Hydropower Case Studies and Good Practice Examples

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ANNEX to "Guiding Principles on Sustainable Hydropower Development in the Danube Basin"

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Disclaimer

This document includes a collection of case studies and good practice examples that were provided by members of the "Team of Experts on Hydropower" who worked on the elaboration of the "Guiding Principles in Sustainable Hydropower Development in the Danube Basin".

This collection should act as a set of practical examples in relation to different elements of the Guiding Principles, but does not infer any formal status.

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Austria

Criteria Catalogue

Country: Austria **Province/region/town:** Government **Status:** Realized

Topic: Supporting tool for a transparent, reliable and standardized application of Art. 4(7) in Austria

Description:

To achieve the targets set in the RES Directive it is necessary to increase Hydropower (HP) generation in Austria up to 2020. This will mainly be reached by construction of new plants. In case of high status or dependent on the current status of the WB, the type of construction as well the intended mitigation measures a new hydropower plant might result in a deterioration of ecological water status or might prevent that the water body to achieve GES. In this case an exemption according to Art. 4(7) is needed provided that the requirements are met.

In the National RBM Plan 2009 it was 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.

To support the water authorities when weighing the diverse public interests in the Art. 4 (7) test, to ensure a common understanding and standardized application as well as to make the decision transparent and reliable it was agreed with the hydropower sector and NGOs to include in the National RBM Plan that a "catalogue of criteria" for HP projects will be developed. This catalogue will include ecological aspects, energy management and other water management aspects (like effects on flood protection, tourism, groundwater quality and quantity etc.). It will also give the information on criteria to assess WBs of high ecological value. Some examples were already mentioned in the RBM Plan.

After a long and intensive discussion process with the hydropower stakeholders as well as the NGOs the catalogue was finalised in December 2011. It includes:

- 4 main criteria for energy management: security of supply, quality of supply, climate protection, technical efficiency – subdivided for run-of-river and storage plants. Every criteria consists of 1-3 indicators for which characteristic numbers are given describing the importance/relevance for energy management in 3 stages: low, medium and high.
- 4 main criteria concerning ecological aspects: regarding the river stretch affected the naturalness of the WB, the rarity, specific function for the catchment and the dimension of negative longitudinal and lateral effect of the specific project. Every criteria consists of 2-5 indicators which are described by 3 levels of ecological importance: low, medium and high.
- 8 main criteria concerning additional water management aspects mostly relevant (sediment transport, flood protection, groundwater quantity & quality, drinking water supply, water quality, restoration activities, recreation/tourism/fishery. Every criteria is described by 5 levels of possible effects of the new hydropower plant: very negative, negative, no effect, positive and very positive effect.

The catalogue is a supporting tool; the application of the catalogue is recommended to the water authorities, but it do not forestall the final decision of authorization body within the approval process. It also helps HP planners to evaluate the chances of a new project to get an approval at a very early stage before detailed project planning is done.

The catalogue was finalised in 2012. It also acts as a basis for a further strategic planning for hydropower development on regional level.

Minimum requirements for old and new hydropower plants

Country: Austria **Province/region/town:** Nationwide **Status:** Realized

Topic: National requirements (State of Art & Technology, BAT, BEP) for existing and future hydropower plants in relation to ecological minimum flow, ecological continuity (fish pass) and habitat quality.

Description:

The ecological effects/impacts of a of hydropower plant differ according to the type of power plant and type of electricity generation (base or peak load) but usually do not depend on the size of the plant.

In case of "diversion plants" (which is the usual type of small hydropower plants in Austria) water is abstracted from the river and after being turbined discharged in the same river again after some hundred meters or km. The main impact on ecology is given by the fact that in the water stretch between abstraction and recharge there is even no flow anymore or at least a significant seasonal reduction of flow resulting in decreased water levels which also mean a constraint to fish migration, loss of flow variations, loss of habitat etc. The dam for water abstraction is an artificial obstacle which results in a disruption of ecological river continuity (migration barrier).

