Water management, Water Framework Directive & Hydropower

Common Implementation Strategy Workshop

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List of Abbreviations

AT	Austria
BAT	Best available technology
BE	Belgium
BEP	Best environmental practice
BG	Bulgaria
CH	Switzerland
CIS	Common implementation strategy
CZ	Czech Republic
DE	Germany
EFTA	European free trade association
ES	Spain

FI	Finland
FR	France
GEP	Good ecological potential
GES	Good ecological status
HMWB	Heavily modified water body
HP	Hydropower
HPP	Hydropower plant
HU	Hungary
IS	Iceland
IT	Italy
MNQ	Annual Mean Low Flow
MQ	Annual Mean Flow
MS	Member state
LT	Lithuania
LU	Luxembourg
LV	Latvia
NL	The Netherlands
NO	Norway
NREAP	National renewable energy action plan
PL	Poland
PT	Portugal
RBMP	River basin management plan
RES	Renewable energy directive
RO	Romania
SE	Sweden
SEPA	Scottish environmental protection agency
SI	Slovenia
SK	Slovakia
SRCAE	Regional scheme for climate, air and energy
UK	United Kingdom
WB	Water bodies
WFD	Water Framework Directive

1 Introduction

1.1 Background

The Water Directors have agreed to continue the Common Implementation Strategy (CIS) activity on the “Water Framework Directive and hydromorphological pressures” as ad hoc activity „Hydromorphology“. The continued activity (Phase 2010-12) focuses on the exchange of information, experiences and examples via workshops. In this context, the Water Directors decided at their meeting in Spa (2-3 December 2010) to carry out a 2nd workshop on Water Framework Directive (WFD) and hydropower, taking place on 13-14 September 2011 in Brussels. This workshop entitled “Water Management, WFD and Hydropower” is organised by Germany, UK and the European Commission together with a CIS organising committee of interested European States (AT, NO, CH, ES, FI, PT, LU, FR).

Recalling earlier CIS principles and recommendations

The 1st workshop on WFD & Hydropower organised in the context of the CIS process (4-5 June 2007, Berlin) was the first occasion, where broad and intensive discussions took place on the European level between hydropower stakeholders and those responsible for the implementation of the WFD on the national level. The focus of the 1st workshop was on hydropower use and the relationship to hydromorphological changes, aiming at reaching common understanding on:

- Instruments to promote hydropower use and to improve water status/potential.
- Technical approaches for good practice in hydropower use.
- Strategies and priorities for the improvement of hydromorphological conditions in catchments used for hydropower generation.

In 2009, a workshop on Heavily Modified Water Bodies (HMWB) took place (12-13 March 2009, Brussels), which also delivered several recommendations relevant to hydropower and the WFD, such as on the interpretation of “significant adverse effects on the use”, good ecological potential and ecological continuum.

In 2010, the Water Directors endorsed a Statement on “Hydropower Development under the Water Framework Directive” summarising key principles and recommendations, which have been previously agreed in the CIS process (WD meeting, Segovia, 27-28 May 2010).[1] This Statement was mainly based on elements of the CIS Policy Paper on WFD and Hydro-morphological pressures[2], the CIS Guidance Document No. 20 on Exemptions to the

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[1] Final Synthesis of Informal meeting of Water and Marine Directors of the European Union, Candidate and EFTA Countries, Segovia, 27-28 May 2010.

[2] Common Implementation Strategy for the Water Framework Directive 2006: WFD and Hydro-morphological pressures - Policy Paper. Version 8.0. 3 November 2006.

Environmental Objectives[3] and the Conclusions of the 1st CIS Workshop on WFD and Hydropower[4].

The following box summarises key conclusions of the 1st WFD & Hydropower workshop (for the full set of conclusions, please refer to the Workshop Conclusions document)[5] as well as key recommendations from the Water Directors Statement, which should be followed in order to achieve hydropower development and ensure meeting the environmental objectives of the WFD. The key conclusions of the 2009 workshop on Heavily Modified Water Bodies (HMWB)[6] are available in Annex IV to this paper.

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[3] Common Implementation Strategy for the Water Framework Directive 2009: Guidance Document No. 20 on exemptions to the environmental objectives. Technical Report - 2009 – 027

[4] Key Conclusions, Common Implementation Strategy Workshop on WFD & Hydropower, Berlin, 4-5 June 2007. Available online: http://www.ecologic-events.de/hydropower/documents/key_conclusions.pdf.

[5] Ibid.

[6] Key Conclusions, Common Implementation Strategy Workshop on WFD & HMWB, Brussels, 12-13 March 2009. Available online: http://circa.europa.eu/Public/irc/env/wfd/library?l=/framework_directive/implementation_conventio/modified_brussels_12-13/conclusions_2009pdf/_EN_1.0_&a=d.

Box 1. Earlier CIS principles and recommendations on WFD & Hydropower

Summary of Key Conclusions of 2007 Workshop on WFD & Hydropower

General remarks

- It is important to ensure that existing and forthcoming EU policies to promote hydropower ensure coherence with the Water Framework Directive/other EU environmental legislation and clearly consider the ecological impacts on the affected water bodies and the adjacent wetlands.
- The discussion has shown that more holistic approaches for hydropower use are needed. The focus should be on catchment level and not only site-specific or on water body level.
- During WFD implementation, an environmental assessment based on WFD criteria is required for all water bodies including those with hydropower plants. This assessment includes other environmental criteria and a socio-economic assessment. In addition, in the River Basin Management Plans, all water uses have to be taken into account.

Instruments to promote hydropower & to improve water status

- National and European instruments (such as tradable certificates, feed-in tariffs, support schemes for renewables or ecolabelling) to support and promote hydropower development should be linked to ecological criteria for the protection of water status
- There should be a clear insight into all costs & benefits of hydropower. This insight will help sustainable decision-making on hydropower projects and implementing the polluter pays principle.
- Pre-planning mechanisms can facilitate the (proper location) identification of suitable areas for new hydropower projects. The use of such preplanning systems could assist the authorisation process to be reduced and implemented faster, provided that the criteria of WFD Art. 4.7 are met. At least 3 categories of areas could be distinguished for pre-planning: suitable, less favourable and non-favourable areas.
- Small and large hydropower should be treated equally with regard to promotion. Promotion should be based on basin-specific as well as site-specific WFD criteria and global environmental criteria (climate change) and not on the size of the hydropower plant per se.

Technical approaches for good practice in hydropower use

- For upstream migration, many solutions are available (e.g. fish passes and fish ladders, but also fish lifts, fish stocking, catch & carry programmes etc.) to mitigate the negative impact of migration barriers – but more work needs to be done on evaluation and monitoring of effectiveness. Much research leading to technical innovations has still to be undertaken, especially related to downstream migration in combination with turbine damage.
- Approaches to determine ecologically acceptable flow have been developed and are being further developed by several European countries. There is no one-size-fits-all approach - a combination with other mitigation measures is often necessary. The use of compensating measures together with mitigating measures is highly recommended.
- Some studies identify serious ecological consequences of hydro-peaking, but there are still knowledge gaps. Mitigation options are limited and often involve high costs

due to the loss of peak-load capacity and their designated function. However, examples for the successful implementation of mitigation measures also exist (like coordination between plants).

- 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).

Strategies & priorities on catchment level

- New hydropower projects are compatible with the WFD as long as they comply with the Art. 4.7 test.
- Prioritisation of measures, catchment areas and rivers is compatible with the WFD but the Member States should deliver a proportionate programme of measures.
- Ecological criteria for prioritising action in regions affected by hydropower should be considered on different scales (European – species and habitat issues of ecological importance; catchment & regional – longitutinal continuity; WBs/groups of WBs – also lateral connectivity, geographical scale of impact and severity and trend identification (to prevent deterioration)).
- We should aim at achieving self-sustained populations of migrating fish where possible/ needed at the catchment level (delivering interconnectivity).
- We should use socio-economic analysis to define a cost-effective programme of measures. This work should ideally be undertaken at a catchment or sub-catchment level, so as to maximise the ecological potential and the energy production.

<u>Key recommendations from 2010 Water Directors Statement</u>

- Pre-planning mechanisms allocating “no-go” areas for new hydro-power projects should be developed. This designation should be based on a dialogue between the different competent authorities, stakeholders and NGOs.
- In order to minimize the need for new sites, the development of hydropower capacities could be supported by the modernisation and the upgrading of existing infrastructures.
- The development of hydropower should be accompanied by an improvement of water ecology, through clear ecological standards for new facilities, or for existing facilities through their modernisation as well as the improvement of operation conditions. New hydropower plants should for example all have fish passages and they should respect a minimum ecological flow.
- An analysis of costs and benefits of the project is necessary to enable a judgement on whether the benefits to the environment and to society preventing deterioration of status or restoring a water body to good status are outweighed by the benefits of the new modifications. This does not mean that it will be necessary to monetise or even quantify all costs and benefits to make such judgement.
- The size of the project is not the relevant criteria to trigger Article 4.7. The relevant approach is to assess if a given project will result in deterioration of the status of a water body. Thus, projects of any size may fall under article 4.7.

Sources: Key Conclusions, Common Implementation Strategy Workshop on WFD & Hydropower, Berlin, 4-5 June 2007; Final Synthesis of Informal meeting of Water and Marine Directors of the European Union, Candidate and EFTA Countries, Segovia, 27-28 May 2010.

1.2 Aims of the workshop

The 2nd CIS workshop on Water Management, WFD & Hydropower aims at bringing the discussions initiated at the 1st workshop on WFD & Hydropower one step further. Since the 1st workshop, the Renewable Energy Directive (RES) has been adopted, setting ambitious targets for the share of energy from renewable sources for all Member States and requiring the submission of national renewable energy action plans by mid-2010. In the same time, the 1st River Basin Management Plans (RBMPs) according to the WFD have been published in most Member States, including measures to improve water body status/potential also in hydropower-affected catchments. However, an earlier screening of the draft RBMPs indicated absence of clear and explicit references to the use of WFD Article 4.7[7], whose requirements have to be taken into account in the case of new hydropower projects.

In this context, the 2nd workshop on Water Management, WFD & Hydropower is practice and measures-oriented. It should be used as a forum to exchange information, experiences gained in the meantime and case studies on:

1. Options and tools of European States in order to implement measures for the improvement and achievement of good ecological status (GES) or potential (GEP):
   a) Legal tools and legal requirements
   b) Technical standards and requirements
   c) Incentives
2. Strategic planning tools on the catchment scale for the designation of "appropriate", "less appropriate" and "not appropriate" areas for new hydropower plants, in order to balance the requirements of the WFD and the Renewable Energy Directive (RES).
3. Approaches for the implementation of WFD Article 4.7.

The workshop also serves as a forum to identify key knowledge gaps and issues for further discussion and common activities in the CIS process.

1.3 Aims of the issue paper

The workshop is intended to be a working meeting and will require the active participation of delegates. The purpose of this issue paper is to stimulate discussions by providing up-to-date information on hydropower and WFD implementation in the European States. The paper also aims at identifying issues which should be discussed, by proposing some key topics to be addressed at the workshop. It also presents the key conclusions & recommendations drawn on the basis of the workshop discussions.

<u>Section 2</u> of the issue paper introduces the issue of balancing the requirements of the WFD and the Renewable Energy Directive (RES).

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7 Kampa, E.; Dworak, T.; Grandmougin, B.; Cheung-Ah-Seung, E.; Mattheiß, V.; Strosser P.; Campling P. (2009): Active Involvement in River Basin Management – Plunge into the debate. Conference document to the 2nd EU Water Conference 2-3 April 2009, Brussels

Sections 3 - 8 are based on the replies of European States to the EU questionnaire on Hydropower and WFD, which European States were invited to fill in prior to the workshop. Thus, sections 3 - 8 summarise key information on the following topics: key figures on hydropower, hydropower and heavily modified water bodies, legal and technical requirements for environmental improvement, incentives which promote hydropower use and water status improvement, strategic planning tools and implementation of WFD Art. 4.7.

In total, 24 European States returned the Hydropower & WFD questionnaire: AT, BE (Wallonia), BG, CH, CZ, DE, ES, FI, FR, HU, IS, IT, LT, LU, LV, NL, NO, PL, PT, RO, SE, SI, SK and the UK. All questionnaires are available online at: http://www.ecologic-events.de/hydropower2/background.htm.

The 2011 EC study on Hydropower Generation in the context of the EU WFD[8] also provides further relevant information on some of the topics listed above.

Section 9 of the paper proposes topics for discussion in the parallel working groups at the workshop.

Section 10 presents the key conclusions & recommendations of the workshop.

The issue paper including the key workshop conclusions & recommendations has been revised after the workshop taking into account comments submitted by the participants.

The workshop presentations are available at the workshop website:

http://www.ecologic-events.de/hydropower2/presentations.htm

[8] Available online: http://circa.europa.eu/Public/irc/env/wfd/library?l=/framework_directive/implementation_conventio/hydropower_september/11418_110516pdf/_EN_1.0_&a=d

2 Balancing WFD & RES requirements

The WFD’s main aim is to prevent deterioration of the status of the water bodies and to achieve good ecological status /good ecological potential of all EU waters, including surface and groundwater, by 2015 (2027 at the latest) through coordinated action. Besides, the Birds and Habitats Directives and the new EU Biodiversity Strategy require European Member States to halt and reverse the loss of biodiversity until 2020. In 2005, the risk assessment carried out for the WFD showed that hydromorphological pressures and impacts are one of the most important risks that need to be addressed in order to achieve WFD objectives.[9] In the 1st implementation report of the WFD, hydropower has been identified as one of the main drivers to hydro-morphological alterations, loss of connectivity and to significant adverse effects on the ability of survival of fish populations.[10] Recent data from all EU Member States on the designation of heavily modified water bodies (HMWB) showed that water storage for hydropower generation is the third most common water use for designating HMWB (following water regulation and flood protection).[11]

The water ecosystem degradation and loss of biodiversity due to hydromorphological pressures from hydropower will continue in the future if infrastructure developments are implemented without taking full account of the requirements of the WFD. It is the environmental NGO view that all new large scale hydropower development represents a significant ecological deterioration of the river ecosystem, as most of the effects cannot be eliminated or mitigated, even when full compliance with the WFD and the Birds and Habitats Directives is ensured. The global assessment of Vörösmarty[12] shows that Europe (except northern Scandinavia) is already in the red zone of global river biodiversity threat. Europe has lost most of its river biodiversity; therefore all possible steps should be taken to maintain the remaining biodiversity. Efforts to restore ecological damage by past hydropower development have to be enhanced, as well. It remains to be seen to what extent the measures included in the first River Basin Management Plans will contribute to the achievement of the WFD objectives by 2015 also in hydropower-affected catchments.

Member States should avoid taking action that could further jeopardize the achievement of the objectives of the WFD, notably the general objective of good ecological status or potential of water bodies. The further use and development of hydropower should consider

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[9] Common Implementation Strategy for the Water Framework Directive 2006: WFD and Hydromorphological pressures - Policy Paper. Version 8.0. 3 November 2006.

[10] COM(2007) 128 final. Commission Staff Working Document accompanying to the Communication from the EC to the European Parliament and the Council. 'Towards Sustainable Water Management in the European Union'. First stage in the implementation of the Water Framework Directive 2000/60/EC.

[11] Kampa, E. & C. Laaser (2009). Updated Discussion Paper. Common Implementation Strategy Workshop Heavily Modified Water Bodies. Brussels, 12-13 March 2009. Available: http://www.ecologic-events.de/hmwb/documents/Discussion_Paper_Updated.pdf.

[12] C. J. Vörösmarty, P. B. McIntyre, M. O. Gessner, D. Dudgeon, A. Prusevich, P. Green, S. Glidden, S. E. Bunn, C. A. Sullivan, C. Reidy Liermann & P. M. Davies. 2010. Global threats to human water security and river biodiversity. Nature 467: 555-561. (30 Sep. 2010).

the environmental objectives of the WFD in line with the requirements of Article 4 (in particular, the requirements of Article 4.7 when new hydropower plants are considered). The requirements of Article 4.7 for new hydropower include amongst others that there are no significantly better environmental options to achieve the beneficial objectives from new hydropower for reasons of technical feasibility or disproportionate cost, that the benefits of the new infrastructure to sustainable development outweigh the benefits to the environment and to society of achieving the WFD environmental objectives and/or the reasons for the modification are of overriding public interest, and that all practicable steps are taken to mitigate the adverse impact on the status of the water body.

In the same time, the Renewable Energy Directive (2009/28/EC) sets legally binding national targets for electricity and transport from renewable sources (not specifically for hydropower), adding up to a share of 20 % of gross final consumption of energy in the EU as a whole. By June 2010, each EU Member State had to adopt a national renewable energy action plan (NREAP) setting out its national targets for the share of energy from renewable sources consumed in transport, electricity, heating and cooling in 2020 and describing the way and the extent to which different renewable sources (wind, hydropower, etc.) will contribute to the achievement of targets.

The Renewable Energy Directive (RES) is part of a package of energy and climate change legislation which provides a legislative framework for Community targets for greenhouse gas emission savings. It encourages energy efficiency, energy consumption from renewable sources, the improvement of energy supply and the economic stimulation of a dynamic sector in which Europe is setting an example.[13]

In a lot of European States, an increase in hydropower generation and an increased use of hydropower as storage may help in the achievement of these targets. It can be achieved by increasing efficiency in hydropower generation at existing sites but also by building new hydropower plants. Renewable energy targets are considered compatible with the environmental objectives established in the WFD. Recommendations for better policy integration and good practices were included in the policy paper and the technical report on the WFD and hydromorphological pressures adopted in November 2006 in the framework of the WFD Common Implementation Strategy[14].

The WFD, the Birds and Habitats and the RES Directives of the EU present an opportunity but also a challenge in reaching multiple environmental objectives. The use of water to gain energy is not ruled out by the WFD but it is also not a necessity to reach renewable targets in some Member States. In order to achieve a proper and well-balanced approach to meet climate protection, water protection and nature protection objectives, the benefits of hydropower as a highly reliable CO2-free and renewable source of electricity production but

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[13] Source: http://europa.eu/legislation_summaries/energy/renewable_energy/en0009_en.htm.

[14] Available on

http://circa.europa.eu/Public/irc/env/wfd/library?l=/framework_directive/thematic_documents/hydromorphology/hydromorphology/_EN_1.0_&a=d

http://circa.europa.eu/Public/irc/env/wfd/library?l=/framework_directive/thematic_documents/hydromorphology/technical_reportpdf/_EN_1.0_&a=d

also the need to maintain the ecological functions of hydropower-affected water stretches have to be taken both into account.[15]

To meet both WFD and RES requirements, win-win measures to improve the status of water bodies with acceptable loss of energy production would be eligible as well as measures to increase hydropower generation without negative effects on water ecology, such as raising efficiency at existing sites and defining suitable sites for new hydropower plants by strategic planning tools and the application of Article 4.7 of the WFD. To limit the impact of possible new hydropower sites, it is necessary to implement strategic planning tools including river ecology aspects.

The strategic planning of the development of hydropower should be accompanied by an improvement of water ecology, through clear ecological requirements for new and existing facilities. The Water and Energy discussions should also be linked to the debate on adaptation to climate change, including other water and energy issues like energy efficiency (WD meeting, Brno 2009).[16]

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[15] Key Conclusions, Common Implementation Strategy Workshop on WFD & Hydropower, Berlin, 4-5 June 2007.

[16] Final Synthesis. Informal meeting of Water and Marine Directors of the European Union, Candidate and EFTA Countries. Brno, 28-29 May 2009.

3 Key figures on hydropower

3.1 Electricity production from hydropower

Figure 1 shows the current electricity production from hydropower and from renewable energy sources in relation to total electricity production. In 6 countries (NO, IS, AT, LV, CH, SE), on the one hand, more than 40% of total electricity is produced by hydropower and more than 50% by renewable energy sources in general. In 7 countries, on the other hand, electricity production from hydropower is currently below 5% and from renewable sources below 10% of total electricity production (CZ, LU, PL, BE, UK, NL, HU).[17]

In more than half of the surveyed countries (14 out of 24), hydropower represents an important component of current total renewable electricity production, contributing by more than 50% (see Figure 2). In 6 countries, the share of electricity production from hydropower to total electricity from renewable sources is even above 90% (CH, LV, SI, FR, NO, RO). In few countries (BE, HU, NL and the UK), the current share of hydropower to total electricity production from renewable sources is below 20%.

In terms of the development of electricity production by 2020, many countries (e.g. DE, FR, ES, NL, PL, CZ, BE and HU) plan a considerable increase in electricity production from renewable sources (see Figure 3). SE is the only country with a slight decreasing trend based on the data of the questionnaire. As far as hydropower is concerned, certain countries (ES, PT, HU, NL) plan a relatively high increase in electricity production from hydropower by 2020 (see Figure 4). Many other countries also plan increase in hydropower production (FR, AT, DE, FI, IT, SI, SK, PL, BE, LU). In some countries, data in the questionnaire indicate that electricity production from hydropower by 2020 will drop (SE, RO, CZ, LV). In some cases, this may be due to the type of data collected via the Hydropower and WFD questionnaires, whereby current electricity production is usually based on a specific hydrological reference year whereas production in 2020 is a statistical average.[18]

The share of hydropower to total renewable electricity production will increase in HU, NL and SE (see Figure 2) but in most countries, the share will decline. This is an indication that by 2020 other renewable energy sources are expected to develop more dynamically than hydropower. In most countries, hydropower will remain a relatively significant contributor of renewable energy.

[17] The original data on hydropower submitted in the European State Questionnaires are listed in Annex I. The data source for all figures in the issue paper are the European State Questionnaires on Hydropower and WFD.

[18] In RO, the year 2010 was from point of view of hydroenergy production an exceptional year, the hydropower production being the second highest in the hydroenergy production history of Romania. The 2020 value in the RO questionnaire is for an average hydrological year.

