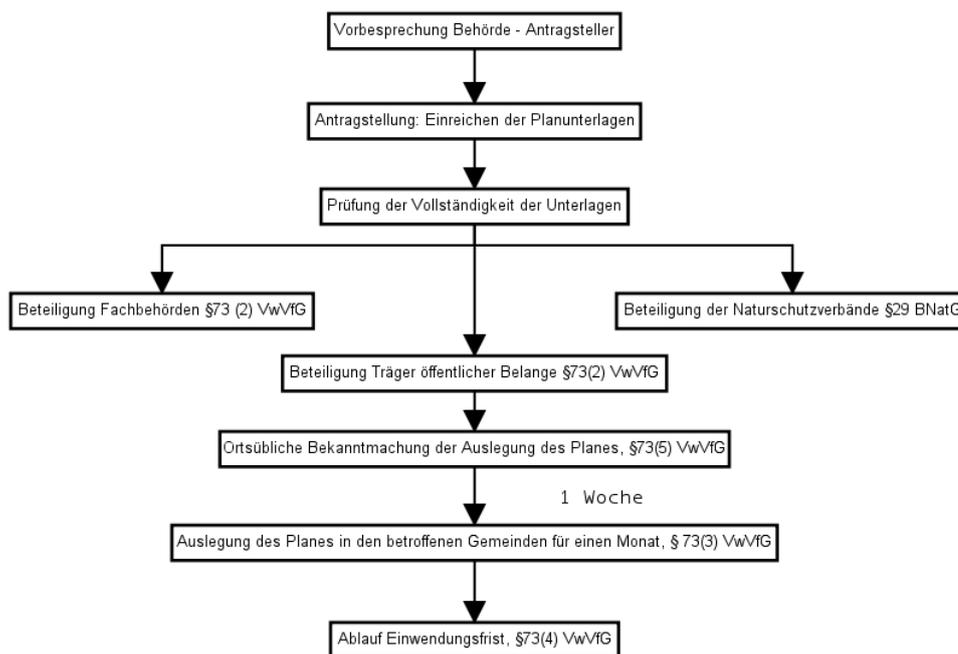
Source of information: Desbarats et al, 2010. Regulation of small-scale hydropower: case studies of Den-mark, France and Germany, Report of the IEEP and Ecologic Institute.

, <http://www.wasserkraft-deutschland.de/wasserkraft/genuehmigungsverfahren.html>

### 2.4.4.4 Flow-chart on the key steps of the authorization procedure for new / existing hydropower plants

The figure below presents a decision flow chart in the case of new HPP.

Source of information: <http://bauingenieurseite.de/recht/wasserrecht.html>



## 2.5 Challenges with regards to policy requirements

<b>Uncertainty in the planning, development and operation of HPP linked to the regulatory framework (national, regional)</b>
Legislation should be more specific regarding the time period within which all existing HPP without mitigation measures in place need to be upgraded.
<b>Uncertainty in the planning, development and operation of HPP linked to authorisation procedures</b>
HPPs with indefinite “ancient water rights” should also comply with regulations for river continuity (WHG §34) (CIS questionnaire on WFD and Hydropower, 2011). Approval procedures are mostly site specific and don’t take cumulative aspects in the basins into account (interview with Fisheries Association Bavaria: 22.06.2017).
<b>Recent changes to the regulatory framework</b>
The new EEG (2014/2017) no longer links to the ecological requirements of §33-35 WHG. In comparison to the older versions of the EEG, this leads to a situation in which environmental aspects are weakened and the focus is mainly on the required 10% increase in efficiency.
<b>Foreseeable changes to the regulatory framework</b>
No foreseeable changes to the regulatory framework are expected.

## 2.6 Financing instruments

The following financing instruments promoting *at the same time* hydropower generation and improvement in water status are implemented (CIS questionnaire on WFD and Hydropower, 2011):

- Feed-in tariffs

- Green power labels
- Support schemes for modernization of existing plants
- Support schemes for mitigation measures in new plants

### 2.6.1 Feed-in tariffs

Name of instrument
Hydropower feed-in rates according to the Renewable Energy Law.
Type of hydropower targeted
<p>The revised <u>Renewable Energy Sources Act</u> (RESA of 2017) allows for hydropower feed-in tariffs. However, is not bound anymore to the proof that the use of hydropower either achieves good ecological water status or substantially improves it. In Germany, small RES-E plants of sizes up to 100 kW are eligible for feed-in tariff as set out in the EEG 2017 (§ 19 par. 1 no. 2. And § 21 EEG 2017). The eligibility is coupled to the obligation of the plant operator to feed the electricity into the grid in the months for which they raise the claim for receiving financial support. Regardless of the size, plants in exceptional cases are eligible for a feed-in tariff reduced by 20% (Ausfallvergütung). However, this can happen for no longer than 3 consecutive months and no more than 6 months in total within a calendar year (§ 21 par. 1 no 2 EEG 2017).</p> <p>In general, all technologies used to generate electricity from renewable sources are eligible for feed-in tariffs (§ 19 par. 1 EEG 2017). Eligibility also applies to electricity that was temporarily stored prior to being fed into the grid (§ 19 par. 3 EEG 2017).</p> <p>Feed-in tariffs are granted only for electricity actually taken over by the grid operator (§ 21 par. 1 EEG 2017). The electricity may not be consumed in the direct surroundings of the power plant and needs to be transmitted through the grid (§ 21 par. 2 no 1 EEG 2017). Additionally, the plant is not allowed to participate in the electricity balancing market (§ 21 par. 2 no 2 EEG 2017). The level of the feed-in tariff is defined by law and varies according to specificities of the technologies (§§ 40 – 49 EEG 2017). For hydropower, 3.47 – 12.40€ct per kWh are paid depending on plant size and date of commissioning, (§ 40 par. 1-4 EEG 2015) minus 0.2 €ct per kWh (§ 53 no. 1 EEG 2017):</p> <p>HPP ≤500 Kilowatt 12,40 Cent per kWh  HPP ≤2 Megawatt 8,17 Cent per kWh  HPP ≤5 Megawatt 6,25 Cent per kWh  HPP ≤10 Megawatt 5,48 Cent per kWh  HPP ≤20 Megawatt 5,29 Cent per kWh  HPP ≤50 Megawatt 4,24 Cent per kWh  HPP &gt;50 Megawatt 3,47 Cent per kWh</p> <p>A HPP operator is entitled to receiving a feed-in tariff according to the subsequent provisions of the law (§ 19 par. 1 EEG 2014) for the amount of energy fed into the grid. The tariff levels will decrease in regular periods of time. New plants will receive the tariff level applicable on the day they are put into operation. This tariff level will apply for the entire payment period, i.e. for 20 years (§§ 25 EEG). For hydropower, the percentages by which the tariff levels will decrease are set by law. The digression rate is 0.5% every year (§ 27 par. 1 no. 1 EEG 2017). The tariff payment period is 20 years from the day of commissioning. For plants receiving a feed-in tariff, the period may be expanded until December 31<sup>st</sup> of the 20th year (§25 EEG 2017).</p> <p style="text-align: center;">For both, however, some specifications differ.</p>
Criteria for ecological improvement
None specifically, just the ones that are already in place, such as the WHG. Older versions of the EEG also stipulated ecological improvements, but this is no longer the case.
Source of funding

The costs of the feed-in tariff scheme are borne by the final consumers.
<b>Source of information</b>
<a href="http://www.res-legal.eu/search-by-country/germany/single/s/res-e/t/promotion/aid/feed-in-tariff-eeg-feed-in-tariff/lastp/135/">http://www.res-legal.eu/search-by-country/germany/single/s/res-e/t/promotion/aid/feed-in-tariff-eeg-feed-in-tariff/lastp/135/</a> (last update: 20.02.2017)

## 2.6.2 Green power labels

<b>Name of instrument</b>
Different green power labels exist in Germany, which use different, or no, environmental criteria to evaluate hydropower energy production. These labels are of minor importance in Germany due the Renewable Energy Sources Act (CIS questionnaire, 2011).
<b>Type of hydropower targeted</b>
n/a
<b>Criteria for ecological improvement</b>
n/a
<b>Source of funding</b>
Energy consumers
<b>Source of information</b>

## 2.6.3 Support schemes for modernization of existing plants and for mitigation measures in new plants

<b>Name of instrument</b>
Favorable credits from the KfW Bank.
<b>Type of hydropower targeted</b>
All
<b>Criteria for ecological improvement</b>
None
<b>Source of funding</b>
National government
<b>Source of information</b>
<a href="https://www.kfw.de/inlandsfoerderung/Unternehmen/Energie-Umwelt/">https://www.kfw.de/inlandsfoerderung/Unternehmen/Energie-Umwelt/</a>

## 2.7 Challenges with regards to financing instruments

Design or implementation dimensions to be improved
<p>Small HPP &lt;100KW: Hardly any new HPPs in this segment in Germany, because, despite the RESA, the business doesn't pay off. Some federal states (e.g. Northrhine Westfalia, Rhineland-Palatinate) buy ancient water rights from those HPP operators that want to stop business. A lot of valuation assessments for HPP are being made. Large HPP &gt;10 MW: From a business point of view the RESA is not relevant here. The prices of the energy stock exchange are much more important.</p>
Recent changes driving developments in the hydropower sector
<p>There are no recent changes driving developments in the hydropower sector.</p>
Foreseeable changes that may drive new developments in the hydropower sector
<p>In some federal states (i.e. Bavaria, North Rhein-Westfalia, Baden-Württemberg) there have been ideas to partly bridge the existing funding gap for small HPP. This incentive, if it comes, could make some small hydropower plants on sites with high environmental requirements profitable again.</p>
<p>Interview with Floecksmühle Energietechnik GmbH (July 27,2017)</p>

## 3 Switzerland

Prepared by Ecologic Institute and ETH Zürich.

### 3.1 Key national policies

The table below presents the key national legislation relevant to ecological improvements in water ecosystems and which may have repercussions in hydropower production.

Policy area	Name of law	Date
Water protection	Federal Act on the Protection of Waters	1991
Fisheries	Federal Act on Fisheries	1991
Environmental impact assessment	Environmental Protection Act	1983
Energy/renewable energy	Energy Act	1998
	Federal Hydropower Act	1918
Water infrastructures	Federal Act on Hydraulic Engineering (Bundesgesetz über den Wasserbau)	1991

The Table below presents, for each law, the relevant aspects for environmental improvements in water ecosystems, environmental conditions related to hydropower schemes or the production of hydropower itself.

Law	Description
<b>Federal Act on the Protection of Waters</b>	<p>The 1991 Federal Act on the Protection of Waters included, among other aspects, important provisions for defining minimum flow. The Waters Protection Ordinance takes up the provisions of the Act and sets them out in greater detail. According to Annex 1 of the Waters Protection Ordinance of 1998 the hydrodynamics (unit bed load discharge and water level and flow regime) and the morphology should correspond to the natural conditions. Other objectives were defined for the biocoenoses of the flora and fauna of surface waters, the environment under their influence and the space requirement of the water-courses (FOEN, SFOE, ARE, 2011). The Federal Act on the Protection of Waters was amended in 2011; this amendment is a milestone of water resources protection in Switzerland.</p> <p>Hydropower plants are the source of 59% of the electricity that is produced in Switzerland. In addition, as of 2016 (BFE, 2017) 54% of this supply is produced in storage power plants mainly located in the Swiss Alps, where water is retained in reservoirs in order to meet demand during peak consumption. This intermittent operation gives rise to unnaturally strong fluctuations in the levels of water in streams and rivers below the power plant (“hydropoaking”), and this in turn has a negative impact on aquatic life. When turbines operate at full speed, the maximum outflow can be up to 40 times greater than the water level in the basin (Kampa et al, 2011). Seasonal reservoirs further allow to shift water from snow and glacier melt in spring and summer to the low-flow winter season when energy generation from run-of-river plants (mainly located on the Swiss Plateau) is below average, but electricity demand is highest. This seasonal storage has effects on the hydrographical flow regimes, damping natural flows during the high-flow season, while increasing base flow during the low-flow season.</p> <p>Thanks to the 2011 revision of the Water Protection Act, it is possible to significantly lessen most of these negative impacts by 2030 through the introduc-</p>

	<p>tion of structural measures, without restricting the level of electricity production. Also, a legal basis has been created for maintaining natural conditions in streams and rivers below hydropower plants (Kampa et al, 2011).</p> <p>The new provisions adopted in the amended Act envisage specifically (Restoring waters to a more natural state: Amended Waters Protection Act in force from January 2011. Press release):</p> <ul style="list-style-type: none"> <li>• Space provided for waters: The Act obliges the cantons to specify and safeguard the space needed to maintain the natural functions of waters and ensure flood protection. Areas used in this space are eligible as ecological compensation areas for farmers. 20 million francs will be made available each year as remuneration for the services provided by those managing these areas.</li> <li>• Rehabilitation: The Act imposes a new obligation on the cantons to conduct the strategic planning and implementation of rehabilitation measures. This ensures the long-term maintenance and restoration of semi-natural watercourses and lakeshores. The Swiss Confederation will provide 40 million Swiss francs per year in co-financing for rehabilitation planning and implementation.</li> <li>• Mitigating the adverse effects of hydropower generation: The cantons are obliged to eliminate impairments caused by hydropeaking operation and to plan the requisite remedial action. The Act envisages that the measures taken in order to meet this obligation should only be engineering measures (such as holding reservoirs) that do not impair electricity generation compared to operational measures. However, the hydropower operator can also select other measures such as adapting its power operation to fulfil the ecological requirements. Furthermore, impairments of the bedload regime must be remediated. The costs of such measures, and of those taken to restore fish passability in accordance with the Fisheries Act, are financed by levying a surcharge of at most 0.1 centimes per kilowatt-hour on the transmission costs of the high-voltage networks.</li> </ul> <p>The timeline set in the amended Act is for the mitigation of hydropeaking, bed load transport and fish migration to take place until 2030 (power plants and Cantons) for the river revitalisations and improvement of the morphology until 2090 (Cantons) (Schweizer, 2017).</p> <p>As regards hydropeaking and bedload regime, the Swiss Waters Protection Ordinance determines which impairments are to be considered serious and for which hydropower plants remedial measures must be considered. It further sets out the procedure to be taken when planning and implementing such measures. The requirements concerning restoration of free fish migration are set out in an amendment to the Ordinance to the Swiss Fisheries Act.<sup>12</sup></p>
<p><b>Federal Act on Fisheries</b></p>	<p>The Federal Act on Fisheries requires taking necessary measures for free fish migration at existing HPP. These measures have to be taken until 2030</p>
<p><b>Energy Act</b></p>	<p>A 2009 revision to the Federal Energy Act contains a package of measures aimed at promoting renewable energies and energy efficiency in the electricity sector, the mainstay of which is the cost-covering remuneration scheme for electricity generated from renewable energies. The maximum surcharge of 0.6 centimes per kilowatt-hour may only be levied once the registered plants with a positive decision have been certified, are feeding electricity into the grid, and are already receiving the cost-covering remuneration. The Federal Office of Energy decided that the 2010 surcharge is to remain at 0.45 centimes per kilowatt-hour. Since the latest revision of the Act in summer 2011, there is also the possibility to use the surcharge for renaturation of rivers impacted by hydropower (Dworak, 2011).</p>

<sup>12</sup> Restoring waters to a more natural state: Amended Waters Protection Act in force from January 2011. Press release.

	According to the Energy Act of 1998, the national high-tension grid operator Swissgrid reimburses operators of existing HPP for the costs of mitigation measures as required by the Water Protection Act and the Federal Law on Fisheries (BAFU 2016).
<b>Federal Hydropower Act</b>	Lays down the procedure for granting concessions

Source of information:

BAFU 2016, Ökologische Sanierung bestehender Wasserkraftanlagen.

Bundesamt für Energie BFE (2017). Schweizerische Elektrizitätsstatistik. Bern.

Bundesamt für Energie BFE (2017). Schweizerische Elektrizitätsstatistik. Bern.

FOEN, SFOE, ARE (eds), 2011, Recommendations for developing cantonal conservation and exploitation strategies for small hydropower plants, Bern

Schweizer, S. (2017). Mitigation of Hydropeaking in the Hasliaare –Selection of Measure(s) – echnical Aspects – Monitoring. Presentation at the CIS Workshop on GEP inter-comparison case studies on water storage, 13 -14 February 2017, Vienna.

Dworak, T., 2011, Green Hydropower in Switzerland, report to the European Commission, grant agreement no. 265213

### 3.1.1 Targets set under the Renewable Energy Directive

The Confederation wishes to promote the use of hydropower more actively in the future using a variety of measures. New plants are to be built and existing plants refurbished and extended with ecological requirements being factored in, so as to exploit the available potential. Instruments for this are the cost-covering feed-in tariffs (CFT) for hydropower plants up to an average gross mechanical output of 10 megawatts and the measures to promote hydropower laid down in the “Renewable Energies” action plan.

The quantitative target under Art. 1 para. 4 EnG is to increase the average annual electricity generation from hydropower plants from its level in the year 2000 by at least 2000 gigawatt-hours by 2030 (FOEN, SFOE, ARE, 2011).

There have been various studies on the remaining Swiss hydropower potential to be tapped until 2050, the most prominent being the one of the Swiss Federal Office for Energy (SFOE) and another one issued by the Swiss Association of Water Resources Management (SWV). The numbers of both give a range accounting for an optimistic and a pessimistic scenario. While SFOE expects ranges from 1.53 – 3.16 TWh, SWV estimates 0 – 5 TWh.

## 3.2 Key regional policies

The section below presents the key regional legislation relevant to ecological improvements in water ecosystems and which may have repercussions in hydropower production.

Canton of Berne (HPP Bannwil test case)		
<b>Nature protection</b>	See- und Flussufergesetz	1982
<b>Water infrastructures</b>	Wassernutzungsgesetz	1997
Canton of Aargau (HPP Schiffmühle test case)		
<b>Water infrastructures</b>	Wassernutzungsgesetz	2008

The Table below presents, for each law, the relevant aspects for environmental improvements in water ecosystems, environmental conditions related to hydropower schemes or the production of hydropower itself.

Law	Description
<b>Wassernutzungsgesetz (law on water use)</b>	Details on the water use, e.g. for hydropower, are specified, as the cantonal authorities are responsible for granting of concessions.
<b>See- und Flussufergesetz (law on lake and river shores)</b>	Construction within 50 m from the shores of the main lakes and rivers in the Canton of Berne are subject to this law.

### 3.3 Strategic planning instruments

#### 3.3.1 Strategic instruments for new hydropower use and development

##### 3.3.1.1 Instruments

The main instrument is a number of recommendations for developing cantonal conservation and exploitation strategies for small hydropower plants.

These recommendations offer the cantons a guide on how to handle the sometimes conflicting legal objectives, especially between the Energy Act and the Waters Protection Ordinance. They offer the stakeholders a guide to decision making with the aim of balancing the different claims to the watercourses against each other. They indicate where rational and reasonable hydropower exploitation is possible and where conservation has priority.

A list of the main criteria is proposed and can be extended by the cantons as necessary. A list of this type is used to evaluate and objectively assess the different conservation and exploitation interests and weigh them against each other transparently if conflicts arise. This means that projects are evaluated nationally under comparable criteria. The planning security for applicants is also increased.

Coordinated over large areas, the recommendations can also be used by the cantons to designate the locations suitable for hydropower exploitation and include them as mandatory in their spatial planning instruments (FOEN, SFOE, ARE, 2011).

##### 3.3.1.2 Administrative level and linked planning process

Recommendations are set out at Federal/national level. Other administrative level is “prefectors”.

Name	National	RBD	Regional	Federal State	Other
<b>Recommendations for developing cantonal conservation and exploitation strategies for small hydropower plants</b>	Yes			Yes	

Recommendations are part of hydropower sector planning.

Planning process	Recommendations for developing cantonal conservation and exploitation strategies for small hydropower plants
Hydropower Sector planning	Yes

### 3.3.1.3 Linking with financing instruments and/or regulatory procedures

If strategic planning instruments are used to identify “suitable” locations for hydropower development, are such areas:	
Targets of financial support schemes for hydropower development?	Subject to more simplified and faster authorisation processes?
No	No

### 3.3.2 Strategic planning instruments to restore continuity

#### 3.3.2.1 Instrument

The main instrument to restore continuity is the “Wiederherstellung der Fischwanderung – strategische Planung” (Restoration of fish migration – strategic planning). This enforcement guide indicates a procedure which is appropriate for fulfilling the requirements of water protection and fisheries legislation in terms of re-establishing fish migration.

Source of information: Könitzer C., Zaugg C., Wagner T., Pedroli J.C., Mathys L. (2012). Wiederherstellung der Fischwanderung. Strategische Planung. Ein Modul der Vollzugshilfe Renaturierung der Gewässer. Bundesamt für Umwelt, Bern. Umwelt-Vollzug Nr. 1209: 54 S.

#### 3.3.2.2 Administrative level and linked planning process

The “Wiederherstellung der Fischwanderung – strategische Planung” is set at national level.

## 3.4 Procedural instruments at the level of hydropower plants

### 3.4.1 Duration of concessions

<b>Typical duration of concessions</b>
between 40-80 years (CIS questionnaire on WFD and HP, 2011)
<b>Is the permit duration for all hydropower plants the same?</b>
No
<b>If the permit duration varies, which criteria define the duration of a permit? (e.g. size of hydropower plant)</b>
Duration is typically dependent on the capacity of the HPP; it is granted by the respective canton except for HPP on binational rivers where the Swiss permit is issued by the Federal Office (SFOE)
<b>Are there differences in the duration of concessions between new and existing HPP?</b>
No

### 3.4.2 Authorisation conditions for new hydropower plants

#### 3.4.2.1 Mitigation measures required

The table below presents the mitigation measures related to fish required to fulfill the conditions for authorizing a new hydropower plant.