In the Austrian Water Act of 1990 it was constituted that water abstraction has to be restricted so that an ecological minimum flow to achieve good ecological status is guaranteed. The ecological flow to achieve good status (base flow and dynamic aspect) is defined in the "Ordinance on quality objectives for ecological quality elements in rivers and lakes" which was set into force March 2010. The National River Basin Management Plan stipulates that an ecological minimum flow has also be restored in existing hydropower plants, which got their permit before 1990, but restoration will be done stepwise until 2027 via an ecological prioritisation approach.

In case of run-off-river plants there is a concrete dam directly in the river where the turbines are situated. The dammed section (impoundment) is usually characterised by reduced flow velocities, embankments/bank fixation, reduced width and depth variations, altered substrate conditions, disconnection of side arms, loss of habitats also. In the Austrian Water Act it is constituted that all constructions should guaranteed good ecological status of water bodies. Even if in case of a deterioration an exemption of Art. 4 (7) is applied the new project has to respect that in beginning (upper part) of the backwater is well structured with a variation of habitats, and that side arms and tributaries are still connected. As an outcome of the River Basin Management Plan this is also obligatory for existing hydropower plants but restoration will be done stepwise via an ecological prioritisation.

It was also included in the Austrian Water Act 2011 that is obligatory to guarantee ecological continuity at all barriers (hydropower plants, obstacles due to flood protection measures, etc.). Upstream continuity is state of the Art & Technology for all obstacles. Fish passes are therefore required for all hydropower plants which are situated in rivers with natural fish habitats. It also means that flow conditions have to allow fish migration (regulations for minimum depth and minimum flow velocity). Concerning specifications for construction of fish passes which guarantee passability necessary for good ecological status a national Guideline has been developed and was published in in 2012

For existing hydropower plants the deadlines to restore continuity will be done stepwise via an (ecological) prioritisation approach.

Possible effects of restoration measures to achieve good ecological status on the Austrian hydropower sector

Country: Austria **Province/region/town:** Nationwide **Status:** Realized

Topic: Supporting tool for decision making in relation to:

- the need of exemptions for restoring good ecological status as well as
- the justifications for the designation of HMWBs
- the definition of Good ecological potential

Supporting tool for the planning process to strengthen public participation

Description:

The Austrian Ministry for Water Management as well as the Ministry for economic affairs together with the hydropower sector initiated a study on "Possible effects of restoration measures to achieve good ecological status on the Austrian hydropower sector" in 2005.

This study was intended to be a supporting tool for any further decision making with special respect to:

- the need of exemptions for restoring good ecological status as well as
- the justifications for the designation of HMWBs
- the definition of Good ecological potential
- Discussions on disproportionate costs

The study was made by the electricity department of the Technical University of Graz. Three main restoration measures (restoration of river continuity by building fish passes, restoring ecological minimum flow, reducing water level/flow fluctuations due to hydropeaking by changing the operational mode of storage plants) were investigated in relation to the investment costs, losses in income and effects (losses) on quality and amount of electricity generation. The calculations were done for the small hydropower sector, the large hydropower sector and for the storage plants sector separately. The results were presented for each sector as well as on the Austrian hydropower sector as a whole.

It also turned out that such a study is a very valuable tool in a planning process by providing reliable data/information which also made the process of stakeholder involvement easier and helped in the public participation process.

For further information please visit:

www.lebensministerium.at/wasser/wasseroesterreich/plan_gewaesser_ngp/umsetzung_wasserrahmenrichtlinie/Wasserkraftstudie.html

Technical upgrading of existing plants and ecological restoration measures

Country: Austria **Province/region/town:** Upper Austria **Status:** Realized

Topic: Good practices on technical upgrading and ecological restoration, awareness raising and advisory programs, funding programs, enhancement of generation, acceleration of restoration measures, good governance example, priorities for river continuity, fish migration aids, ecological flow.

Description:

Upper Austria, a province in the north-west of Austria, has 1,4 million inhabitants and covers 78 % of its electricity demand from hydropower. 860 hydropower plants generate 10.200 GWh. How to upgrade this large number of existing plants? How to combine upgrading and ecological restoration? How to implement priorities for enforcing ecological restoration?