Figure 1: Current electricity production from hydropower and from renewable energy sources as a percentage of total national electricity production (%)

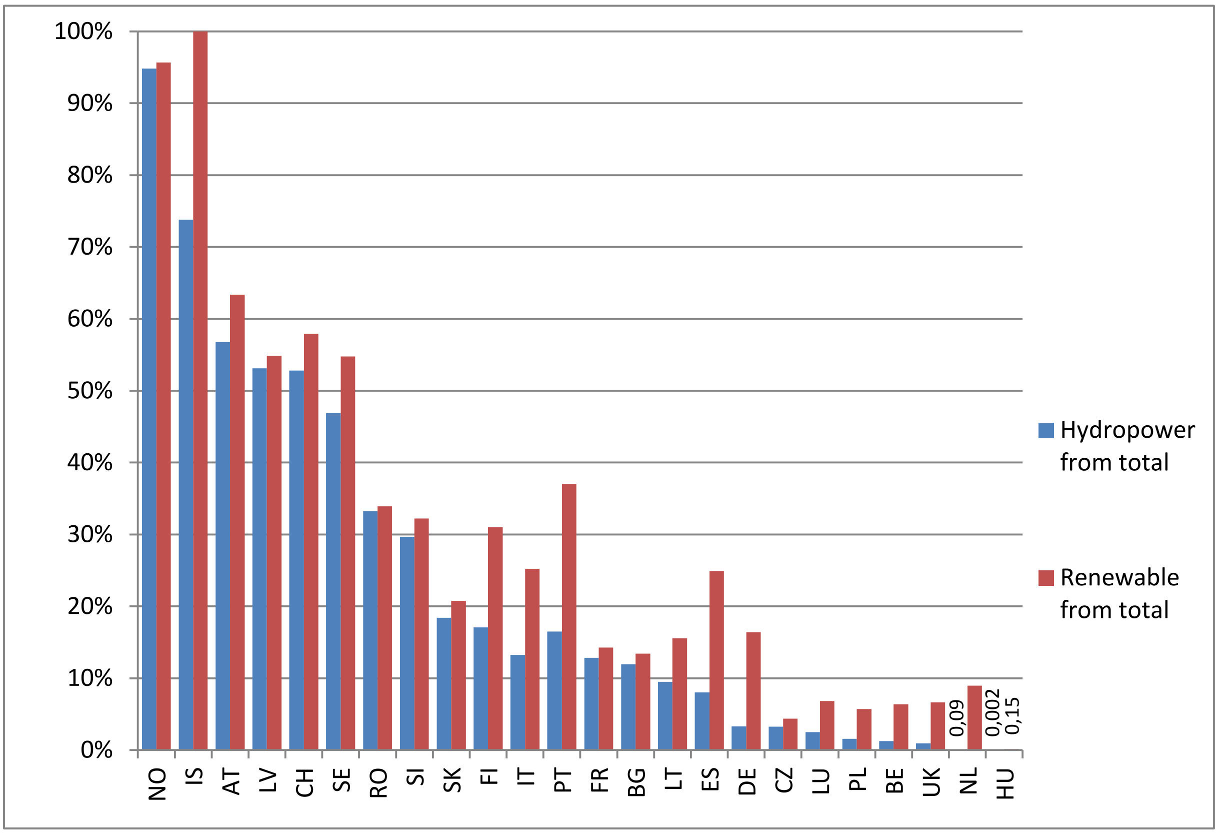
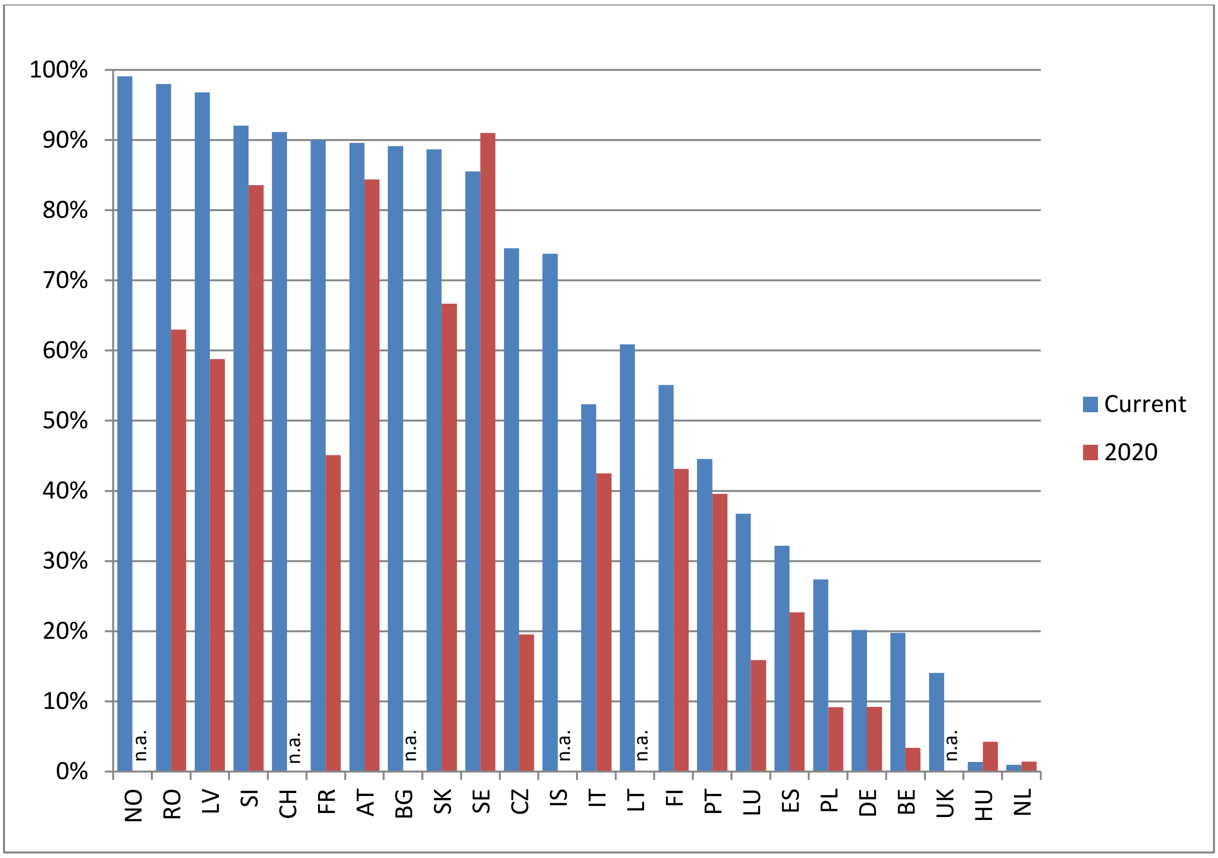
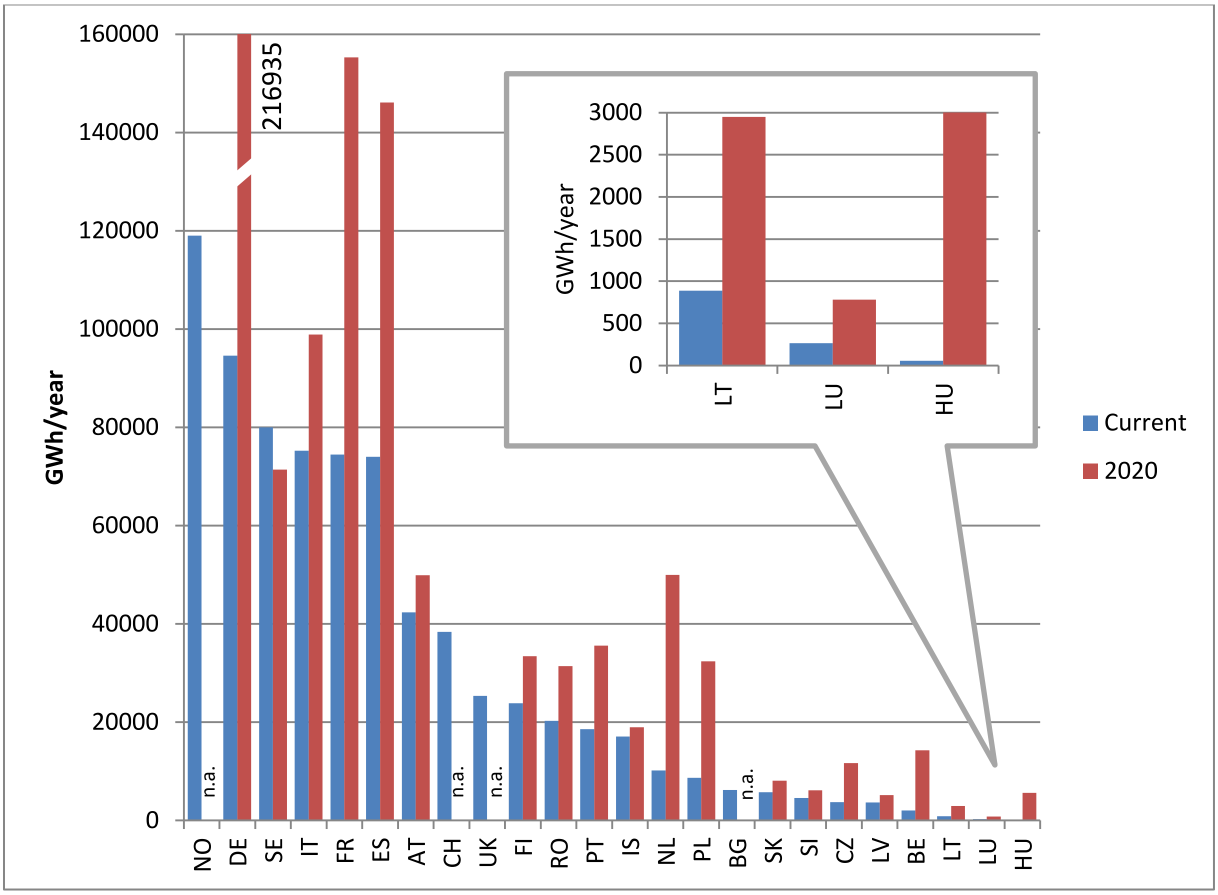


Figure 2: Total national electricity production from hydropower as a percentage of total electricity production from renewable energy sources (currently and in 2020) (%)



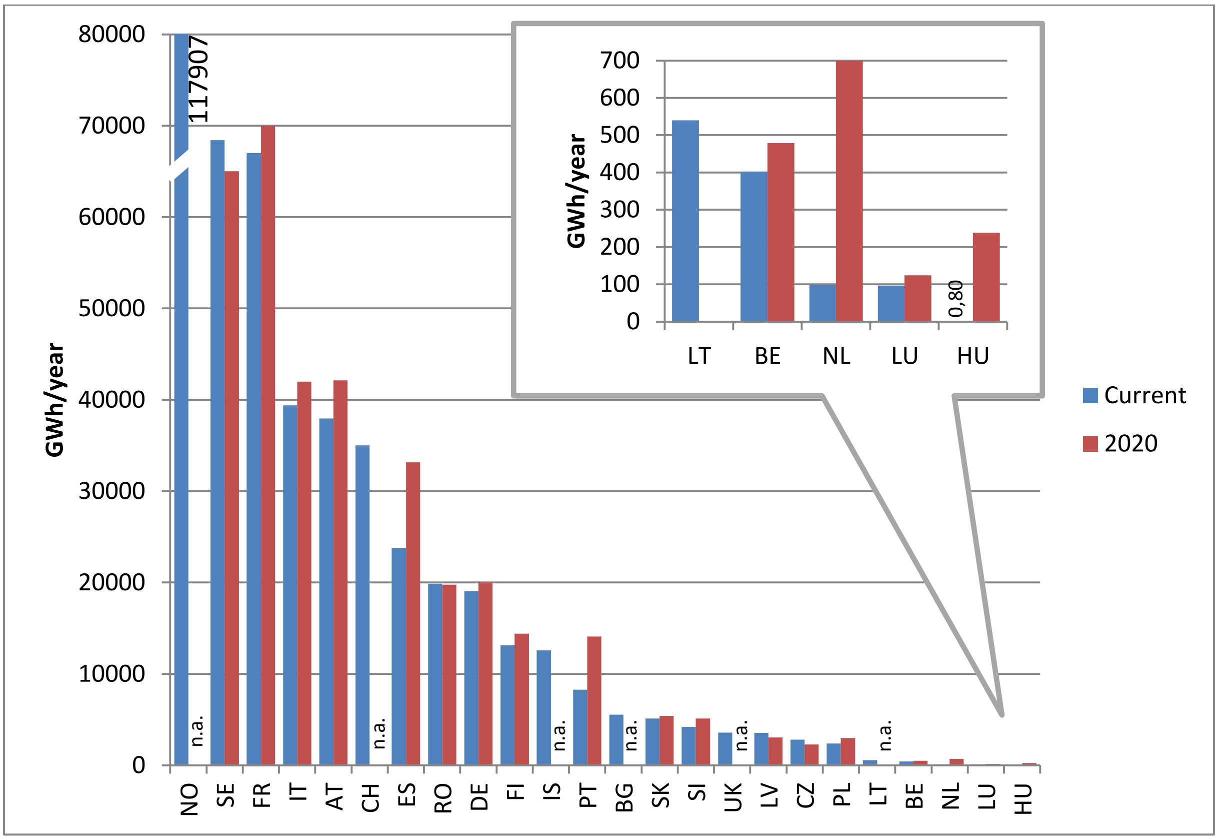
Note: 1) Values for current electricity production from hydropower exclude pumped storage. For FR, NO and ES, data for hydropower excluding pumped storage was not available and is replaced by the value of hydropower including pumped storage. 2) Certain European States have no pumped storage hydropower schemes (NL, LV, FI, RO), while in SE hydropower from pumped storage is very limited (only 2 schemes).

Figure 3: Electricity production from renewable energy sources currently and in 2020 (GWh/y)



Note: 1) Information about expected electricity production in 2020 from renewable sources was not provided for BG, CH, NO and UK.

Figure 4: Electricity production from hydropower currently and in 2020 (GWh/y)



Note: 1) Information about expected electricity production in 2020 from hydropower was not provided for BG, CH, NO, UK, LT and IS. 2) In RO, 2010 was an exceptional year from the point of view of hydroenergy production, the hydropower production being the second highest in the hydroenergy production history of Romania. The 2020 value is for an average hydrological year.

The table below indicates how European States intend to achieve the objectives set for the contribution of hydropower to the 2020 renewable energy targets via construction of new hydropower plants, refurbishment or modernization and maintenance. The table is based on qualitative statements of countries on the level of importance of the contribution of each option to the targets.

The following trends can be detected for specific countries:

- In AT, SI, SK and the UK, mainly the construction of new plants will contribute to the 2020 renewable energy targets. In the UK, new hydropower development is expected to be dominated (in terms of numbers of schemes) by small (< 1.5 MW) run-of-river schemes. In AT, modernisation will play a considerable role for small hydropower while in the UK, refurbishment and modernisation are considered negligible contributions.
- On the other hand, in DE, ES, CZ and IT, the construction of new hydropower plants is considered a minor contribution, whereas the refurbishment, modernization and maintenance of plants will be the main source of contribution to renewable energy targets. In LV, the situation is similar. In ES, any new constructions will focus on increasing pumping storage capacity.

- FR considers all options to be a main source of contribution for achieving the 2020 renewable energy targets. The refurbishment and modernisation targets are to balance the loss of production due to minimum flow rising in 2014 for all existing plants. On the contrary, LU considers all options to be minor contributions to the 2020 renewable energy targets.
- For FI, the NL and RO, the construction of new plants and modernisation and maintenance will be the main contributors to the 2020 renewable energy targets from hydropower.
- For NO and PT, the main source of contribution to the 2020 renewable energy targets from hydropower will come from the construction of new plants and refurbishment.
- SE mainly plans to refurbish hydropower plants in order to contribute to the 2020 renewable energy targets.

	Main source of contribution	Minor source of contribution	Negligible source of contribution
Construction of new hydropower plants	AT, BE, FI, FR, NL, NO, PT, RO, UK, SI, SK	DE, IT, LU, CZ	LV, SE, ES
Refurbishment of plants[19]	DE, FR, IT, LV, NO, PT, SE, CZ, ES	AT, LU, RO, IS	FI, UK, SI, SK
Modernisation and maintenance of plants[20]	DE, FI, FR, IT, LV, NL, RO, CZ, ES	AT, LU, NO, PT, SE, IS	UK, SI

Note: 1) No information in the questionnaires of PL, LT, HU, BG. 2) For CH: Refurbishment and modernization: 2.4 TW; New plants: small HP: 1.9 TW; large: 2.4 TW the numbers refer to 2035.

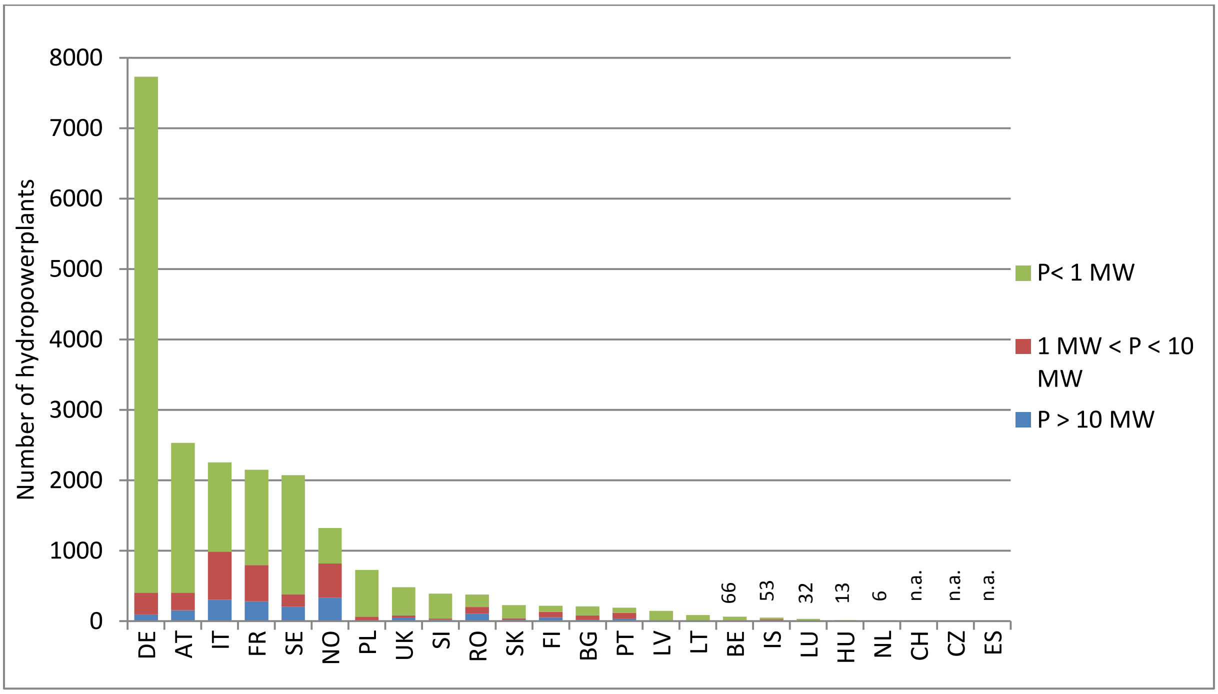
3.2 Number and capacity of different hydropower plant sizes

The highest number of plants in most countries lies in the category of plants smaller than 1MW (see Figure 5). Figure 6 shows that in 15 countries, plants < 1 MW make up for more than 50% of total plants. In LV, DE, PL and LT, these small plants even make up for more than 90%. In absolute numbers, DE has by far most small plants (7.325), which is 44 % of small plants in all countries of the survey.

[19] Refurbishment refers to measures which increase installed capacity in existing hydropower plants.

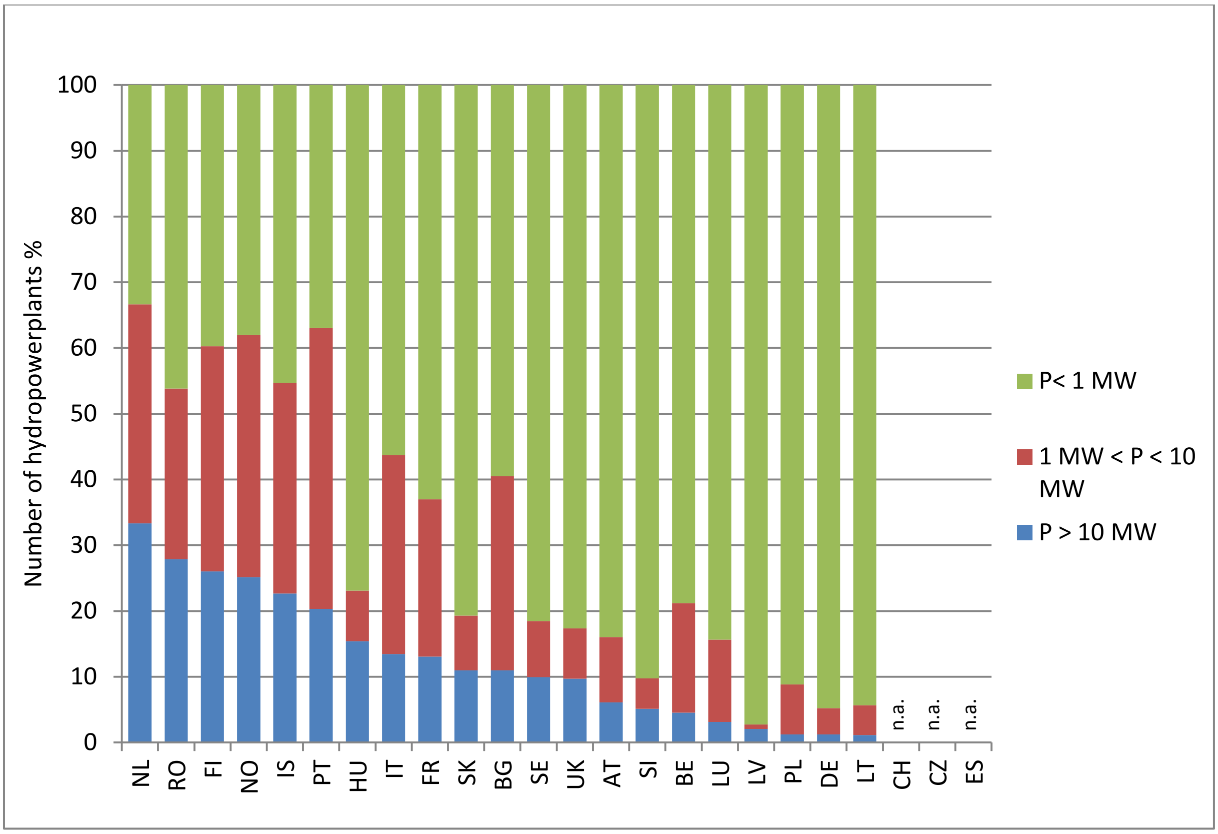
[20] Modernisation refers to measures which increase electricity production and in the same time contribute to ecological improvement, e.g. new turbines according to best available techniques/good environmental practice.

Figure 5: Total number of existing hydropower plants for different plant sizes



Note: 1) Data was not available for CH, CZ and ES. In CH, there are 556 plants > 300 kW and ca. 1000 plants < 300 kW. In the CZ, a different range is followed: P<0.5 MW, 0.5 MW<P<10 MW, P>10 MW (other data is not available).