Types of mitigation	Requirement based on legislation?	If no relevant legislation, is requirement based on a recommendation?	If no relevant legislation or recommendation, is requirement defined in individual cases?	Is there no requirement at all for this type of mitigation?
<b>Upstream fish migration</b>	Yes			
	Amended Waters Protection Act / Fisheries Act required mitigation of interrupted fish migration by 2030. Every new HPP is required to have a fish pass which fulfils its function. The latter has to be proved by monitoring results which are prescribed by the authorities.			
<b>Downstream fish migration</b>	Yes			
	Amended Waters Protection Act / Fisheries Act required mitigation of interrupted fish migration by 2030 Every new HPP is required to ensure downstream continuity. Monitoring is prescribed by the authorities to check for the proper functioning of the fish protection and guidance measure chosen.			
<b>Flow conditions</b>	Yes			
	<p>Until 1991, there was no clear definition of minimum flow. Since 1991, via the adoption of the Federal Act on the Protection of Waters, there is clear definition of residual flow conditions for all new HPP (Schweizer, 2017) according to the following articles:</p> <ul style="list-style-type: none"> <li>• Art.31(1): Starting point is Q347 (5%-Percentile of Annual Flow)</li> <li>• Art. 31(2): Focus on aquatic species (preservation of typical species like fish (habitats and migration) and macroinvertebrates)</li> <li>• Art. 32: Possible reduction of residual flow when no fish occur or the ecological potential is not high</li> <li>• Art. 33: Possible increase of the residual flow with balancing of the interests for and against the water use (landscape, seasonal variation, energy Losses, net stability, energy strategy etc)</li> </ul> <p>Summary of residual flow for a new concession (Schweizer, 2017):</p> <ul style="list-style-type: none"> <li>• Minimum flow requirements in winter</li> <li>• Seasonal increase</li> </ul> <p>The dynamics of floods also have to be considered (sediment transport, morphological aspects, floodplains)</p>			
<b>Hydropeaking</b>	Yes			
	Waters Protection Act requires mitigation of hydropeaking by 2030 According to the Act, structural measures which in contrast to operational measures do not affect electricity production may be applied by the power plants. This can be the construction of compensation basins or underground channels to a lower lake			

Types of mitigation	Requirement based on legislation?	If no relevant legislation, is requirement based on a recommendation?	If no relevant legislation or recommendation, is requirement defined in individual cases?	Is there no requirement at all for this type of mitigation?
	(Kampa et al, 2011). Operational measures can be applied only when owner of the power plant agrees.			
<b>Gravel transport (sediment)</b>	Yes			
	Waters Protection Act requires mitigation of gravel transport by 2030. A number of measures can be applied, from structural adaptations via reservoir drawdown and flushing to sediment replenishment below dams, the selection being very site-specific (Boes et al. 2017).			
<b>Habitat enhancement</b>	Yes			
	Waters Protection Act requires river revitalisations and improvement of the morphology until 2090. However, these measures have to be taken by the Cantons, not the power plants.			
<b>Fish stocking</b>				Yes

Source of information: Boes, R.; Albayrak, I.; Friedl, F.; Rachely, C. Schmocker, L.; Vetsch, D.; Weitbrecht, V. (2017). Geschiebedurchgängigkeit an Wasserkraftanlagen. *Aqua viva* (Die Zeitschrift für Gewässerschutz): in Druck.

### 3.4.2.2 Link to WFD requirements

This is not relevant as Switzerland does not implement the WFD.

## 3.4.3 Authorisation conditions for existing hydropower plants

### 3.4.3.1 Permit revisions

<b>Time period to upgrade, retrofit or modernize existing hydropower plants</b>
Mitigation of hydropeaking, bed load transport and fish migration has to take place until 2030.
<b>Adaptation of existing concessions to WFD requirements</b>
Not applicable.
<b>Conditions when the authorization of an existing HPP is running out</b>
When an existing concession is running out, a clear definition of residual flow conditions is applied, as for new HPP projects. The above-mentioned topics further apply (if applicable), i.e. mitigation of hydropeaking, reestablishment of fish migration and of bed load continuity.
<b>Indefinite concessions and permit revisions</b>
Not relevant
<b>Turbine upgrades and permit revisions</b>
Only if the capacity increases significantly. This typically applies if the turbine flow is increased, but not

from increased turbine efficiency alone.

Source of information: Schweizer, 2017

### 3.4.3.2 Mitigation measures required

The table below presents the mitigation measures related to fish required when revising the conditions of existing hydropower plants permits.

Types of mitigation	Requirement based on legislation?	If no relevant legislation, is requirement based on a recommendation (e.g. guideline, technical standard)?	If no relevant legislation or recommendation, is requirement defined in individual cases?	Is there no requirement at all for this type of mitigation?
<b>Upstream fish migration</b>	Yes			
	Federal Act on Fisheries requires from existing HPP to take necessary measures for free fish migration. These measures have to be taken until 2030.			
<b>Downstream fish migration</b>	Yes			
	Federal Act on Fisheries requires from existing HPP to take necessary measures for free fish migration. These measures have to be taken until 2030.			
<b>Flow conditions</b>	Yes			
	<p>In case of existing (valid) concessions, the Water Act in 1991 asked for the «Restoration of minimum flow conditions» until 2012. However, for these cases, there was no clear definition of minimum flow conditions provided. Until now, only 50% have increased the minimum flow.</p> <p>In case an existing concession was running out, a clear definition of minimum flow was to be applied (similar as to new concessions since 1991).</p> <p>However, the fact that the 1991 Act could only be fully applied in the context of a renewal of the concessions, which typically run over 80 years, no major changes in operation could be expected before the year 2020.</p> <p>The problem that the authorities were unable to impose any new regulations on electricity companies during the period of validity of a license was solved in the form of a special provision in the amended Water Protection Act (2011) which stipulated a retrofitting requirement for all existing hydropower plants, regardless of the duration of the operating license. At the same time, the amended Act provided for the payment of full compensation to the operator for the required structural measures</p>			
<b>Hydropeaking</b>	Yes			
	<p>Waters Protection Act requires mitigation of hydropeaking by 2030.</p> <p>According to the Act, only structural measures which in contrast to operational measures do not affect electricity production have to be applied by the power plants. This can be the construction of compensation basins or underground channels to a lower lake (Kampa et al, 2011).</p> <p>Operational measures can be applied only when owner of the power plant agrees.</p>			
<b>Bed load transport (sediment)</b>	Yes			
	Waters Protection Act requires mitigation of bed load transport by 2030			

Types of mitigation	Requirement based on legislation?	If no relevant legislation, is requirement based on a recommendation (e.g. guideline, technical standard)?	If no relevant legislation or recommendation, is requirement defined in individual cases?	Is there no requirement at all for this type of mitigation?
Habitat enhancement	Yes			
	Waters Protection Act requires river revitalisations and improvement of the morphology until 2090. However, these measures have to be taken by the Cantons, not the power plants.			
Fish stocking				Yes

Sources of information: Schweizer, 2017; Dworak, 2011, ; Kampa et al, 2011.

### 3.4.4 Authorisation aspects relevant to new and existing hydropower plants

#### 3.4.4.1 Requirements for monitoring effectiveness

Fish passages (both up- and downstream) have to be monitored after implementation to check for their effectiveness. Control of the effectiveness of measures is generally required and financed.

Source of information: Gysi, M.H. (2017). Forum conference, slides 5 and 39. Fischabstieg an Wasserkraftanlagen in der Schweiz, Presentation at Conference Forum Fischschutz und Fischabstieg, Dessau, 16-17 May 2017

#### 3.4.4.2 Further aspects to be considered when setting mitigation requirements

For the prioritisation and selection of the mitigation measures, the Water Protection Act asks to consider the interests of flood protection, energy policy targets for the promotion of renewable energy and the proportionality of the investment. Therefore the extent of the measures is not decided only upon ecological criteria. A balanced cost- benefit ratio should be aimed for. The mitigation measures should also be cost-effective.

Source of information: BAFU, 2016. Ökologische Sanierung bestehender WKA

#### 3.4.4.3 Regulatory agencies involved in the authorization procedure

Typically water right and environmental authorities on a cantonal level are involved. Depending on the size of the HPP scheme, federal authorities are also involved (e.g. dam safety section of the SFOE).

## 3.5 Challenges with regards to policy requirements

<p><b>Uncertainty in the planning, development and operation of HPP linked to the regulatory framework (national, regional)</b></p> <p>At concession end, the respective canton may decide to not grant the water concession right to third parties any more, but to use the water by itself ("Heimfall"). A HPP owner thus does not necessarily know in advance if the concession will be renewed, even if all legislative requirements are fulfilled.</p> <p><b>Uncertainty in the planning, development and operation of HPP linked to authorisation procedures</b></p>
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The amount of environmental flow release is usually quite uncertain as it may be significantly higher than the basic value according to the Water Protection Act, Art. 33 (see 3.4.1), putting a risk on the economic assessment of a HPP development project.

#### Recent changes to the regulatory framework

Amendment of the Waters Protection Act in 2011 (see responses in previous sections of template and in section about financing instruments)

#### Foreseeable changes to the regulatory framework

The new Energy law (entering into force from 01.01.2018) will potentially enable new large HPP schemes even in protected areas if they are of overarching national interest. The feed-in tariff for small HPP will be based on a surcharge on the grid tariff that will be raised to 2.3 centimes/kWh. Only new HPP can then be subsidized. For extensions of existing HPP with a capacity larger than 300 kW a federal investment subsidy may be granted upon request.

Source of information: Bundesamt für Energie (2017). Kostendeckende Einspeisevergütung: Informationen für Projektanten von Biomasse-, Windkraft-, Kleinwasserkraft- und Geothermieranlagen (Version 3.0 vom 22. Mai 2017)

## 3.6 Financing instruments

The following financing instruments promoting *at the same time* hydropower generation and improvement in water status are implemented:

- Feed-in tariffs
- Green power labels
- Support schemes for modernization of existing plants

### 3.6.1 Feed-in tariffs

Name of instrument
Cost-covering feed-in tariff ("Kostendeckende Einspeisevergütung" (KEV))
Type of hydropower targeted
small HPP with a capacity between 1 MW and 10 MW; HPP in combination with drinking water supply or wastewater sewage schemes with a capacity below 10 MW new HPP and enlargement of existing HPP
Criteria for ecological improvement
The criteria set in the Water Protection Act have to be fulfilled
Source of funding
energy consumer (surcharge on the grid tariff)
Source of information
amongst others: Bundesamt für Energie (2017). Kostendeckende Einspeisevergütung: Informationen für Projektanten von Biomasse-, Windkraft-, Kleinwasserkraft- und Geothermieranlagen (Version 3.0 vom 22. Mai 2017)

### 3.6.2 Green power labels

Name of instrument
<p>Naturemade labeling scheme</p> <p>“Naturemade” is the quality mark for ecologically produced energy (Naturemade star) and energy from renewable sources (Naturemade basic). The label is awarded after thorough inspection by the Association to Promote Environmentally Friendly Electricity (VUE). Naturemade covers a broad range of electricity production methods, including bioenergy, solar, wind, and hydropower. In the case of hydropower, all existing plants are awarded the basic level of certification, while low-impact plants can be awarded Naturemade star for meeting additional environmental criteria.</p> <p>A certification procedure for hydropower facilities (called greenhydro) has been designed for implementation as part of the ecolabel Naturemade</p>
Type of hydropower targeted
<p>All.</p> <p>New power plants and power plant extensions can be awarded naturemade star certification if the impact of construction works and operation does not impair additional natural or near-natural habitats, populations or landscapes (prohibition of deterioration) or brings about an improvement.</p> <p>The more stringent requirements for new plants do not apply where existing water utilization is renewed after 1.1.2001 at the previous or a smaller scale. Old plants which are in the process of being environmentally upgraded to earn VUE Naturemade star certification can only be awarded the Naturemade basic quality seal until the upgrade is complete. Under certain conditions, which must be agreed in writing with VUE, operators may, however, communicate that they are seeking certification as a “green power plant”</p>
Criteria for ecological improvement
<p>Hydropower plants have to fulfil a set of basic requirements, which have been formulated in a general way. The basic requirements ensure that all certified power plants reach a comparable ecological standard. Under the basic requirements, environmental domains to be considered include (1) hydrological character, (2) connectivity of river systems, (3) solids load and morphology of the river, (4) landscape and biotopes and (5) biocenoses and protected species along and in the river. Management domains considered include: (1) regulations on residual flow, (2) regulations on hydropeaking regime, (3) regulations on reservoir management, (4) guidelines on bed load management and (5) guidelines on an environmentally compatible power plant design.</p> <p>Second, power plants commit to carrying out measures for the ecological improvement of their immediate surroundings and for the protection of the impacted river. Such measures are financed by an income generated by a fixed surcharge per kWh of green electricity sold (eco-investments). The eco-investments are specifically adapted to the ecological situation of the power plant at hand. These so called eco-investments will be used to restore, protect or upgrade the environment in the catchment area of the plant at hand. In principle, the facility invests a fixed monetary contribution per sold kWh of green electricity in the restoration, protection or ecological improvement of the affected catchment. These green electricity contributions guarantee a targeted, local ecological evaluation of the scheme requirements and allow credible communication with the green electricity customers.</p>
Source of funding
<p>With regard to eco-investments, for instance, it was decided that an amount of 0.1 centimes (about 0.09€ct) has to be paid for every kilowatt-hour (kWh) produced in a greenhydro power plant. An additional 0.9 centimes/kWh (0.80€ct/kWh) has to be paid for the electricity sold to end consumers under a naturemade star product. As a matter of fact, a fund for financing eco-investment, will receive a total of 1 centimes (0.9€ct) for every kWh sold as green electricity</p>
Source of information
<p>Wustenhagen, R. et al., 2003, Diffusion of green power products in Switzerland, Energy Policy 31, pp 626-627</p> <p><a href="http://www.naturemade.ch/en/naturemade-star-certification-of-hydroelectric-power-">http://www.naturemade.ch/en/naturemade-star-certification-of-hydroelectric-power-</a></p>

plants.html?file=files/PDF/Zertifizierung/Wasserkraft/Issue\_7\_English.pdf

[http://www.naturemade.ch/en/naturemade-zertifizieren.html?file=files/PDF/Zertifizierung/Richtlinien/Richtlinien\\_e.pdf](http://www.naturemade.ch/en/naturemade-zertifizieren.html?file=files/PDF/Zertifizierung/Richtlinien/Richtlinien_e.pdf)

[https://ec.europa.eu/energy/intelligent/projects/sites/iee-projects/files/projects/documents/clean\\_e\\_development\\_of\\_ecological\\_standards\\_for\\_hydropower.pdf](https://ec.europa.eu/energy/intelligent/projects/sites/iee-projects/files/projects/documents/clean_e_development_of_ecological_standards_for_hydropower.pdf)

Ecologic Institute, 2007, Water Framework Directive & Hydropower: Issues Paper, For Common Implementation Strategy Workshop, Berlin, 4-5 June 2007

### 3.6.3 Support schemes for the modernization of existing plants

Name of instrument
<p>Financing of measures for ecological mitigation at existing HPP</p> <p>According to the amended Water Protection Act (2011), operators get the full costs for the mitigation of hydropeaking, fishpasses (up and down) and bed load transport reimbursed.</p>
Type of hydropower targeted
<p>Compensation is independent of the type of concession, whether it is still valid or is expiring and needs to be renewed. This way, mitigation is independent of the situation with the concession of single HPP.</p> <p>Only applies to existing plants</p>
Criteria for ecological improvement
<p>Operators of existing HPP which carry out mitigation measures on hydropeaking, bed load transport and fish migration, receive reimbursement of all costs of the measures by Swissgrid (national high voltage grid company) if mitigation is done by 2030.</p> <p>For the prioritisation and selection of the mitigation measures, the Water Protection Act asks to consider the interests of flood protection, energy policy targets for the promotion of renewable energy and the proportionality of the investment. Therefore the extent of the measures is not decided only upon ecological criteria. A balanced cost- benefit ratio should be aimed for. The mitigation measures should also be cost-effective (BAFU, 2016).</p> <p>In addition, if measures are not fully functional, they can be adapted (adaptive management) and still be financed.</p>
Source of funding
<p>The funding of around 1 billion Swiss francs which will be required by 2030 for the construction of compensation basins, bypass watercourses, fish ramps and other structures is to be financed via an electricity surcharge of 0.1 centimes per kilowatt-hour. Thus in keeping with the “user pays” principle, the costs of these measures are to be borne by the consumer (Kampa et al., 2011).</p> <p>The powerplants have to pay «Wasserzinsen» ≈ 1.6 Rp/kWh (SWV, 2017).</p> <p>River revitalisations and improvement of the morphology (by 2090) are paid by the Cantons / State of Switzerland (Schweizer, 2017).</p> <p>Around 50 million Swiss francs per year are raised for measures on fish continuity, hydropeaking and gravel transport (Gysi, 2017).</p>
Source of information
<p>SWV - Schweizerischer Wasserwirtschaftsverband (2017). Der Wasserzins – die bedeutendste Abgabe auf der Wasserkraft. <i>Faktenblatt</i>, <a href="https://www.swv.ch/Dokumente/Faktenblaetter-SWV-28Download-Ordner29/Faktenblatt-Wasserzins_SWV.pdf">https://www.swv.ch/Dokumente/Faktenblaetter-SWV-28Download-Ordner29/Faktenblatt-Wasserzins_SWV.pdf</a></p> <p>BAFU, 2016; Gysi, 2017; Schweizer, 2017.</p>

### 3.7 Challenges with regards to financing instruments

<b>Design or implementation dimensions to be improved</b>
The above mentioned amount of 1 billion Swiss francs for all the rehabilitation measures at HPP will by far not suffice according to today's knowledge
<b>Recent changes driving developments in the hydropower sector</b>
The full financing of mitigation measures is relatively new since 2011 and drives developments on mitigation measures for HPP in Switzerland. The feed-in tariff has recently been changed to apply to small HPP > 1 MW only; formerly they applied also to HPP with lower capacities.
<b>Foreseeable changes that may drive new developments in the hydropower sector</b>
The subsidy of large HPP (> 10 MW) is currently being politically discussed. It is planned to give favourable capital investment grants to companies investing in large HPP.

## 4 Spain

Prepared by ITAGRA-GEA.

### 4.1 Key national policies

The table below presents the key national legislation relevant to ecological improvements in water ecosystems and which may have repercussions in hydropower production.

Policy area	Name of law	Date
<b>Water protection</b>	Water Act of 2001. RD legislativo 1/2001, del Texto Refundido de la Ley de Aguas.	07.25.2001
<b>Nature protection</b>	Natural Heritage and Biodiversity Act of 2007. Ley 42/2007, del Patrimonio Natural y Biodiversidad.	12.15.2007
<b>Fisheries</b>	Rivers Fishing Act of 1942. Ley de Pesca de 1942.	05.20.1942
<b>Environmental impact assessment</b>	Environmental Impact Assessment Act of 2013. Ley 21/2013, de Impacto Ambiental.	12.12.2013
<b>Energy/renewable energy</b>	Electric Sector Act of 2013. Ley 24/2013 del Sector Eléctrico.	28.12.2013
<b>Water infrastructures</b>	Water Act of 2001. RD legislativo 1/2001, del Texto Refundido de la Ley de Aguas.	07.25.2001

The Table below presents, for each policy, the relevant aspects for environmental improvements in water ecosystems, environmental conditions related to hydropower schemes or the production of hydropower itself.

Law	Description
<b>Water Act of 2001</b>	This act defines and treats the legal regime of both private and public waters, and their use and protection. In relation to river connectivity, it declares rivers and their public domain and of public interest, for instance: the general protection of water bodies and the treatment of damages as an exception, even though it leaves connectivity to further development of the Act.
<b>Natural Heritage and Biodiversity Act of 2007</b>	It protects the wild flora and fauna of Spain and their habitats, according to the EU Law. It declares the types of legal protection and the naturally protected areas of Spain, both terrestrial and marine ones, and the treatment of the use of species and territories.
<b>Rivers Fishing Act of 1942</b>	This old act fosters fishing and some protection of relevant species, such as salmon, sturgeon and trout, by imposing limits to catching and by promoting restocking. This act has been widely overcome by regional acts. In Castilla and León region, the 9/013 Act of Fishing does not include any matter on rivers connectivity for the general jurisdiction in water works on the Duero river basin depends on the State, as the Constitutional Courts has sentenced.
<b>Environmental Impact Assessment Act of 2013</b>	In relation to the EU law, it describes those projects and plans subject to EIA, the administrative procedure and the value of the final decision taken before a project or plan is approved. Some regional law declares the submitting of EIA on certain water works, generally on small water infrastructures, but the pro-

	cedure on national basins must be carried out by the regional government.
<b>Electric Sector Act of 2013</b>	This Act, and many more that develop it, declares the general framework of production, transport, distribution, and trading of energy, and the relationships among companies, Governments and consumers.

Source of information: Boletín Oficial del Estado ([www.boe.es](http://www.boe.es))

#### 4.1.1 Targets set under the Renewable Energy Directive

The 2020 target is to reach 26,950 MW from the current level of 18,600 MW. It is still an ongoing debate, due mainly to the environmental effects on rivers.

Source of information: Ministry of Industry: <http://www.minetad.gob.es/energia/es-ES/Novidades/Paginas/PER2011-2020Voll.aspx>

## 4.2 Key regional policies

The table below presents the key regional legislation relevant to ecological improvements in water ecosystems and which may have repercussions in hydropower production.