Awareness and advisory program

In Upper Austria an "Energy Agency" is responsible for awareness raising and an advisory program with consultations of plant owners, trainings and awareness campaigns.

790 of the Upper Austrian hydropower plants are smaller than 0,5 MW. Thus a special focus of the advisory service is on small hydropower plants.

Owners of small hydro power plants can ask for preliminary advice about the optimization potential, technical and ecological requirements (BAT including river continuity) and funding and incentive schemes. Since 2007 338 consultations were carried out by independent experts, each with a duration of one to two days. Costs are met entirely by the program, thus providing a very attractive incentive.

Funding programs for existing plants

From 2004 till 2011 the ÖKOP-investment-funding-program for existing hydropower plants smaller than 1 MW was in place. Plant owners could get up to 25 % of the investment for technical upgrading and ecological restoration, max. 50.000 €.

243 small existing hydropower plants were upgraded, most of them refurbished and ecologically restored at the same time. The funds amounted to 4,8 million €. The investments caused were 7,7 times higher and amounted to 37,3 million €. The upgrading resulted in an additional generation of 80 GWh, which is the electricity demand of 22.800 households. The ecological benefit was considerable as well.

Since 2012 a national investment-funding-program for upgrading of existing plants and for new plants is in place. The national budget is 33 million € per year, half of it for small plants (up to 30 % of investments). Alternatively plant owners can apply for guaranteed feed-in tariffs (period 13 years). Whoever applies for a licence has to ensure river continuity and respect ecological requirements (BAT).

The national program is accompanied by an Upper Austrian co-investment-funding program for plants smaller 1 MW, restricted to plants respecting severe ecological requirements (additional funding up to 25 % of investment, max. 50.000 €).

In Upper Austria the funding program should result in an upgrading and ecological restoration of more than 100 plants and an increase in hydropower generation of approx. 150 GWh. The win–win incentive package enhances generation of hydropower while accelerating restoration of river ecology at the same time.

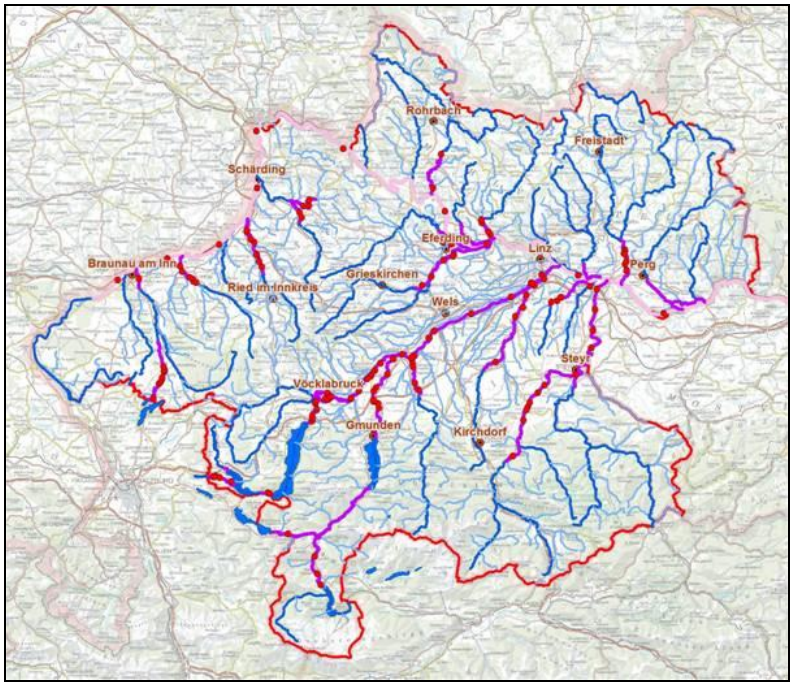
Picture 1: Refurbished hydropower plant with fish ladder

© Energie AG Oberösterreich

Priorities for river continuity

In Austria the first "National River Basin Management Plan" (2009) prioritizes river stretches with middle-distance fish-migrants (nase, barbel and Danube salmon). While legislation is allocated to the Federal State, the majority of executive tasks in water management is allocated to the Länder.