Figure 6: Percentage of number of existing hydropower plants for different plant sizes (%)

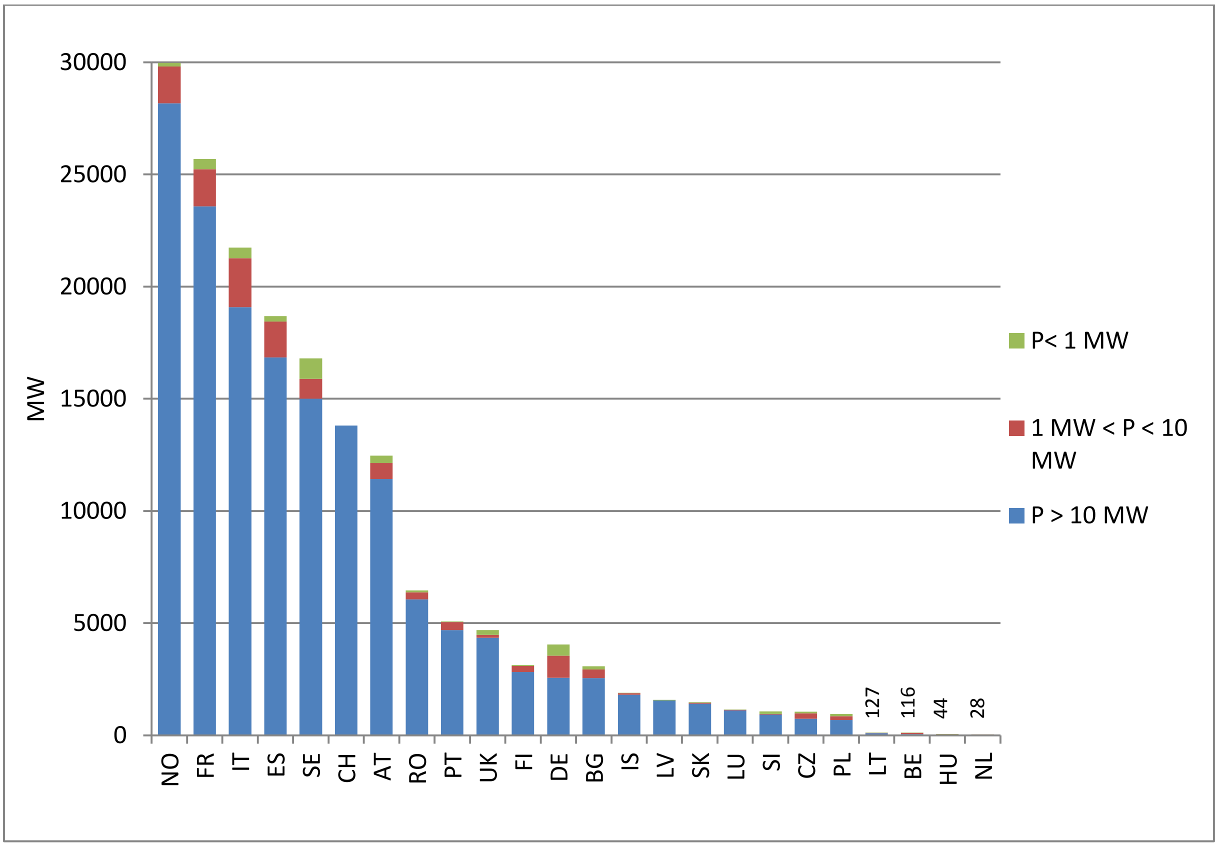


Note: 1) Data was not available for CH, CZ and ES.

Figure 7 and Figure 8 show the installed capacity of hydropower by plant size category (respectively, in absolute numbers and percentage). Hydropower plants > 10 MW take up 60% to over 90% of total installed capacity in most countries. Only a few countries have a share of approximately 20% - 40% of hydropower plants between 1MW and 10MW (e.g. DE, NL, PL, CZ, BE). Plants < 1MW only account for a small share of installed hydropower capacity (approximately 10% in DE, PL, LT, CZ, SI and below 5% for the remaining countries).

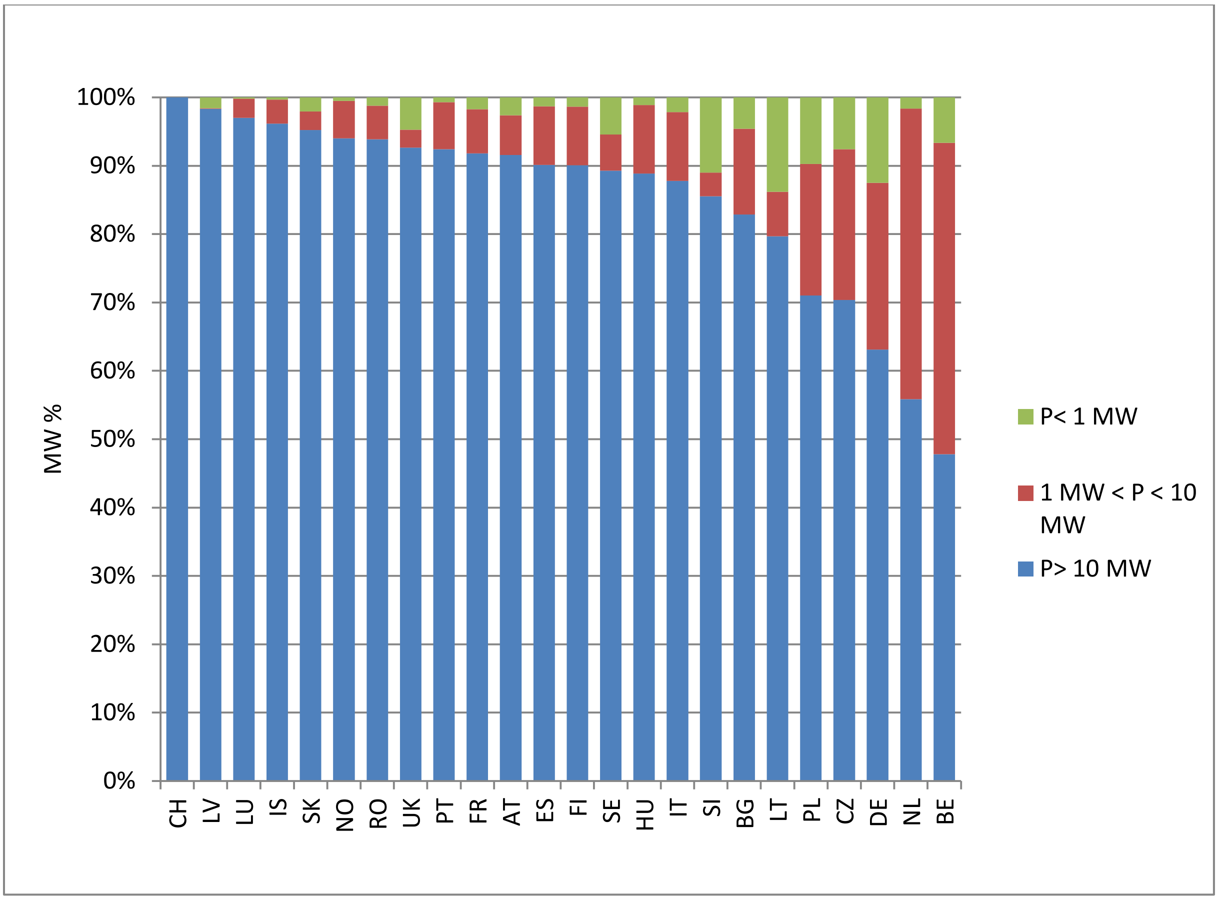
Thus, in most countries, a relatively small number of hydropower plants > 10MW account for the largest share of installed capacity. For example, FR has a relatively small number of plants > 10MW (281 plants P>10MW against 515 plants between 1MW and 10MW and 1355 plants < 1MW) but they account for 90% of installed capacity. DE has a very high number of plants < 1 MW (7325 plants), but installed capacity from these plants accounts only for 12% of total capacity.

Figure 7: Total installed hydropower capacity for different HP plant sizes (MW)



Note: 1) Data for P< 1 MW and 1 MW < P < 10 MW was not available for CH. 2) The indicated amounts of installed capacity stand in relation to the total hydropower capacity for the different HP plant sizes.

Figure 8: Percentage of total installed hydropower capacity for different HP plant sizes (%)



Note: 1) Data for P< 1 MW and 1 MW < P < 10 MW was not available for CH.

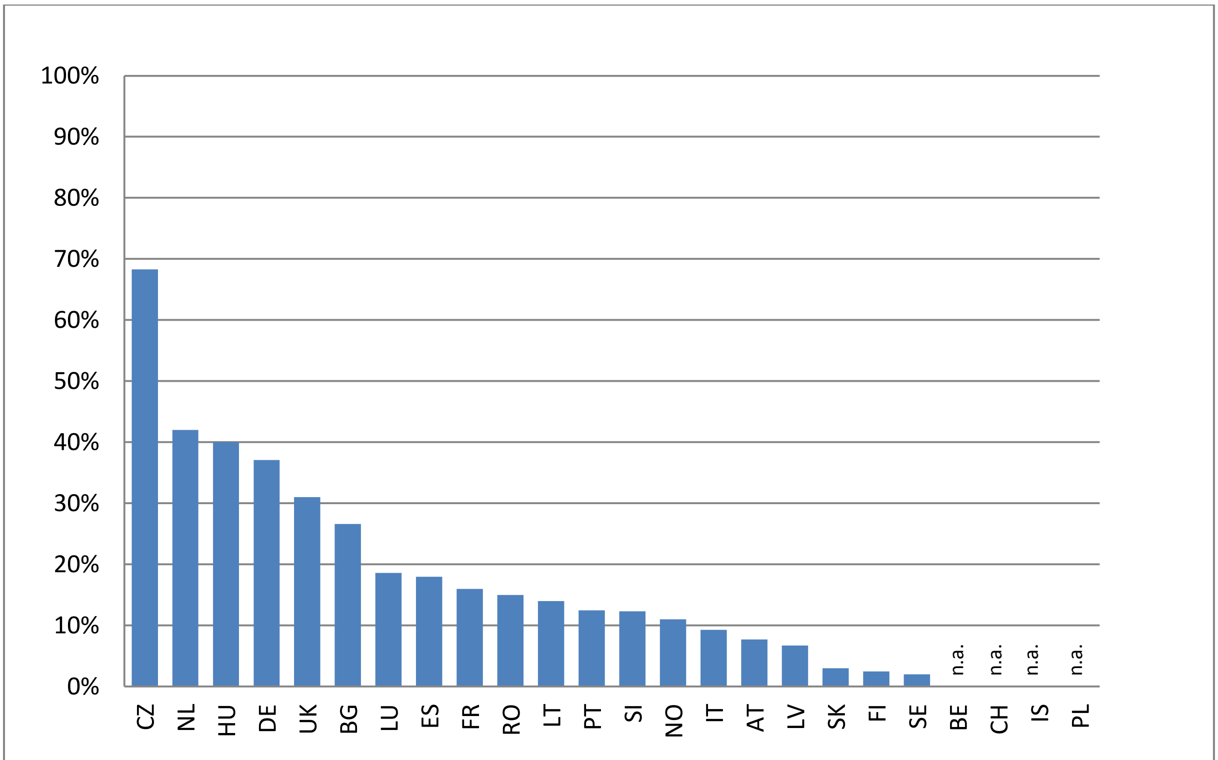
4 Hydropower and heavily modified water bodies

Figure 9 gives an overview of designated heavily modified water bodies (HMWB) in relation to the number of total surface water bodies. From this overview, the following may be noted:

- CZ, the NL, HU, DE and UK have the highest percentage of HMWB (31% to 68%).
- SK, FI and SE have the lowest percentage of HMWB (equal to or below 3%).

Compared to the data presented on designated HMWB at the 2009 CIS Workshop on HMWB and GEP (Brussels, 12-13 March 2009), which was partly based on the first draft RBMPs,[21] the % of HMWB has changed only slightly or has not changed at all in most countries. Exceptions are a few countries such as CZ (increase from ca. 22% to 68% of HMWB), RO (reduction from ca. 38% to 15% HMWB), LT (reduction from ca. 22% to 14% HMWB) and HU (increase from ca. 22% to 40% HMWB).

Figure 9: Percentage of HMWB in relation to total number of surface water bodies (%)



Note: 1) Percentages were reported in the WFD and Hydropower questionnaires of European States. 2) Data was not available for BE, CH, IS, PL. 3) The mean is calculated based on the percentages provided in the European States questionnaire.

Figure 10 shows the percentage of HMWB designated as such due/linked to hydropower use in relation to total HMWB.

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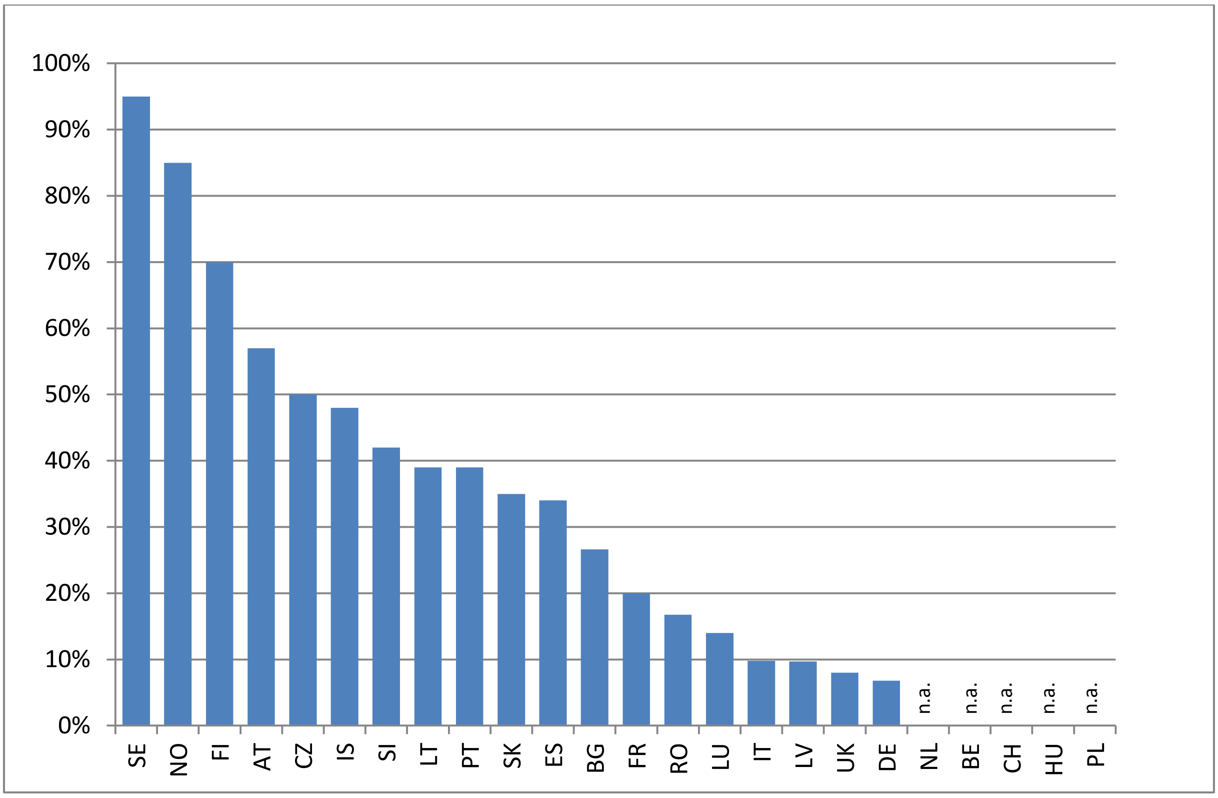
[21] Kampa, E. & C. Laaser (2009): Updated Discussion Paper. Common Implementation Strategy Workshop Heavily Modified Water Bodies. Brussels, 12-13 March 2009. Available: http://www.ecologic-events.de/hmwb/documents/Discussion_Paper_Updated.pdf.

- SE, NO, FI, CZ and AT have the highest percentage of designated HMWB due/linked to hydropower (above 50% of total HWMB).
- The NL, DE, UK, LV and IT have the lowest percentage of designated HMWB due/linked to hydropower (below 10% of total HMWB).[22]

Figure 10: Percentage of HMWB designated due/linked to hydropower in relation to total HMWB (%)



Note: 1) Percentages were reported in the WFD and Hydropower questionnaires of European States. 2) Data was not available for CH, BE, HU, PL. 3) The mean is calculated based on the percentages provided in the European States questionnaire.

The majority of countries (20 of the 24 surveyed) plan to make improvements to water bodies affected by hydropower by 2015. Mainly in the context of the WFD programme of measures, there are new ecological flow regimes being implemented (e.g. PT, BG) and other measures to make hydropower plants more ecological friendly (e.g. via fish ladders in the NL).

In the context of making improvements to water bodies via specific measures, 10 European States have agreed national or local criteria for determining what impact on hydropower generation is acceptable (i.e. not a significant adverse effect). However, in an equal number of countries, no such criteria could be determined so far (see table below).

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[22] The IT data may be underestimated because they were obtained by filtering HMWB by the pressure type "hydroelectric dam".

In the case of the UK, no accurate data is available yet for the whole country. The majority of hydropower HMWBs is in Scotland where they account for 56 % of the 412 Scottish HMWBs or about 7 % of UK HMWBs.

	Yes	No
Are improvements to any water bodies affected by hydropower schemes planned by 2015?	BG, FI, FR, IT, LV, LT, LU, NL, NO, PT, RO, SW, UK, CZ, IS, ES, SI, SK, AT, DE[23]	CH
Have national or local criteria for determining what impact on hydropower generation is acceptable (i.e. not a significant adverse effect) been agreed?	AT, FR, IT, LV, LT, NL, RO, CH, IS, ES	BG, DE, FI, LU, NO, PT, SE, UK, CZ, SI

Note: 1) No answer by BE, HU and PL.

The following summarises examples of criteria used to determine what impact on hydropower generation is acceptable.

Table 1: Examples of criteria used to determine what impact on hydropower is acceptable

AT	Based on the outcome of a study on the possible effects of WFD on hydropower by using different scenarios and the ecological requirements set out in the Ordinance on ecological quality objectives, it was calculated that to restore upstream continuity for fish migration in all Austrian hydropower plants and restoring an ecological minimum flow would not lead to a loss in hydropower generation of more than 3% of the total generation (that is about 1,2 TWh). In the frame of the development of the National River Basin Management plan it was agreed that these losses are acceptable. This leads to the following commitments: Losses of HP generation due to the building of fish migration aids (to restore continuity) cannot be stated as significant adverse effect as a rule. Losses of HP generation due to restoration of ecological minimum flow by a HP plant (by which the diverted water is reverted into the same river after a certain distance from the abstraction point) cannot be stated as a significant adverse effect as a rule. Losses of HP generation due to the restoration of ecological minimum flow in rivers, where the water is abstracted and transferred to a storage reservoir,, will lead to a decrease of peak load production and of ancilliary services and are therefore are excluded from this rule and might be stated as significant adverse effect. Changes in the operational mode of hydropeaking power plants to reduce high flow variations resulting in significant losses of peak load production and ancillary services can be stated as significant adeverse effects on use as a rule (But costs might be a reason for applying an exemptions according to Art (4(4) or 4(5) of the WFD!) Investments costs for restructuring the head sections of impoundments, improving habitat structures in impoundments and water stretches affected by hydropeaking like builiding a compensation reservoir, constructing spawning grounds cannot be stated as significant

[23] AT and DE have replied “No” to the making of improvements to water bodies affected by hydropower by 2015. However, for both countries, it is explained in their questionnaires that improvements will be made by 2015 in a selected number of water bodies. In AT, improvements will not be made in all water bodies until 2015, as the number of restoration projects needed is very high (technical constraints, therefore use of exemptions according to WFD Art.4.4). There is a prioritisation for 2015, starting restoration mainly in larger rivers which form the migration corridor for most endangered middle distance migrating fish species affected by migration barriers due to impoundments and water abstraction in the frame of hydropower generation. In DE, measures are being implemented in all HMWB, where the defined objectives are not being achieved. For many surface water bodies, extension of deadline (WFD Art. 4.4) is being used, planning improvements by 2027.

	adverse effect as a rule.
FR	About 2 000GWh lost by minimum flow raising in 2014 for existing plants and few dams removals. Through the Law about minimum flow, we accepted a certain loss of production. The loss of production will be compensated by refurbishment (1000 GWh) and modernisation (1000 GWh)
NL	Fish mortality: not more than 10% for the whole Dutch part of the river basin (cumulative). Therefore the criteria leads to tailor made criteria for each specific case
RO	Reduction/loss of energy production < 2%/year for a single HPP and the reduction/loss of energy production < 5%/year for a whole hydropower development scheme is considered acceptable (without having a significant adverse effect)
UK	In the UK (Scot), criteria are being developed that will aim to limit any loss in generation so as not to impede progress towards achieving Scotland's renewable electricity targets. The criteria will include consideration of scheme-level impacts and cumulative impacts on Scotland's renewable electricity generation

5 Legal and technical requirements for environmental improvement

Section 5.1 below summarises information on hydropower permits. Sections 5.2 and 5.3 focus on legal and technical requirements related to the following key domains of environmental improvement at hydropower plants: minimum ecological flow, upstream continuity facilities, downstream continuity facilities, hydropeaking mitigation and sediment/bedload transport. Section 5.4 lists other domains identified as relevant for environmental improvement in the questionnaires. Section 5.5 addresses the issue of cumulative effects.

5.1 Permits for hydropower plants

The duration of permits for hydropower plants varies significantly between countries, being based on different criteria. In SE, the NL, LT, IS and FI, all permits are of unlimited duration (see Table 2 for further specifications). In some countries, there is a mix of permits in perpetuity and time-limited permits (UK, NO, AT and DE) and in the remaining countries only time-limited permits exist.

In the case of time-limited permits, duration depends often on following criteria:

- Time needed to recover the investment (related also to the size of the plant) (PT, FR, AT, BE)
- Duration depends on the operational period of the plant (RO, LV)
- Differentiated duration for publicly and privately owned plants (NO)
- Differentiated duration for new and old plants (IT, AT, DE)

In most countries, it is possible to make changes to permits of hydropower plants. Changes can be made and additional measures requested (either in the context of permit revision or at any time), when this is considered necessary to achieve environmental objectives or when a degradation of environmental conditions has been identified. In some countries, the State has to compensate plant owners when the requested mitigation measures exceed a certain limit of impact on production value (e.g. SE and FI).