Policy area	Name of law	Date
<b>Water protection</b>	Water Act of Andalusia of 2010. Ley 9/2010 de Aguas de Andalucía.	08.10.2010
<b>Nature protection</b> (many regional acts)	2015 Castilla and León Act of Natural Heritage. Ley 4/2015, de Patrimonio Natural de Castilla y León	03.10.2015
	2015 Aragón Act of Protected Areas	08.07.2015
	2003 Wild Flora and Fauna Act of Andalusia	11.13.2003
<b>Fisheries</b>	2008 Fishing Act of Galicia	12.16.2009
	2002 Fishing Act of Asturias	10.01.2002
<b>Environmental impact assessment</b>	2009 Act of EIA of plans of Catalonia	05.27.2009
	2014 Act of EIA of Aragón	12.11.2014
<b>Energy/renewable energy</b>	No relevant regulation	
<b>Water infrastructures</b>	Royal Decree of the Catalanian water district	05.25.2017

The Table below presents, for each law, the relevant aspects for environmental improvements in water ecosystems, environmental conditions related to hydropower schemes or the production of hydropower itself.

Law	Description
<b>Water Act of Andalusia of 2010</b>	In relation to the regional water basins of Andalusia, it describes the jurisdiction and effects of the regional government in protecting water and regulating uses and permits.
<b>2015 Castilla and León Act of Natural Heritage, 2015 Aragón Act of Protected Areas and 2003 Wild Flora and</b>	All acts declare large protected areas in which many hydropower plants are placed, and pose some restrictions to their functioning.

<b>Fauna Act of Andalusia</b>	
<b>2009 Act of EIA of plans of Catalonia, and 2014 Act of EIA of Aragón</b>	In developing the EU and national law, those acts treat the administrative procedure of some energy projects and plans.
<b>Royal Decree of the Catalanian water district</b>	It approves the general framework of rivers, wetlands, and aquifers of Catalonia, basin after basin.

Source of information: Boletín Oficial del Estado and regional official bulletins

## 4.3 Strategic planning instruments

### 4.3.1 Strategic instruments for new hydropower use and development

#### 4.3.1.1 Instruments

There are two types of strategic instruments:

- Hydrological Plans of Water Districts. The hydrological water districts plans foresee areas in which further development of water works are either not permitted or under serious restrictions.
- National Plan of Renewable Energy 2011-2020 which is mainly, to reduce CO<sub>2</sub> levels and the import of petrol and gas.

#### 4.3.1.2 Administrative level and linked planning processes

The table below presents the strategic planning instruments in place for new hydropower use and development and the administrative level at which they act.

Name	National	RBD	Regional	Federal State	Other
<b>Hydrological Plans of Water Districts</b>		Yes			
<b>National Plan of Renewable Energy 2011-2020</b>	Yes				

Source of information: Ministry of Industry: <http://www.minetad.gob.es/energia/es-ES/Novidades/Paginas/PER2011-2020Voll.aspx>

Planning process	Hydrological Water District Plans	Renewable Energy Plan 2011-2020
<b>River Basin Management Planning</b>	Yes	
<b>National Renewable Energy Action Plan</b>		Yes

#### 4.3.1.3 Linking with financing instruments and/or regulatory procedures

If strategic planning instruments are used to identify “suitable” locations for hydropower development, are such areas:	
Targets of financial support schemes for hydropower development?	Subject to more simplified and faster authorisation processes?
Yes, due to different kinds of subsidies	Yes, mainly for small and medium-sized hydro-

	power projects
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Source of information: Ministry of Industry: <http://www.minetad.gob.es/energia/es-ES/Novedades/Paginas/PER2011-2020Voll.aspx>

### 4.3.2 Strategic planning instruments to restore continuity

#### 4.3.2.1 Instruments

Two instruments exist:

- The National Strategy of River Restoration which aims to restore rivers connectivity and riparian and flooding areas in relation to civil protection and environmental purposes.
- Basin Water Plans (minimum flows and river restoration)

#### 4.3.2.2 Administrative level and linked planning processes

The National Strategy of River Restoration is set at national level while the Basin Water Plans are set at river basin district levels.

Name	National	RBD	Regional	Federal State	Other
<b>National Strategy of River Restoration</b>	Yes				
<b>Basin Water Plans (minimum flows and river restoration)</b>		Yes			

Both strategies are linked to the RBMP process.

Source of information: Ministry of Agriculture: <http://www.mapama.gob.es/es/agua/temas/delimitacion-y-restauracion-del-dominio-publico-hidraulico/estrategia-nacional-restauracion-rios/>

## 4.4 Procedural instruments at the level of hydropower plants

### 4.4.1 Duration of concessions

Typical duration of concessions
Permits, water rights and authorizations on public waters: Currently up to 75 years. Newly-issued permits from 25 up to 50 years.  The national water law defines a maximum concession period of up to 75 years. River basin plans can define different or additional requirements, for example shorter permit durations, within the boundaries of the national law.  Until 1985 the duration was up to 99 years in some cases.
Is the permit duration for all hydropower plants the same?
No, it depends on the year in which the water permits were issued.
If the permit duration varies, which criteria define the duration of a permit? (e.g. size of hydropower plant)
Mainly the number of MW and if the permits was issued before the new Water Law of 2001.

**Are there differences in the duration of concessions between new and existing HPP?**

Yes, due to new regulation on the environmental aspects of hydropower and social pressure.

## 4.4.2 Authorisation conditions for new hydropower plants

### 4.4.2.1 Mitigation measures required

The table below presents the mitigation measures related to fish required to fulfill the conditions for authorizing a new hydropower plant.

Types of mitigation	Requirement based on legislation?	If no relevant legislation, is requirement based on a recommendation?	If no relevant legislation or recommendation, is requirement defined in individual cases?	Is there no requirement at all for this type of mitigation?
<b>Upstream fish migration</b>	Yes			
	The Royal Decree of Public Hydraulic Domain reform of 2012 and some regional fishing and natures acts, such as the 2015 Act of Natural Heritage of Castilla and León, which promotes river connectivity, fish ladders and obstacles demolition, even though the jurisdiction to do it is State's.			
<b>Downstream fish migration</b>	Yes			
	The Royal Decree of Public Hydraulic Domain reform of 2012 and some regional fishing and nature acts, such as that of Castilla and León.			
<b>Flow conditions</b>	Yes			
	Regulation of Public Hydraulic Domain reform of 2012 and some regional fishing acts and hydrological planning, such as the Catalanian water plans. Minimum flows are going to be implemented in the new river basin management plans, generally before 2015, on a case by case basis. Minimum flows are defined following a consultation process in which users and affected parties participate (CIS questionnaire on WFD and Hydropower, 2011).			
<b>Hydropeaking</b>	Yes		Yes	
	Regulation of Public Hydraulic Domain reform of 2012 and some regional fishing acts, and jurisprudence, which forbid hydropeaking in certain types of hydropower plants. The mitigation of hydropeaking effects was an issue to be implemented in new river basin management plans after 2015 (CIS questionnaire on WFD & HP, 2011).			
<b>Gravel transport (sediment)</b>	Yes			
	Hydrological planning Act, which foresees sediments as a requirement of minimum flows.			
<b>Habitat enhancement</b>	Yes			
	Hydrological planning and protected areas regulation under the Habitats Directive, such as protected areas from being developed..			
<b>Fish stocking</b>	Yes			
	Regional fishing acts: In Castilla and León region, the 9/013 Act of Fishing, which			

Types of mitigation	Requirement based on legislation?	If no relevant legislation, is requirement based on a recommendation?	If no relevant legislation or recommendation, is requirement defined in individual cases?	Is there no requirement at all for this type of mitigation?
	promote the use of non exotic species and it avoids re-stocking with exotic species or genomics.			

Source of information: Boletín Oficial del Estado and regional official bulletins

#### 4.4.2.2 Link to WFD requirements

Authorisation procedures for new hydropower have not been adapted to the requirements of the WFD. It follows the general regime of water works authorization procedure in rivers and wetlands.

Source of information: Boletín Oficial del Estado and regional official bulletins

### 4.4.3 Authorisation conditions for existing hydropower plants

#### 4.4.3.1 Permit revisions

<b>Time period to upgrade, retrofit or modernize existing hydropower plants</b>
There is a time period set requiring upgrading, retrofitting or modernizing existing HPP, mainly in some water planning instruments and the regulation of some protected areas.
<b>Adaptation of existing concessions to WFD requirements</b>
Not specifically, it depends on the specific permit regime and the water plan of the district, and the jurisprudence related to determined cases. Changing existing permits is complicated and bound to produce legal proceedings if existing rights of concessionaires are affected.
<b>Conditions when the authorization of an existing HPP is running out</b>
The main rule is that the works on public domain should be demolished and the place restored at the permittee's expenses, unless a new permit require it be issued under all the environmental provisions.
<b>Indefinite concessions and permit revisions</b>
Under some special jurisprudence, very rare, there are some cases of infinite concessions, according to some exceptional historic rules, recognized under certain XIX <sup>th</sup> century Supreme Court case law.
<b>Turbine upgrades and permit revisions</b>
Not generally, it is up to the permit granted and the state of the works.

Source of information: Boletín Oficial del Estado and regional official bulletins, jurisprudence, CIS questionnaire on WFD & HP, 2011, Public Goods Act of 2003, Supreme Court case law, Regulation of Dams Safety

#### 4.4.3.2 Mitigation measures required

The table below presents the mitigation measures related to fish required when revising the conditions of existing hydropower plants permits.

Types of mitigation	Requirement based on legislation?	If no relevant legislation, is requirement based on a recommendation (e.g. guideline, technical standard)?	If no relevant legislation or recommendation, is requirement defined in individual cases?	Is there no requirement at all for this type of mitigation?
<b>Upstream fish migration</b>	Yes			
	The Royal Decree of Public Hydraulic Domain reform of 2012 and some regional fishing acts.			
<b>Downstream fish migration</b>	Yes			
	The Royal Decree of Public Hydraulic Domain reform of 2012 and some regional fishing acts. For existing plants only in some cases, the plant is required to ensure downstream continuity (CIS questionnaire on WFD & HP, 2011).			
<b>Flow conditions</b>	Yes			
	Regulation of Public Hydraulic Domain reform of 2012 and some regional fishing acts and hydrological planning. A basic legal framework for ecological flows exists. Many licenses for the use of water resources include requirements concerning minimum flows. Depending on specific conditions, new minimum flow requirements for existing plants may be determined on a case by case basis (CIS questionnaire on WFD & HP, 2011).			
<b>Hydropeaking</b>	Yes			
	The cited Royal Decree of Public Hydraulic Domain reform of 2012 and some regional fishing acts, and jurisprudence.			
<b>Gravel transport (sediment)</b>	Yes			
	Hydrological planning			
<b>Habitat enhancement</b>	Yes			
	Hydrological planning and protected areas regulation under the Habitats Directive.			
<b>Fish stocking</b>	Yes			
	Regional fishing acts.			

Source of information: Boletín Oficial del Estado and regional official bulletins

#### 4.4.4 Authorisation aspects relevant to new and existing hydropower plants

##### 4.4.4.1 Requirements for monitoring effectiveness

Yes: government inspections and control systems.

##### 4.4.4.2 Further aspects to be considered when setting mitigation requirements

Mainly in relation to heritage protection of infrastructures. The relevant laws are the national and regional Historic Heritage Acts.

#### 4.4.4.3 Regulatory agencies involved in the authorization procedure

Water basin authorities that issue the water permit, and environmental agencies that inform them. The River Basin Authorities are competent for granting concessions for hydroelectric projects of less than 5 MW, and the General Directorate of Water through the Ministry of Agriculture, Food and the Environment, for hydroelectric power plants greater than 5 MW or affecting several autonomous communities.

Source of information: Boletín Oficial del Estado and regional official bulletins, Glachant et al. 2015.

### 4.5 Challenges with regards to policy requirements

<b>Uncertainty in the planning, development and operation of HPP linked to the regulatory framework (national, regional)</b>
Administrative discretionality, unavoidable in many sectoral aspects of governmental activities, under which there is no certainty to foresee the real outcome of a problem..
<b>Uncertainty in the planning, development and operation of HPP linked to authorisation procedures</b>
Administrative discretionality, unavoidable in many sectoral aspects of governmental activities, under which there is no certainty to foresee the real outcome of a problem.
<b>Recent changes to the regulatory framework</b>
None.
<b>Foreseeable changes to the regulatory framework</b>
None.

### 4.6 Financing instruments

The following financing instruments promoting *at the same time* hydropower generation and improvement in water status are implemented:

- Feed-in tariffs
- Compensation options (to reduce energy production losses due to mitigation measures)
- Monetary compensation to give up a concession at a particular location
- Support schemes for modernization of existing plants
- Support schemes for mitigation measures in new plants

Source of information: Boletín Oficial del Estado and regional official bulletins

#### 4.6.1 Feed-in tariffs

<b>Name of instrument</b>
Register of specific tariff regime (Registro de régimen retributivo específico)
<b>Type of hydropower targeted</b>
Electricity produced through hydropower can be fed into the system at higher rates than power produced

through plants using fossil fuels. Up to 50 MW HPP, both new and existing.
<b>Criteria for ecological improvement</b>
None
<b>Source of funding</b>
National government
<b>Source of information</b>
Ministry of Industry: <a href="http://www.minetad.gob.es/energia/es-ES/Novedades/Paginas/PER2011-2020Voll.aspx">http://www.minetad.gob.es/energia/es-ES/Novedades/Paginas/PER2011-2020Voll.aspx</a>

#### 4.6.2 Compensation options

<b>Name of instrument</b>
There are many compensation options, not specifically foreseen under Spanish law
<b>Type of hydropower targeted</b>
All types
<b>Criteria for ecological improvement</b>
Riparian connectivity instruments: by-pass channels, ladders, and so on.
<b>Source of funding</b>
National, regional and from the EU.
<b>Source of information</b>

#### 4.6.3 Monetary compensation

<b>Name of instrument</b>
Under Spanish law there is currently a non stable jurisprudnece on monetary compensatory measures. I depends the case is considered a "taking of property".
<b>Type of hydropower targeted</b>
All
<b>Criteria for ecological improvement</b>
Riparian connectivity: i.e. demolition, minumun flows, ladders, etc
<b>Source of funding</b>
National, regional and from the EU.

Source of information

#### 4.6.4 Support schemes for modernization of existing plants

Name of instrument
Renewable Energy Plan 2011-2020
Type of hydropower targeted
All
Criteria for ecological improvement
Greenhouse gases
Source of funding
European, national and regional.
Source of information

#### 4.6.5 Support schemes for mitigation measures in new plants

Name of instrument
Different kinds of measures. Mainly direct financing and sometimes under Environmental Projects (i.e. Life and others).
Type of hydropower targeted
All
Criteria for ecological improvement
River connectivity and flows.
Source of funding
European, national and regional.
Source of information

### 4.7 Challenges with regards to financing instruments

Design or implementation dimensions to be improved
The main issue is that those financing instruments are set to promote new dams, but not to reduce their effects in rivers.

<b>Recent changes driving developments in the hydropower sector</b>
Yes, above all its reduction due to economic crisis.
<b>Foreseeable changes that may drive new developments in the hydropower sector</b>
None

## 5 France

Prepared by The French Agency for Biodiversity (AFB; <http://www.afbiodiversite.fr/>).

### 5.1 Key national policies

The table below presents the key national legislation relevant to ecological improvements in water ecosystems and which may have repercussions in hydropower production.

Policy area	Name of law	Date
<b>Water protection, Nature Protection and Fisheries, Environmental impact assessment</b>  <i>These 4 aspects are often mixed in French laws</i>	Law on fish and fisheries	31/05/1865
	Law n°64-1245 on water Regime and distribution and pollution control	16/12/1964
	Law n°76-629 on nature protection	10/07/1976
	Law n°84-512 on freshwater fishing and the management of fish resources	29/06/1984
	Law n°92-3 on water	04/01/1992
	Law n°2006-1772 on water and aquatic environments	30/12/2006
	Law n° 2009-967 for the implementation of the "Grenelle de l'environnement"	05/08/2009
<b>Energy/renewable energy, Water infrastructures</b>	Ministerial circular on waterworks	23/10/1851
	Law on the use of hydraulic energy	16/10/1919
	Law n°80-531 on economies of energy and heat utilisation	18/07/1980
	Law n°2000-108 on the modernization and development of the public electricity service	10/02/2000
	Law n°2005-781 setting the energy policy guidelines (POPE)	13/07/2005
	Law n°2015-992 on the energy transition for green growth	17/08/2015

The Table below presents, for each law, the relevant aspects for environmental improvements in water ecosystems, environmental conditions related to hydropower schemes or the production of hydropower itself.

Name of law	Relevant aspects
<b>Ministerial circular on waterworks (23/10/1851)</b>	A standard water regulation must be complied with for waterworks located on public watercourses  One of the provisions of the water regulation is the construction of fish ladders

<b>Law on fish and fisheries (31/05/1865)</b>	<p>Possibility of installing fish ladders on the dams of hydraulic plants following an inquiry learned by the conservators of Waters and Forests</p>
<b>Law on the use of hydraulic energy (16/10/1919)</b>	<p>"No person may dispose of the energy of tides, lakes and watercourses, irrespective of their classification, without a concession or authorization from the State" (Article 1)</p> <p>Organization of the development regime according to their maximum power (maximum falling height * maximum derived flow) (Article 2):</p> <ul style="list-style-type: none"> <li>• P &gt; 4.5 MW → Concession</li> <li>• P ≤ 4.5 MW → Authorization</li> </ul> <p>Maximum duration of a concession fixed at 75 years; Renewable in increments of 30 years.</p> <p>Maximum duration of an authorization fixed at 75 years; renewable.</p>
<b>Law n°64-1245 on water Regime and distribution and pollution control (16/12/1964)</b>	<p>Organization of decentralized water management by major river basin (6 basins), in a concerted manner and with financial incentives</p> <p>Creation of basin committees (consultative structure) and water agencies (executive body) (Articles 13 and 14)</p> <p>Establishment of the National Water Committee (Article 15)</p> <p>For installations that aim to regulate the river flow or increase the flow during low flow period, other than hydroelectric power stations, their authorization can determine a minimum flow to maintain in the river downstream of the intake, called "reserved flow", during different periods of the year, in order to safeguard the general interests and satisfy the needs of other authorized diversion beneficiaries and those of local residents (Article 26).</p>
<b>Law n°76-629 on nature protection (10/07/1976)</b>	<p>Obligation to carry out an impact assessment on the natural environment prior to the works and development projects (Article 2).</p> <p>Definition of the minimum content of the impact assessment, including the measures envisaged to eliminate, reduce and if possible compensate for the harmful consequences on the environment (ERC sequence) (Article 2).</p> <p>Creation of the status of protected species (Articles 3 and 4)</p> <p>Creation of nature reserves (Article 16 and following)</p>
<b>Law n°80-531 on economies of energy and heat utilisation</b>	<p>Creation of "reserved rivers": rivers or portions of rivers, designated by decree, on which no authorization or concession is given for new hydraulic scheme</p> <p>Establishment of "reserved flow": minimum flow to be maintained in the natural bed of the river between the water intake and the restitution of a hydroelectric power station</p> <p>(Article 25 that modify the article 2 of the Law on the use of hydraulic energy [16/10/1919]).</p>
<b>Law n°84-512 on freshwater fishing and the management of fish resources (29/06/1984)</b>	<p>"The preservation of aquatic environments and the protection of the fish population are of general interest" (Article 2).</p> <p>Confirmation of the obligation to maintain a minimum flow ("reserved flow") downstream of the project, which permanently guarantee the life, circulation and reproduction of the species that inhabit the waters (Article 4)</p> <p>The facilities and works likely to destroy the spawning grounds, the feeding and the growing areas of the fish are subject to authorization (article 408)</p> <p>Minimum value set for the reserved flow (Article 410):</p> <ul style="list-style-type: none"> <li>• 1/10 (10%) of the average annual flow for any new project, and for ex-</li> </ul>

	<p>isting project when renewing their authorization or concession.</p> <ul style="list-style-type: none"> <li>• 1/20 (5%) for any new project located on a watercourse with a mean annual discharge greater than 80 m<sup>3</sup>/s and for existing project when renewing their authorization or concession.</li> <li>• 1/40 (2.5%) for project already existing on the date of publication of the law, within 3 years from that date.</li> </ul> <p>Creation of classifications of rivers or parts of rivers on which the circulation of migratory fish must be ensured (Article 411):</p> <ul style="list-style-type: none"> <li>• In rivers or parts of rivers and canals, listed by decree, any project shall include devices to ensure the circulation of migratory fish. The operator shall be responsible for the operation and maintenance of these devices.</li> </ul> <p>Existing projects shall comply, without compensation, with these obligations within five years from the publication of a list of migratory species by ministerial order.</p>
<p><b>Law n°92-3 on water (04/01/1992)</b></p>	<p>Water is part of the common heritage of the nation. Its protection, its development and the development of the usable resource, while respecting the natural balances, are of general interest. (Article 1)</p> <p>Strengthens the imperative of protecting the quality and quantity of water resources (Articles 2 and 8)</p> <p>Establishment of new tools for water management: in river basin district, the general plan on development and water management (SDAGE) (Article 3 and 4) and more locally the plan on development and water management (SAGE) (Article 5).</p> <p>regulation of installations, works and activities ("IOTA" nomenclature) having an impact on water and aquatic environments: in order to be authorized by the administrative authority, these projects must be subject to an authorization procedure or declaration on the basis of an impact statement (impact assessment)</p>
<p><b>Law n°2000-108 on the modernization and development of the public electricity service (10/02/2000)</b></p>	<p>"Before 31 December 2002, a law will set out the energy policy guidelines for multiannual production investment planning. The Minister for Energy make public the multiannual production investment program which sets out the objectives for the allocation of production capacity by primary energy source and, where appropriate, by production technology and geographical area. "(Article 6)</p> <p>Possibility of using call for submissions when production capacity does not meet the objectives of multiannual investment planning (Article 8).</p> <p>Creation of the obligation for EDF to buy, if requested by the producers concerned, the electricity produced by HPP using renewable energies, whose installed capacity per production site does not exceed 12 megawatts [...]. (Article 10).</p>
<p><b>Law n°2005-781 setting the energy policy guidelines (13/07/2005)</b></p>	<p>Objective of production of renewable electricity of 21% of consumption in 2010 (compared with 14% in 2005) (Article 4).</p> <p>Possibility to turbine whole or part of the reserved flow (articles 35 and 46).</p> <p>Possibility to increase the power of an authorized or conceded plant by a maximum of 20% per declaration (Article 44).</p>
<p><b>Law n°2006-1772 on water and aquatic environments (30/12/2006)</b></p>	<p>Should allow achieving the objectives of the European Water Framework Directive (WFD), in particular the restoration of good ecological status by 2015.</p> <p>Revision of rivers classifications (Article L214-17 of the environment code) with the creation of 2 lists:</p> <ul style="list-style-type: none"> <li>• List 1: list of rivers, parts of rivers or canals, among those that are in very good ecological state, or identified by the general plan on development and water management (SDAGE) as a biological reservoir</li> </ul>