Upper Austria designated 720 km priority river stretches.



Map 1: Priority area for measures in first WFD cycle

River continuity ensured by a single ordinance

In 2011 the Governor of Upper Austria issued an ordinance for mitigation measures in the priority river stretches. Thus the existing permits do not have to be changed case by case.

The ordinance enforces the establishment of river continuity at 310 barriers, 100 of it barriers of hydropower plants. The holders of permits are obliged to submit projects related to river continuity and ecological minimum flow till end of 2013. The measures have to be licensed and implemented till end of 2015.

End of 2012 18 % of the mitigation measures in the priority river stretches were implemented yet, 7 % were under construction, for 35 % projects have been submitted, however for 40 % no activities have been set so far.

In a study the losses in generation through mitigation measures were evaluated. Losses can be considerable high for single plants, but in total they are less than 1 % of the hydropower generation in Upper Austria. Thus they do not endanger the climate protection targets.

Germany

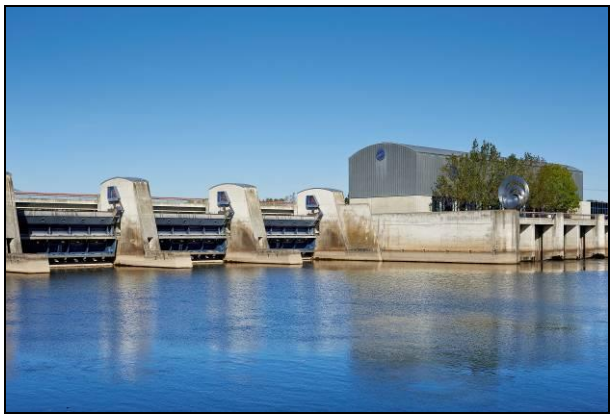
Bypass system HPP Vohburg / Danube

Country: Germany **Province/region/town:** Bavaria **Status:** Realized

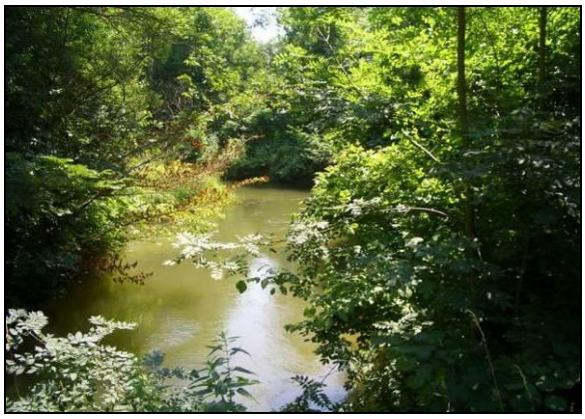
Topic: Good practice in mitigation measures – fish migration aids

Description:

During the construction of the Hydropower plant Vohburg on the Danube, also a fish bypass system was built to enable fish migration. The Bypass channel is similar to a natural stream, bypassing the hydropower plant. As the dam is preserved unchanged, its functions are not negatively affected. The whole impounded section of the river can thus be bypassed. Recent inquiries prove the functionality of the fish bypass system. The bypass system not only connects head- and tail water but also provides a new living environment for fish and other aquatic fauna.