Table 2: Permits of hydropower plants (duration and types of changes possible)

	Duration of permits for hydropower plants	Types of changes possible to existing permits
AT	Existing very old small hydropower plants: Unlimited duration, 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	According to the WFD, a change of permits can be done according to the measures set in the national action plan. For example, in the frame of regional restoration programmes (which have the character/form of an Ordinance by the regional authorities) and restoration measures like restoring continuity by building a fish pass, guaranteeing a minimum ecological flow, a deadline can be set by which the owner of a permit has to submit a restoration

	situation in relation to flow and existing water uses	project to the authorization body.
BE	20 years max. for an environmental permit (which is needed for a plant with more than 100 Kw)	Always possible to review a permit
BG	6 -10 years Permit duration varies and is determined based on present schedule for completion of construction. After completion of construction, permit can be extended with equal intervals of 5 years	Possible changes in the parameters of abstraction - the quantity used, structural part, time of completion of construction
CH	Ranges between 40 and 80 years	Almost no changes.
CZ	Usually 30 years	If environmental objectives are deteriorated, water authority can require additional rules of operation and service and during extremely low flow forbid to manipulate water
DE	New plants: 20 or 30 years (there are individual exceptions) Existing plants: Longer duration or unlimited (old rights). Changes to the legal framework for permit duration has not affected existing permits	Permits can be withdrawn under certain conditions and certain measures can be requested retrospectively.
ES	Currently up to 75 years.	Changing existing permits is complicated and bound to poduce legal proceedings if existing rights of concessionaires are affected
FI	All permits are permanent, but the obligations of permit can be reviewed	Water-levels and discharges can be changed. If conditions in the water body change remarkably, then it is possible to present new obligations. However, the monetary losses for the hydropower companies have to be compensated. In addition, the total benefit of the project should not diminish.
FR	Max. 75 years Duration is based on level of investments Relicensing is 20 years, if there is no particular investment, and ca. 30 - 40 years if there is much investment Many perpetual old permits for former mills	Rules to impose a fish-pass or sediment management can be added on existing permits on listed rivers (where continuity restoration is a priority) without any financial compensation Permits can be changed without financial compensation when justified by a public interest, especially when hydraulic conditions are not compatible with aquatic ecosystems preservation.
IS	No limit on duration of harnessing permit, limit on contract with landowner is 60 years	Harnessing permit can be withdrawn in the case of a misconduct by the licensee
IT	Range between 15 years (new plants) and 30 years (old plants) Duration is based on the recovery of investment costs	Changes are possible only at the renewal of permits
LT	Unlimited duration	It is planned to implement limited duration permits for hydropower plants, which would be renewed only when the operation of hydropower plants does not deteriorate ecological status or ecological potential of

		water bodies
LV	All permits are issued for the whole period of operation of the relevant installation (till 27.10.2009, permits were issued for 5 years)	Possible to review permit conditions at any time if conditions do not ensure the protection of surface water and groundwater from pollution and drying up and achievement of particular environmental quality objectives in the particular water body
NL	Unlimited duration The permit is of unlimited duration, only for as long as the criteria (such as ecological flow, fish migration facilities i.e.) are met. Duration can be limited if this is necessary for reaching environmental objectives (limitations can be formulated as part of the programme of measures)	The permit (only applicable to new hydropower facilities) requires monitoring of fish mortality. If this leads to the conclusion that the mortality rate is too high, extra measures are demanded.
NO	Publicly owned (2/3) and small hydropower permits (< 10MW): Usually unlimited duration Privately owned plants: 60 years	Modernisation and deletion of outdated conditions and introductions of new conditions to remedy environmental damage e.g. minimum flow and habitat improving measures. Environmental improvement is weighed against energy security (possibility to storage in reservoir is of particular importance). A revision of licensing conditions will in general not cause a significant energy loss.
PT	Plants >50 MW: Duration 50 - 75 years Plants 30-50 MW: Duration 35 - 50 years Plants <30: 15 - 35 years Duration is based on time needed to recover the investment	Permits can be revised by the administration if: changes occur in the factual circumstances existing at the date of the permit and determinants issue, including the degradation of the conditions of the water environment.
RO	Duration is represented by the duration of its operational period of time (renewed every 5 years) Duration is established case-by-case following the requirements of safety dams legislation	Change is possible only if the beneficiary requires a change/changes in the license, in which case a new water management license needs to be issued
SE	Unlimited time for all permits	The changes could reach as far as the limit for economical feasability of the plant which is judged case by case. If mitigation measures require more water then 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 nomally below 5%.
SI	30 years for HPP<10 MW 50 years for HPP > 10 MW (generally)	Any type, also rescission is possible
SK	Unlimited license for construction-technical part; duration of license for utilization of water could be limited	For existing permits, only minimum changes are possible (described in issued permit). Changes beyond conditions set in permit (e.g. legislative change, change of operation, construction changes, fish pass etc) require revision of permit
UK	Scotland: all permits changed in 2006 to be in perpetuity	Permits can be varied, suspended or revoked at any time by the relevant environment agency, provided that the change is reasonable (eg necessary to achieve

England and Wales: Some in perpetuity and some time-limited (duration normally reflects the policy and legislative framework existing at the time the scheme was first authorised)	environmental objectives etc)

Note: No answer by LU, PL and HU.

5.2 Legal requirements for environmental improvement

Most countries have relevant legislation on national level (in a few, also on regional level) to ensure minimum ecological flow and upstream continuity via fish passes at hydropower plants (see table below summarising legal requirements on key domains for environmental improvement).

For downstream continuity and hydropeaking mitigation, fewer countries have legislative requirements to ensure environmental improvement in this respect. Requirements for measures are rather defined in individual cases (e.g. as a condition of authorisation) and, in some countries, there is generally no relevant legislative means.

For mitigating the disruption of sediment/bedload transport, several countries have no relevant legislative means. Only a few countries have national legislation and, in several countries, mitigation measures are defined in individual cases.

More details of country-specific legal requirements can be found in the individual European State questionnaires.

	There is relevant legislation		**There is no legal requirement but there is a relevant recommendation**		**No legal requirement or recommendation but defined in individual cases**	**Generally no legislative means**
	National	Regional	National	Regional		
Minimum ecological flow	AT, NL, RO, NO, LT, HU, BG, LV, IT, FR, DE, CH, CZ, ES, SI	DE, IT	UK, PT, CZ, SK	UK	LU, SE, NO, FI, DE, BE, IS	FI
Upstream continuity facilities	AT, BG, FR, DE, LV, LT, LU, NL, RO, CH, SI, SK	DE	NO, PT, UK	UK	FI, IT, NO, BE, CZ, IS, ES	FI, SE
Downstream continuity facilities	FR, DE, RO, CH, SI, SK	NL, DE	NL, DE	UK	IT, LV, LU, NO, (AT), BE, CZ, IS, ES	BG, FI, LT, PT, SE
Hydropeaking mitigation	AT, LT, LV, LU, RO, CH	DE, LU			FI, FR, DE, IT, NO, PT, SE, UK, CZ, IS, ES, SI, SK	SE, NL, BG, BE
Sediment/ bedload transport	BG, FR, IT, CH			UK	FI, DE, NO, PT, (AT), CZ, IS, SI	LV, LT, LU, NL, SE, BE, RO, SK

Note: 1) In Romanian legislation there is no distinction between upstream and downstream continuity facilities for fish migration.

Note: 2) No answer on legal requirements for minimum ecological flow in PL; No answer on legal requirements for upstream continuity, downstream continuity and hydropeaking in PL and HU; No answer on legal requirements for sediment/bedload transport in PL, HU and ES.

For new hydropower plants, in most countries, legal requirements exist for every plant to ensure minimum ecological flow and upstream continuity (see table below). It should be noted, however, that there are specific cases where the requirements are not applied, e.g. requirements for fish passes on rivers where fish migration is not significant. For instance, in NO, new stream diversions might not have a minimum flow requirement. In FI, fish passes were mandatory in old legislation. Practice showed that fish passes are not working properly, if there is not enough spawning and breeding grounds or intensive fishing. Current legislation allows for more flexibility, with measures including fish stocking and catch-and-carry programmes. In AT, fish passes are now required for all hydropower plants which are situated on rivers where fish naturally used to live (areas in high alpine regions are excluded where natural fish habitats do not exist due to natural obstacles). IS also clarified that in some rivers there is no salmon or other fish requiring a fish pass.

For existing hydropower plants, many countries do not have a requirement for minimum ecological flow and upstream continuity which is being applied to every single installation. Nonetheless, new additional measures can usually be requested by the authorities on case-by-case basis (e.g. by varying the conditions of existing permits). In some countries (e.g. BG and PT), other solutions are used to mitigate the negative impacts of migration barriers in existing plants, such as stationary fish aggregation devices, fish lifts, fish stocking and catch and carry programmes.

For ensuring downstream continuity, most countries do not have relevant requirements to do so for every new hydropower plant and, in even less cases, for every existing plant. Certain country approaches can be mentioned:

- In the UK, all new schemes are required to provide for downstream fish passage if the scheme would otherwise impair fish migration (but not all schemes are located on rivers in which fish migration occurs). Where appropriate, the relevant environment agency can require operators of existing schemes to provide for fish migration where this is currently not provided (by varying the conditions of authorisation).
- In FR, new and existing hydropower plants are required to ensure downstream continuity (as well as upstream continuity and sufficient sediment transfer) on so-called “listed rivers” (see section 7 for details on ”listed rivers”). On all other rivers, this depends on whether an adverse impact on continuity is identified through the environmental assessment. Exceptions exist when there are natural falls near the facilities that make a fish pass unsuitable.

	New hydropower plants		**Existing hydropower plants**	
Does a requirement exist for every hydropower plant on:	**Yes**	**No**	**Yes** Note 1)	**No** Note 1)
Minimum ecological flow	LU, UK, SE, PT, NL, RO, LT, BG, LV, IT, FR, AT, DE, CH, BE, CZ, IS, ES, SI,	FI	LU, LT, BG, LV, IT, FR, (AT), ES, SI, SK	UK, SE, PT, NL, NO, FI, DE, CH, BE, CZ, IS, RO

	SK, NO[24]			
Upstream continuity facilities	AT, BG, DE, LT, LU, NL, PT, RO, CH, BE, CZ, ES, SI, SK	FI, IT, LV, NO, UK, IS	AT, LU, NL, SI, SK	BG, FI, DE, IT, LV, LT, NO, PT, SE, UK, BE, CZ, IS, ES, RO
Downstream continuity facilities	BG, DE, NL, RO, CH, BE, CZ, ES, SI, SK	AT, FI, IT, LV, LT, LU, NO, PT, SE, UK, IS	BG	AT, FI, IT, DE, LV, LT, LU, NL, NO, PT, SE, UK, CH, BE, CZ, IS, ES, RO

Note: 1) For existing hydropower plants, the reply „Yes" is interpreted as follows: There is a relevant legal requirement for all existing plants, which has to be implemented immediately for all plants (and permits).The reply "No" is interpreted as follows: a legal requirement may exist also for existing plants but these have the right to continue operating in non-compliance until the next revision of the permit. E.g. in DE, there are no requirements for existing plants with "old" water use rights (Altrechte).

Note: 2) On requirements for minimum ecological flow, no answer by PL and no complete information available for HU; On requirements for upstream and downstream continuity, no answer by PL and HU.

Several countries reported needs for improving the enforcement and implementation of environmental improvement requirements at hydropower plants. Examples include:

- Better linkage of existing requirements to WFD requirements for GES/GEP achievement (SE, IT).
- Monitoring and data improvements, e.g. with respect to the effectiveness of fish passes in order to improve relevant technologies.
- Need for further technical research and innovation to improve downstream continuity (e.g. reported by FR, LT, NL, PT, SE, DE), for instance, related to the improvement of natural fish production in streams, innovation related to turbine damage and existing guidance systems.
- Need for higher requirements for fish protection of diadromous species (DE).
- Training and accreditation schemes: Developers of new hydropower schemes do not always have the expertise or environmental management procedures to ensure good environmental performance during construction and operation. To avoid the need for costly enforcement action, training and accreditation schemes are being discussed with sector representative bodies (UK).
- Improvement of measures for hydropeaking mitigation. 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. Also in NO, measures will be constantly improved and a large international R&D project is ongoing (EnviPeak).

[24] *Exceptions may apply to minor tributaries.*

5.3 Technical requirements for environmental improvement

For most domains relevant to environmental improvement at hydropower plants, it seems that relevant technical standards are frequently set on case-by-case basis, e.g. within permit requirements (see table below). In a few countries, there are technical standards set by law and recommendations, especially for requirements related to minimum ecological flow.

	There is a technical standard set by law		There is a recommendation		Set on case-by-case basis	No relevant method defined
	National	Regional	National	Regional		
Minimum ecological flow	PT, LT, BG, AT, CH, ES, SI, RO		LU, UK, PT, NO, IT, DE, CZ	UK, IT, DE	LU, SE, NO, LV, FR, FI, BE, IS, ES	SE, NL, BG
Upstream continuity facilities	LT, RO		AT, DE, ES	AT, DE, NL, UK	FI, FR, IT, LV, LU, NO, PT, RO, SE, CH, UK, BE, CZ, IS, SI	BG, CH, SK
Downstream continuity facilities	BG, LT, RO		NL, DE	UK	FR, IT, LV, LU, NO, RO, CH, UK, BE, CZ, IS, SI	AT, BG, FI, LT, PT, CH, ES, SK
Hydropeaking mitigation	LT				AT, FI, FR, DE, LV, IT, LU, NL, NO, PT, SE, CH, CZ, IS, ES, SI, RO, SK	BG, SE, CH, UK, BE
Sediment/ bedload transport			DE	UK	AT, FR, IT, LU, NO, PT, CH, UK, CZ, IS, SI	BG, FI, LV, LT, NL, RO, SE, CH, BE, SK

Note: No answer on technical requirements for minimum ecological flow in PL, HU, SK and RO; No answer on technical requirements for upstream continuity, downstream continuity and hydropeaking in PL and HU; No answer on technical requirements for sediment/bedload transport in PL, HU and ES.

Methods for the definition of minimum ecological flow

Most countries use a static definition of minimum ecological flow (e.g. 5% of annual mean flow) and/or dynamic definition, complemented in several cases by modelling determination. In 6 countries, all three approaches are used, i.e. static definition, dynamic definition and modelling (UK, IT, FR, AT, DE, CH). Solely a static definition is used in SE, RO, LT, CZ, SK and BG. Solely a dynamic definition (in some cases, complemented by modelling) is applied in PT, NL, NO, IS, SI and FI. Several countries comment on the need for site specific considerations. Details on the methods applied to define minimum ecological flow in different countries are listed in Annex II.

Requirements for upstream continuity facilities

The methods/approaches used to ensure upstream continuity include the following requirements (see Annex III for specific methods listed by European States and comments):

- **Type of fish pass** (technical or bypass channel) in 7 countries. These requirements are in some countries decided on a case-by-case basis, as in LU, where the most natural solution is always preferred, and FR, NO and the UK, where the technical option used depends on site-specific characteristics and individual consideration.
- **Special type of fish pass** (e.g. denil, vertical slot fish pass) in 6 countries, decided on a case-by-case basis. AT indicates that denil is not an appropriate type and prefers vertical slot in case of a technical fish pass; the NL mention vertical slot fish passes as a specific requirement, which in the NL has so far been designed only for 1 hydropower plant.
- **Hydraulic design** in 7 countries. In LT, hydraulic requirements apply to new hydropower plant projects. AT mentions specific aspects of the hydraulic design method that are required, including discharge, flow velocity, energy dissipation and attraction flow dependent on the river-type and the most relevant fish species. DE has requirements for hydraulic design based on the size of the fish pass, the size of the river and fish indicator species.
- **Recommendations/requirements on the duration of time for passability of the fish pass** in 5 countries. In AT, passability is required the whole year except in extreme weather conditions. In FR, permanent passability is reinforced in periods of upstream migration. In DE, a passability of 300 days / year is aimed at. LU, NO and the UK refer to requirements on a case-by-case basis, whereas LT only requires fish passes to be operational during migratory fish spawning periods.
- **Recommendations/requirements for fish to find a fish pass** in the river (i.e. by means used to attract fish to the fish pass) in 6 countries (LU, LT, FR, AT, DE, NO).

Tools for downstream continuity facilities

Several tools are used in European States in the context of measures to ensure downstream continuity at hydropower plants:

- **Physical barriers to protect fish from turbine intake channels (screens)** (in 11 European States). However, some countries use them rarely or only for pilot projects. LV uses fish fenders with intervals 20-35mm before the turbine intake channel. FR has a legal requirement to have physical barriers (screens). 2 cm width combined with the management of water velocity through the intake channel are progressively imposed on long migratory fish rivers. DE requires a width of 15–20mm at small hydro power plants.
- **Bypasses and sluiceways** (in 10 European States), however, 5 countries use them where suitable, rarely or only in a few pilot cases.
- **Plant operation management and spill flow (water releases independent of power generation)** (in 9 European States). In LT, this is a requirement during spawning and migration periods, and in FR used especially during eel downstream migration.
- **Fish friendly turbines** (in 9 European States). LV uses fish friendly turbines together with fish fenders. In LT, it is planned to implement schemes for supporting the

modernisation of existing hydropower plants by replacing old turbines with turbines which are less harmful for fish.

- **Monetary compensation for restoration measures for land owners, fishermen, environment/fishery authorities (single or annual payment)** (in 5 European States). In FR, compensation is given if the negative impact cannot be reduced anymore through technical measures. In SE, approximately 12 million € /year are used for compensation, however only a small portion is used for environmental mitigation. In AT, in case of negative effects on fish due to a hydropower plant, which cannot be mitigated by technical measures the owner of the fish area can receive monetary compensation in some cases. In LT, compensation is managed according to EIA procedures.

- **Compensation according to fish stocking (e.g. smolts and fingerlings)** (in 6 European States), but application is not wide and often related to individual cases. However, in SE and FI this is an important issue in large hydro-exploited rivers where spawning areas are reduced. In NO, funding to enhance flora and fauna with focus on fish is common, in LV, compensation according to fish stocking is used in the Daugava river basin since 2009 and, in DE, it has been applied in individual cases, such as the cascade in the Mosel.

- **Compensation for measures taken to reproduce habitats** (construction of spawning and rearing channels, restoration of habitats) (in 6 European States). In DE, such tools are widely applied for hydromorphological improvement measures, but less as compensatory measures for hydropower plants.

- **Catch-and-carry or trap-and-truck** measures (in 7 European States), but some countries specify that they use these rarely or when there is no better option (for instance for large chains of facilities).

Tools	Used	Not used	Unknown
Physical barriers to protect fish from turbine intake channels	AT, FI, FR, DE, LV, LT, LU, NO, RO, SE, UK, BE, CZ, IS, ES	PT	
Bypasses and sluiceways[25]	AT, FI, FR, DE, LV, LT, NO, RO, SE, UK, BE, CZ, IS, ES	PT	
Plant operation management spill flow	FR, DE, LT, LU, NL, NO, PT, SE, UK, CZ, IS, ES	AT, FI, LV	SK
Fish friendly turbines	AT, FI, FR, LV, LT, NO, PT, SE, UK, BE, ES	AT, CZ, SK	DE, CH, IS
Compensation for restoration measures for land owners, fishermen, envi./fishery authorities	AT, FI, FR, LV, NO, SE, BE, IS	LT, LU, UK, SK	DE, PT, CH, CZ
Compensation according to	FI, DE, LV, NO, SE, UK	AT, LT, LU,	PT, CH, CZ, IS

25 A sluiceway is an open channel inside a dam designed to collect and divert ice and trash in the river before they get into the turbine units and cause damage. On several dams, sluiceways are being used as, or converted into, fish bypass systems (source: (http://www.streamnet.org/glossarydam.htm).

fish stocking		SK	
Compensation for measures taken to reproduce habitats	AT, FI, FR, DE, NO, SE, IS	LV, LT, LU, SK	PT, CH, CZ
Catch and carry/trap and truck	FR, DE, LU, NO, PT, SE, UK, IS	AT, FI, LV, LT, CH, CZ, SK	

Specific requirements for hydropeaking mitigation

The country-specific recommendations and/or standards on hydropeaking mitigation include several specific requirements as summarised by the table below. Several countries specify that the inclusion of all these requirements is defined on a case-by-case basis (e.g. in AT, DE, NO).

Amplitude of flow fluctuation	Frequency of hydropea-king	Duration of rising and falling of hydropeaking	Compensation basins	Improvement of hydromorphological structures	Coordination of different plants' operation
AT, FR, LV, LT, NL, NO, RO, SK	AT, FR, NO, RO, SK	AT, FR, LT, NO, RO	AT, FR, NO, RO, CH	AT, FR, NO, RO, CH	AT, FR, LV, LT, NO, RO, CH, SK

Specific requirements for sediment/bedload transport

The recommendations/standards for the mitigation of sediment/bedload transport disruption include:

- Technical solutions for the transfer of sediment/bedload (in 5 European States). In the UK, where suitable, (scooped) intake structures designed to enable sediment to be ashed downstream by flood flows are used. In FR, solutions include opening gates, flushes, dredging and release dowstream, transport, etc. In DE, there are diverse possible techniques to this end and, in IT, river management aimed at a sustainable sediment flux is the main solution.
- Addition of sediment/bedload (in 3 European States). In the UK, excavated sediment accumulating behind the structure to the river downstream is returned at the intake structures. In FR, this is done only by reactivating lateral erosion when it is possible in the water body. In DE, addition of sediment is common in the federal water ways used for transport.

5.4 Other domains for environmental improvement

The following other domains for possible environmental improvement related to hydropower were reported in the questionnaires:

- A catchment approach to old, abandoned weirs with the aim of improving connectivity - development of some weirs for hydropower generation can provide for the installation of a fish pass. However, where there are many weirs, fish passes may not prevent cumulative impacts on fish migration. Options for improving the ecological potential of storage reservoirs are often limited but there can be scope where multiple reservoirs are operated conjunctively (UK).

- Similarly, in FR, a national plan of rivers continuity restoration has been launched. Not only hydropower dams have to be equiped with fish-passes or managed to ensure sediment transport, but all dams, on certain river beds, especially on water bodies being at risk of failing good status and on long distance migratory fish rivers. The plan recommends to remove as much as possible, unuseful and abandoned weirs and dams to improve continuity and to recover habitats.
- Habitat improvement in impounded sections: at the head of the impoundment, in particular, creating new "flowing" river habitats parallel to the impounded sections (AT).
- Water quality, e.g. oxygen saturation (NL), eutrophication, pollution of the impounded water, temperature increase, specially upstream of the reservoir, restoration of lateral mobility of the river in the water-body (FR).
- Terminal fishing as a frequent problem on large HMWB rivers (FI).
- Geomorphological processes management at the appropriate scales as the best methodological approach to hydromorphological improvement (IT).