	<p>necessary to maintain or restore the good ecological status of rivers in a watershed, or in which complete protection of migratory fish living alternately in fresh and salt water is required, in which no authorization or concession can be granted for the construction of new project if they constitute an obstacle to ecological continuity.</p> <p>→ Obligation that apply when the list is published.</p> <ul style="list-style-type: none"> <li>List 2: list of rivers, parts of rivers or canals in which it is necessary to ensure adequate transport of sediments and the circulation of migratory fish. All projects must be managed, maintained and equipped according to rules defined by the administrative authority, in consultation with the owner or the operator.</li> </ul> <p>→ Obligation that applies at the end of a period of five years after the publication of the lists, to the existing facilities regularly installed.</p> <p>→ Publication of lists by 1 January 2014 at the latest. Lists published in 2012 and 2013 by river basin district.</p> <p>Revision of the reserved minimum flow values and their implementation time:</p> <ul style="list-style-type: none"> <li>1/10 (10%) of the mean annual discharge in general</li> <li>1/20 (5%) of the mean annual discharge for projects located on a watercourse with a mean annual discharge greater than 80 m<sup>3</sup>/s.</li> <li>1/20 (5%) of the mean annual discharge for HPP which, by their modulation capacity, contribute to the production of electricity during periods of peak consumption (list fixed by decree).</li> <li>Possible lower values on non-typical rivers.</li> </ul> <p>→ Possibility of setting different minimum flow values depending on the time of year, provided that the annual average of these values is not less than the minimum flows set. The lowest value shall be greater than half the annual minimum value.</p> <p>→ Possibility of derogation during exceptional natural low flow.</p> <p>→ Implementation by 1 January 2014 at the latest.</p>
<p><b>Law n° 2009-967 for the implementation of the "Grenelle de l'environnement (05/08/2009)</b></p>	<p>Commitment to increase the proportion of renewable energies to at least 23% of the final energy consumption by 2020 (Article 2).</p> <p>Objective of achieving good ecological status for at least 2/3 of the watercourses (Article 27).</p> <p>Aim to create a "green and blue network", which will help to preserve and restore the ecological continuity of the environment by, in particular, studying the most problematic obstacles to fish migration (Article 24, 26 and 29)</p>
<p><b>Law n° 2015-992 on the energy transition for green growth (17/08/2015)</b></p>	<p>Target of 23% of renewable energy by 2020 and 32% by 2030 (article 1)</p> <p>At that time, the law sets the target of producing 40% of electricity from renewable sources (article 1)</p> <p>Allow the gathering of several hydroelectric concessions, linked hydraulically (article 116)</p>

### 5.1.1 Targets set under the Renewable Energy Directive

In accordance with the “multiannual energy plan,” there is a slight increase of hydropower planned between 2018 and 2023: between 500 MW and 750 MW (a total of 61TWh to 63 TWh). The Multiannual Energy Plan was debated extensively (consultation of several comities and public consultation). Hydroelectricity is considered already well developed in France.

Source of information: Decree n°2016-1442 published on October 27, 2016; Multiannual Energy Plan : <https://www.ecologique-solidaire.gouv.fr/programmations-pluriannuelles-lenergie-ppe>

## 5.2 Strategic planning instruments

### 5.2.1 Strategic instruments for new hydropower use and development

#### 5.2.1.1 Instruments

The Table below presents the existing strategic instruments on new hydropower use and development.

Name	Key objectives
<b>Classification of rivers (list 1)</b>	See description above
<b>Regional climate, air and energy scheme (SRCAE)</b>	There is not high objective to develop hydroelectricity as explained above. The Regional climate, air and energy schemes identify more precisely within each region new sites and existing weirs where equipment are possible. See <a href="http://www.srcae.fr/">http://www.srcae.fr/</a>
<b>Calls for submission</b>	Contribute to the achievement of 23% of renewable energy by 2020 by developing hydroelectricity

On stream or part of streams classified “list 1” according to the article L.214-17 of the environment code (see the description of the law n°2006-1772 on water and aquatic environments published on December 30, 2006), it is not allowed to build new scheme which constitute an obstacle to the ecological continuity (the notion of obstacle to the ecological continuity is defined by law). Even equipped with devices for upstream and downstream migration and sediment transport, as these devices are never fully efficient, it is considered up to now that it is not possible to build a new intake for hydropower on these streams.

As of 2009, following the “Grenelle de l’environnement” Law, which calls for qualitative and quantitative targets to be reached by geographical areas for the development of renewable energy potential by 2020 and 2050 (SRCAE), studies of the potential for development of hydroelectricity (new sites and equipment of existing weirs or dams) were conducted at the hydrographic district level. In 2013, a synthesis of these studies was made by the ministry of energy and by hydroelectric companies (UFE; [ufe-electricite.fr](http://ufe-electricite.fr)) to identify the potential for hydropower development at national level; see tables bellow.

However, most part of this potential (roughly 70%) is on river classified in list 1. The remaining potential is only around 3 TWh.

## New sites:

Etude de convergence des potentiels hydroélectriques UFE/DREAL  
Création de nouveaux ouvrages – régions avec convergence

Régions	Potentiel retenu		Sources
	P [MW]	E [GWh/an]	
ALSACE	-	-	DREAL (SRCAE)
AQUITAINE	58,1	205,8	UFE/DREAL
AUVERGNE (bassin Adour-Garonne)	162,8	524,8	UFE/DREAL
BASSE-NORMANDIE	-	-	DREAL (SRCAE)
BOURGOGNE	6,9	24,5	UFE/DREAL
CENTRE	-	-	DREAL (SRCAE)
CHAMPAGNE-ARDENNE	-	-	DREAL (SRCAE)
FRANCHE-COMTE	22,9	80,2	UFE/DREAL
HAUTE-NORMANDIE	-	-	DREAL (SRCAE)
ILE-DE-FRANCE	-	-	DREAL (SRCAE)
LANGUEDOC-ROUSSILLON	204,5	715,1	UFE/DREAL
LIMOUSIN (bassin Adour-Garonne)	124,9	437,2	UFE/DREAL
MIDI-PYRENEES	530,4	1.822,9	UFE/DREAL
NORD-PAS-DE-CALAIS	-	-	DREAL (SRCAE)
PAYS-DE-LA-LOIRE	-	-	DREAL (SRCAE)
PICARDIE	-	-	DREAL (SRCAE)
POITOU-CHARENTES	-	-	DREAL (SRCAE)
PROVENCE-ALPES-COTE AZUR	612,7	2.144,6	UFE/DREAL
RHONE-ALPES	753,0	2.996,0	UFE/DREAL
<b>TOTAL</b>	<b>2.476,2</b>	<b>8.950,1</b>	

NB : " - " = potentiel marginal

## Equipment of existing sites:

Etude de convergence des potentiels hydroélectriques UFE/DREAL  
Equipped des seuils existants – régions avec convergence

Régions	Potentiel retenu		Sources
	P [MW]	E [GWh/an]	
ALSACE	1,8	8,2	DREAL (SRCAE)
AQUITAINE	22,0	79,0	UFE/DREAL
AUVERGNE - AG	9,0	31,0	UFE/DREAL
BASSE-NORMANDIE	-	-	DREAL (SRCAE)
BOURGOGNE	26,0	92,0	UFE/DREAL (SRCAE)
CENTRE	-	-	DREAL (SRCAE)
CHAMPAGNE-ARDENNE	<b>44,6</b>	156,1	DREAL (SRCAE)
FRANCHE-COMTE	96,0	336,0	UFE/DREAL
HAUTE-NORMANDIE	NC	NC	DREAL (SRCAE)
ILE-DE-FRANCE	<b>12,0</b>	42,0	DREAL (SRCAE)
LIMOUSIN - AG	0,5	1,5	UFE/DREAL
MIDI-PYRENEES	50,0	176,0	UFE/DREAL
NORD-PAS-DE-CALAIS	-	-	DREAL (SRCAE)
PAYS-DE-LA-LOIRE	NC	NC	DREAL (SRCAE)
PICARDIE	-	-	DREAL (SRCAE)
POITOU-CHARENTES	NC	NC	DREAL (SRCAE)
<b>TOTAL</b>	<b>261,9</b>	<b>921,8</b>	

NB : " - " = potentiel marginal

"NC" = non connu

Pour Champagne-Ardenne et Ile-de-France, la puissance a été évaluée en considérant 3500 heures de fonctionnement annuel à pleine puissance

In April 2016 and May 2017, two calls for submissions for the construction and operation of hydroelectric installations were published by the Ministry for the Environment. Their objective is to contribute to the achievement of 23% of renewable energy by 2020 by developing hydroelectricity. Projects must propose the best possible integration of environmental issues in order to be able to succeed and be authorized.

In 2016, projects could concern:

- Installations on new sites, with a capacity greater than or equal to 500 kW (25MW of cumulative power)
- Installations on existing weirs or dams, for a cumulative power of 30 MW (possibility to have a capacity  $\geq$  500 kW or between 150 and 500 kW).
- Installations on existing weirs or dams, with a capacity between 36 and 150 kW (within the limit of 50 installations).

In 2017, the call for submission concerns actually:

- Installations on new sites, with a capacity greater than or equal to 1 MW (60 MW of cumulative power)
- Installations on existing weirs and dams, with a capacity greater than or equal to 1 MW (45 MW of cumulative power).

Projects are evaluated according to 2 criteria:

- The proposed purchase price (70%) (maximum 120 or 130 €/MWh)
- The environmental quality of the project (30%).

Sources of information:

Ministry website: <https://www.ecologique-solidaire.gouv.fr/hydroelectricite>

Websites of hydroelectricity producers: <http://www.france-hydro-electricite.fr/dossiers/potentiel-hydroelectricite>; <http://ufe-electricite.fr/publications/etudes/article/quel-potentiel-hydroelectricite>; [http://ufe-electricite.fr/IMG/pdf/annexe\\_1.pdf](http://ufe-electricite.fr/IMG/pdf/annexe_1.pdf); [http://ufe-electricite.fr/IMG/pdf/annexe\\_2.pdf](http://ufe-electricite.fr/IMG/pdf/annexe_2.pdf)

Website of the Regulatory Commission of Energy:

<http://www.cre.fr/documents/appels-d-offres/appel-d-offres-portant-sur-la-realisation-et-l-exploitation-d-installations-hydroelectricques-developpement-de-la-petite-hydroelectricite>

### 5.2.1.2 Administrative level and linked planning processes

The table below presents the strategic planning instruments in place for new hydropower use and development and the administrative level at which they act.

Name	National	RBD	Regional	Federal State	Other
<b>Classification of rivers (list 1)</b>		Yes			
<b>Regional climate, air and energy scheme (SRCAE)</b>			Yes		
<b>Calls for submissions</b>	Yes, project selection is done on a national scale		Yes, project scoring is done on a regional scale		

The table below presents the planning processes which the planning instrument is part of.

Planning processes	Classification of rivers (list 1)	Regional climate, air and energy scheme (SRCAE)	Calls for submission
River Basin Management Planning	Yes		
National Renewable Energy Action Plan		Yes	Yes
Hydropower Sector planning		Yes	Yes
Regional planning procedures	Yes	Yes	Yes

### 5.2.1.3 Linking with financing instruments and/or regulatory procedures

If strategic planning instruments are used to identify “suitable” locations for hydropower development, are such areas:	
Targets of financial support schemes for hydropower development?	Subject to more simplified and faster authorisation processes?
No, the financial support tools are not specifically targeted to the “suitable” locations identified for hydropower development.	Not specifically, but the chance to get an authorisation is higher on these sites

## 5.2.2 Strategic planning instruments to restore continuity

### 5.2.2.1 Instruments

There are several strategic instruments to restore continuity.

Name	Key objectives
Classification of rivers (list 2)	See description above.
Regional ecological coherence scheme (SRCE)	<p>The SRCE includes:</p> <ul style="list-style-type: none"> <li>• a diagnosis of the regional territory and a presentation of the stakes related to the reservation and the restoration of environmental continuity at the regional scale</li> <li>• a presentation of the ecological continuities selected to constitute the Regional “trame verte et bleue” and identifying the biodiversity reservoirs and the corridors they include</li> <li>• a strategic action plan</li> <li>• a cartographic atlas</li> <li>• a monitoring and evaluation system</li> </ul> <p>The SRCE do not create new regulatory tools. It ensures the coherence of the existing devices and complements them with its network approach. See: <a href="http://www.trameverteetbleue.fr/vie-tvb/avancement-srce">http://www.trameverteetbleue.fr/vie-tvb/avancement-srce</a></p>

There is a list of stream or part of streams (called “list 2”), where it's necessary to ensure the sediment transport and the circulation of migratory fishes (see the description of the law n°2006-1772 on water and aquatic environments published on December 30, 2006). These lists were established for each River Basin District and published in 2012 or 2013. This obligation applies at the end of a period of five years after the publication of the lists (2017 or 2018). The compliance period has recently been extended by 5 years (law n°2016-1087 published on August 08, 2016).

### 5.2.2.2 Administrative level and linked planning processes

The table below presents the strategic planning instruments in place to restore continuity and the administrative level at which they act.

Name	National	RBD	Regional	Federal State	Other
Classification of rivers (list 2)		Yes			
Regional ecological coherence scheme (SRCE)			Yes		

The table below presents the key planning process which the strategic planning instrument is part of.

Planning process	Classification of rivers (list 2)
River Basin Management Planning	Yes
Eel Management Plans	Objectives of this plan were included in the RBMP

## 5.3 Procedural instruments at the level of hydropower plants

### 5.3.1 Duration of concessions

Typical duration of concessions
For concessions and authorizations, the maximal duration is 75 years (articles L521-4 for conceded HPP et L531-2 for authorized HPP of energy code). Formerly, for new concessions and authorizations, maximal duration was generally adopted. Nowadays, durations adopted for new or renewed concessions and authorizations are generally lower, between 20 and 50 years, as the amount of investments is generally much lower (for renewed). The levels of taxes and of investments for new facilities (including mitigation measures) are taken into account.
Is the permit duration for all hydropower plants the same?
No, see above.
If the permit duration varies, which criteria define the duration of a permit? (e.g. size of hydropower plant)
See above.
Are there differences in the duration of concessions between new and existing HPP?
Yes, see above.

## 5.3.2 Authorisation conditions for new hydropower plants

### 5.3.2.1 Mitigation measures required

The table below presents the mitigation measures related to fish required in order to fulfill the conditions for authorizing a new hydropower plant.

Types of mitigation	Requirement based on legislation?	If no relevant legislation, is requirement based on a recommendation?	If no relevant legislation or recommendation, is requirement defined in individual cases?	Is there no requirement at all for this type of mitigation?
<b>Upstream fish migration</b>	Yes, if the stream is listed in "list 2".		Yes, if the stream is not listed in "list 2".	
	<p>Article L 214-17 of environment code, created by the law n°2006-1772</p> <p>There is a list of stream or part of streams (called "list 2"), in which it is necessary to ensure adequate transport of sediments and the circulation of migratory fish. All projects must be managed, maintained and equipped according to rules defined by the administrative authority, in consultation with the owner or the operator.</p> <p>These lists were established for each River Basin District and published in 2012 or 2013. This obligation applies at the end of a period of five years after the publication of the lists (so 2017 or 2018). The compliance period has recently been extended by 5 years (law n°2016-1087 published on August 08, 2016).</p> <p>Owners or operators of obstacle have an obligation of results, not an obligation of means ("obligation de résultats, et non obligation de moyens").</p> <p>But in fact, all stakeholders try to agree on the design and dimensioning of the solution, given that a true assessment of solution efficiency after implementation is costly and consequently rare (see section 5.3.4.1). In most cases, a consensus is found. If not, a monitoring can be asked to the owner to prove that its solution is effective.</p> <p>There is no standard or norms for the design and dimensioning of devices for upstream and downstream migration. However, there are technical guides which are quite well respected. There is the place to discussion to adapt the implementation of criteria if this is justified by the constraints of each site. Technical guides can notably be found at the following links :</p> <p><a href="http://www.onema.fr/node/1611">http://www.onema.fr/node/1611</a></p> <p><a href="http://www.onema.fr/node/1570#pap">http://www.onema.fr/node/1570#pap</a></p> <p>Concerning the sediment transport, the law raise a question: what is an "adequate" sediment transport? From which point of view? In addition, we lack of methods and tools to assess the issues of transport. We also lack of criteria for the design and dimensioning of solutions.</p>			
<b>Downstream fish migration</b>	Yes, if the stream is listed in "list 2".		Yes, if the stream is not listed in "list 2".	
	<p>Article L 214-17 of environment code, created by the law n°2006-1772</p> <p>See description dealing with upstream migration which is common for downstream migration.</p>			
<b>Flow conditions</b>	Yes			
	<p>Article L 214-18 of environment code, created by the law n°2006-1772</p> <p>This article confirmed the obligation to maintain a minimum flow ("reserved flow") downstream of each project, which permanently guarantees the life, circulation and reproduction of the species that inhabit the waters. This is an objective (already</p>			

Types of mitigation	Requirement based on legislation?	If no relevant legislation, is requirement based on a recommendation?	If no relevant legislation or recommendation, is requirement defined in individual cases?	Is there no requirement at all for this type of mitigation?
	<p>present in the law n°84-512 on freshwater fishing and the management of fish resources (29/06/1984).</p> <p>This article also revised the minimum flow values :</p> <ul style="list-style-type: none"> <li>• 1/10 (10%) of the mean annual discharge in general</li> <li>• 1/20 (5%) of the mean annual discharge for projects located on a watercourse with a mean annual discharge greater than 80 m<sup>3</sup>/s.</li> <li>• 1/20 (5%) of the mean annual discharge for HPP which, by their modulation capacity, contribute to the production of electricity during periods of peak consumption (list fixed by decree).</li> <li>• Possible lower values on non-typical rivers.</li> </ul> <p>It's possible to set several minimum flow values depending on the time of year, provided that the annual average of these values is not less than the annual minimum value set. The lowest value shall be greater than half of this annual minimum value. It's possible to derogate during exceptional natural low flow.</p> <p>These minimum values have to be implemented by 1 January 2014 at the latest.</p> <p>To comply with the objective (to permanently guarantee the life, circulation and reproduction of the species), it could be necessary to adopt minimum flow significantly higher than the minimum values.</p> <p>The minimum flow value is debated for each individual case, depending on the results of studies on the hydrology (characterisation of natural low flows notably) and the variations of hydro-morphological and habitat parameters in function of the flow.</p> <p>A circular published in July 5<sup>th</sup> 2011 described the procedure to implement the article L 214-18, and the different methods to determine the biological minimum flow.</p>			
<b>Hydropeaking</b>			Yes	
	<p>Unless the disposition concerning the minimum flow (described above), there is no additional national disposition to regulate the hydropeaking management. The requirements are defined for each individual case at a local scale, depending on the results of studies on the biological impacts.</p> <p>However, the article L 214-4 indicate that :</p> <p>II : an authorization can be suppressed or modify without indemnity [...] : 3° In case of a major threat to the aquatic environment, and particularly when aquatic environments are subjected to critical hydraulic conditions incompatible with their preservation</p> <p>II bis : since January 1<sup>st</sup> 2014, on stream or part of streams listed in list 1 according to L 214-17, an authorization can be modify, if the operation of the facility does not comply with the preservation of migratory species alternately living in fresh and salt water (created by the law n°2006-1772).</p>			
<b>Gravel transport (sediment)</b>	Yes, if the stream is listed in "list 2".		Yes, if the stream is not listed in "list 2".	
	<p>Article L 214-17 of environment code, created by the law n°2006-1772</p> <p>See description dealing with upstream migration which is common for sediment transport.</p>			
<b>Habitat en-</b>	Yes			

Types of mitigation	Requirement based on legislation?	If no relevant legislation, is requirement based on a recommendation?	If no relevant legislation or recommendation, is requirement defined in individual cases?	Is there no requirement at all for this type of mitigation?
<b>Enhancement</b>	<p>The article 8 of the order of September 11, 2015 (NOR: DEVL1413844A) indicate in its article 8 that:</p> <p>The project includes measures to compensate for their significant residual impact, including that related to the increase of the "staging effect" on the watercourse, the creation of a reservoir, the creation an obstacle to ecological continuity or the creation of a bypassed section.</p> <p>These measures may consist of actions and fundings of actions, preferably in the hydromorphologically homogeneous section of the watercourse, aiming at the improvement of the functionalities of aquatic environments (removal of obstacles, restoration of alluvial annexes, mobility lateral, land-water transition, spawning grounds, etc.) or the ecological status of the body of water.</p>			
<b>Fish stocking</b>			Yes	
	<p>Formerly, fish stocking was a compensation measure for the HPP. This could be replaced by a tax paid to the association for fishing and protection of rivers, or to the State. This tax was suppressed in 2014.</p> <p>Nowadays, to our knowledge, fish stocking is not a measure implemented to mitigate or compensate the impacts of an HPP.</p>			

### 5.3.2.2 Link to WFD requirements

Not directly linked, but the definition of mitigation measures are now more ambitious to preserve or restore the good ecological status of streams.