5.5 Cumulative effects

Cumulative effects are taken into account in the definition of measures set for **individual hydropower plants** in most countries (11 European States). For instance, in FI, cumulative effects are taken into account if there are several hydropower plants on a water body and mitigation measures for spawning and breeding grounds in tributaries are taken into consideration. Several countries take cumulative effects into account through other policies, such as through the environmental impact assessment procedure (BG, IT, FR). In DE, recommendations on considering cumulative effects can be derived from the continuity strategies of the river basin authorities, which are instruments for strategic water management on river basin and subbasin level (e.g. continuity strategies for potamodromous and diadromous fish). In AT, all effects including cumulative ones are taken into account when assessing the impact of a new hydropower plant to the water body in which the plant is planned as well as to other water bodies which might be affected. Cumulative effects are also one criterion when weighing public interest in applying Article 4.7. Some countries report that methods on cumulative effects are still being developed (UK) or that consideration of cumulative effects is only done partly (SE).

Cumulative effects are also taken into account in the pre-planning of hydropower plants as a strategic instrument of management of **the catchment area** (9 European States). In the UK (Scot), small run-of-river schemes (< approx 100 kw) are normally only permitted in sites where the risk of cumulative impacts is minimal. In DE, the continuity strategies of the river basin authorities for potamodromous and diadromous fish can be used to identify suitable areas for the use of hydropower. In LV, cumulative effects on catchment level are considered through the EIA procedure, whereas IT takes them into account through scenario analysis at the catchment scale.

	Yes	No
Cumulative effects taken into account in the definition of measures **for individual HP plants**	AT, PT, NL, RO, NO, LT, BG, LV, IT, FR, FI, DE, CZ, IS	LU, SE, BE, ES, SI
Cumulative effects taken into account in the pre-planning of HP plants as a strategic instrument of **management of the catchment area**	UK, PT, RO, NO, LV, IT, FR, AT, DE, IS	LU, SE, LT, BG, FI, BE, ES, SI

Note: No answer by PL, HU, SK and CH.

6 Incentives

National and European instruments (such as tradable certificates, feed-in tariffs, support schemes for renewables or ecolabelling) to support and promote hydropower development should be linked to ecological criteria for the protection of water status (Conclusion of 2007 CIS Workshop on WFD & Hydropower).[26]

According to the European State questionnaires on Hydropower and WFD, in most countries, incentives which support hydropower (existing and new) exist but these are not all related to ecological criteria.

Types of incentives	**Presence of incentives in countries**		
	Yes	**No**	**Under development**
Feed-in tariffs	DE, FR, IT, LV, UK, CZ, ES	AT, FI	
Support schemes for new plants	DE, FI, IT, LV, RO, UK, CZ	AT, LT	NO
Support schemes for modernisation	AT, FI, DE, RO, UK, CZ	IT, LV	NO, LT
Ecolabelling	AT, CH, DE, FI, SE	IT, LV, LT	FR
Tradable certificates	DE, NO, RO, SE	AT, FI, LV, LT, UK	FR
Simplified authorisation and licensing procedure	FR, LV, UK	DE, FI, LT	
Compensation for energy production loss (monetary or other)	CH	AT, DE, FI, FR, LT, UK	

Note : 1) No answer on incentives in the questionnaire of RO, HU, PL. 2) There are no incentives available in the following countries: BG, BE, IS, SI, SK

Feed-in tariffs are usually applied to schemes up to 5 MW (in FR, for the first implementation of plants up to 12 MW and certain level of renovation of such existing plants). Details on the criteria for ecological improvement were only provided by FR and DE: fish passes, measures on upstream and downstream continuity, minimum flow and hydromorphological improvement.

Support schemes for new plants exist, in most cases, for small and medium size hydropower (in the UK, for any size). However, most support schemes are not related to environmental criteria or no relevant information was provided in the questionnaires. In AT, the support scheme for new plants is not directly linked to ecological improvements/criteria, but only indirectly as any new plant needs a permit by the water authority, which is only given

[26] Key Conclusions, Common Implementation Strategy Workshop on WFD & Hydropower, Berlin, 4-5 June 2007. Available online: http://www.ecologic-events.de/hydropower/documents/key_conclusions.pdf.

for those plants which fullfill ecological requirements (e.g. fish pass and/or ecological minimum flow). In addition, in AT there are support schemes for investments to improve the ecological status at existing plants (builiding fish passes, improving habitat diversity, reconnection of side arms, etc) earlier than by 2015. 20-30 % of investment costs are promoted by the government with an obligatory concurrent promotion by the regional government (up to additional 25%).

The information provided is similar for **support schemes to modernise HP plants**, i.e. schemes exist mainly for small and medium size hydropower with no related environmental criteria or no relevant information provided in the questionnaires. In LT, according to the RBMPs, it is planned to implement schemes for supporting the modernisation of existing plants by replacing old turbines with turbines less harmful for fish.

With respect to **ecolabelling**, it is worth mentioning their use in Scandinavian countries and in CH. In SE, an NGO ecolabelling (Bra Miljoval) is used with minimum flow requirements, which is related to an environmental fund. In FI, the producer invests 8 ct/MWh to measures, which should mitigate the environmental impact of HP, via an environmental fund. There is no monetary benefit for the producer, if the ecolabelled electricity is not sold for a higher price. In CH, the criteria minimum flow regulations, hydropeaking, reservoir management, bedload management and power plant design are used to certify the plants on two levels (basic and star). Both labels require that the plants also invest 1 cent /kWh into renaturations of rivers in their catchment area.[27]

In the case of **tradable certificates**, little information was provided. No environmental criteria are used in SE. The Water District administration has recently suggested an interpretation of the law for tradable certificates, which includes compensatory support for mitigation measures for small scale hydropower. In NO, tradable certificates are currently not connected to water status improvements either.

Simplified authorisation and licensing procedures have been reported by 3 countries (UK, FR, LV). In the UK (Scot), reduced licence application fees and streamlined information requirements apply to small run-of-river schemes (compared with larger schemes). In FR, simplified procedures are used only to implement hydropower generating facilities on existing dams which have another use and to increase the power of an existing plant till 20%.

In CH, **compensation instruments** for energy production loss have been developed. A new law (Amended Waters Protection Act in force from January 2011) pays the full costs for the mitigation of hydropeaking, fish passes (upstream and downstream) and sediment transport (see Box 2 below).

Box 2 Switzerland to lessen the negative impacts of hydropower

Hydropower plants are the source of 56% of the electricity that is produced in Switzerland. This renewable source offers numerous ecological benefits, but in many cases it can also have negative impacts on the original aquatic habitat. Thanks to a revision of the Swiss Water Protection Act, however, it will be possible to significantly lessen most of these negative impacts by 2030 through the introduction of structural measures, without restricting the level of electricity production.

Approximately half of this supply (100 hydropower plants) is produced in storage power plants in the

[27] For details see: http://www.naturemade.ch/Englisch/Label/label_e_naturemade.htm.

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, 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.

With the revision of the Water Protection Act (January 2011), the legal basis has meanwhile been created for maintaining natural conditions in streams and rivers below hydropower plants. Only constructional measures which in contrast to operational measures not affect electricity production have to be applied by the power plants. This can be the construction of equalising basins or underground channels to a lower lake. In addition to dampening the effects of turbine-related surges, the aim here is to overcome various other ecological problems such as the build-up of silt and debris in the vicinity of dams, and the interruption of fish migration routes by weirs, machinery buildings, etc.

The problem that the authorities are unable to impose any new regulations on electricity companies during the period of validity of a licence is to be solved in the form of a special provision in the Water Protection Act stipulating a retrofitting requirement for all existing hydropower plants, regardless of the duration of the operating licence, but at the same time providing for the payment of full compensation to the operator for the required structural measures.

The funding of around 1 billion Swiss francs which will be required during the coming 20 years for the construction of equalising basins, bypass watercourses, fish ramps and other structures is to be financed via an electricity surcharge of 0.1 cents per kilowatt hour. Thus in keeping with the “user pays” principle, the costs of these measures are to be borne by the consumer.

7 Strategic planning tools

In most countries, there are pre-planning instruments for the strategic development of new hydropower generation (exceptions are LU, BE, CZ, SE, BG and FI).

Levels and types of pre-planning instruments

The pre-planning instruments are used on several levels and, in the majority of countries, different instruments are applied on different levels. Most common are pre-planning instruments on national and regional level.

Examples of national pre-planning instruments include:

- AT – Hydropower potential studies for the national (and some on regional) level
- AT - Definition of ecological high sensitive (high value) and sensitive water bodies
- CH – Recommendations for developing cantonal conservation and exploitation strategies for small hydropower plants
- DE - Hydropower potential study for the national level; in addition, the water authorities check on federal state level whether hydropower use is possible on non-removable cross-river structures
- IS - National master plan on the protection vs. development of hydropower and geothermal energy resources will be submitted to parliament for decision in autumn of 2011
- LV - National ban to build new HP plants on 213 rivers or stretches of rivers
- NL - National level study for the designation of appropriate areas for HP plans
- NO - Definition of national salmon rivers, and in addition a Master Plan for systematic verifiable prioritisation of hydropower projects, based on different user interests and power plant economics.
- PT - National programme for dams with high hydropower potential (which is also integrated in the RBMPs)

Examples of regional pre-planning instruments include:

- AT - Hydropower potential studies for some regions (Bundesländer)
- AT - High status water bodies as not appropriate areas in Vorarlberg, 4 water bodies designated for hydropower use
- DE - Hydropower potential studies for some subcatchments
- FR - Regional scheme for climate, air and energy (SRCAE) fixing, among others, areas with the largest hydropower potential[28]

[28] In FR, appropriate areas are areas with potential which are not on no-go rivers. But the areas can be more or less "appropriate", if there is another protection like Natura 2000, national parks,

- NO – Regional small scale hydropower master planning
- UK (Scot) - Local planning authorities are advised under national planning advice to produce regional plans for hydropower development

Boxes 3-8 give more information on selected pre-planning instruments used in FR, NO and CH.

In some countries, pre-planning instruments are also applied on river basin level. For example, in NO there are permanent protected catchments. In France, lists of rivers are fixed in the basin, including rivers protected against new dams (no-go rivers) and rivers where continuity restoration is a priority (dams must be managed or equipped in 5 years, to ensure upstream and downstream migration of species and a sufficient transfer of sediment). In DE, there are numerous instruments on river basin and subbasin level on strategic water management, such as continuity strategies for potamodromous and diadromous fish.

The pre-planning instruments are part of the following overall planning processes:

	Countries
River Basin Management Planning	PT, NL, RO, IT, FR, AT, DE, ES
National Renewable Energy Action Plan	DE, AT, FR, LT, RO, ES, SI, SK
Hydropower Sector planning	AT, CH, DE, NO, RO
Designation of areas for new hydropower use:	
- Appropriate areas	NL, NO, LT, FR, AT, DE, CH, IS
- Less appropriate areas	CH, DE, AT, FR, NO
- Not appropriate areas	CH, AT, NO
- No-go areas	CH, FR, IT, LV, LT, NO
Land use planning	UK (Scot), IS

Note: No answer on strategic planning in the questionnaires of HU and PL.

Box 3 Development of renewable energy planning in France

Regional schemes for climate, air and energy (SRCAE) built by regional authorities and the state are in process in each Region, until 2012, in accordance with "Grenelle environment acts" of 2009 and 2010. The aim of these schemes is to fix regional guidelines and objectives by 2020-2050, in the field of greenhouse gases reduction, energy efficiency and savings, renewable energies development, air pollution policy and climate change adaptation.

In the field of renewable energies, the schemes will identify areas with large or interesting potential or fix development targets. The identification of the hydropower potential areas (appropriate areas) will be mainly based on producers' data and compatibility with new lists of "no go rivers", restoration of continuity' priorities or biodiversity preservation (Natura 2000, national parks, endemic species, etc.) which constitute "less appropriate or non appropriate areas".

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natural reserves, endemic or protected species, etc. or if the restoration of continuity is a priority on the river concerned.

Stakeholders and NGOs participate actively to the process of the schemes' establishment through technical committees or consultations.

Box 4 Protected rivers in France

The revision of the current lists of protected rivers is in process in France until 2012-2013. In 2006, a law on water and aquatic environments provided a new "classification" of rivers on which special provisions to ensure protection or restoration of ecological continuity, must be respected. Two lists of rivers must be drawn up by the state authority in the basin.

- List 1 is a list of protected rivers against new dams (no-go rivers). This list is based on a selection of rivers among three criteria: high status rivers or migratory amphihaline fish rivers or "biological reservoirs". These "biological reservoirs" are stretches of rivers rich of aquatic species needed to achieve or maintain good ecological status by spreading in water bodies connected to these stretches. Construction of any new obstacle to continuity cannot be authorised on this list 1 rivers, whatever the use concerned.
- List 2 is a list of rivers where continuity restoration is a priority. On these rivers, existing dams must be managed or equipped within 5 years, to ensure upstream and downstream fish migration and a sufficient transfer of sediment. New dams can be authorised if they ensure this continuity. The list 2 is based on migratory fish rivers and rivers at risk of failing the environmental objectives due to hydromorphological pressures, determined in the basin management plan.

Both lists of rivers are fixed after an assessment of the impact on the existing water uses or on the potential of new hydropower development and after stakeholders, local authorities and NGOs consultation.

Both list 1 and list 2 are automatically included in the green and blue infrastructure whose implementation is also in process until 2012-2013, on a regional scale. The aim of the green and blue infrastructure is to restore and preserve land (green) and aquatic (blue) ecological continuity by reducing fragmentation of natural environments or habitats, with special concern to migrating species. Riparian wetlands whose preservation or restoration is necessary to achieve good ecological status of water bodies, will also be included in the green and blue infrastructure.[29]

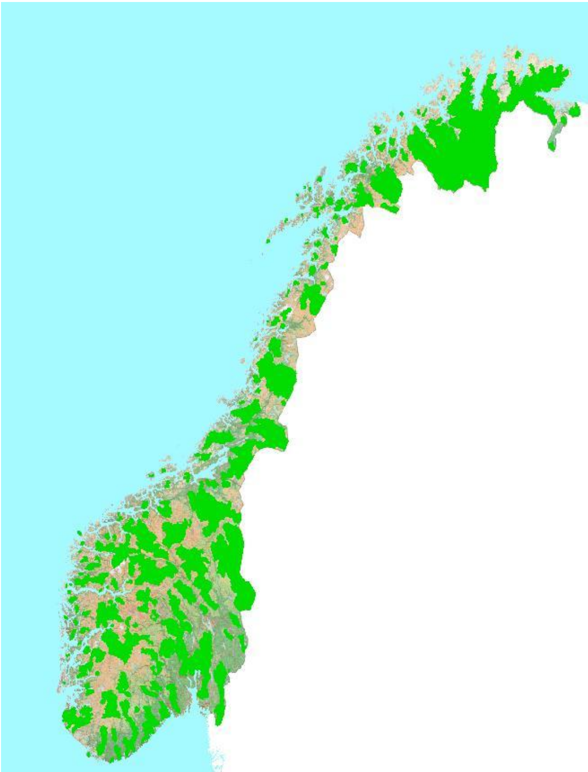
Box 5 Protection Plans for Watercourses in Norway

The conflict between hydropower development schemes and environmental considerations brought about a need for protection plans for rivers and lakes as well as for master plans concerning hydropower development. Protection plans for inland waters were initiated in the early 1970s. By these plans, 388 watercourses (corresponding to 38 % of the total catchment area of Norway)

[29] The Green and Blue Infrastructure was introduced in France by two laws of the 3 August 2009 and the 12 July 2010 following a commitment of the French environment round table ("Grenelle environment"). This initiative aimed at maintaining and reconstituting a network of corridors within France so that animal and plant species can communicate, circulate, find food, reproduce and rest. It is based on three interlocking levels: 1) national guidelines adopted by decree; 2) regional scheme of ecological coherence, drawn up jointly by the regional council and the state government before the end of 2012, in concertation with all local stakeholders and subject to a public participation; these schemes take follow the national guidelines into account and identify the Green and Blue Infrastructure at regional level; 3) planning documents and plans produced by government and by local councils, in particular regarding land use and urban planning, which take the regional scheme of ecological coherence into account at local level.

have been protected against hydropower development.

The purpose of the protection plans is to safeguard complete watersheds to maintain the environmental diversity stretching from the mountains to the fjords. The current plans only protect against hydropower, but a restraint policy should also be exerted towards other kinds of development activities. However, other activities may be permitted in accordance with the licensing system pursuant to the Water Resources Act. This may sometimes result in conflicting situations, where a protected watercourse/watershed actually can be exploited for other uses than hydropower, uses that can have even greater environmental impacts.



There is also an opening for development of mini- and micro hydropower (<1 MW) in protected watercourses, but only if the development is not contradictory to any of the protection criteria. In practice, the policy is very restrictive and permissions are only given in special cases.

Figure. Permanent protected rivers in Norway. 388 rivers/parts of rivers are protected from hydropower development (green areas). Estimated HP-potential in protected areas: 45,7 TWh

Box 6 Master Plan for Hydropower Development in Norway

A white paper to the Parliament in 1980, Norway's future energy- use and production, asked for development of a national master plan for hydropower. The Government was in demand for an extended planning and licensing system that took into account not only the particular hydropower scheme, but also hydropower development at a broader scale, including consideration of socioeconomic and environmental issues. The plan includes many strategic elements comparable to a SEA.

Altogether 310 hydropower schemes larger than 5 GWh/year were considered with respect to project economy and it also comprised possible impacts on the regional economy and conflicts with other user- and protection interests (13 topics were considered). Based on an overall assessment, the projects were then divided into three categories:

Category I comprises the hydropower projects that are ready for immediate licensing and consecutively "go projects",

Category II comprises the hydropower projects that need Parliament approval, and

Category III cover "no go" projects due to disproportionately high development costs and/or high degree of conflict with other user interests, including environmental interests.

The plan has later been supplemented and category II and III have been merged.

Reference: Ministry of Environment. The Master Plan for Hydro Power development.

Box 7 "Regional Master Plans" for Small Scale Hydropower in Norway

In Norway, the interest for small hydropower (1-10 MW) is growing rapidly, and app. 600 applications are currently in some stage of the licensing process. The licensing follows the regulations in the Water Resources Act, but is simplified compared to larger projects. A general description of possible environmental impacts and conflicts is required, and a separate and more detailed report on biodiversity with focus on Red List species is compulsory.

In order to ensure better planning and handling of cumulative impacts arising from several separate projects within a limited area or watershed, the Government has called for development of master plans at the regional level. The plans will also increase predictability and provide guidance for developers, presumably resulting in better applications and discouragement of poorly planned projects. The county administrations will coordinate the planning process pursuant to the Planning and Building Act and the final plans will be approved by the county councils.

As a basis for the regional planning, the Ministry of Petroleum and Energy, together with the Ministry of Environment, have provided national guidelines as a tool for the regional authorities for development of plans and to promote harmonisation of the planning procedures. The first step in the planning process is to demarcate "planning areas" in each county based on the resource maps for small hydropower (development potential) that are available from the Directorate for Water Resources and Energy. It is recommended to carry out planning first in areas where the density of feasible projects is high (clusters) and where conflicts are not likely to occur. Second step implies mapping of various interests (topics) that are sensitive to small hydropower, such as landscape, biodiversity, recreation and tourism, cultural heritage, salmon and fishery, unaffected "wilderness" areas without major infrastructure development (at least 1 kilometre away from such development), and Sami interests (reindeer husbandry) that are mainly associated with northern Norway. The topical areas within each of the planning areas will be defined and classified according to their intrinsic "value": High, medium and low value. Use of available EIA methodology is generally recommended, although it may have to be adapted to serve the specific purpose. By combing the resource maps for small hydropower and the topical maps, e.g. by use of overlay, possible areas of conflict will appear. Methodologies for classification of possible cumulative effects and related conflicts are less developed, and the classification will therefore have to rely more on expert judgement.

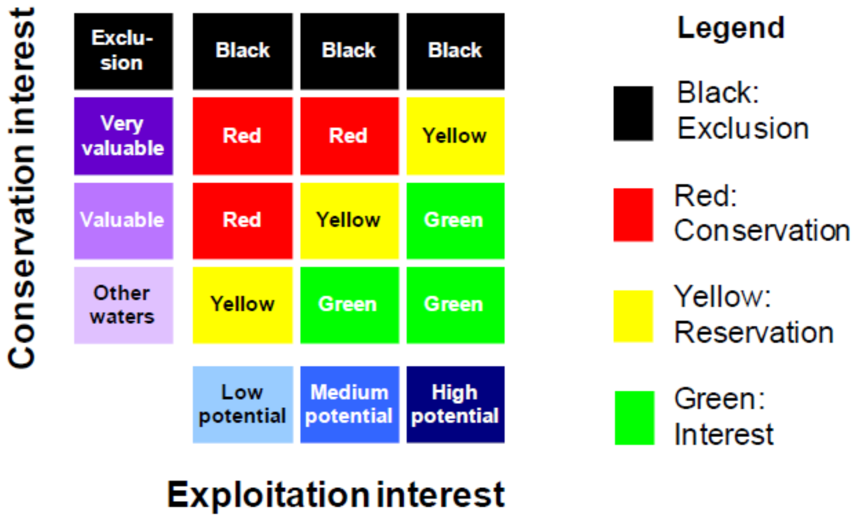
The final step includes development of management policies, strategies and regulative measures based on the systematised information for each of the planning areas. The counties can make references to the plan during the formal inquiry, which is part of the licensing process. Hence, approved plans and inquiries will be directional for the licensing process at the national level.

Box 8 Recommendations for developing cantonal conservation and exploitation strategies for small hydropower plants in Switzerland

The cost-covering feed-in remuneration for electricity from renewable sources has stimulated numerous projects for small hydropower plants in Switzerland which must be assessed in terms of electricity generation, water protection and landscape conservation. These implementation recommendations are intended to support the cantons in this task. They contain ecological, energetic and economic criteria which should be considered when balancing the conservation and exploitation interests. The criteria are given in the following table:

	Recommended requirements for hydropower exploitation / Meaning of colours
Black	**Exclusion → No exploitation** Exploitation of the watercourse is totally excluded and no weighing of interests is carried out. This classification should be used if: — full legal protection already exists, e.g. for mires and mire landscapes of great beauty and national importance, — conservation interests of national importance exist and intervention would cause a serious impact, — hydropower exploitation is always incompatible with the existing conservation objectives in the affected area.
Red	**Conservation → In general no exploitation is possible** The ecological and/or landscape interests associated with watercourses in this class are generally higher than the interest in exploitation of its hydropower. Therefore exploitation constitutes serious intervention and the watercourse is protected. Authorisation can only be obtained in exceptional cases, subject to very stringent conditions.
Yellow	**Reservation → Special conditions must be expected** On valuable watercourses with medium potential and very valuable watercourses with high potential, the ecological and/or landscape and hydropower exploitation interests are both high. The legal discretion granted for the authorisation is interpreted in favour of watercourse and/or landscape conservation and exploitation must represent only minor intervention. The applicant must expect the concession to be granted with special requirements and conditions, stringent if necessary, in favour of watercourse, nature and landscape conservation and must assume higher costs. Micro hydropower plants can generally be expected on other watercourses with low potential. The applicant does not have to expect the concession to be granted with more stringent requirements and conditions in favour of watercourse, nature and landscape conservation. However, because less funding is often available for the planning and operation of micro hydropower plants, safety (flood protection) and compliance with the legal watercourse and/or landscape protection regulations should be given special consideration.
	Recommended requirements for hydropower exploitation / Meaning of colours
Green	**Interest → Exploitation is generally possible** The ecological and landscape interests on watercourses in this class are usually lower than the hydropower exploitation interests. The legal discretion is interpreted in favour of hydropower exploitation due to the lower impact. The applicant can expect authorisation without more stringent conditions.

The final result is a matrix for assessing the conservation and exploitation interests of watercourses:



For details see: http://www.bafu.admin.ch/publikationen/publikation/01593/index.html?lang=en.

Criteria of pre-planning instruments

Due to the variety of pre-planning instruments used in different countries, the criteria applied are very diverse. The following Table 3 summarises the main criteria per instrument reported.

Criteria include in most cases trade-offs between environmental, fishing and recreation interests and energy/economic aspects.

Areas which in several countries are protected from further HP development (defined as “protected”, “not appropriate”, “no-go” etc) include rivers of high conservation and biological value, free-flowing stretches, migratory fish rivers and high status water bodies.

Examples of areas and/or criteria for allowing new HP development include: new HP at existing non-removable cross-river structures, delivery of ecological minimum flow, new HP at existing ponds.

Table 3: Examples of criteria of pre-planning instruments

Country/instrument	Criteria
AT Regional pre-planning (state Vorarlberg)	Water stretches (Water bodies) in high status are not appropriate areas
AT Regional pre-planning (state Tirol)	Voluminous criteria catalogue taking into account ecology, nature protection, energy/economic aspects, water management aspects, regional/spatial planning
AT National criteria catalogue	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 deterioriation (supporting tool for applying Art 4 / WFD) and basis for further planning on regional level
AT Alpine Convention	Common Guidelines for the use of small hydropower in the alpine region
CH Guideline / recommendations for developing cantonal conservation and	Combination of conservation criteria, exploitation criteria, consideration of the watercourse system in its catchment

exploitation strategies for small hydropower plants	area as well as other aspects (e.g. social functions of water course, flood protection, etc) , to produce a matrix of water course exploitation for HP Four recommended requirements for HP exploitation: • Exclusion / no exploitation • Conservation / In general no exploitation is possible • Reservation / Special conditions must be expected • Interest / Exploitation is generally possible
DE National Hydropower Potential Study	Ecological exclusion criteria, e.g. no new HP plants in free-flowing stretches, new HP plants at existing cross-river structures only with delivery of ecological minimum flow
DE Designation of suitable weirs	Check whether hydropower use is possible on existing cross-river structures Criteria for allowing HP can be: removing a weir is not possible for other reasons (e.g. regulation of groundwater levels), delivery of ecological minimum flow, no influence on flood protection functions
DE Continuity strategies for fish fauna	Definition of migration routes of special importance for the conservation and re-settlement of diadromous and potamodromous species. Includes: • Agreement on fish species • Weir register with evaluation of fish continuity • Hydromorphological status and development potential of the habitats
FR Regional scheme (SRCAE) - areas with the largest hydropower potential	Based on producers' data and compatibility with lists of no-go rivers and restoration of continuity' priorities
FR List of no-go rivers	3 criteria: high status waterbodies, migratory fish rivers, biological reservoirs (fixed after an assessement of the impact on the existing water uses or the potential of new HP and after stakeholders consultation)
FR List of rivers with continuity restoration as priority	Based on migratory fish rivers and at risk of failing the environmental objectives due to hydromorphological pressures, determined in the RBMP (fixed after an assessement of the impact on the existing water uses or the potential of new HP and after stakeholders consultation)
IS National master plan on the protection vs. development of hydropower and geothermal energy resources	The following is evaluated: status and qualitative value of nature at sites/areas with potential hydropower and geothermal resources; the effects of their possible development; their importance for other uses (e.g. tourism, grazing, angling); potential effects on the regional and national economy; potential resources at each site and their possible competitiveness. A ranking of potential schemes is performed based on these critera. Each scheme is placed in one out of three categories: To be harnessed, to be protected or pending a decision
LT	New HP can be developed only in places where ponds are already built Approved list of rivers were new HP plants cannot be built (even on existing ponds) In some cases, possibility to install HP plants on artificial water bodies
NO Master plan for water resources	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
NO Permanent protected catchments	Criteria for protection of rivers are trade-offs between conservation values and user interests where unspoiled nature, science, outdoor activities, landscape, wildlife / fishing, cultural sites, water quality and raindeer/Sami interests are considered. HP development is not allowed in the protected rivers, with some exceptions for HP smaller than 1 MW
NO National salmon rivers	New initiatives and activities that can harm wild salmon are not allowed. Environmental improvements should be given priority for wild salmon, when HP licences terms are revised (appr. 20 waterbodies/ HP-plants within the National Salmon Rivers)
NO Small scale hydropower planning	Used voluntarily on regional or local level Criteria include landscape (valuable landscape elements, fragile mountain areas, fjords), biodiversity, intervention-free natural areas, fish and fishing, cultural heritage, recreation, tourism, reindeer and cumulative impacts
PT National programme for dams with high hydropower potential	Based on strategic environmental assessment methodology (SEA) Approval of individual HP plants depends on the issuance of a favourable environmental impact assessment (EIA) and compliance with WFD requirements for new modifications

Pre-planning and dialogue with water users

Ten countries replied that their pre-planning instruments foster the dialogue with the water users (AT, DE, PT, NO, LT, FR, IT, IS, ES, SK). In NO and AT, for instance, all pre-planning instruments have been the subject of extensive consultations with stakeholders. In LT, water users can take part in pre-planning processes when the procedure of environmental impact assessment is performed.

8 Implementing WFD Article 4.7

Under Article 4.7 exemptions from achieving good status or potential and the "non-derogation clause" can be applied for new modifications and new sustainable human development activities. This can relate to new projects (e.g. new specific hydropower dams) or to modifications to existing projects. In most countries, it is generally assumed that a new hydropower plant will lead to a deterioration of good status and the procedure of Article 4.7 is generally followed (see table below):

	Yes	No	Unknown	No answer
Is it generally considered that new hydropower plants will lead to a deterioration of GES?	LV, BG, DE, NO, NL, PT, SE, LT, LUX, ES, IS, SI	AT, FI, FR, IT, RO, UK, CZ	HU	PL, CH, BE (Wallonia), SK
If it is assumed that new hydropower plants will deteriorate GES, is the procedure of Article 4.7 for new plants generally followed?	DE, PT, UK, FR, LT, LUX, RO, ES, SI, NO	BG, NL	SE, IS[30]	LV, BE (Wallonia), SK

Member States that do not generally consider that new hydropower plants will lead to a deterioration of GES all highlight the site-specific nature of hydropower plants and mention certain variables to take into account in this context:

- Current status of water body, type of hydropower plant/design, obligatory and feasible mitigation measures (AT).
- Size, design and location of hydropower plant (UK).
- Catchment characteristics (IT).
- Outcome of environmental impact assessments (RO).
- In FR, deterioration is assessed case by case and deterioration of good ecological status is not considered systematically, but it is considered that any new plant will deteriorate very high status (FR).

From the questionnaires, the following picture on current application of Article 4.7 is drawn:

	Yes	No	Unknown	No answer
	Country (nr. plants)			
Has Article 4.7 been already applied for new hydropower plants?	AT (2), IT(N.N), NO(N.N), PT(10), UK(30), RO(2)[31], CZ, SI (4)	DE, FI, CH, LV, BG, NL, FR, HU, LT, LUX, ES, IS[32]	SE	PL, BE (Wallonia), SK

[30] WFD is not in force yet.

[31] The construction of these HPPs in RO was approved before the year 2000 and having in view that their construction is currently under way, the exemptions have been identified and requested

	Yes	No	Unknown	No answer
	Nr. plants (country)			
Number of plants approved although a deterioration of GES is expected	1 (AT), 9 (PT), 28 (UK), 2 (RO), 4 (SI)		Figure not available (NO), No definitive answer (CZ)	IT, SK

In AT, PT and UK, not all hydropower plants for which Article 4.7 was applied were approved under the process.

In AT, one out of the two hydropower projects was rejected for not passing the Article 4.7 test. Concerning the low number of test application, AT also mentioned that it is recommended to discuss new hydropower projects with the water management planning department of the local authority very early. This is already done before a detailed plan of the power plant is made to find out at a very early stage whether a deterioration of ecological status can be expected which cannot be mitigated by technical measures and what the chances are to pass the Article 4.7 test. This way of doing should support people/companies, who plan to build a small hydropower plant in particular, in their decision, whether it really makes sense to invest money for a detailed planning. As only low chance of passing the Article 4.7 test was forecasted, many hydropower projects were not further pursued and not brought into the official approval process where the Article 4.7 test would have had to be applied.

In PT, the result of the environmental impact assessment also indicated that Article 4.7 was not applicable in one case. The UK did not provide information as to why 2 plants did not pass the Article 4.7 test.

For those countries currently not applying Article 4.7 for new hydropower plants, only LV and FR have plans to do so.

If Article 4.7 is applied (and the GES or GEP is derogated), the Directive specifies the following reasons for applying this exemption[33]:

- Modifications to the physical characteristics of water bodies mean modifications to their hydro-morphological characteristics. The impacts may result directly from the modification or alteration or may result from changes in the quality of water brought about by the modification or alteration. For example, hydropower plants, flood protection schemes and future navigation projects are covered by this provision.
- New sustainable human development activities: The Directive does not give a definition of those activities. In general, such activities cannot be defined per se

in the frame of the RBMPs; steps of the application of the Art. 4. 7. procedure will be followed and further approached.

[32] WFD is not in force yet.

[33] See CIS Guidance Document No. 20: Guidance on exemptions to the environmental objectives (2008).

through a set of criteria or policies but are framed by the relevant decision making process requirements within an open ended and iterative procedure. The exact definition for an activity falling under sustainable development will thus depend on the time, scale, stakeholders involved and information available.

In order to apply Article 4.7, a certain process has been agreed in the WFD Common Implementation Strategy.

- **WFD Article 4.7(a)** requires mitigation, which aims to minimise or even cancel the adverse impact on the status of the body of water. Mitigation measures could be the construction of fish passes in case of a new hydropower facility, or the establishment of minimum ecological flow **(see Questionnaire 6.3 (a))**.

  Concerning the issue of which practicable steps have been taken to mitigate the adverse impacts on the status of the affected water body(s), the following interesting examples have been identified:

Box 9: Example from AT

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. Austria has published a catalogue of mitigation measures. It included measures stated to be State of the Art and Technology/ best available techniques for all kinds of hydrological alterations and also information on the relevance for ecological improvement.

In the frame of the HMWB designation process mitigation measures to achieve GES were identified out of the measure - catalogue mentioned above which mean a significant adverse effect on specific uses/wider environment and for hydropower as a use in particular. These measures are excluded. The rest of measures – if technical feasible at the specific water body – will be used as a basis for the definition of GEP (alternative measure approach).

From the Austrian point of view, it makes sense to link measures needed for the GEP definition with mitigation measures for new hydropower plants which would mean a deterioration of water status. and require an application of Art. 4(7). Those measures relevant for GEP (and not disproportionate costly) are at least also relevant for the definition of practical measures to mitigate the adverse impact as mentioned in 4.7 (a).

In many cases, the following mitigation measures are used: constructing high variability (fish) habitats in the impoundments (at the head of the impounded section in particular), improving habitat structures, constructing spawning habitats, reconnection of flood plains/side arms, building new (connected) side arms.

Any new hydropower project has to give the following information to the authorization body.

- Which water body /bodies will be affected by the new project.
- What is the status of the affected water bodies (includes at least information on the hydrological data, morphological data, existing migration barriers, results of the biological survey/assessment,…)
- Detailed description of the design of the power plant and mitigation measures (obligatory ones and additionally planned ones)

- Estimated effects of the new installation including the planned mitigation measures on the water bodies affected–
    - Additional information has to be provided whether other public interests (already listed in the National Water Act like flood protection, nature /cultural heritage, …) are expected to be negatively affected.

Based on this the authorization body decides whether a deterioration of status is assumed or not. In case of a forecasted deterioration the Art. 4(7) will be applied by answering the following questions:

- are there additional mitigation technical measures, which are technical feasible and not disproportionate costly to stop deterioration or at least to minimise negative effects significantly
- is the new modification of overriding public interest, …. (4.7 c WFD)
- is there a better environmental option, which is technical feasible and not disproportionate costly (4.7.d WFD)

Box 10: Example from UK

In the UK, mitigation measures are required as preconditions to receive authorisation (license, etc) for new plants. To aid in the authorisation process, a guidance document has been published by the Scottish Environment Agency[34] which outlines the process of applying for a water use licence including the following steps:

1. Provide information on river flow characteristics
2. Carry out a habitat and biological survey
3. Identify likely natural and artificial obstacles to fish migration up and downstream
4. Carry out a bryophyte and lichen survey due to the rarity of such flora
5. Provide information on the river morphological type to assess potential impacts on sediment movements and transport as result of the development
6. Identify historical buildings and monuments potentially affected by hydrower construction
7. Identify recreational use that may be affected by the project
8. Identify mitigation measures

Special considerations also need to be taken into account in nature protection areas.

In addition, England's Environment Agency has published a good practice guideline[35] for hydropower developments, focussing on environmental site audits of proposed hydropower plants, ecological requirements (including minimum flow and seasonal fish migration, flow monitoring and fish passage, among others.

Box 11: Example from CZ

The Czech Republic has used a methodological direction for establishing minimum residual flow and control of the use of water. Presently a new government order and a new methodological direction based on an acceptable degree of natural flow modification for individual catchments are prepared.

[34] http://www.sepa.org.uk/water/hydropower.aspx),

[35] http://publications.environment-agency.gov.uk/PDF/GEHO0310BSCT-E-E.pdf

The water authority will be responsible for assessing what is considered as acceptable modification of natural flow and the use of water.

WFD Article 4.7(c) requires that the new modification is justified because it is of overriding public interest / the benefits of the project outweigh the benefits of achieving the WFD environmental objectives **(see Questionnaire 6.3 (b))**. According to the European State questionnaires, the overriding public interest has been justified as follows:

- It will depend on the level of production on a case by case basis (FR).
- In the licensing process, expert judgement is based on consultation with stakeholders. All decisions must be properly justified (NO).
- Projects have to contribute to goals of renewable energy production, reduce greenhouse gas emission, and allow other uses. Additionally, it is also expected that the construction is associated with employment creation and economic development gains (PT).
- Promoting renewable energy is considered an overriding interest and sustainable development (RO).
- Public interested is limited (SE).
- In the UK (Scot), the Environment Agency weighs the social, economic and environmental impacts of a new modification and judges whether or not the benefits on their own outweigh the benefits of protecting the environment from deterioration.
- Hydropower potential is almost depleted (CZ). Therefore, the focus for the CZ in this time is not to support new big hydropower plants but to support reconstruction and modernization of small hydropower plants.
- In the Austrian national river basin management (NGP) plan, it was generally stated that when weighing public interest, it is a clear principle that the higher the ecological value of a water stretch (water body) the higher the energy output has to be[36]. To support the water management authorities when weighing the different public interests in the Article 4.7 test, to ensure an Austrian wide common understanding and application as well as to make the decision transparent, it was included in the NGP that a catalogue of criteria for hydropower has to be developed. This catalogue has to include ecological aspects, energy management and other water management aspects (like effects on flood protection, tourism, groundwater quality and quantity). It will also give the information, which water bodies are of high or very high value.

- **WFD Article 4.7 (d)** requires Member States to assess if the beneficial objectives served by new modifications or alterations of a water body cannot for certain reasons (technical feasibility, disproportionate costs) be achieved by other means, which are a significantly better environmental option **(see Questionnaire 6.3 (c))**.

  Few examples of methods to carry out such an assessment exist given that many European States have not yet applied Article 4.7. NO mentions that all relevant

[36] Please note that there is a more detailed criteria catalogue available. See Annex 1 of the Austrian questionnaire on Hydropower & WFD at: http://www.ecologic-events.de/hydropower2/background.htm.

impacts (cumulative) and benefits are taken into account in the licensing process. Then all matters of importance are discussed, including cumulative impacts. Adjustments of project design and relevant mitigation measures are considered. Based on that, hydropower plants considered to have major environmental impact are denied. In IT and SE, the assessment of alternatives is still ongoing. In AT, the Energy Strategy 2010 clearly sets that, besides other renewable energy sources, 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).

The following interesting examples of methods for assessing significantly better environmental options have been identified:

Box 12: Example from RO

To assess the new modifications against significantly better environmental options, the technical feasibility and disproportionate costs are analysed in relation with the alternatives (refurbishment, energy production, modernisation, etc). A matrix of relevance from technical feasibility and disproportionate costs is analyzed for all possible alternatives. Qualitative data are completed with quantitative in some cases. Once the technical feasibility analysis shows disproportionate costs, the project is excluded.

Box 13: Example from UK (Scot)

Within the assessment of alternative options, SEPA takes the following factors into account:

1. Use of alternative sites: adverse impact of a scheme derives primarily from the particular sensitivity or importance of the site rather than just from the scale or nature of the proposal itself, there are a reasonable number of potential alternative sites, and there are other feasible sites that are not disproportionately costly to develop

2. Use of a comparable and established renewable energy technology known to have considerable capacity for development: evidence that wind farms capable of producing at least the equivalent energy output have potential to be developed [e.g. knowledge of applications; recent development trends; etc].

3. Improve the output of existing hydropower schemes: evidence that the energy output of the scheme is small or very small; and the output has not been maximised at all medium and large schemes.

Box 14: Example from PT

Considering the demands of the Renewable Energy Directive (2009/28/EC) and consequent National renewable energy action plan, as well as the National energy policy, the promotion of hydropower was considered has a crucial measure in order to achieve the goals set out at a National level. Therefore, considering that these projects are of overriding public interest and that the beneficial objectives served by them cannot be achieved by any other means, a decision on the implementation of new hydropower plants in Portugal, along with other measures (*e.g.* refurbishment of existing plants), was made.

This decision was a two stage process supported through i) The Portuguese National Programme for Dams with High Hydropower Potential (PNBEPH) corresponding to a Strategic Environmental Assessment – SEA (fully concluded stage); and ii) Environmental Impact Assessment (EIA) procedures on a case by case basis (stage not yet fully concluded).

Several of the steps and questions necessary to trigger Art. 4.7 of the WFD, and laid out in the WFD exemption guidance document[37], were considered throughout the various stages of these processes (although not necessarily in the same order as indicated in the guidance).

25 areas with potential to develop hydropower projects were analysed in a SEA in terms of critical environmental factors (but also for heritage and socio-economic factors). Among the environmental factors the SEA considered the identification and assessment of the affected water bodies (considering WFD requirements), river continuity, biodiversity and nature protected areas, eutrophication risk, sediment transportation and coastal erosion, sensitive areas, 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 the establishment of a “rating” for each of the 25 areas in terms of environmental impact.

Ultimately, SEA results translated into a preliminary selection of the 10 most favourable projects which maximize the cost-benefit relation (where cost is considered in an environmental perspective). For the 10 selected projects the SEA also establishes a list of mitigation and compensation measures that should be implemented if these projects are approved. The SEA report has been subjected to public consultation resulting in a final report where further recommendations on mitigation and compensation measures and monitoring procedures were included.

Following SEA approval the 10 preliminary selected projects are subjected to EIA processes in accordance with National and Community legislation. The projects are further analysed in more detail and several steps of the Art. 4.7 are carefully examined. Namely a detailed identification and quantification of the environmental impacts caused by these projects is made, assessing not only the water bodies directly affected by the project but also other water bodies within the same river basin. Also, the technical requirements of mitigation and compensation measures (that were broadly identified in the SEA stage, but assumed as a precondition to proceed with the projects development) are defined accordingly, namely the type and functioning mechanisms for promoting the migration of fish and the ecological flow regime.

Another necessary step to trigger Art. 4.7 is also further examined in the EIA stage, the assessment of implications of the project implementation in the achievement of other Community legislation objectives. In this respect, one of the hydropower projects selected during the SEA failed to comply with Art. 4.7 procedures. During the EIA studies a previously unknown population of freshwater pearl mussel (Margaritifera margaritifera), included in annex II and V of Habitats Directive, was identified in the river basin. Since no mitigations measures were considered totally effective in order to decrease or completely nullify the impacts on this protected species (and also on the salmonid species on which it depends to complete its life cycle) the project was rejected.

The EIA processes are still in progress, although they have been concluded for 3 of the 10 projects. From these, 2 projects were approved and one was rejected. It is also worth mentioning that after the EIA stage the approved projects are subject to licensing were all obligations of the permit owner are defined in detail, including the mitigation and compensation measures as well as all technical requirements of the monitoring programmes for which the permit owner is accountable for.

All relevant information resulting from the SEA and EIA processes is integrated in the River Basin Management Plans where all the reasons for the implementation of these projects and which lead to the application of Art. 4.7 are explained in detail.

[37] Common Implementation Strategy for the Water Framework Directive 2009: Guidance Document No. 20 on exemptions to the environmental objectives. Technical Report - 2009 – 027.

9 Discussion topics for the workshop

The following topics are proposed for discussion in the breakout groups at the workshop:

Block A. Environmental improvement on hydropower schemes

This block will cover existing and new schemes, including differences in the technical and legal requirements for existing and new schemes:

(a) technical mitigation measures to improve the environment (e.g. ecological minimum flow, upstream continuity, downstream continuity, hydropeaking, sediment bed load, other);

(b) identification of impacts on the amount of hydroelectricity production due to mitigation measures (e.g. Are impacts identified on local level or/and aggregated national level?);

(c) exclusion of mitigation measures that would have significant adverse effects on the water use; (What is considered as significant adverse effects on hydropower use? What experiences do countries have with the definition of significant adverse effects? Are the effects defined on water body level or on national level?)