### 5.3.3 Authorisation conditions for existing hydropower plants

#### 5.3.3.1 Permit revisions

<b>Time period to upgrade, retrofit or modernize existing hydropower plants</b>
None specifically. However, if an existing plant ( $P \leq 12$ MW) wants to benefit from a feed-in tariff for the purchase of its production, it must carry out an investment program to modernize the plant within a defined period. Minimum flow had also to be implemented by the January the 1st 2014 at the latest.
<b>Adaptation of existing concessions to WFD requirements</b>
Not directly. However, if an existing HPP is located on a stream classified in "list 2", it has to ensure the sediment transport and the circulation of migratory fishes, during the compliance period (Initial period of 5 years, extended by 5 years). Minimum flow had also to be implemented by the January the 1st 2014 at the latest
<b>Conditions when the authorization of an existing HPP is running out</b>
The concession or authorisation for an existing HPP run out can be renew (vast majority of cases) or not (rarely). If not, the scheme has to be removed. In case of renewal of a concession or authorization, mitigation measures are taken into account and renegotiated.
<b>Indefinite concessions and permit revisions</b>

N/a
<b>Turbine upgrades and permit revisions</b>
Not necessarily, but it could be a good opportunity to change for fish-friendly turbines and thus comply with obligation relative to downstream migration of fish.

Source of information: Law n°2006-1772 on water and aquatic environments (30/12/2006)

### 5.3.3.2 Mitigation measures required

There is no difference between new permits and renewal of existing permits. If existing HPP have already mitigations measures which are considered satisfactory for fish, nothing additional will be imposed.

## 5.3.4 Authorisation aspects relevant to new and existing hydropower plants

### 5.3.4.1 Requirements for monitoring effectiveness

Yes in principle there are requirements. In reality, it also depends on the financial capacity of the HPP, the biological stakes and the existence or not of a consensus on mitigation measures. Generally, monitoring plans are inexistent or reduced for authorised HPP (< 4.5 MW), and more ambitious for conceded HPP (> 4.5 MW). For example, the monitoring of the effectiveness of migration devices for fishes with telemetry studies is still rare (a few studies each year). Monitoring of effect of flow conditions on invertebrate and fish populations are more frequent.

### 5.3.4.2 Further aspects to be considered when setting mitigation requirements

The article L 214-17 of Environment Code indicates that “obligation (relative to migration of fish, sediment transport and environmental flow) shall be entitled to compensation only if they impose a special and exorbitant burden on the owner or operator”. In fact, the cost proportionality of measures is taken into account to do not impose a special and exorbitant burden.

In a general way, the article L 211-1 of Environment Code advocates a balanced and sustainable management of water resources ("gestion équilibrée et durable de la ressource en eau"), which take into account the necessary adaptations to the climate changes. Even if this is not precisely defined, authorizations and concessions of HPP must take into account all others waters uses, and inversely. For example, schemes with storage capacity are frequently used to release water during drought periods. Many schemes that create an artificial lake are used for recreational activities (bathing, canoeing, fishing, ...) ; in such cases, a minimal level of the lake must generally be maintained during summer.

The articles L 214-12 of Environment Code and L4242-2 and 4242-3 of Transport Code indicates that the circulation on watercourses of non-motorized recreational boats is carried out freely (except in case of specific prohibitions), and that decrees should precise the conditions for establishing and updating a list of projects where a device allowing the crossing or circumvention of boats should put in place (these decrees are not yet published).

### 5.3.4.3 Regulatory agencies involved in the authorization procedure

For authorized HPP, the instructor service is the Departmental Directorate of Territories ("Direction Départementale des Territoires"; DDT)

For conceded HPP, the instructor service is the regional directorate for the environment, plan-ning and housing ("Direction Regionale de l'Environnement, de l'Aménagement et du Logement"; DREAL).

Others public organisms are consulted by the instructor service to issue a technical notice, notably:

- National agency for biodiversity ("Agence Française pour la Biodiversité" [AFB], which replace the "Office National de l'Eau et des Milieux Aquatiques" [ONEMA] since the beginning 2017).
- Regional health agency ("Agence Régionale de Santé" [ARS]).

There is also a public consultation ("enquête publique") and the consultation of a commission including representatives of local authorities, consumer associations, and associations of fisheries and environmental protection ("Conseil Départemental de l'Environnement et des Risques Sanitaires et Technologiques"; CODERST).

#### **5.3.4.4 Flow-chart on the key steps of the authorization procedure for new / existing hydropower plants**

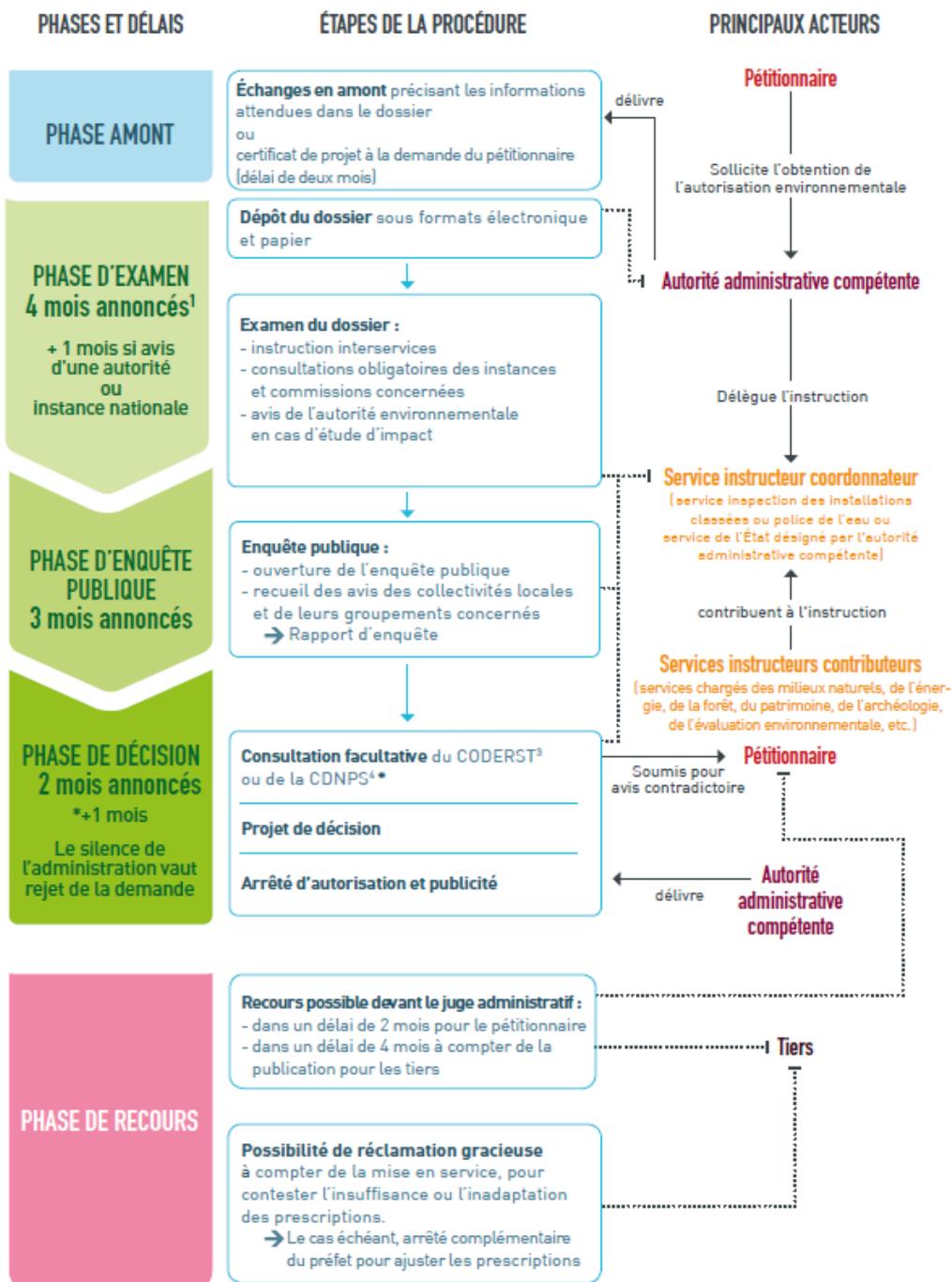
##### **For authorized HPP (< 4.5 MW):**

The procedure of authorisation is instructed according to the articles L311.1 and L531-1 to L531-6 of Energy Code, which refer to the article L214-1 to L214-11 of Environment Code, except specific provisions.

Recently, since March 1st 2017, the procedure of environmental authorisation has been re-formed to be simpler and faster (ordonnance n°2017-80 published in January 26th 2017 which create the articles L1818-1 to L181-31 of Environment Code ; decrees n°2017-81 and 2017-82 published January 26th 2017). Nowadays, there is a unique procedure that includes all the requirements of the various articles from the different codes (Energy, Environment, Forest ...). One objective is to limit the duration for the instruction to 9 months in the general case, against 12 to 15 months previously.

The article 181-15 of Environment Code indicates that " the extension or the renewal of an environmental authorisation are submitted to the getting of a new authorisation if there is a substantial change of the authorized project, or in case of substantial change in the circumstances leading to the issuance of the initial authorization.

The procedures to obtain a new authorisation and to renew the authorization of an existing HPP are therefore the same. For an existing HPP, as written in Q12 of 3.4.2, if mitigations measures are considered satisfactory, nothing additional will be imposed. However, in many cases, the renewal of the authorisation is an opportunity to improve the mitigation measures (taking into account new species, the downstream migration [more recently addressed], improving the efficiency of migration devices ...).



1. Ces délais peuvent être suspendus, arrêtés ou prorogés : délai suspendu en cas de demande de compléments ; possibilité de rejet de la demande si dossier irrecevable ou incomplet ; possibilité de proroger le délai par avis motivé du préfet. 2. ONPN : Conseil national de la protection de la nature. 3. CODERST : Conseil départemental de l'environnement et des risques sanitaires et technologiques. 4. CDNPS : Commission départementale de la nature, des paysages et des sites.

DIDCOM-SPES/PUA/16269 - Janvier 2017 - Crédits photos : page 1 : Thierry Degan (cours d'eau x2), Arnaud Bouissou/Terra (éolienne), page 2 : Aurélien Miralles, page 3 : Arnaud Bouissou/Terra, Laurent Mignaut/Terra

**For conceded HPP (> 4.5 MW):** The procedure of concession is instructed according to the articles L311.1 and L521-1 to L521-17 of the Energy Code. The specifications of the concession includes a regulation on the modalities of water management ("réglement d'eau" ; dealing with minimum flow, turbine flow, hydropeaking, lake level ...) which is defined with respect of L211-1 and L214-1 to L214-6 of Environment Code.

Formerly, concessions of hydroelectric schemes were renewed with a preference for the producer in place, if he so requests, and subject to acceptance of the new specifications. The French electricity market was opened to competition in 2000. The preference for the

producer in place in case of renewal was repealed by the law n°2006-1772 on water and aquatic environments (30/12/2006; article 7), and by the decree n°2008-1009 published September 26th 2008.

The French government announced in 2010 the beginning of renewal of hydroelectric concessions opened to competition (notably 10 concessions for 5.3 GW). But, since this date, all the procedures are in standby, due to a political will to avoid or limit the “liberalisation” of the hydroelectric production. Nevertheless, legal provisions to implement the renewal of concessions opened to competition have been completed by the Law n° 2015-992 on the energy transition for green growth (17/08/2015) and the decree 2016-530 (30/04/2016).

On 22 October 2015, the European Commission sent a Letter of Formal Notice to France concerning the granting of most of the country's hydro concessions (infringement decision n° 20152187). The Commission is required to ensure that all generators have the possibility to acquire access to hydro concessions in a transparent and non-discriminatory manner.

## 5.4 Challenges with regards to policy requirements

<b>Uncertainty in the planning, development and operation of HPP linked to the regulatory framework (national, regional)</b>
This is rather limits than uncertainties. On a producers point of view, the classification of rivers in “list 1” according to the article L.214-17 of the environment code is too important, as most part of the remaining hydroelectric potential in France (roughly 70%) is concerned (see previous section on strategic planning instruments). Some producers wish that some streams or parts of stream would be declassified. Another wish is also that an HPP with devices for upstream and downstream migration would not be considered as an obstacle to the ecological continuity, neither as a source of a degradation of the good ecological status. The fact that the procedure of renewal of the concessions is in stand-by since several years is not favourable to new development (including mitigation measures) within the concerned facilities.
<b>Uncertainty in the planning, development and operation of HPP linked to authorisation procedures</b>
Yes, from a producers' point of view, the duration of authorisation procedures was too long and the content of environmental studies asked by the administration was not always clearly defined or understood. The recent reform should improve these aspects.
<b>Recent changes to the regulatory framework</b>
The procedure of environmental authorisation has been reformed to be simpler and faster (see section 5.3.4.4) and so should facilitate the development of new plants. The recent calls for submission in April 2016 and May 2017 should drive new developments (see previous sections on strategic planning instruments).
<b>Foreseeable changes to the regulatory framework</b>
None, except the beginning of renewal of concessions.

## 5.5 Financing instruments

The following financing instruments promoting *at the same time* hydropower generation and improvement in water status are implemented:

- Feed-in tariffs

## 5.5.1 Feed-in tariffs

Name of instrument
<p>(1) Purchase obligation contracts and (2) Supplementary remuneration</p> <p>In France, a public support system known as the "purchase obligation" introduced in 1946 is designed to promote renewable energy development, including hydroelectricity. Its principle is to guarantee for private producers of renewable energy, over a period of 15 or 20 years, a price for the purchase of the electricity produced that exceeds the price of the market, in order to ensure the profitability of the investments made for the production of renewable energies. The terms of the energy feed-in tariffs are set by decrees of the Ministry in charge of energy and submitted to the Energy Regulatory Commission for opinion. Electricité De France company is entrusted with the task of purchasing the electricity produced by renewable electricity generation facilities.</p> <p>Reformed in the form of a public service by the law n°2000-108 published in 10/02/2000 on the modernization of the public electricity service, this support system was revised in depth by Law 2015-992 on the energy transition published in 18/08/2015. This revision follows a review by the European Commission of the framework for granting aid which Member States can provide to renewable energy producers. This Law 2015-992 introduces a new so-called "supplementary remuneration" system, which is intended to partially replace the obligation to purchase. The additional remuneration is a premium paid to producers in addition to the income they earn from direct sales in the electricity market.</p> <p>Otherwise, HPP benefiting from rates of purchase (in the form of purchase obligation or supplementary remuneration) can no longer collect other public subsidies.</p>
Type of hydropower targeted
<p>Until 2015, to qualify for the purchase obligation, new or retrofitted HPP must have an installed capacity less than or equal to 12 MW (decree No. 2000-1196 published on December 6, 2000).</p> <p>From 2017 (decree published on December 13, 2016), only new HPP with an installed capacity less than or equal to 499 kW can benefit from the purchase obligation. New HPP with an installed capacity between 500 and 999 kW can benefit from the supplementary remuneration. Existing HPP can only benefit from the supplementary remuneration, subject to the realization of an investment program.</p> <p>Until 2015, new and existing HPPs can benefit from purchase obligations contracts. It is possible for existing HPP since only 2001 (decree No. 2001-410 published on 2001 May 10), if they make significant investment for their renovation. The amount and nature of such investments are set by ministerial orders.</p> <p>From 2017, new HPP can benefit from purchase obligation or supplementary remuneration according to their production capacity (cf. above). Existing HPP can only benefit from supplementary remuneration, subject to the realization of an investment program.</p>
Criteria for ecological improvement
<p>There is no strict reference to environmental criteria, but in order to benefit from purchase obligations or supplementary remuneration, HPPs must comply with the environmental laws in effect.</p> <p>For existing power stations, the construction of device who ensure circulation of migratory fish is part of the investments selected (renovation works) to benefit from purchase obligations (until 2015) or supplementary remuneration (from 2017).</p>
Source of funding
<p>The additional cost of purchasing the support schemes, that is to say the difference between the remuneration paid to producers and the value of the energy sold, constitutes an expense attributable to the public service remit, a contribution due from final consumers, contribution to the public electricity utility (CSPE).</p>
Source of information
<p>5.5.1.1.1 <a href="https://www.edf-oa.fr/content/connaître-lobligation-dachat">https://www.edf-oa.fr/content/connaître-lobligation-dachat</a></p>

## 5.6 Challenges with regards to financing instruments

<b>Design or implementation dimensions to be improved</b>
Hard to say, as the instruments in place have been recently revised.
<b>Recent changes driving developments in the hydropower sector</b>
The public support system known as the "purchase obligation" was revised in 2015 (see section on feed-in tariffs). The calls for submission are recent (April 2016 and May 2017; see sections on strategic planning instruments).
<b>Foreseeable changes that may drive new developments in the hydropower sector</b>
None

## 6 Norway

Prepared by SINTEF Energy Research.

### 6.1 Key national policies

The table below presents the key national legislation relevant to ecological improvements in water ecosystems and which may have repercussions in hydropower production.

Policy area	Name of law	Date
<b>Water protection</b>	The Watercourse Regulation Act /	December 14, 1917
	The Water Resources Act	January 1, 2001
<b>Nature protection</b>	The Plan and Building Act	January 1, 2010
	The Biodiversity Act	January 1, 2016
<b>Fisheries</b>	The Plan and Building Act	January 1, 2010
	The Salmon and inland fisheries Act	January 1, 2016
<b>Environmental impact assessment</b>	The Plan and Building Act	January 1, 2010
<b>Energy/renewable energy</b>	The Energy Act	January 1, 1991
<b>Water infrastructures</b>	The Watercourse Regulation Act /	December 14, 1917
	The Water Resources Act	January 1, 2001

The Table below presents, for each law, the relevant aspects for environmental improvements in water ecosystems, environmental conditions related to hydropower schemes or the production of hydropower itself.

Name of law	Relevant aspects
<b>Water Resources Act</b>	The Water Resources Act is a law that aims to ensure a socially sound use and management of watercourses and groundwater. The Act regulates waterway installations, which are defined as building or construction in or over watercourses, and other measures in the river basin which, by their nature, are suitable for influencing water flow, water level, river bed or flow direction and velocity or physical and chemical water quality in other ways than by pollution (which is covered by a separate law). Furthermore, the Act provides the regulation in the rights to use of groundwater, groundwater drilling, and concessions for hydropower development and expropriation for hydropower production.
<b>The Watercourse Regulation Act</b>	This Act applies to all types of regulations or introduction of installations of watercourses that aim at changing the water flow. Regulations of watercourses are understood to be installations or other measures for regulating a watercourse's rate of flow, including expanding or altering older regulating installations. Installations or works intended to increase the rate of flow by diverting water and pumping water to a reservoir located at a higher elevation are likewise to be regarded as regulations of watercourses.
<b>The Plan and Building Act</b>	The Act shall promote sustainable development in the best interests of individuals, society and future generations.  Planning pursuant to this Act shall facilitate the coordination of central government, regional and municipal functions and provide a basis for administrative decisions regarding the use and conservation of resources. The processing of building applications pursuant to this Act shall ensure that projects are carried

	out in compliance with statutes, regulations and planning decisions. Individual projects shall be carried out in a proper manner. Planning and administrative decisions shall ensure transparency, predictability and public participation for all affected interests and authorities. There shall be emphasis on long-term solutions, and environmental and social impacts shall be described. With respect to hydropower development, this The Norwegian directorate for Water and Energy Resources (NVE) is the responsible authority, which specifies the Environmental Impact Assessment (EIA) program and also controls the fulfilment of the EIA.
<b>The Energy Act</b>	The Act shall ensure that the generation, conversion, transmission, trading, distribution and use of energy are conducted in a way that efficiently promotes the interests of society, which includes taking into consideration any public and private interests that will be affected. In this Act, electrical installation is defined as: a generic term for electrical equipment and associated building structures for the generation, conversion, transmission and distribution of electrical energy. In this Act, district heating plant is defined as: a term for technical equipment and associated building structures for the generation, transmission and distribution of hot water or some other heating medium to external consumers.

### 6.1.1 Targets set under the Renewable Energy Directive

A common certificate market with Sweden started up January 1, 2012. Through the common certificate market with Sweden, Norway shall finance 13.2 TWh renewable electricity production, 15.2 TWh in Sweden, giving a total ambition to build 28.4 TWh new renewable electricity 2020. In Norway, hydropower and windpower will probably be the main sources for new production. In Norway, the arrangement is handled by The Norwegian Water Resources and Energy Directorate (NVE). By the end of 2016, approximately 17.7 TWh new electricity production was in generation since 2012, while Norway contributed by approximately 4 TWh.

Norway has adopted the EU Renewable Energy Directive and according to this agreement, Norway has committed to have a renewable energy share of 67.5% by 2020. (In 2014 Norway's share of renewable energy was 69.2%). These goals on development of new renewable electricity by 2020 is politically agreed upon and adopted in the Act of Green certificates.

Sources of information:

lovdata.no

[https://www.regjeringen.no/globalassets/upload/oed/vedlegg/lover-og-reglement/act\\_no\\_17-of\\_14\\_december\\_1917.pdf](https://www.regjeringen.no/globalassets/upload/oed/vedlegg/lover-og-reglement/act_no_17-of_14_december_1917.pdf) (Site of the Government)

<https://www.regjeringen.no/en/dokumenter/planning-building-act/id570450/> (Site of the Government)

[https://www.regjeringen.no/globalassets/upload/oed/vedlegg/lover-og-reglement/act\\_no\\_50\\_of\\_29\\_june\\_1990.pdf](https://www.regjeringen.no/globalassets/upload/oed/vedlegg/lover-og-reglement/act_no_50_of_29_june_1990.pdf) (Site of the Government)

NVE ([www.nve.no](http://www.nve.no))

<https://www.regjeringen.no/no/sub/eos-notatbasen/notatene/2008/apr/fornybardirektiv-2/id2432192/> (Governmental web site)

## 6.2 Strategic planning instruments

### 6.2.1 Strategic instruments for new hydropower use and development

#### 6.2.1.1 Instruments

The table below presents the key objectives of strategic planning instruments in place for new hydropower use and development.