(d) mechanisms used to secure environmental improvement, including legal requirements and incentives.

Block B. Strategic planning mechanisms

(a) Strategic planning mechanisms for existing and new hydropower schemes (in the context of overall planning processes incl. RBMP, NREAP, hydropower sector planning, designation of areas for new HP use)

Block C. Application of WFD Article 4.7 - Balancing hydropower development and the protection of the water environment

This block will cover new schemes. It will focus on:

(a) defining over-riding public interest and deciding whether the benefits to the environment and society are outweighed by the benefits to human health, human safety or to sustainable development (WFD Art. 4.7.c);

(b) assessing significantly better environmental options (WFD Art. 4.7.d);

(c) measures to mitigate the adverse impacts of the hydropower plant on the water body incl. good practice examples for new schemes (WFD Art. 4.7.a).

10 Conclusions & recommendations of the workshop

10.1 Overview

1. The first WFD Common Implementation Strategy workshop on hydropower was held in 2007. Since then, most Member States have finalised and published their first river basin management plans and have begun the process of implementing programmes of measures.

2. This practical experience underpinned and facilitated a good technical exchange of information at the 2011 workshop. It was clear from the exchanges that countries and stakeholders still have much to learn from each other.

3. In 2009, Directive 2009/28/EC on the promotion of renewable energy generation was adopted. The Habitats and Birds Directives as well as the new Biodiversity Strategy of 2010 require that Europe halts and reverses the loss of biodiversity until 2020, which also applies to river ecosystems. Successful implementation of all Directives requires properly integrating energy and water policy.

10.2 Existing hydropower schemes

General conclusions

4. All countries are seeking to improve the water environment with a minimum impact on renewable electricity generation. This includes seeking opportunities wherever possible to deliver environmental improvements without any reduction in power generation (win-win) and possibilities of modernisation and upgrading of existing infrastructures in order to minimize the need for new sites.

5. The potential cumulative total reductions in existing hydroelectricity generation due to WFD implementation so far foreseen by the few countries which have undertaken these analysis and the European Commission are very similar at around 1,5% to 5%.

6. There are still gaps in understanding the ecological effectiveness of mitigation measures for some of the adverse effects of existing hydropower schemes. However, there is already sufficient existing knowledge to begin work on improvement measures where there is adequate confidence in their effectiveness.

7. The effects of hydropower schemes on river continuity for sediment transport, and the potential to mitigate these effects, should receive greater attention by countries than they have so far received.

Good practice recommendations

8. Good practices to ensure the achievement of the improvement objectives established in the river basin management plans include:

- Where possible, providing flexibility in the legal framework to enable timely revision of permit conditions.

- Engagement with hydropower operators and, where appropriate, use of incentives to ensure progress towards achievement of objectives for water environment even where there are long concessions.

9. Given the importance of renewable energy, environmental protection and the current economic challenges, we should aim to ensure that any mitigation measures entailing a reduction in electricity generation or requiring significant investment also deliver significant environmental improvements.

10. Good practices to help maximise environmental benefits include:

- Prioritising mitigation action where there is reasonable certainty that it will deliver significant environmental improvements.
- Prioritising improvements that will deliver multiple benefits.
- Using no regrets measures where there is uncertainty about ecologically optimum mitigation and then fine-tuning measures as knowledge about ecological needs improves.

11. On-going efforts to improve understanding of the most ecologically effective mitigation are also important. Good practices to help do this include:

- Using monitoring programmes to help better assess the ecological status, explain changes in the WFD biological indicators values and better understand effectiveness of measures.
- Stimulating and supporting innovation of lower impact techniques by the sector. Examples include:

  (a) providing sufficient advanced warning of improvement requirements to allow time for the development of solutions with the minimum impact on generation;

  (b) collaboration on and/or co-funding of research and development (R&D) projects;

  (c) use of incentives and feed-in-tariffs that are clearly conditioned on environmental improvements and reward environmental performance;

  (d) competitions for concessions in countries, where the concessioning process allows it, based on the best environmental performance.

12. There is already some expertise on mitigation measures across Europe and this is being increased through national research projects. One example is the Hydropower Sustainability Assessment Protocol aimed at helping assess and improve the effectiveness of mitigation.[38] The workshop recommended establishing a mechanism to collate the outcomes of national research efforts to help make them available more widely.

13. Good practice recommendations for mitigation measures include providing:

- 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.

[38] Available at: http://hydrosustainability.org/.

- Where relevant, effective provision for upstream and downstream migration of fish including sufficient flows.
- Dampening of hydropeaking by, for example, gentle ramping or discharging tailrace flows into a retention basin.

The choice and design of mitigation should take account of relevant site-specific circumstances, in particular the potential for ecological improvement.

Designation as heavily modified

14. Some Member States have designated water bodies affected by run-of-river schemes as well as those affected by storage schemes as heavily modified. Others have limited designation to water bodies affected by water storage schemes.

15. It is important when designating heavily modified water bodies, particularly those not affected by water storage schemes, to give clear reasons and criteria for designation in accordance with the WFD Article 4(3) criteria.

10.3 Strategic planning

General conclusions

16. The river basin management planning process provides an opportunity to integrate strategic planning for hydropower development with water environment objectives.

17. Good strategic planning can help streamline the authorisation process on proposed new hydropower developments and improve transparency and predictability for hydropower developers.

Good practice recommendations

18. Good practices on strategic planning include:

- Using the strategic planning process as a key opportunity to help integrate water and energy policy objectives as well as the objectives of other key policy areas, such as nature conservation (e.g. by engaging the different Ministries/policy leads in the development of the plan; sharing ownership of the plan).
- Linking strategic planning for the water environment, nature conservation and hydropower with the national energy planning on renewable electricity.
- Involving all interested parties in the development of plans.
- Using the planning process to help set priorities (e.g. with respect to balancing energy, environment and water management priorities).

19. Good practice uses of strategic plans include:

- Using the plan to provide upfront information to developers about where (geographically) gaining authorisation will be more or less difficult.
- Using the criteria on which the strategic plans are based as a framework for project level decision-making.

- Using the policies and criteria established in the plans to help manage risk of cumulative impacts from schemes in the (sub)river basin and even to decommission hydropower plants on priority river sections.

20. There is already considerable expertise on strategic planning in relation to hydropower and the water environment. The workshop recommended establishing a mechanism to collate and share the criteria on which countries' strategic planning frameworks are based.

10.4 Deciding whether deterioration is acceptable

Conclusions

21. Not all hydropower developments result in deterioration of status. For those that do, Member States have still been able to authorise them where the WFD Article 4.7 exemption requirements are met.

22. Even small hydropower schemes can have significant adverse impacts on the water environment, particularly if they are inappropriately located or do not include adequate mitigation. Approval requirements for new schemes and mitigation priorities for existing schemes should be based on environmental risk/impact rather than on scheme size. Similarly, any financial support system intended to help encourage environmental improvements at existing schemes or support low impact new schemes should be linked to environmental performance rather than scheme size.

23. The Article 4.7 exemption tests are a legal requirement for new modifications and their proper application reflects good practice environmental decision-making.

24. A hydropower project is not automatically of overriding public interest just because it will generate renewable energy. Each case has to be assessed on its own merits.

25. Addressing better alternative options in a strategic plan will make the application of the exemption tests much more straightforward. Strategic planning is thus important to make informed decisions about better alternative options.

26. Article 4.7 requires the reasons for modification or alterations leading to deterioration of status (including those resulting from hydropower developments) are set out and explained in the river basin management plans. So far, Member States have only rarely reported on the application of Article 4.7 in the current river basin management plans and the reasons for this are not clear.

Good practice recommendations

27. Good practice examples on the application of WFD Article 4.7 include:

- Fully embedding the exemption tests in the normal authorisation process.
- Being clear and transparent upfront about the decision-making criteria, whether or not a strategic plan is in place.
- Consulting interested parties about the decision making criteria.
- Creating a proportionate and streamlined system for decision-making with the aim of minimising unnecessary delays that could compromise timely achievement of renewable energy targets.

- Making clear the reasons for a decision to grant or refuse authorisation.
- When considering better alternative options, a key consideration is whether the alternative would provide an equivalent benefit to that of the scheme. This has implications for the geographic scale at which alternatives are considered. For example, where the main benefit is its contribution to renewable energy targets, the appropriate scale for alternative renewable energy sources is the scale at which those targets are set. Alternative locations for a hydropower scheme usually cannot be restricted to the local level.

28. Article 4.7 requires that the reasons for a new scheme are of overriding public interest and/or the benefits to the environment and to society of achieving the objectives for the water environment are outweighed by the benefits of the new modifications or alterations to human health, to the maintenance of human safety or to sustainable development. Good practice in applying this test involves balancing the benefits for society and the disadvantages/damages to public interest; it is important to weigh ecological values, energy values and other benefits; transparent criteria are needed for all aspects.

29. There is growing experience on the application of Article 4.7. The workshop recommended establishing a mechanism to share information on the decision-making criteria being used by Member States (i.e. the factors being weighed in the balance; how weightings of different factors are decided).

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Annex I: Key figures on hydropower

	National electricity production	Electricity produciton from RES	Electricity production from HP including pumped storage	Electricity production from HP excluding pumped storage	Currently installed HP capacity: Total		Currently installed HP capacity: From run-off river HP-plants		Currently installed HP capacity: From storage HP-plants		Currently installed HP capacity: From pumping storage HP-plans		Figure of installed capacity includes pumping storage
Unit	(GWh/y)				MW	GWh/y	MW	GWh/y	MW	GWh/y	MW	GWh/y	
AT	66841,00	42369,00	40690,00	37958,00	12469,00	40690,00	5192,00	28413,00	7069,00	12276,00	4285,00	n.a	yes
BE	31875,00	2035,00	1740,00	402,00	115,90	402,00					1307,00	1338,00	No
BG	46260,00	6196,00	6160,00	5523,00	3108,00		143,00		2027,00		938,00		yes
CH	66300,00	38400,00	37500,00	35000,00	15400,00	37500,00	n.a	16000,00		21500,00	n.a	n.a	No
CZ	85910,00	3741,00	3381,00	2790,00	2203,00	3381,00					1147,00	591,00	yes
DE	576829,00	94600,00	24834,00	19059,00	4050,00	20095,00	n.a.	n.a.	n.a.	n.a.	6213,00	6413,00	No
ES	297000,00	74000,00	23800,00		18687,00	34617,00	3390,00	6506,00	12751,00	24472,00	2546,00	3640,00	yes
FI	77000,00	23870,00	13147,00	13147,00	3127,00	13147,00	n.a	n.a	n.a	n.a	0,00	0,00	No
FR	522132,00	74428,00	67000,00		25688,00	62545,00							yes
HU	40025,00	58,10		0,80	56,00		42,00						
IS	17059,00	17057,00	12592,00	12592,00	1883,00		167,00		1716,00		0,00		No
IT	298208,00	75269,00	42141,00	39402,00	21856,00	53771,00	20758,00	20914,00	17995,00	18670,00	4017,00	3189,00	yes
LT	5700,00	887,00	1300,00	540,00	n.a.						900,00	760,00	No
LU	3878,00	264,00	833,00	97,00	1134,00	833,00	34,00	97,00			1100,00	736,00	yes
LV	6627,00	3635,00		3520,00	1567,00	3520,00	1567,00	3520,00				0,00	No
NL	113503,00	10147,00	98,00	98,00	37,00	106,00	37,00	106,00	0,00	0,00	0,00	0,00	yes
NO	124360,00	119000,00	117907,00		29973,00	124445,00	6556,00	31473,00	22073,00	90782,00	1344,00	2190,00	yes
PL	151697,00	8679,00		2375,00	946,00	2375,00					1756,00		No

	National electricity production	Electricity produciton from RES	Electricity production from HP including pumped storage	Electricity production from HP excluding pumped storage	Currently installed HP capacity: Total		Currently installed HP capacity: From run-off river HP-plants		Currently installed HP capacity: From storage HP-plants		Currently installed HP capacity: From pumping storage HP-plans		Figure of installed capacity includes pumping storage
Unit	(GWh/y)				MW	GWh/y	MW	GWh/y	MW	GWh/y	MW	GWh/y	
PT	50207,00	18590,00	9009,00	8284,00	5080,00	9009,00	2659,00	5706,00	1392,00	2578,00	1029,00	725,00	yes
RO	59766,20	20264,90	19857,20	19857,20	6453,00	19857,00	2755,99	11181,00	3697,01	8676,00	0,00	0,00	yes
SE	146021,00	80000,00	68429,00	68429,00	16195,00	68429,00	800,00	2000,00	15395,00	66000,00			yes
SI	14142,00	4559,00	4624,00	4198,00	1188,00	4588,00	950,00	3993,00	53,00	169,00	185,00	426,00	yes
SK	27720,00	5750,00	5493,00	5099,00	2584,00	5493,00	1361,00	4597,00	308,00	502,00	915,00	394,00	yes
UK	381247,00	25355,00	6708,00	3558,00	1651,00						2744,00		No

	Number and capacity of hydropower plants P< 1 MW			Number and capacity of hydropower plants 1 MW < P < 10 MW			Number and capacity of hydropower plants P > 10 MW			Set targets for electricity production from HP (excludes pumping storage)
Unit	Nr	MW	GWh/y	Nr	MW	GWh/y	Nr	MW	GWh/y	
AT	2127,00	328,00	1611,00	252,00	721,00	3217,00	154,00	11419,00	35862,00	Yes
BE	52,00	7,70	22,20	11,00	52,80	205,40	3,00	55,40	17,43	
BG	125,00	140,28		62,00	386,35		23,00	2546,52		Yes
CH							n.a	13800,00	33700,00	Yes
CZ		80,00	323,00		233,00	995,00		743,00	1472,00	Yes
DE	7325,00	507,00	2300,00	309,00	987,00	4050,00	95,00	2558,00	11650,00	Yes
ES		242,00	831,00		1603,00	4973,00		16842,00	28813,00	Yes
FI	87,00	42,00	n.a	75,00	268,00	n.a	57,00	2817,00	n.a	Yes
FR	1355,00	448,00	1331,00	515,00	1654,00	4774,00	281,00	23586,00	56439,00	Yes
HU	10,00	0,50		1,00	4,40		2,00	39,00		Yes
IS	24,00	6,00		17,00	66,00		12,00	1811,00		
IT	1270,00	466,00	1823,00	682,00	2190,00	7260,00	304,00	19083,00	32951,00	Yes
LT	83,00	17,45		4,00	8,26		1,00	100,80		Yes
LU	27,00	2,00	6,00	4,00	32,00	91,00	1,00	1100,00	736,00	Yes
LV	143,00	25,00	70,00	1,00	1,20	6,00	3,00	1550,00	3444,00	No
NL	2,00	0,45	0,70	2,00	11,80	30,00	2,00	15,50	76,00	No
NO	503,00	156,00	676,00	487,00	1642,00	7013,00	333,00	28176,00	116756,00	
PL	663,00	92,00	292,00	55,00	182,00	628,00	9,00	672,00	1455,00	Yes
PT	71,00	35,00	79,00	82,00	351,00	822,00	39,00	4694,00	8108,00	Yes
RO	174,00	80,00	247,70	98,00	315,00	1025,40	105,00	6058,00	18584,00	Yes
SE	1692,00	914,00	1700,00	177,00	885,00	2600,00	206,00	15000,00	60700,00	
SI	352,00	118,00	262,00	18,00	37,00	192,00	20,00	916,00	3744,00	Yes
SK	184,00	30,00	140,00	19,00	40,00	243,00	25,00	1403,00	5110,00	Yes
UK	400,00	221,00		37,00	123,00		47,00	4350,00		No

Regarding the planned electricity production from hydropower in 2020 according to the 2020 objectives of the Renewable Energy Directive as set in your NREAP													
	Expected electricity production 2020			Expected installed HP capacity in 2020 from:									Figure of installed capacity includes pumping storage
	Total	from RES	from HP	Total HP		run-off river HP-plants		storage HP-plants		pumping storage HP-plants			
Unit	GWh/y	GWh/y	GWh/y	MW	GWh/y	MW	GWh/y	MW	GWh/y	MW	GWh/y		
AT		49900,00	42112,00	8997,00	42112,00	?	?	?	?	4285,00	2732,00		No
BE		14253,00	479,00	139,00	479,00								No
BG													
CH													
CZ	85000,00	11660,00	2275,00	1125,00	2275,00								No
DE	567000,00	216935,00	20000,00	4309,00	20000,00	?	?	?	?	7900,00	8395,00		No
ES	350584,00	146080,00	33140,00	22362,00	39593,00					5700,00	8023,00		Yes
FI	101270,00	33420,00	14410,00	3300,00	14410,00	n.a	n.a	n.a	n.a	0,00	0,00		No
FR	no objective	155284,00	70000,00	28688,00	70000,00								Yes
HU		5597,00	238,00										
IS	18956,00	18956,00											
IT	360683,00	98885,00	42000,00	17800,00	42000,00					2600,00	2730,00		No
LT	11700,00	2950,00	n.a.	141,00	470,00					1150,00			No
LU	n.a	780,00	124,00	1344,00	1052,00	44,00	124,00			1300,00	928,00		Yes
LV	8681,00	5191,00	3051,00	1567,00	3520,00	1567,00	3520,00						No
NL		50000,00	700,00	200,00	700,00	0,00	0,00	0,00	0,00	0,00	0,00		Yes
NO													
PL	194600,00	32400,00	2969,00	1152,00	2969,00								No
PT	51632,00	35584,00	14074,00	9548,00	14074,00	5246,00	14074,00			4302,00			Yes
RO	100000,00	31388,00	19768,00	7729,00	19768,00	3536,00	10046,00	4193,00	9722,00	0,00	0,00		Yes
SE		71400,00	65000,00										n.a.
SI	15607,00	6129,00	5121,00	1820,00		1182,00		53,00		585,00			Yes
SK	34650,00	8100,00	5400,00	2728,00	5850,00	1504,00	4900,00	308,00	500,00	915,00	450,00		Yes
UK				n.a.									

	% of HWMB to the total WBs	% of HMWB due to HP to total HMWB
Unit	%	%
AT	7,70	57,00
BE		
BG	26,60	26,60
CH	0,00	
CZ	68,30	50,00
DE	37,10	6,80
ES	18,00	34,00
FI	2,50	70,00
FR	16,00	20,00
HU	40,00	
IS		48,00
IT	9,30	9,80
LT	14,00	39,00
LU	18,62	14,00
LV	6,70	9,70
NL	42,00	0,00
NO	11,00	85,00
PL		
PT	12,50	39,00
RO	15,00	16,76
SE	2,00	95,00
SI	12,30	42,00
SK	3,00	35,00
UK	31,00	8,00

Annex II: Methods for defining minimum ecological flow

8.11 What method/approach is (are) applied to defined minimum ecological flow in your country?						
	Static defin.	Dynamic def.	Modeling	Other methods	Explain methods	Comments
AT	x	x	x			Guide values for a "basic" minimum flow and additional "dynamic flow" (Ordinance on Ecological Status Assessment) or determination by modelling which proofs that good status for all biological elements is achieved - see Annex 2 of AT questionnaire
BE	x		x			Depends of the type of the watercourses (navigable or unnavigable)
BG	x					10% of annual mean flow
CH	x	x	x			within a catchment area the minimum's can be optimised e.g., one rive no water - the other more water.
CZ	x				According to value of Q355 category is chosen and after minumum residual flow (MRF) is calculated which is based on values Q330, Q355 and Q364. If flow Q355 is < 0,05 m3.s-1; MRF=Q330 0,05 - 0,5 m3.s-1; MRF=(Q330 + Q355)*0,5 0,51 - 5,0 m3.s-1; MRF=Q355 > 5,0 m3.s-1; MRF= (Q355+ Q364)*0,5	
DE	x	x	x			

ES					For relevant locations double studies are carried out, using hydrological and ecological (IFIM) data. According to the results obtained, the most adequate results are used, on a case by case basis	
FI		X	X		In some cases: fish habitat and other habitat modelling based on the relationship between flows, water depth, substrate and the quality and quantity of available habitats.	
FR	x	x	x		The lower limit is 10% or 5% (law) The adapted ecological minimum flow is generally based on "micro-habitats méthod, EVHA" (Souchon & al.), which can be completed or remplaced whith modeling or extrapolations. But there are other possible methods adapted when this one doesn't fit whith the type of river	It depends on the type of the river. This ecological minimum flow can be differently distributed over the year, in a compatible way between use and species interests
HU						
IS		x				
IT	x	x	x	Baseflow method and similar		Details on minimum ecological flow can be found in the regional water protection plans, included in the RBMPs.
LT	x					
LU	x	x			10% AMF or 30% MMF	
LV	x	x				Guaranteed rate of flow; summer 30 day period mean minimal flowrate with 95% coverage.
NL		x				
NO		x				Different methods are being assessed.Ongoing R & D. A specific technical requirement to set minimum flow is not recommended in Norway due to large variations in river basins and the purpose of setting minimum flow. However, hydrological indexes are commonly used (e.g Q95 summer/winter in small scale HP)
PL						

PT		x	x		INAG has develop a simple method (based on historical flows) than can be used when there is not many knowledge about an area. The IFIM method is is recommended
RO	x				
SE	x				Commonly static byt in some cases defined from fish migration
SI		x		Ecological acceptable flow considers hydrological baseline, type of water abstraction, hydrological, hydromorphological and biological characteristcs and information on protection regimes. Hydrological baseline considers value of mean minimum flow and mean flow at the location of water abstraction. Qes=f*sQnp (Qes - ecological acceptable flow, f-factor depend on ecological type of watercourse, sQnp - mean minimum flow) It is also possible to choose interdisciplinary holistic approach.	
SK	x			Q355 - Average daily water discharge during the reference period, achieved or exceeded during 355 days in the year	
UK	x	x	x	The national guidance is available at: http://www.wfduk.org/UKCLASSPUB/LibraryPublicDocs/gep_hmwb_final. This includes a list of good practice mitigation measures. In relation to flow, the list includes maintenance of a proportion of the flow that would have naturally been exceeded 95 % of the time. The proportion depends on the river type but is typically about 85 %. It also includes provision of variable higher flows, depending on the needs of the site-specific ecological characteristics. These flows are defined on a case-by-case basis.	The minimum flow requirements may differ from scheme to scheme depending on ecological needs (eg whether or not fish migration needs to be supported) and on what flow can be provided without a significant impact on electricity generation

Annex III: Requirements for upstream continuity facilities

8.17 Do the methods/approaches mentioned above include requirements regarding:					
Type of fish pass		**Special type of fish pass**	**Hydraulic design**	**Recommendations/ requirements on duration of time for passability**	**Other/comments**
AT	No preference concerning Technical fish pass or bypass channel (more or less natural), ramps. decision depends on what is the best ecological and technical feasible solution at the specific location	Denil not appropriate	Discharge, flow velocity, energy dissipation, attraction flow	Whole year except extreme situations (i.e. floods > HQ1, icing)	Depth / length and width of baisns, width of slots; For each river stretch (river type) the relevant fish species which have to pass the fish pass are defined including the length of the largest one which forms the basic element for designing a fish pass
FR	Yes, it depends on the species, the site, the river concerned, and the facilities characteristics (height, etc.)	Yes, it depends on the species, the height, the flow, etc.		Yes. Generally permanent time of passability, sometimes reinforce in some specific periods of upstream migrations.	The legal requirement is a result requirement. The equipment must be the most efficient as possible regarding of technical and species's behaviour knowledge.
SE	Technical fish ladders most common (ap. 450 fish ladders in total). Ap. 60 bypass channels				Ap. 15 % of the dams in Sweden (above 1.5 m in height) has fish passes
LU	Most natural solution is always preferred (fish ramp, bottom ramp,…) followed by more or less technical solutions				

NL		No specific requirements; for the HP Borgharen a vertical slot fish pass is designed.	
Additional comments			
NO	We use all of the above after individual consideration. Whatever works best in the different cases. Ongoing R & D.		
UK	The technical guidance covers all of the above topics - the precise requirements depend on the technical option used (eg type of fish pass) and the site-specific characteristics.		

Note: This table only includes specific comments from European States. An overview of the responses on technical requirements for upstream continuity is provided in section 5.3.

Annex IV: Conclusions of 2009 Workshop on WFD & HMWB

BACKGROUND

1. Improving the status of the water environment is an important goal and a key aim of the Water Framework Directive.
2. Water uses can also provide important benefits.
3. Designation of HMWB, identifying GEP and setting objectives is about striking the right balance.
4. A key change to European water management introduced by the Directive is the introduction of ecological objectives and consequently the need to manage the adverse ecological impacts of hydromorphological alterations.

DESIGNATION OF HMWBS

5. Across Europe, large numbers of water bodies are being designated as heavily modified or artificial. The average percentage of Member State water bodies being designated as heavily modified is just over 15 %.
6. The proportion of water bodies being designated as HMWBs ranges between 1 and 42%. The main uses for which water bodies are being designated vary between countries.

Designation process

7. Most Member States appear to have reviewed their provisional designations indicated in their Article 5 reports.
8. The final designations are based on additional information (including information provided by the water use sectors) and fuller assessment.
9. Representatives from environmental NGOs reported that some designations were not based on the procedure and criteria described in the CIS guidance, especially designations added after provisional identification in the Article 5 reports.

Designated uses

10. Based on questionnaire results, the clarity provided by Member States about the “use” or "uses" for which they have designated water bodies as heavily modified is very variable. Examples are given in the Table below.

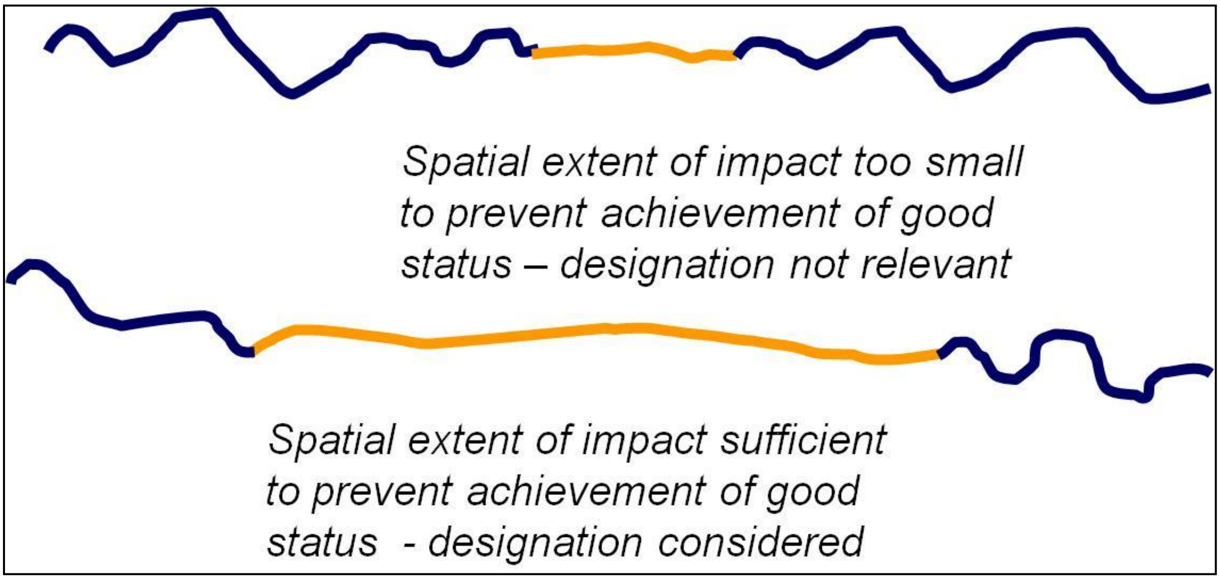
Use specified and in line with Art. 4.3	Use not specified or not mentioned in Art 4.3
Hydropower generation - storage	“Agriculture” *(e.g. is it land drainage for agriculture;*

	etc?)
Drinking water supply – storage	“Industry” (e.g. for what industrial use listed in 4.3?)
Flood defence	“Canalisation” (e.g. for what use?)
Inland navigation	“Dredging” (e.g. for what use?)
Navigation ports	“Morphological alterations” (e.g. for what use?)

11. A recommendation of the workshop was that it is good practice to be specific about the use or uses for which water bodies are designated as HMWBs and to relate the identified uses to the list of uses in Article 4.3.

Scale of modification leading to potential designation

12. For designation to be considered, there must be adverse impacts (i.e. which cannot be addressed without a significant adverse impact on one or more uses or the wider environment) of sufficient magnitude to prevent achievement of good ecological status.
13. The spatial extent of impacts is a relevant consideration in deciding if this is the case *(e.g. km of river impacted;* km^2 *of transitional waters; etc).* Consideration should be given to the cumulative impact of the alterations associated with the use or uses.
14. An assessment of the precise spatial extent of impacts is not necessary where physical modifications are obviously extensive.
15. There was some evidence at the workshop that similar spatial criteria are being used *(e.g. Norway, Austria and UK 1 – 2 km)*.
16. The workshop concluded that it is good practice to be transparent about ecological status classification criteria.



Types of modifications

17. All Member States are considering designation if impacts clearly result from morphological alterations.
18. Impacts resulting from abstraction with no morphological alteration are not normally considered for designation.
19. “For less clear cases” (abstraction with small dam at intake) some States are considering designation and others are not.
20. At the end, the practical effect on the ecological objective that is applied may not be significant.

Significant adverse impact on use

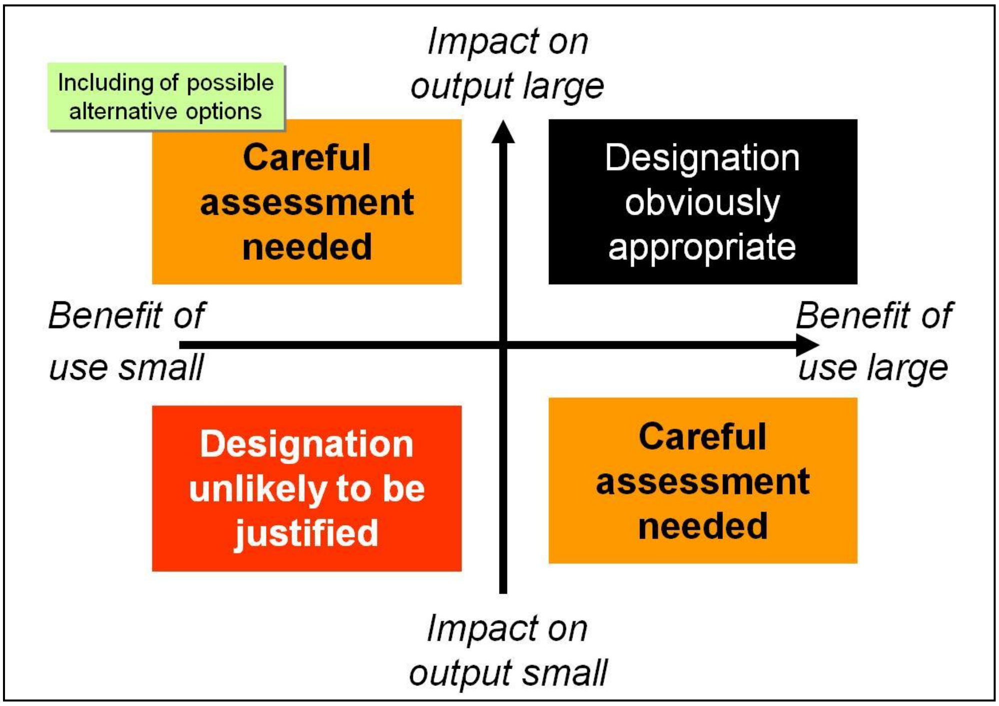
21. Everyone agrees it cannot mean "no impact on use".
22. Fixing common thresholds at EU level for “significance” is not practical or appropriate.
23. Ultimately, a decision on what is 'significant' involves some element of political judgement.
24. The reasons and criteria for judgements on significance should be made clear.
25. Member States are aiming to maximise improvement with the minimum of impact on use.

Significant in relation to what?

26. The workshop recommended that it is good practice to be clear on what is taken into account when making judgement.
27. For example, several factors appear to be possible considerations in determining if an impact on hydropower generation is significant:
    - ➔ Proportion of scheme’s total output

- ➔ Proportion of annual variation in scheme's total output
- ➔ Proportion of renewable energy targets
- ➔ Cumulative impact on renewable energy targets
- ➔ Scale of benefit to the water environment

27A. The figure below represents the workshop's conclusions on the factors that affect the relative difficulty of deciding whether it is appropriate to designate a water body as a HMWB. In the situations represented by the orange boxes, careful assessment is needed to decide whether the impact on the use would be significant and, if so, whether alternative options for providing the benefits of the use can be ruled out.



ECOLOGICAL POTENTIAL

Good ecological potential

28. Designation of a water body as a HMWB is not an excuse for doing nothing.

29. Good ecological potential (GEP) means close to the best that can be done for ecology without significant adverse impact on use.

30. GEP can be an ambitious objective – e.g. if only limited mitigation is currently in place

31. Where the modifications support multiple uses, the achievement of GEP may require contributions from each user.

Ecological continuum

32. Everyone agrees that ecological continuum is a relevant consideration in defining GEP as well as MEP (Maximum Ecological Potential).

33. “There must be fish” – fish (in particular, migratory species) is seen as a good indicator of ecological continuum. There was general agreement at the workshop that providing river continuum for fish migration is normally a necessary component of good ecological potential.

34. It is good practice to consider ecological continuum at river basin scale - but act at local scale.

35. Lateral connectivity (e.g. with shore zone; riparian zone etc) and sediment transport are also relevant for ecological continuum.

GEP – comparability between methods

36. Most Member States believe that the two CIS methods identified for defining GEP should give comparable results.

37. The two methods are:

    (1) the reference-based method; and

    (2) the mitigation measures method.

GEP – reference-based method

38. Questionnaire results prior to the workshop indicated that around 50 % of Member States were using the reference-based method or both methods (reference-based and mitigation measures methods). However, discussions at the workshop revealed that a significant number of Member States who had reported using both methods were in fact using the mitigation measures method albeit with different ways of defining the associated ecological targets. Based on this, the conclusion of the workshop was that only a few Member States will use the reference-based biological method (in relation to impacts of hydromorphological alterations) in the first cycle and often will apply it to only a sub-set of their HMWBs.

39. Examples where it will be used include:

- Assessment of pollution in all HMWBs.
- Where there are many water bodies with very similar modifications (e.g. canals and ditches in the NL).
- Change of water category but otherwise similar to existing natural water bodies (e.g. some reservoirs which closely resemble natural lakes).

GEP – mitigation measures method

40. Most Member States base GEP on the mitigation measures method.

41. Most Member States link mitigation measures to ecological improvement targets.

42. There are various approaches to describing ecological targets *(e.g. simple qualitative descriptions; modified ecological quality ratio class boundary values).*

43. For example, to derive an ecological target, the existing ecological quality ratio (EQR) for each relevant biological quality element in the water body is measured. The improvement in the value of the biological quality element EQRs resulting from GEP mitigation measures is then estimated and added to the measured EQRs. The revised EQR values represent the ecological quality expected to result from the mitigation measures and hence the EQRs for GEP.

44. The environmental objective is not just a list of mitigation measures.

45. It is the ecological change those measures are designed to achieve.

46. Both of the above are part of the mitigation measures method.

GEP – practical challenges

47. A large number of water bodies needs to be classified in short time.

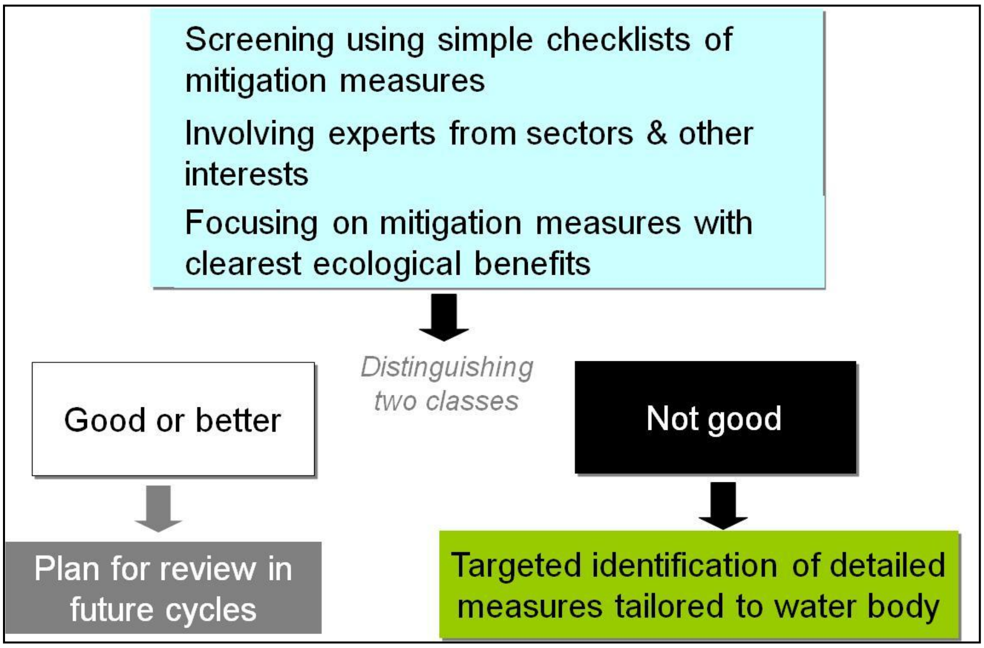
48. There is no time for overly complicated approaches.

49. There is need to prioritise – i.e. identify water bodies that are clearly not at GEP and then direct effort to these.

50. Experience from a number of Member States indicates that the mitigation measures method is easier to understand and apply by water managers.

51. One reason identified by Member States for not using the reference-based method is that defining biological reference values in relation to site-specific modifications has not been possible.

Examples of approaches being used



51A. The figure above illustrates some of the approaches being used to assess large numbers of heavily modified water bodies for the first river basin management plans. Differentiation of water bodies identified as "not good" into moderate, poor and bad ecological potential will be required subsequently.

GEP and ecological quality

52. The ecological quality represented by good ecological potential depends on:

- the specific modifications associated with the use or uses of the water body and the specific adverse ecological impacts caused (given the characteristics of the water body concerned);
- the level of mitigation originally incorporated into the modifications (i.e. because retrofitting a mitigation measure may be technically infeasible or have a significant impact on the existing use); and
- judgements about the significance for the use(s) or wider environment of mitigation – and hence on what additional mitigation can be applied.

Where these factors vary, good ecological potential will not represent the same ecological quality.

53. Ecological quality at GEP may be more similar for some uses than others.

54. It may be most similar for uses involving very similar modifications to very similar types of water bodies. Some countries (e.g. France) are developing typologies for HMWBs.

55. For example, it may be similar for inland navigation (e.g. canals; large rivers) serving similar types of vessel and with similar use-levels; etc.

GEP – improving understanding of GEP comparability

56. *Short term* - transparency about the mitigation measures for GEP considered applicable by different Member States.

57. At higher level of description, mitigation measures already appear comparable for at least some uses *(e.g. hydropower).*

58. *Medium term* - development/improvement of biological assessment methods for assessing hydromorphological alterations *[e.g. take account of absolute abundance as well as composition]*. Not all Member States currently have such methods.

↓

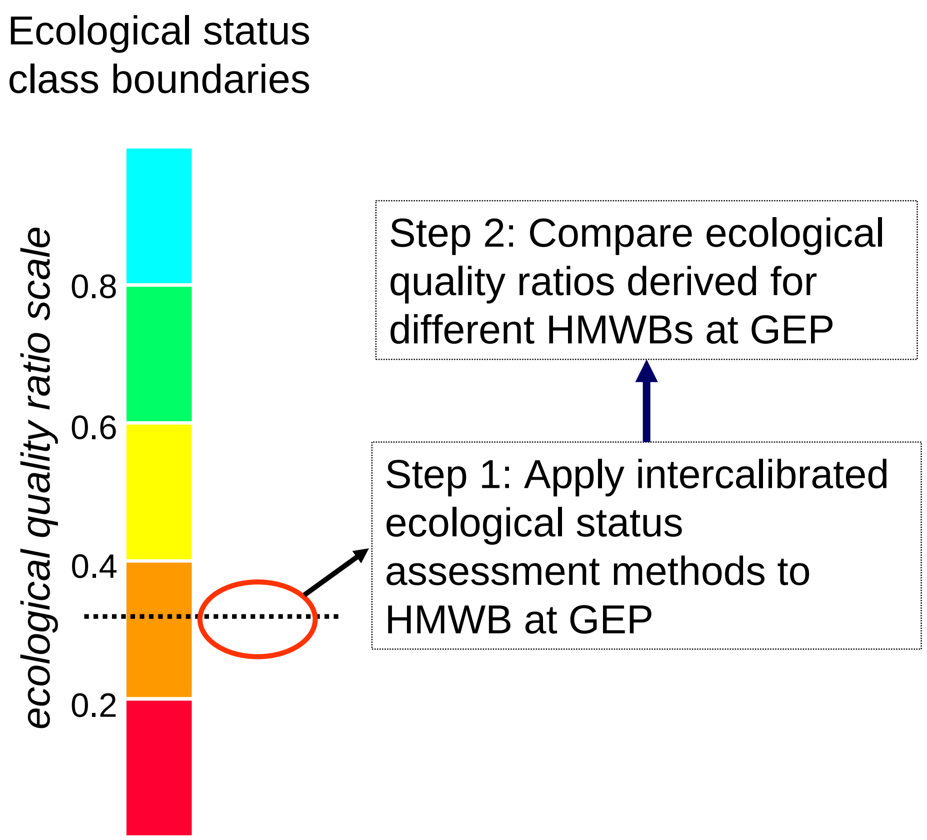
Intercalibration of <u>good ecological status</u> boundaries for the above systems.

↓

Classification of ecological status of HMWBs - as well as ecological potential - to provide a directly comparable reality check on GEP.

59. Challenge: Requires ecological status biological assessment methods that fully reflect the impact of hydromorphological alterations. These and assessment methods for morphological quality elements are not yet developed by all Member States.

60. Recommendation: Exchange of information between Member States with such assessment methods and those without.



60A. The above figure illustrates how the ecological quality represented by GEP in different water bodies can be compared using the biological assessment methods developed for the closest comparable water body types. The process requires the intercalibration of biological assessment methods for ecological status that are sensitive to hydromorphological alterations.

60B. Not all Member States have yet developed biological assessment methods sensitive to hydromorphological alterations and Phase 1 of intercalibration did not specifically address hydromorphological pressures.

OBJECTIVE SETTING

Objective setting – application of time extensions

61. Extension of deadlines will be used.

62. Main reasons for time extensions appear to be:

1. natural recovery times

2. need to phase major investment programmes

63. Time extensions can deliver prioritised improvements – e.g. target where it is possible to get large and clear benefits; etc.
64. Simple criteria & expert judgement have been used in many cases to set time extensions.
65. It is good practice to explain what will be achieved (in terms of improvements to individual quality elements) by 2015, 2021 and 2027.

Objective setting – consideration of less stringent objectives

66. The tests for applying a less stringent objective or a time extension are similar.
67. Member States do not appear to be planning to consider applying less stringent objectives to HMWBs before 2027.
68. The general view of the workshop is that it would not be appropriate to apply less stringent objectives to HMWBs before 2027 except possibly in relation to adverse impacts caused by severe pollution.
69. There is review need for less stringent objectives in the third planning cycle.

STAKEHOLDER INVOLVEMENT

Stakeholder involvement in process

70. Benefits:

- Sector's knowledge of uses.
- Understanding of value to other stakeholders of improving the water environment.
- Contribution of technical knowledge to the detailed design of mitigation measures.

71. Examples of good practice:

- Stakeholder involvement in the development of methods and criteria.
- Workshops with users and other stakeholders to apply methods.
- Consultation on the detailed design of improvements as part of licence reviews.

72. It is good practice to be clear on the criteria on which expert judgements are based.

Manage expectations

73. Assessments and judgements are not going to be perfect the first time.
74. Update and improve for future planning cycles.

PROPOSALS FOR FURTHER WORK (E.G. IN THE MANDATES ECOSTAT/HYMO 2010-12)

75. Continue information exchange on:
    - Methods for hydromorphological assessment

- Minimum ecological flow

76. Collate Member States checklists of mitigation measures:
    - Effectiveness
    - Practicality

77. Further information exchange on the comparison of methods for defining GEP in 2011/12. In addition, phase 2 of intercalibration should specifically address hydromorphological pressures, as an integrated activity of the CIS work programme 2010-2012 for the WG ECOSTAT.

78. Information exchange on hydromorphological modifications for agriculture
    - And probably also other uses (e.g. fisheries, shellfish …)