Name	Key objectives
<b>Samlet plan (Master</b>	Samlet plan is an old planning instrument going back to 1984-85 with the

<b>plan for hydropower)</b>	aim to classify all water courses for development or protection. This national master plan is based on a systematic verifiable prioritisation of hydropower projects, based on the degree of conflict in relation to different user interests (environment, fishing, biodiversity, recreation, etc.) and power plant economics. From 2016, Samlet Plan was actually formally phased out as a planning instrument.
<b>Regional small scale hydropower master planning</b>	The purpose of the regional small-scale hydropower plans is to map the hydropower resources and the characteristics of these resources. The resources are typically assessed with respect to biodiversity, areas without landscape qualities, prior encroachments, fish and game fishing, historical/cultural sites, recreation, tourism and domesticated reindeer. The regional plans and guidelines will be an important basis for the total assessment made for the individual project and should not replace today's licensing.
<b>"Revision of concessions"-report (2013)</b>	The "Revision of concessions"-report (2013) was a national exercise of those approx. 400 hydropower concessions that can undergo a revision of terms (environmental requirements) the coming 6-7 years. The national authorities screened these 400 objects in order to make a prioritised list of in which concessions environmental improvements are prioritised and which concessions that will be "saved" (no losses of power production accepted), as they were considered very important for the provision of energy and regulated power. In order to do such an assessment, a set of environmental and energy-related criteria were established, as the basis for the prioritised list.

Sources of information:

Master plan hydropower (Samlet plan):

<http://www.miljodirektoratet.no/no/Tema/Vannforvaltning/Samlet-plan-for-vassdrag/> (Norwegian Environment Agency)

<https://www.nve.no/nytt-fra-nve/nyheter-konsesjon/samlet-plan-for-vassdrag-er-avviklet/>

Small scale hydro:

<https://www.regjeringen.no/globalassets/upload/oed/pdf20filer/retningslinjer-for-sma-vannkraftverk.pdf> (Governmental site)

### 6.2.1.2 Administrative level and linked planning processes

The table below presents the strategic planning instruments in place for new hydropower use and development and the administrative level at which they act. Samlet plan is now a fairly old planning instrument, and maybe not in use as extensively as from the mid-80s. From 2016, Samlet Plan was actually formally phased out as a planning instrument. A few regions have developed regional plans for the development of small-scale hydro-power plants.

Name	National	RBD	Regional	Federal State	Other
<b>Master plan for Hydropower development (Samlet Plan)</b>	Yes				
<b>Regional small scale hydro-power master planning</b>			Yes		
<b>Revision of concessions-report (2013)</b>	Yes		Yes		

The table below presents the planning processes which the strategic planning instrument is part of.

Policy area	Samlet Plan	Small scale hydropower planning	Revision of concessions
River Basin Management Planning	Yes		Yes
National Renewable Energy Action Plan	Yes	Yes	Yes
Hydropower Sector planning	Yes	Yes	Yes
Regional planning procedures		Yes (small scale)	

### 6.2.1.3 Linking with financing instruments and/or regulatory procedures

If strategic planning instruments are used to identify "suitable" locations for hydropower development, are such areas:	
Targets of financial support schemes for hydropower development?	Subject to more simplified and faster authorisation processes?
No, All new renewable electricity can receive financial support (up to 2020, but might be continued in some form)	No. No simplified approach, but these planning tools represent an initial screening and will, on the contrary, give a signal to those projects more likely to be rejected in the authorisation process

Sources of information:

<http://www.miljodirektoratet.no/no/Tema/Vannforvaltning/Samlet-plan-for-vassdrag/> (Norwegian Environment Agency)

Small scale hydro:

<https://www.regjeringen.no/globalassets/upload/oed/pdf20filer/retningslinjer-for-sma-vannkraftverk.pdf> (Governmental site)

## 6.2.2 Strategic planning instruments to restore continuity

### 6.2.2.1 Instruments

The environmental targets of the EU WFD are the strongest instrument in order to restore continuity for migrating species in regulated rivers. In addition, the "revision of concessions" (only revision of the environmental terms, not the concession itself) have identified those objects that will be prioritized (given higher environmental requirements/standards), and migration is one of the key ecological processes to be restored/mitigated. In addition, it is possible to apply for financial support from the Norwegian Environment Agency to build and restore fish ladders.

Name	Key objectives
<b>EU WFD</b>	The main objective of the EU WFD is to reach good ecological status in all water bodies, while the HMWB have to be handled slightly differently. There are no specific environmental goals related to restoring continuity, but this is, of course, a very important measure in many rivers as barriers/fragmentation are many places the main problem in order to reach the goals of EU WFD.
<b>Revision of concession (2013)</b>	This is a national report and must be considered only giving indications about the measures that are needed in order to improve the environmental status. More detailed studies in the individual cases are needed to specify

	the most cost-efficient measures, but restoring of continuity is considered being the most important measure in many rivers together with increased releases of water in bypass sections.
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### 6.2.2.2 Administrative level and linked planning processes

The table below presents the strategic planning instruments in place to restore continuity and the administrative level at which they act.

Name	National	RBD	Regional	Federal State	Other
<b>EU Water Framework Directive</b>		Yes			
<b>Revision of concessions report</b>	Yes				

Revision of concessions report (2013) is a national screening leading to a prioritization of which concession objects that are expected to be prioritized for environmental improvements, and which ones that will be 'protected' due to their importance for hydropower production.

The table below presents the key planning process which the strategic planning instrument is part of.

Planning process	EU WFD	Revision of concession
<b>River Basin Management Planning</b>	Yes	
<b>Eel Management Plans</b>		
<b>Other</b>		Yes

We have indicated 'Other' as the Revision of concessions report (2013) is a national screening exercise. It is also possible to apply for financial support from the Norwegian Environment Agency to build and restore fish ladders.

## 6.3 Procedural instruments at the level of hydropower plants

### 6.3.1 Duration of concessions

<b>Typical duration of concessions</b>
Publicly owned (2/3) and small hydropower (< 10MW) permits usually have unlimited duration. Privately owned hydropower permits have limited duration (60 years)
<b>Is the permit duration for all hydropower plants the same?</b>
No (see above).
<b>If the permit duration varies, which criteria define the duration of a permit? (e.g. size of hydropower plant)</b>
Revisions of licencing conditions (environmental terms) after 50 years, then 30 years (after 1992) for the larger hydropower plants.
<b>Are there differences in the duration of concessions between new and existing HPP?</b>
Yes. After 1992 the environmental of terms specified in the concession are revised after 30 years.

## 6.3.2 Authorisation conditions for new hydropower plants

### 6.3.2.1 Mitigation measures required

The table below presents the mitigation measures related to fish required in order to fulfill the conditions for authorizing a new hydropower plant.

Types of mitigation	Requirement based on legislation?	If no relevant legislation, is requirement based on a recommendation?	If no relevant legislation or recommendation, is requirement defined in individual cases?	Is there no requirement at all for this type of mitigation?
<b>Upstream fish migration</b>	Yes			
	The mitigating measures are defined on case-by-case basis. For every new hydropower licence, terms will be set, such as minimum water flow, reservoir restrictions, rules of operation, habitat restauration, weirs, fish ladders etc.			
<b>Downstream fish migration</b>			Yes	
	The mitigating measures are defined on case-by-case basis. For every new hydropower licence, terms will be set, such as minimum water flow, reservoir restrictions, rules of operation, habitat restauration, weirs, fish ladders etc.  Environmental requirements related to downstream migration have historically been an issue only to a limited extent, and have received less attention than upstream migration. However, there is growing concern that this is a key issue which also requires mitigation.			
<b>Flow conditions</b>	Yes			
	The use of the statistical value "common low flow" (allminnelig lavvannføring) has been a very common flow value set in bypass section as a minimum flow requirement. This is calculated by a defined statistical method, most likely only used in Norway. In many case, the common low flow value ends up in the same range as Q95, which is a very common flow value in other European countries.			
<b>Hydropeaking</b>			Yes	
	The mitigating measures are defined on case-by-case basis. Requirements on hydro-peaking operations have been defined in only very few cases so far (but some producers have introduced voluntary restriction on such operations in some selected cases). Recent research from CEDREN (research centre, not an authoritative body) have proposed guidelines to be used when restriction on hydro-peaking operations are to be defined, but so far not used (to our knowledge)			
<b>Gravel transport (sediment)</b>				Yes
	The mitigating measures are defined on case-by-case basis. This specific problem has limited attention in Norway.			
<b>Habitat enhancement</b>		Yes		
	The mitigating measures are defined on case-by-case basis. Habitat enhancement seems to be more common as a measure, but has historically to only a limited extent been used.  We have checked "based on a recommendation" as habitat conditions and adequate conditions are standard in the terms of the concession.			

<b>Fish stocking</b>	Yes			
	The mitigating measures are defined on case-by-case basis. This has historically been a very common measure to enhance the salmon and trout populations. This could be specified as a number of smolts, 1+, 0+, or more recently egg, that are to be stocked in a reservoir/lake or river every year.			

### 6.3.2.2 Link to WFD requirements

Authorisation procedures for new hydropower have been adapted to the requirements of the WFD. According to the Norwegian Water Resources and Energy Directorate, 'The EU Water Framework Directive (Water Directive) is central in the authorization process of new hydropower permits, and the process of revising the terms in the concession. Local action plans as well as management plans (as part of EU WFD) provide useful input to the environmental considerations and what measures should be considered in the audit. Revision of license terms will be a key instrument for improving the environmental condition, which is a main objective of the EU WFD. The audit process should therefore be coordinated with the Water Directive as far as possible and appropriate.'

Source of information: The Norwegian Water Resources and Energy Directorate: <https://www.nve.no/energiforsyning-og-konsesjon/vannkraft/revisjon-av-konsesjonsvilkar/>

## 6.3.3 Authorisation conditions for existing hydropower plants

### 6.3.3.1 Permit revisions

<b>Time period to upgrade, retrofit or modernize existing hydropower plants</b>
Revisions of licensing conditions (environmental terms) after 50 years, then 30 years (after 1992) for the larger hydropower plants.
<b>Adaptation of existing concessions to WFD requirements</b>
See above. Please note that it is only the environmental terms that are revised, not the concession itself. Terms that are revised are typically minimum flow, requirements about physical habitat improvements, continuity, maybe related to ramping rates and dates for filling of reservoirs, and qualities that can be important for use (recreation, fishing, etc.). The highest and lowest regulated levels are not opened for revision.
<b>Conditions when the authorization of an existing HPP is running out</b>
The mitigating measures are defined on case-by-case basis. For every new hydropower license, terms will be set, such as minimum water flow, reservoir restrictions, rules of operation, habitat restoration, weirs, fish ladders etc. Please note that the concession itself is not running out, only the terms, that possibly are revised as part of the revisions.
<b>Indefinite concessions and permit revisions</b>
The terms related to the concessions (e.g. minimum flow, requirements for continuity, etc) are revised at regular intervals (see 3.4.3 – Q8). The concession itself, are usually unlimited for publicly owned entities.
<b>Turbine upgrades and permit revisions</b>
Refurbishments of existing machinery, reduction of head losses in tunnels, pressure shafts, etc will normally not lead to revision of terms. Extensions such as transfer of water into your system, increase of reservoir capacity, increased power production capacity (installed capacity), re-building/new power plant, etc will normally lead to revision of terms.

Source of information: Questionnaire on Hydropower and the Water Framework Directive, filled in 2011; [www.nve.no](http://www.nve.no); Olje og Energi departementet: Retningslinjer for revisjon av konsesjonsvilkår for vassdragsreguleringer (Oil and Energy Dept: Guidelines for revision of terms of concessions for river regulations)

#### **6.3.3.2 Mitigation measures required**

This is similar to requirements for new HPP, see previous section.

### **6.3.4 Authorisation aspects relevant to new and existing hydropower plants**

#### **6.3.4.1 Requirements for monitoring effectiveness**

The authorization process usually requires monitoring of effect of measures. The power producer is often requested to monitor the fish population (e.g. number of smolts, juvenile fish densities, etc). In some controversial cases the authorities have defined a period (sometimes 5 years) where a specific operational regime (e.g. minimum flow) is tested and evaluated afterwards, based on the findings of the environmental impacts/effects.

Source of information: Personal communication with Environment Agency.

#### **6.3.4.2 Further aspects to be considered when setting mitigation requirements**

During the work of writing the Concession revision report (2013), an assessment of which objects (hydropower plants) are important/critical for the provision of energy/peak power was made. Vice versa, those objects that were considered affecting rivers with high environmental values were identified. Based on these assessments, objects were sorted with respect to priority. In this process the lost power due to e.g. release of minimum flow was calculated and the value of this lost power, used as input to the sorting/priority of objects for revision.

Also other aspects that environmental conditions are covered in the authorisation process, such as recreation, tourism, other local industry/commerce. Landscape aspects, fishing, etc are also covered by the EIA. It is a principle that the costs related to measures should be balanced with the benefits of the measure.

Source of information: NVE-publication 49/2013 (2013) Vannkraftkonsesjoner som kan revideres innen 2022. Nasjonal gjennomgang og forslag til prioritering (revision of concessions-report).

#### **6.3.4.3 Regulatory agencies involved in the authorization procedure**

NVE is the main licencing authority in Norway, i.e. in handling operational aspect of the process. The ministry defines the framework for licencing, and is the appealing authority. Please note that small (< 10 MW) and large hydro are handled differently, i.e. a simplified regime for small hydro. The Norwegian Environment Agency (Directorate) is a very important hearing partner, and the authority that defines the environmental terms (in rivers with anadromous fish). In rivers with inland fish, the county governor (Fylkesmannen in Norwegian) is the authoritative body that defined the terms.

Source of information:

[https://www.regjeringen.no/globalassets/upload/oed/faktaheftet/facts\\_energy\\_water.pdf](https://www.regjeringen.no/globalassets/upload/oed/faktaheftet/facts_energy_water.pdf)

#### **6.3.4.4 Flow-chart on the key steps of the authorization procedure for new / existing hydropower plants**

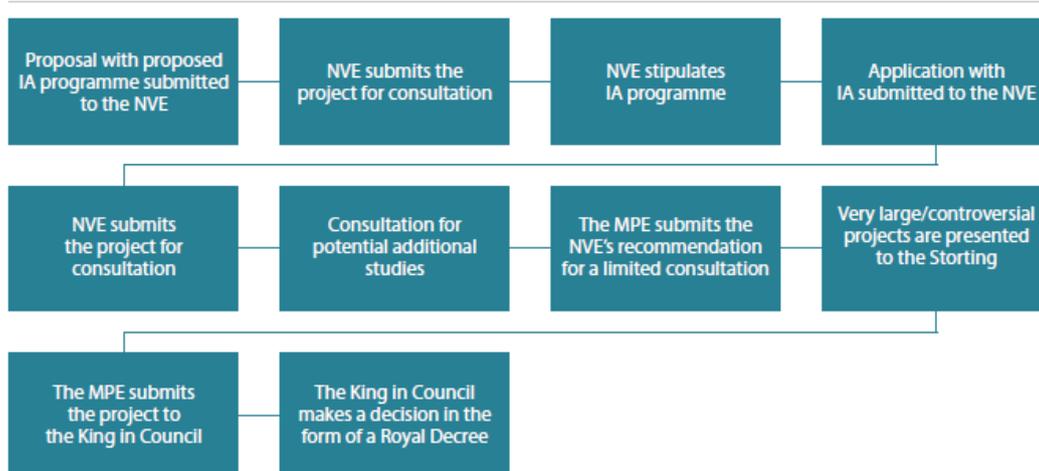
The licensing authority includes the agencies responsible for processing licence applications and granting licences. The licensing authority includes the Storting, the King in Council, the Ministry of Petroleum and Energy and the NVE. Below follows a description of the

licensing processes pursuant to the Watercourse Regulation Act, the Water Resources Act, as well as electrical installations pursuant to the Energy Act.

Source of information:

[https://www.regjeringen.no/globalassets/upload/oed/faktaheftet/facts\\_energy\\_water.pdf](https://www.regjeringen.no/globalassets/upload/oed/faktaheftet/facts_energy_water.pdf);  
[https://www.nve.no/media/2274/retningslinjer-for-revisjon\\_25mai\\_siste.pdf](https://www.nve.no/media/2274/retningslinjer-for-revisjon_25mai_siste.pdf)

**Figure 1.2: Procedure for development of major hydropower projects pursuant to the Water Resources Act and water regulations pursuant to the Watercourse Regulation Act.**



No flowchart for revision of existing hydropower plants. The process is comprehensively described (in Norway) in the following document:

[https://www.nve.no/media/2274/retningslinjer-for-revisjon\\_25mai\\_siste.pdf](https://www.nve.no/media/2274/retningslinjer-for-revisjon_25mai_siste.pdf)

## 6.4 Challenges with regards to policy requirements

Uncertainty in the planning, development and operation of HPP linked to the regulatory framework (national, regional)
Yes, the environmental goals for the EU WFD HMWBs are not clearly defined, and neither the level when the costs of measures are considered disproportional. Norway is deeply involved in the on-going EU CIS work related to HMWBS and hydropower. In natural water bodies, the environmental goals are clearly defined.
Uncertainty in the planning, development and operation of HPP linked to authorisation procedures
We believe that there is still open questions related to how EU WFD affects and will affect the authorisation process in the planning, development and operation of HPP. There are, of course, a number of hydropower projects that have been granted the last 10-15 year, which gives precedent for how environmental terms are set, but according to hydro-power producers with idea for new projects WFD poses uncertainty to this process.
Recent changes to the regulatory framework
The financial support given by the green certificate market with Sweden, stimulates for building of new hydropower (and wind power)
Foreseeable changes to the regulatory framework
There is an on-going discussion of the financial support (green certificates) will be extended beyond 2020.

Source of information: [www.nve.no](http://www.nve.no) / personal communication

## 6.5 Financing instruments

The following financing instruments promoting *at the same time* hydropower generation and improvement in water status are implemented:

- Support schemes for modernization of existing plants

### 6.5.1 Support schemes for modernization of existing plants

Name of instrument
Green electricity market with Sweden
Type of hydropower targeted
Independent of size, mode, etc. All new power production can apply for certificates (financial support). For existing plants, only the extra power production qualifies for support.
Criteria for ecological improvement
Source of funding
Electricity certificates are an aid scheme for power produced from renewable energy sources. The electricity customers finance the system of electricity bills by the fact that power suppliers add the energy tax cost to the electricity price.
Source of information
<a href="https://www.nve.no/energiforsyning-og-konsesjon/elsertifikater/">https://www.nve.no/energiforsyning-og-konsesjon/elsertifikater/</a>

## 6.6 Challenges with regards to financing instruments

Design or implementation dimensions to be improved
N/a
Recent changes driving developments in the hydropower sector
The financial support given by the green certificate market with Sweden, stimulates for building of new hydropower (and wind power)
Foreseeable changes that may drive new developments in the hydropower sector
The present Green electricity market with Sweden will be phased out in 2020. There is an on-going discussion if it should be extended/replaced by a new arrangement, but this is still pending, even though most people tend to think a new scheme will be put in place. Anyhow, it represents a risk to those power producers considering developing new hydropower projects.

## 7 Portugal

Prepared by HIDROERG.

### 7.1 Key national policies

The table below presents the key national legislation relevant to ecological improvements in water ecosystems and which may have repercussions in hydropower production.

Policy area	Name of law	Date
<b>Water protection</b>	Water Law that transpose the WFD into the national legal framework (Law n.º 58/2005, 29 of December and posterior updates, namely Rectification n.º 11-A/2006, Decrees-Law n.º 60/2012 and n.º 130/2012, and Law n.º 42/2016),	December 2005
<b>Nature protection</b>	National network of protected areas (Decree-Law n.º 142/2008, 24 of July).  Decree-Law n.º 140/99, 24 of April, that transpose the Habitats Directive, republished with some changes by the Decree-Law n.º 49/2005 (24 of February).	July of 2008 and April of 1999
<b>Fisheries</b>	Freshwater Fisheries Law (Law n.º 7/2008, 15 of February, with some aspects changed by the Decree-Law n.º 221/2015, 8 of October) and regulation (Decree-Law n.º 222/2015, 8 of October).	October of 2015
<b>Environmental impact assessment</b>	Decree-Law n.º 151-B/2013, 31 of October, that transpose the European Directive 2011/92/UE, on the assessment of the effects of certain public and private projects on the environment.	November of 2013
<b>Energy/renewable energy</b>	Decree-Law n.º 215-B/2012, 8 of October, which strengthens the legal framework applicable to the electricity production with emphasis for the one based on renewable sources and completes the transposition of the Directive of the European Parliament and of the Council n.º 2009/28/EC.	October 2012
<b>Water infrastructures</b>	Water use legislation (Decree-Law n.º 226-A/2007, 31 of May).	May of 2007

The Table below presents, for each law, the relevant aspects for environmental improvements in water ecosystems, environmental conditions related to hydropower schemes or the production of hydropower itself.

Name of law	Relevant aspects
<b>Water Law</b>	The Water Law (WFD (Law n.º 58/2005, 29 of December and posterior updates Rectification n.º 11-A/2006, Decrees-Law n.º 60/2012 and n.º 130/2012 and Law n.º 42/2016) transposes the WFD to the Portuguese legislation. It is the main legislation on the protection of the portuguese water resources and bodies. It establishes the need to implement measures to attain a good ecological status (or potential) in all water bodies, namely rivers, the need for the new

	<p>water uses to comply with those objectives, and the cases where exceptions to the requirement to prevent further deterioration or to achieve good status under are allowed (unforeseen or exceptional circumstances, or for reasons of overriding public interest or new modifications to the physical characteristics of a surface water body, provided that all practicable steps are taken to mitigate the adverse impact on the status of the body of water).</p>
<p><b>National network of nature protected areas - Decree-Law n.º 142/2008, 24 of July-, and Decree-Law n.º 140/99, 24 of April</b></p>	<p>The first Decree-Law establishes and structures the national network of nature protected areas, including Natura 2000 sites and other protected areas. The second Decree-Law transpose the Habitats Directive, that aims to protect/maintain habitats, animal and plant species endangered in the European Union territory. Several of the listed habitats and species are aquatic and riparian, thus closely linked to rivers. Iberian habitats and species are listed in the Directive Annexes and in the Portuguese legislation.</p>
<p><b>Freshwater Fisheries Law and regulation</b></p>	<p>This recent legislation replaces older legal documents (dating from 1959 and 1962) and aims to protect freshwater fisheries by means of sustainable management. It includes several articles related to the mitigation of impacts resulting from new hydraulic projects, namely by imposing the owners or users of water infrastructures to release environmental flows allowing the maintenance of good ecological status (article n.º 12) and related to river connectivity (if deemed necessary, existing projects that block fish passage could be forced to install fish passes, article n.º 13).</p>
<p><b>Legislation on environmental impact assessment (Decree-Law n.º 151-B/2013, 31 of October).</b></p>	<p>The legislation transposes the European Directive 2011/92/UE, on the assessment of the effects of certain public and private projects on the environment. Hydropower projects are subjected to an environmental impact assessment (EIA) for installed capacities <math>\geq 20</math> MW, in any area, or <math>\geq 1</math> MW, if in a Nature protected area, including Natura 2000 sites. Projects with less than 1 MW but that promote changes in the hydrologic regime or require the construction of weirs are also subjected to EIAs if located in Nature protected areas. Projects not subjected to EIA are nonetheless subjected to a similar study, albeit somewhat less detailed, named "Estudo de Incidências Ambientais". The EIA assesses compatibility of the project with other legislation, including on water protection. Therefore it is at this stage that the impacts of the project are evaluated as to their compatibility with the WFD environmental objectives. It is also at this stage that matters such as environmental flows and fish passages are discussed.</p>
<p><b>Water Resources Utilization Regime/Regime the Utilização dos Recursos Hídricos (Decree-Law n.º 226-A/2007, 31 of May, with several small amendments issued in posterior legislation)</b></p>	<p>This legislation details the aspects related to the issuing of water use permits. Hydropower production is one of the water uses requiring a water permit (concession), including the water use for energy production and the build of water infrastructures. The Decree-Law establishes the procedures needed for someone (usually a private entity) to require a water use permit, the maximum concession period (maximum 75 years, and variable according to the investment required; concession periods may vary from 50-75 years for an installed capacity <math>&gt; 50</math> MW, from 35-50 years for an installed capacity 30-50 MW and from 15-35 years for an installed capacity <math>&lt; 30</math> MW). It also establishes some of the users obligations, such as the need to monitor the water use and its impacts (ecological state), as well as the situations where the cessation of the water use can be enforced.</p>
<p><b>Legal Framework of the Activities Developed under National Electric System (SEN)/ Regime Jurídico Aplicável às Atividades Integrantes do Sistema Elétrico Nacional (SEN) (Decree-Law n.º 215-B/2012, 8 of</b></p>	<p>Besides completing the transposition of European Directives into the Portuguese legal tissue, this decree-law clarifies the framework of the energy production based on renewable energies by private entities – the so-called special regime, which is the more relevant one in the scope of the FIThydro project. Regarding this regime, along with the previous guaranteed selling price system, a market selling price system can also be applied. However, the additional legislation that was supposed to follow up this decree-law in order to support the option for one of the previous selling systems was never published which definitely compromised and even stopped the development of the private energy production sector.</p>

October).	
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### 7.1.1 Targets set under the Renewable Energy Directive

No targets. Targets have been set for production based on renewable sources, but not specifically for hydropower. However, there is an estimation of hydropower production for 2020: 14 529 GWh, i.e. 45% of the estimated total electricity production in 2020).

Sources of information: Legislation referred above, Brito, A.G., Brito, A., Chainho, P., Cruz, P., Ferreira, M.T., Godinho, F.N., e Trindade, A. (2009). *Articulação entre a Gestão da Água e a Conservação da Natureza e da Biodiversidade* (articulation between water management and conservation of nature and biodiversity, in portuguese). Série de Publicações do Ministério do Ambiente, do Ordenamento do Território e do Desenvolvimento Regional.

PNAER 2020 (Plano Nacional de Ação para as Energias)

## 7.2 Strategic planning instruments

### 7.2.1 Strategic instruments for new hydropower use and development

#### 7.2.1.1 Instruments

There were previous experiences with strategic planning for hydropower, but not presently. From those experiences the most relevant one was the Programa Nacional de Barragens com Elevado Potencial Hidroelétrico (PNBEPH), National Program for Dams with High Hydroelectric Potential, 2007. Within this program, a Strategic Environmental Assessment (SEA) was made targeting 25 areas with potential to develop new hydropower projects.

Regarding the environmental factors, the SEA focused on several aspects such as: the identification and assessment of the affected water bodies (considering the WFD requirements); the river continuity; the biodiversity and Nature protected areas; the eutrophication risk; the sediment transport and the coastal erosion; the sensitive areas; and the vulnerable zones and protection perimeters. This analysis was carried out not only at the local level of project implementation, but also considering a wider view at the river basin level.

The process allowed ranking the 25 areas in terms of environmental impact and, ultimately, to select the 10 most favorable projects which maximize the (environmental) cost-benefit. From those 10 projects, 8 were later subjected to Environmental Impact Assessment (EIA) processes. One of the projects was rejected during EIA due to its impacts on a previously unknown population of freshwater pearl mussel (*Margaritifera margaritifera*). From the remaining projects, two were recently cancelled by the authorities (Girabolhos, in the Mondego river, and Alvito, in the Ocreza river), another one was delayed pending on a future evaluation (Fridão in the Tâmega river) and only one is presently finishing its construction.

In addition to the PNBEPH, there was an interesting regional experience in the northern river basins where a first tentative was made to identify: i) areas with high natural value and high fluvial connectivity where hydropower plants are scarce (or inexistent); in these areas the construction of new hydropower plants was not allowed (“no go” areas); ii) areas already affected by hydropower that were targeted for river restoration (in the long term these areas would tend to “no go” areas); and iii) areas where the construction of new hydropower plants was allowed. The document with the previous assessment was incorporated in the first generation of the River Basin Management Plan made under the WFD framework, but not in the second generation, which is the one that is currently in force.

Sources of information:

Programa Nacional de Barragens com Elevado Potencial Hidroelétrico/ National Program for Dams with High Hydroelectric Potential (PNBEPH, 2007); EU Hydropower Study: De-

voldere, K., Adriaensens, V., Redeker, M., Dumont, U., Anderer, P., 2011 *Hydropower Generation in the context of the EU WFD*, Report to EC DG Environment, Contract no 070307/2010/574390.

Kampa, E., von der Weppen, J., Dworak, T., 2011, *Water management, Water Framework Directive & Hydropower*, Issue Paper (draft 2) for Common Implementation Strategy Workshop, Brussels, 13-14 September 2011.

Revisão do PNBEPH. Visão integrada da utilização, renaturalização e proteção dos rios (Ministério do Ambiente, 2016). Conservação da natureza e restauro da biodiversidade em articulação com a valorização energética da rede hidrográfica: elementos para a definição da estratégia da ARH do Norte (2010).

### 7.2.1.2 Administrative level and linked planning process

As referred above, presently there are not strategic planning instruments in place.

### 7.2.1.3 Linking with financing instruments and/or regulatory procedures

As referred above, presently there are not strategic planning instruments in place.

## 7.2.2 Strategic planning instruments to restore continuity

### 7.2.2.1 Instruments

The River Basin Management Plans (Planos de Gestão de Região Hidrográfica, Ministers' Council Resolution n.º 52/2016, 20 of September, and the National Water Plan (Plano Nacional da Água, Decree-Law n. 76/2016, 9 of November) presently in force establish the development of a plan for the restoration of river connectivity and of the riparian vegetation and for the revision of the environmental flows (Plano para a reconstituição da continuidade fluvial, restauração da vegetação ripária e revisão do regime de caudais ecológicos). According to the River Basin Management Plans, the program for the restoration of river connectivity, riparian vegetation and revision of environmental flows should be made from 2017 to 2019 and put in force thereafter.

Name	Key objectives
<p><b>Plan for the restoration of river connectivity and of the riparian vegetation and for the revision of the environmental flows (Plano para a reconstituição da continuidade fluvial, restauração da vegetação ripária e revisão do regime de caudais ecológicos)</b></p>	<p>To improve the hydromorphological conditions of water bodies.</p> <p>The preparation of this plan recognises that the alteration of the river regime is one of the major anthropogenic pressures upon rivers. It also states that there are some barriers (dams and weirs) no longer used but that represent barriers for fish. Although the river basin management plans foresee the implementation of this plan at each river basin district, the national water plan recognized that a national plan would allow a more detailed and coordinated analysis of this question, including different authorities (water authorities, nature protection authorities and energy authorities) and operators (e.g. hydropower plant owners). The results of the plan should secure the efficiency of the environmental flows in force accounting for the environmental objectives settled for the water bodies bellow dams and weirs.</p>

### 7.2.2.2 Administrative level and linked planning processes

The Plan for the restoration of river connectivity and of the riparian vegetation is under development. It applies to the national and river basin levels as it should be considered both in the river basin management plans and in the national water plan.

Name	National	RBD	Regional	Federal State	Other

<b>Plan for the restoration of river connectivity and of the riparian vegetation and for the revision of the environmental flows (Plano para a reconstituição da continuidade fluvial, restauração da vegetação ripária e revisão do regime de caudais ecológicos)</b>	Yes	Yes			
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The table below presents the key planning process which the strategic planning instrument is part of.

Planning process	Plan for the restoration of river connectivity
<b>River Basin Management Planning</b>	Yes
<b>National Water Plan</b>	Yes

Source of information: The River Basin Management Plans (Planos de Gestão de Região Hidrográfica, Ministers Council Resolution n.º 52/2016, 20 of September), and the National Water Plan (Plano Nacional da Água, Decree-Law n. 76/2016, 9 of November).

## 7.3 Procedural instruments at the level of hydropower plants

### 7.3.1 Duration of concessions

Typical duration of concessions
In the past there were some expected licensing/concession periods that no longer apply (35 years for the small private hydropower schemes). Nowadays the duration of the licensing/concession periods is case-dependent and can vary according to several factors, including the installed capacity of the hydropower plant (for very large dams it can go up to 75 years). Theoretically it should allow recovering the investment and, therefore, larger hydropower schemes should have larger licensing/concession periods. Regardless the framework of the energy production when based on private small hydropower schemes (ordinary regime or special regime), the licensing/concession contract should specify the duration of the licensing/concession period. Because there were no such contracts issued in the last years (due to the non-existence of legislation regarding the energy selling price system that should be applied) the sector does not know what to expect. According to the hydropower sector, 20 to 25 years should be the lower limit of the licensing/concession period.
Is the permit duration for all hydropower plants the same?
No
If the permit duration varies, which criteria define the duration of a permit? (e.g. size of hydropower plant)
The general practical rule is that the duration of a permit should allow recovering the investment. As a consequence, larger HPP may have permits with longer duration. Duration is for HPP with an installed capacity >50 MW between 50 and 75 years; with an installed capacity 30-50 MW between 35 and 50 years; and with an installed capacity <30 between 15 and 35 years. Complementary, the specific legal framework that applies to the energy productions based on small hydropower schemes establishes that the duration of the licensing/concession should be the one specified in each contract.
Are there differences in the duration of concessions between new and existing HPP?
Yes. For small hydropower schemes until a few years ago the expected duration of the license/concession was and equal to 35 years. Now it depends on several issues and is specified in each license/contract. For large schemes the maximum period is presently 75 years.

Source of information: Decree-law n.º 226-A/2007, 31 of May (Water Resources Utilization Regime/Regime the Utilização dos Recursos Hídricos, updated by the Decrees-Law n.º 391-A/2007, n.º 93/2008, n.º 107/2009, n.º 245/2009 and n.º 82/2010 and by the Law n.º 44/2012). Decree-Law n.º 215-B/2012, 8 of October (Legal Framework of the Activities Developed under National Electric System (SEN)/Regime Jurídico Aplicável às Atividades Integrantes do Sistema Elétrico Nacional (SEN)). Water Law (Law n.º 58/2005, 29 of December and posterior updates Rectification n.º 11-A/2006, Decrees-Law n.º 60/2012 and n.º 130/2012 and Law n.º 42/2016).

### 7.3.2 Authorisation conditions for new hydropower plants

#### 7.3.2.1 Mitigation measures required

The table below presents the mitigation measures related to fish to be implemented to fulfill the conditions for authorizing a new hydropower plant.

Types of mitigation	Requirement based on legislation?	If no relevant legislation, is requirement based on a recommendation?	If no relevant legislation or recommendation, is requirement defined in individual cases?	Is there no requirement at all for this type of mitigation?
<b>Upstream fish migration</b>	Yes		Yes	
	The obligation to maintain connectivity is settled in national legislation (e.g. Freshwater Fisheries Law and regulation). For new projects (or for the alteration of old ones), the Freshwater Fisheries Authority (ICNF) evaluates the need to install fish passes (or other ways of maintaining connectivity for fish). The need and configuration of the fish passes (or other methods/devices) in new projects is assessed on a case-by-case basis during environmental impact evaluation.			
<b>Downstream fish migration</b>			Yes	
	Although there are not specific requirements, the need to consider downstream migration in new projects can be assessed during environmental evaluation on a case-by-case basis (including methods such as catch and carry/trap and truck). However, legislation is unclear concerning this mitigation measure.			
<b>Flow conditions</b>	Yes	Yes		
	The obligation to maintain an environmental flow is settled in the national legislation (e.g. Freshwater Fisheries Law and regulation). There is a hydrologic method used by the water authority to propose an environmental flow during licensing. Operators can propose another environmental flow for each specific case based on other methodologies (e.g. IFIM).			
<b>Hydropeaking</b>			Yes	
	Although there are not specific requirements, the need to consider hydropeaking mitigation measures in new projects can be assessed during environmental evaluation on a case-by-case basis			
<b>Gravel transport (sediment)</b>			Yes	
	Although there are not specific requirements, the need to consider mitigation measures for sediment transport can be assessed during environmental evaluation on a case-by-case basis.			
<b>Habitat en-</b>			Yes	

<b>hancement</b>	Although there are not specific requirements, the need to consider habitat enhancement as a mitigation measure or, more often, as a compensation measure can be assessed during environmental evaluation on a case-by-case basis.			
<b>Fish stocking</b>	Yes			
	Freshwater Fisheries Law which details several aspects related with fish stocking (species allowed, procedures for authorisation. It is recommended that stocking is used only after the fail of other mitigation measures)			

Source of information: Legislation (Freshwater Fisheries Law n.º 7/2008, 15 of February, and posterior updates), EIA from recent HPP projects.

### 7.3.2.2 Link to WFD requirements

Authorisation procedures for new hydropower have been adapted to the requirements of the WFD. During the environmental evaluation (EIA or similar process for smaller HPP) the compliance of the project with WFD objectives is assessed.

Source of information: Water Law that transpose the WFD (Law n.º 58/2005, 29 of December and posterior updates Rectification n.º 11-A/2006, Decrees-Law n.º 60/2012 and n.º 130/2012 and Law n.º 42/2016).

## 7.3.3 Authorisation conditions for existing hydropower plants

### 7.3.3.1 Permit revisions

<b>Time period to upgrade, retrofit or modernize existing hydropower plants</b>
None.
<b>Adaptation of existing concessions to WFD requirements</b>
None.
<b>Conditions when the authorization of an existing HPP is running out</b>
After the end of the licensing/concession period and according to the legislation, the HPP becomes propriety of the State. It could be relicensed to the same or to another operator/owner. The issuing of a new water permit requires the evaluation of the compliance with the WFD objectives and other environmental laws, which could depend upon the implementation of mitigation measures.
<b>Indefinite concessions and permit revisions</b>
There are no indefinite concessions for hydropower.
<b>Turbine upgrades and permit revisions</b>
Theoretically, any change of the layout of a HPP could lead to a revision of the licensing/concession contract.

Source of information: Hidroerg experience.

### 7.3.3.2 Mitigation measures required

There is no option to revise the conditions of existing HPP permits. However, for HPP permits which run out, a new licensing process is initiated with similar requirements to those for a new HPP (see mitigation measures required for new HPP above).

### 7.3.4 Authorisation aspects relevant to new and existing hydropower plants

#### 7.3.4.1 Requirements for monitoring effectiveness

Monitoring is made in new and recent HPP and also in HPP subjected to relicensing, in any case aiming at assessing the effectiveness of the implemented measures. Monitoring targets specifically the ability of the environmental flows to maintain good ecological/potential status downstream dams and weirs. Monitoring includes fish, other biological elements, and hydromorphological and physico-chemical conditions (*sensu* WFD). The efficiency of other mitigation (or compensation) measures, namely fish passes, is determined at the environmental assessment phase (EIA).

Source of information: EIA from HPP projects. Hidroerg experience.

#### 7.3.4.2 Further aspects to be considered when setting mitigation requirements

N/a

#### 7.3.4.3 Regulatory agencies involved in the authorization procedure

Environmental Authority (responsible for the EIA process), Water Authority (responsible for licensing the water use), Freshwater Fisheries Authority (responsible for assessing the need for fish passes or other means of increasing connectivity), Energy Authority, and Directorate General for Energy and Geology (responsible for licensing electricity production). Presently, the Environmental Authority and the Water Authority belong to the same institution, namely the Portuguese Environment Agency (APA)/Agência Portuguesa do Ambiente (APA). The river basin authorities (Administração da Região Hidrográfica –ARH) are also implicated. Other regulatory agencies participate during the EIA process, namely the Directorate General for Cultural Heritage/Direção-Geral do Património Cultural and the Directorate General for Territory/Direção-Geral do Território.

Source of information: Hidroerg experience, Glachant et al. (2015)

## 7.4 Challenges with regards to policy requirements

<b>Uncertainty in the planning, development and operation of HPP linked to the regulatory framework (national, regional)</b>
See Section 7.1
<b>Uncertainty in the planning, development and operation of HPP linked to authorisation procedures</b>
See Section 7.1
<b>Recent changes to the regulatory framework</b>
See Section 7.1. Small HPP (< 10 MW) had feed-in tariffs that ended in 2012. From 2012 a new legal framework was required. However the corresponding legislation was not yet produced. Only projects licensed within the framework prior to the Decree-Law n.º 215-B/2012, 8 of October, had feed-in tariffs. New projects are still waiting for the definition of a new legal framework, namely concerning the energy selling price system or any other financial supporting system.
<b>Foreseeable changes to the regulatory framework</b>
See Section 7.1. The further developments of the present legal framework made mandatory by the Decree-Law n.º 215-B/2012, 8 of October, may or may not enhanced the sec-

tor.

Source of information: Decree-Law n.º 215-B/2012 and Hidroerg experience.

## 7.5 Financing instruments

No instruments have been found.

## 7.6 Challenges with regards to financing instruments

<b>Design or implementation dimensions to be improved</b>
As described, presently there are not financial or other type instruments aiming at boosting the hydro-power sector, independently or cumulatively with the improvement of the status of water bodies. Accordingly, any type of instrument would be desirable.
<b>Recent changes driving developments in the hydropower sector</b>
Yes. As described in section 1.1 the sector is presently on hold because is waiting for new legislation which can enhance or, on the contrary, hinder it.
<b>Foreseeable changes that may drive new developments in the hydropower sector</b>
Yes, see above.

Source of information: Portuguese legal framework and Hidroerg experience.

## 8 Sweden

Largely based on a draft report prepared by the Stockholm Environment Institute (SEI) for the SusWater project (on WFD and hydropower in Sweden) with the involvement of the FIThydro partner SINTEF. Additional information has been provided by Statkraft (partner in the FIThydro project). On the basis of these sources, this policy template has been compiled by Ecologic Institute.

### 8.1 Key national policies

The table below presents the key national legislation relevant to ecological improvements in water ecosystems and which may have repercussions in hydropower production.

Policy area	Name of law	Date
<b>Water protection</b>	Ordinance on Water Quality Management	2004
	Environmental Code	1999
	Water Law	1918
<b>Fisheries</b>	Ordinance concerning EQS for fish and mussels	2001
<b>Energy/renewable energy</b>	Electricity Preparedness Act (Elberedskapslagen)	1997: 288

The Table below presents, for each law, the relevant aspects for environmental improvements in water ecosystems, environmental conditions related to hydropower schemes or the production of hydropower itself.

Name of law	Relevant aspects
<b>Ordinance on Water Quality Management 2004, Environmental Code 1999, Water Law 1918</b>	<p>The WFD was transposed into Swedish law, and specifically the Environmental Code, in 2004 through the Ordinance on Water Quality Management (Ordinance 2004:660).</p> <p>The Environmental Code was adopted as new environmental legislation in 1999. In 1999, the Swedish Parliament also decided on 15 (later 16) national Environmental Quality Objectives. The Environmental Quality Objectives are divided into subcategories, each with different sets of indicators. The most immediately relevant to hydropower impacts is Objective 8, "Flourishing lakes and streams", which has 11 indicators. These are (freely translated): Good ecological and chemical status; unexploited water courses; quality of surface waters; ecosystem services; structures and water flow; preservation and genetic variation; threatened species and restored habitats; invasive species and genome types; genetically modified organisms; preservation of natural and cultural values; and outdoor life. The Swedish Agency for Water and Marine Management (SwAM) is responsible agency overseeing the "Flourishing lakes and streams" objective.</p> <p>Several of the Environmental Quality Objectives are highly relevant for hydropower generation, beyond "Flourishing lakes and streams".</p> <p>The Water Law of 1918 was designed largely to enable rapid development of hydropower generation to meet burgeoning demand and still regulates most of the current hydropower capacity in the country (including on key issues such as water diversion from rivers and reservoir impoundment).</p>
<b>(1997:288) Elberedskapslagen, Electricity Preparedness Act</b>	<p>If owner of a power plant is about to do changes, e.g. mitigations, that will have an impact on the ability to produce energy the owner must give notice to TSO (Svenska Kraftnät). This applies on HEP's with significant importance.</p>

<b>Ordinance concerning EQS for fish and mussels</b>	No specific provisions which relate to environmental improvements for fish in HP schemes
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### 8.1.1 Targets set under the Renewable Energy Directive

The NREAP projects that Sweden will increase its renewable energy proportion from 39.7% in 2005 to 50.2% in 2020. Hydroelectricity’s contribution to Sweden’s electricity supply is expected to decrease; there are no plans to increase hydroelectric generation capacity (large hydro capacity would be the only source of change, with a small increase from 15,397 MW to 15,412 MW). In the projection in the NREAP, hydroelectric production is expected to decrease largely because 2005, the base year for the projection, was a wet year that resulted in an unusually high level of hydropower production in Sweden. As there has only been a projection to 2020, with intervening years interpolated, the results demonstrate a consistent reduction in production, which will likely not be borne out in reality.

Sources of information: Draft SEI report 2017, pers.comm Statkraft, [http://gef.eu/wp-content/uploads/2017/01/GEF-10-06\\_NREAP\\_EN\\_web\\_final.pdf](http://gef.eu/wp-content/uploads/2017/01/GEF-10-06_NREAP_EN_web_final.pdf)

## 8.2 Strategic planning instruments

### 8.2.1 Strategic instruments for new hydropower use and development

The national strategy for hydropower is currently under development in Sweden.

Name	Key objectives
<b>National strategy for hydropower (SEA &amp; SwAM)</b>	Balanced approach between WFD and EU energy directives  Provide a framework for prioritization in regulating Swedish river basins, based on a system designed to determine the respective energy and environmental values of major Swedish river basins

In 2014, the Swedish Energy Agency (SEA) and the Swedish Agency for Marine and Water Management (SwAM) published a proposed national strategy for hydropower that aims for a balanced approach between the WFD (and Environmental Quality Objective 8) and the EU energy directives. The relevant report is called “Strategy for Measures in the Area of Hydropower: Balancing Energy Targets and the Environmental Quality Objective “Flourishing Lakes and Streams” (SEA and SwAM 2014).

The proposed national strategy aims to provide a framework for prioritization in regulating Swedish river basins, based on a system designed to determine the respective energy and environmental values of major Swedish river basins. It assesses the value of each major river basin in Sweden with hydropower installations, based on national environmental and energy targets and assigned water quality indicators applicable in all relevant river basins. This exercise provides a foundation for evaluating what environmental measures can be implemented locally in the river basins to balance energy and environmental targets.

Perhaps the most important outcome of the work is the definition of significant adverse effect on power production. The report proposes a threshold of 2.3% or 1.5 TWh loss of annual national hydropower power production due to measures taken to improve water quality.

The calculations underlying the suggested 1.5 TWh limit simulated power production losses from different typical environmental measures (such as minimum flows and fish ways) given specific conditions, to come up with different scenarios of power loss. The cap also implies that strategic thinking is needed when implementing environmental intervention measures, that river basins of less importance to the energy system should be prioritized

for environmental measures, and that measures employed should have as little impact on hydropower generation as possible.

The identification of a threshold of 1.5 TWh total generation capacity loss is a major accomplishment, given the complexity of such a process. Though there are still question marks over the methodology, and the figure remains somewhat controversial, it appears to have been broadly accepted (and thus, arguably, legitimized) in the multistakeholder dialogue process managed by SwAM. Clarification of the methodology and rational behind the figure would be a welcome and necessary step.

Source of information: Draft SEI report 2017

### 8.2.1.1 Administrative level and linked planning processes

The national strategy for hydropower is currently under development in Sweden.

### 8.2.1.2 Linking with financing instruments and/or regulatory procedures

The national strategy for hydropower is currently under development in Sweden.

## 8.2.2 Strategic planning instruments to restore continuity

No planning instruments in place to restore continuity.

## 8.3 Procedural instruments at the level of hydropower plants

### 8.3.1 Duration of concessions

Typical duration of concessions
<p>Unlimited time duration.</p> <p>About 90% of hydropower concessions active today in Sweden were granted long before modern environmental legislation with implications for hydropower generation was enacted (Rudberg 2013). The Water Law of 1918, which was designed largely to enable rapid development of hydropower generation to meet burgeoning demand, regulates most of the current hydropower capacity in the country (including on key issues such as water diversion from rivers and reservoir impoundment).</p> <p>Permits granted prior to the introduction of the Environmental Code in 1999 are essentially open-ended and have legal force for all parties (Rudberg 2013). As a consequence, many measures incorporated in modern hydropower practice designed to promote ecological sustainability – such as fauna passages and minimum flow rates – are not common among the active concessions. As a result, there were significant refurbishment needs in the following decade.</p> <p>The Water Activity Review of 2014, which was a governmental inquiry on new and changed legal frameworks for water activities running from 2012 to 2014, recommended that all hydropower plants (including old ones) acquire permits in accordance with the Environmental Code. Another key recommendation was that hydropower concessions should be time-limited rather than practically open-ended, as is currently the case.</p>
Is the permit duration for all hydropower plants the same?
No
If the permit duration varies, which criteria define the duration of a permit? (e.g. size of hydropower plant)
Are there differences in the duration of concessions between new and existing HPP?
No

Sources of information: CIS questionnaire on WFD and hydropower (2011), Draft SEI report 2017.

### 8.3.2 Authorisation conditions for new hydropower plants

#### 8.3.2.1 Mitigation measures required <sup>13 14 15</sup>

The table below presents the mitigation measures related to fish to be implemented to fulfill the conditions for authorizing a new hydropower plant.

Types of mitigation	Requirement based on legislation?	If no relevant legislation, is requirement based on a recommendation?	If no relevant legislation or recommendation, is requirement defined in individual cases?	Is there no requirement at all for this type of mitigation?
<b>Upstream fish migration</b>				Yes
	The Water Activity Review of 2014 recommended that all hydropower plants (including old ones) acquire permits in accordance with the Environmental Code. The suggestions also imply compulsory use of fish ways, which currently only exist in about 10% of Swedish hydropower plants.			
<b>Downstream fish migration</b>				Yes
<b>Flow conditions</b>			Yes	
	Minimum flow requirements are set case by case during permit procedure in the Environmental Court. New plants have rarely minimum flow above 5 % of average flow which commonly is less than average minimum flow. In some cases, specific minimum flow requirements are set during fish migration periods.			
	In practice, there are different views of what minimum requirements should be and there have been several cases where Land and Environmental Courts have been asked to rule. In general, the courts have seemingly argued for the maintenance of at least mean low flow (MLQ), though urging that minimum flow be kept as high as possible.			
Relevant rulings highlight that measures necessary for the movement of fish should be established without any reimbursement to the operator of related costs – except when the cost is disproportionately large compared to the expected environmental gain, in which case the operator can be freed from the specific responsibility. However, there are also cases where MLQ has not been assessed as a requirement due to limited impacts on the environment.				
The Water Activity Review of 2014 recommended that all hydropower plants (including old ones) acquire permits in accordance with the Environmental Code. This recommendation has often been interpreted as a demand for minimum flows of water in river systems and an attempt to reduce drastic variations of high and low water levels in water storage reservoirs.				
<b>Hydropeaking</b>			Yes	Yes

<sup>13</sup> Jensen 2012

<sup>14</sup> Draft SEI report 2017

<sup>15</sup> CIS questionnaire on WFD and hydropower (2011)

	n/a			
<b>Gravel transport (sediment)</b>				Yes
<b>Habitat enhancement</b>				
<b>Fish stocking</b>	n/a			
	n/a			

Sources of information:

Jensen, J. (2012). Plan för miljöbättre vattenkraft föreslås (Plan proposed for environmentally sound hydropower). <http://miljo-utveckling.se/plan-formiljobattre-vattenkraft-foreslas/>.(cited in draft SEI report, 2017)

Draft SEI report 2017, CIS questionnaire on WFD and hydropower (2011)

### 8.3.2.2 Link to WFD requirements

Authorisation procedures for new hydropower have not been adapted to the requirements of the WFD. The Water Activity Review came in response to EU criticism of a perceived lack of Swedish commitment regarding aspects of implementing the WFD. The Water Activity Review recommendations are under review by the Ministry for the Environment and Energy and a proposition for new legislation is expected during 2017 (Älvräddarna 2017).

Source of information: Älvräddarna (2017). Nu är det dags för ny lag! (Time for a new law!). 18 April. <http://www.alvraddarna.se/aktuellt/nu-ar-det-dags-for-ny-lag/> (cited in draft SEI report 2017.)

### 8.3.3 Authorisation conditions for existing hydropower plants

#### 8.3.3.1 Permit revision

##### Time period to upgrade, retrofit or modernize existing hydropower plants

There is no time period set. However, if changes to existing permits are made, they depend on the limit for economical feasibility of the plant which is judged case by case. If mitigation measures require more water than 20 % of the production value for plants built after 1983 (very few plants), the State has to compensate the plant owner. Older plants (the majority) the same limit is set to 5 %. The praxis is however normally below 5%.

##### Adaptation of existing concessions to WFD requirements

In 2015, SEA and SwAM published a new document that suggests how review processes for hydropower operating licenses can be harmonized with modern environmental requirements (SEA and SwAM, 2015), A Proposal for Review of Hydropower Generation). The suggested timeframe for when all Swedish hydropower should be brought up to modern environmental standards, in line with EU standards and with regular check-ups at the end of each six-year cycle of WFD implementation, is 20 years. In many regards, the proposal addresses many of the elements deliberated in the Water Activity Review, but makes some different recommendations.

The document proposes that individual reviews should be carried out that reflect the specific water-using activity (e.g. hydropower plant) and local conditions. It also recommends that although existing permits can be subject to complete reassessment, it would be most efficient only to review their conditions, not the permit as a whole. However, specific conditions must be added – if they do not already exist –that would allow for the hydropower plant to be decommissioned if found necessary. It also rec-

<p>ommends that the scope of the review should not be determined solely by the applicant (i.e. power plant operator), but that the supervisory authority, or at least some other relevant stakeholder, should be able to influence it.</p> <p>In contrast to the Water Activity Review, however – which recommended that reviews should generally lead to termination of existing permits and the award (or denial) of a new permit – the SwAM-SEA proposal recommends that it should be possible for new environmental requirements to be added to existing permits, except in areas covered by a new review, where they would be superseded or complemented by new permits.</p>
<p><b>Conditions when the authorization of an existing HPP is running out</b></p>
<p>Not applicable</p>
<p><b>Indefinite concessions and permit revisions</b></p>
<p>Both the operator and a public authority (county government; “the legal, financial and administrative service agency”) can initiate permit revisions through a concession modification hearing. When this happens, a process in the court is initiated, which is managed by lawyers. Permit revisions can end with concessions being reviewed or denied depending on whether there is any damage occurring and if all EU obligations are being met.</p>
<p><b>Turbine upgrades and permit revisions</b></p>
<p>Yes, permits can be revised in the case of turbine upgrades.</p>

Source of information: CIS questionnaire on WFD and hydropower (2011), pers.comm Statkraft

### 8.3.3.2 Mitigation measures required

The table below presents the mitigation measures related to fish required when revising the conditions of existing hydropower plants permits.

Types of mitigation	Requirement based on legislation?	If no relevant legislation, is requirement based on a recommendation (e.g. guideline, technical standard)?	If no relevant legislation or recommendation, is requirement defined in individual cases?	Is there no requirement at all for this type of mitigation?
Upstream fish migration				Yes
Downstream fish migration				Yes
Flow conditions			Yes	
	In older permits from 1900 to 1930 some plants have minimum flow requirement equal to average minimum flow.			
Hydropeaking			Yes	Yes
	Some plants have a downstream plant to reduce the water level effects from hydropeaking.			
Gravel transport				Yes

<b>(sediment)</b>				
<b>Habitat enhancement</b>				
	n/a			
<b>Fish stocking</b>				
	n/a			

Source of information: CIS questionnaire on WFD and hydropower (2011)

### 8.3.4 Authorisation aspects relevant to new and existing hydropower plants

#### 8.3.4.1 Requirements for monitoring effectiveness

If installation of fishway we have to monitor the effect. In Anundsjö we do this with a Vaki fish teller. Also in other types of actions we have to monitor different kinds of parameters due to “ordinance of self-control”

Source of information: pers.comm Statkraft

#### 8.3.4.2 Further aspects to be considered when setting mitigation requirements

If changes to existing permits are made, they depend on the limit for economical feasibility of the plant which is judged case by case.

Source of information: CIS questionnaire on WFD and hydropower (2011)

#### 8.3.4.3 Regulatory agencies involved in the authorization procedure

Mostly county government and often with the role of supervision

## 8.4 Challenges with regards to policy requirements

### Uncertainty in the planning, development and operation of HPP linked to the regulatory framework (national, regional)

The judicial system could help to shape the updated rules for hydropower generation in Sweden. How the courts interpret the Environmental Code and the WFD for licensing purposes and internalize new knowledge is fundamental to what changes will eventually be implemented at the national level.

### Uncertainty in the planning, development and operation of HPP linked to authorisation procedures

In December 2015 SEA and SwAM built further on the 2014 proposed strategy for hydropower, addressing some outstanding issues in a new document that suggests how review processes for hydropower operating licences can be harmonized with modern environmental requirements (SEA and SwAM 2015). The document also provides suggestions for how this revised process can be financed. The suggested timeframe for when all Swedish hydropower should be brought up to modern environmental standards, in line with EU standards and with regular check-ups at the end of each six-year cycle of WFD implementation, is 20 years. In many regards, the proposal addresses many of the elements deliberated in the WAR, but makes some different recommendations.

The document proposes that individual reviews should be carried out that reflect the specific water-using activity (e.g. hydropower plant) and local conditions. It also recommends that although existing permits can be subject to complete reassessment, it would be most efficient only to review their conditions, not the permit as a whole.<sup>9</sup> However, specific conditions must be added – if they do not already exist – that would allow for the hydropower plant to be decommissioned if found necessary. It also recommends that the scope of the review should not be determined solely by the applicant (i.e. power plant operator), but that the supervisory authority, or at least some other relevant stakeholder, should be able

<p>to influence it.</p> <p>In contrast to the WAR, however – which recommended that reviews should generally lead to termination of existing permits and the award (or denial) of a new permit – the SwAM-SEA proposal recommends that it should be possible for new environmental requirements to be added to existing permits, except in areas covered by a new review, where they would be superseded or complemented by new permits.</p>
<p><b>Recent changes to the regulatory framework</b></p> <ul style="list-style-type: none"> <li>• 1999. Environmental Code</li> <li>• 2013. SwaM was assigned by the government to start dialogue between industry, authorities and NGO's</li> <li>• 2014. A new national strategy for hydropower was presented, where energy and environment in rivers are related to each other</li> <li>• 2016. A report on the importance of regulation of water was presented, where each hydropower plant is given a quantitative number of the importance to the net (the ability to be managed according to the electric consumption momentarily). The most important ones should be protected to some extent.</li> </ul>
<p><b>Foreseeable changes to the regulatory framework</b></p> <p>The Water Activity Review (2014) recommendations are under review by the Ministry for the Environment and Energy and a proposition for new legislation is expected during 2017 (Älvräddarna 2017).</p> <p>A suggestion on new legislation will probably be proposed by Swedish government this autumn.</p>

Source of information: Draft SEI report 2017, pers.comm Statkraft

## 8.5 Financing instruments

The following financing instruments promoting *at the same time* hydropower generation and improvement in water status are implemented:

- Green power labels
- Support schemes for modernization of existing plants

### 8.5.1 Green power labels

<p><b>Name of instrument</b></p> <p>NGO Ecolabelling (Bra Miljoval) with Minimum flow requirement Good Environmental Choice Ecolabelling by the Swedish Society for Nature Conservation</p>
<p><b>Type of hydropower targeted</b></p> <p>Only electricity from hydropower plants built before 1 January 1996 can be approved for licensing for electricity labelled with Good Environmental Choice.</p>
<p><b>Criteria for ecological improvement</b></p> <p>NGO Ecolabelling (Bra Miljoval): Minimum flow requirement. Good Environmental Choice Ecolabelling: Criteria for hydropower include: The total tapping through a turbine and outside the turbine should be at least as large as the water flow's average low discharge or, if the permit's permanent dam or lowering limits are limited, calculated to at least inflow minus evaporation. Average low discharge is calculated as an average of the lowest low water flow every year during a period of at least ten years.</p>

Minimal tapping should in the first place be released into the mainstream and secondly into the stream that provides the greatest benefit to the environment. Minimal tapping should in the first place be released outside the turbine but in cases where this does not provide a positive net effect on the environment or where it is technically not possible, minimal tapping can be released through the turbine.

#### Source of funding

Good Environmental Choice Ecolabelling: The hydropower included in the electricity labelled with Good Environmental Choice should complete a yearly provision to an environmental fund equivalent to 1500 SEK/GWh hydropower in the electricity sold as being environmentally labelled. The environmental fund provision can be used in projects undertaken by the licensee's own operations or placed in SSNC's central environmental fund. All projects financed by the environmental fund should be approved by Swedish Society for Nature Conservation.

General demands for projects that can be financed by the environmental fund include that:

- The measures should have the aim of minimising hydropower's potential for damage
- The measures must not be required by legislation or current permits
- The project owner must be able to demonstrate the environmental benefit of the measure

#### Source of information

CIS questionnaire on WFD and hydropower (2011); Electricity Criteria 2009:4 ([https://www.naturskyddsforeningen.se/sites/default/files/dokument-media/Electricity\\_Criteria\\_2009-4\\_1.pdf](https://www.naturskyddsforeningen.se/sites/default/files/dokument-media/Electricity_Criteria_2009-4_1.pdf))

## 8.5.2 Support schemes for modernization of existing plants

#### Name of instrument

Vattenkraftens Miljöfond (Environmental Fund for Hydropower)

#### Type of hydropower targeted

Vattenkraftens Miljöfond is available for all water operations that are conducted adjacent to the generation of hydro power electricity, or which had the aim of such generation when they commenced. Such operations will receive compensation for both review costs and those costs for environmental improvement measures (including any demolition costs) and loss of generation costs that are required to achieve modern environmental conditions according to the national review plan that is proposed to be included in the Swedish legal system.

This seems to be mainly relevant to existing permits.

#### Criteria for ecological improvement

Decisions on financing for operators will be made on the basis of objective criteria that are set in advance and reconciled with certain conditions set in advance.

Establishing modern environmental conditions in Swedish hydro power will require about 1,800 projects to be implemented over a period of 20 years.

#### Source of funding

The work of setting up a financing function under the name of Vattenkraftens Miljöfond is currently in progress between representatives for the major hydro power companies, referred to below as the Financiers. The idea is that all operators shall be able to receive compensation for costs for environmental measures with the aim of achieving modern environmental conditions in hydro power in accordance with a national legally binding review plan, prioritising environmental measures in rivers where the benefits are substantially higher than the benefits of hydro power generation and vice versa prioritising hydro power production in rivers where the hydro power production is of big importance for the society. A cap for a maximum im-

impact on hydro power production is needed in the plan.

Vattenkraftens Miljöfond's establishment is based on meeting certain prerequisites, among which are:

- A national review plan for the implementation of environmental measures that balance the environmental interest and the energy interest against each other at a national level is incorporated in the legal system. The aim of the plan is for the update to modern environmental conditions to deliver the greatest possible benefit for the aquatic environment and the minimum possible negative impact in relation to effective national access to hydroelectric power. It has been presupposed that it is possible to limit the total impact on Swedish hydro power generation to a maximum of 2.3 per cent of a normal year's generation or 1.5 terawatt hours. This is in accordance with the National Strategy presented by the Swedish Energy Agency and the Swedish Agency for Marine and Water Management in June 2014.
- The update to modern environmental conditions for hydro power is assumed to take place through rational and effective reviews of the conditions in the existing permits of hydropower electricity operations.
- To achieve a good level of effectiveness, the operators shall themselves be responsible for a proportion of the financing. An operator shall thus be responsible for a) 15 per cent of the costs for environmental measures including the court trial process and b) loss of generation up to 5 percent of normal annual generation.

A project to prepare for the setting up of Vattenkraftens Miljöfond AB has been underway since March 2017 with the ambition to be operational in the first half of 2018. The definitive decision on the setting up of the fund will be taken after the Swedish Parliament has decided on the new regulations, which might be in November 2017.

#### Source of information

Article Vattenkraftens Miljöfond (Environmental Fund for Hydro Power) - Industry-wide financing to achieve modern environmental conditions in Swedish hydropower, Version 14 June 2017 (unpublished).

## 8.6 Challenges with regards to financing instruments

<b>Design or implementation dimensions to be improved</b>
N/a
<b>Recent changes driving developments in the hydropower sector</b>
N/a
<b>Foreseeable changes that may drive new developments in the hydropower sector</b>
See information above on the instrument under preparation (Vattenkraftens Miljöfond (Environmental Fund for Hydropower)). This financing tool will play a key role in the development of mitigation measures in the hydropower sector.