Hydropower plant Vohburg



Natural stream bypass

Additional turbine and vertical slot passage - Hydropower plant Gottfrieding / Isar

Country: Germany **Province/region/town:** Bavaria **Status:** Realized

Topic: Good practice in empowering of an existing hydro power plant

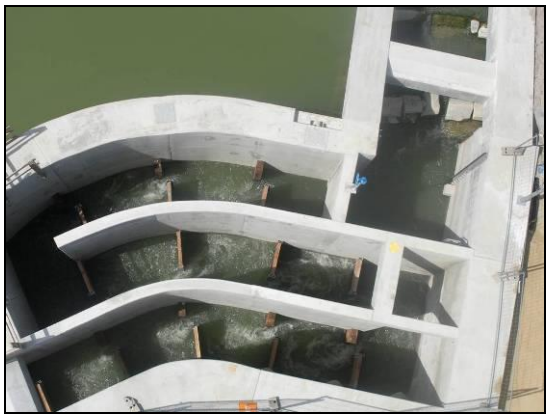
Good practice in mitigation measures – fish migration aids

Description:

The existing hydropower plant Gottfrieding on the river Isar has been empowered by installing a third turbine to increase the extension ratio of the plant. Thereby an additional electrical power of 5 MW has been gained without having to raise the headwater level.

A vertical slot passage has been built for enabling fish migration. A vertical-slot fish passage is similar to a pool-and-weir system, except that each "dam" has a narrow slot in it near the channel wall. This allows fish to swim upstream without leaping over an obstacle. Vertical-slot fish passages also tend to handle reasonably well the seasonal fluctuation in water levels on each side of the barrier. Actually, the functionality of the fish passage is under examination. Fish monitoring results are generally positive, but showing some demand for technical optimisation measures.

Hydropower plant Gottfrieding



Vertical slot pass

Movable hydropower plant

Country: Germany **Province/region/town:** Thüringen, Baden-Württemberg **Status:** Realized

Topic: Sediment transport

Description:

Information according to manufacturer:

Opportunities and challenges for low pressure hydropower stations < 5m:

- Hydraulic losses should be small due to low drop height
- Facilities react sensitive to reduced drop heights resulting e.g. from sediment aggradation
- Energy output is reduced by increased water levels below the hydropower plant
- Environmental regulations are requiring downstream migration for fish
- Ideally the facilities should not be visible or cause noise
- Specific construction costs are high

Idea:

- Power house can be lifted in order to allow for direct sediment transport
- No additional sediment trap or similar installations are required
- Visually not noticeable as far as possible
- Allow for downstream migration of fish via the power house and in addition enable transport of debris and driftwood
- Making use of high flows for increased energy generation

Requirements:

- No deterioration of the river cross-section in case of flood events
- Allowing for upstream and downstream migration of fish and other aquatic species
- No sedimentation of impounded and discharge sections
- No emissions
- High efficiency
- Hydropower stations should be integrated harmoniously into the surrounding landscape
- Optimal hydraulic conditions for inflow and outflow
- Short construction time and low construction costs
- Enable economic use of low drop heights for hydropower production

The following components are integrated in the movable overflow and underflow hydropower plant:

- Pivoting power house casing is replacing movable weir lock
- Channel for sediment and bedload transfer

- Hydraulically optimized inflow and outflow funnel
- Fish friendly arch screen at the water intake
- Surface- and riverbed near downstream migration aid
- Fish ladder placed next to the tray

The concept offers the following advantages compared to conventional designs:

- Improved flow conditions during flood events without requiring additional structures
- Allowing for upstream- and downstream migration of fish and other aquatic species
- No sedimentation of impounded and discharge sections
- No emissions due to use of permanent magnet generators instead of gears
- Very high overall efficiency due to optimized hydraulic conditions and choice of machine components
- High energy recovery due to usage of ejector effect at the end of the intake pipe
- Robust, long-life technology requiring low maintenance
- Nearly invisible because constantly overflowed
- Short construction time and low construction costs due to simple construction technique
- Up to 30% reduced construction costs for same annual production

Development steps:

The hydraulic design of the overall installation was optimized at the Institute for hydraulic machines at the University of Stuttgart. A compact turbine- / generator-unit with a synchronous generator is in operation since March 2008 at the test site Faurndau / Fils in Germany. The permanent magnet of the unit is cooled down by using the process water of the facility.

Implementation:

At Sophienwehr / Ilm in Bad Sulza (Thuringia, Germany) the world's first movable overflow and underflow hydropower plant was developed and constructed. Movable overflow and underflow hydropower plants are in addition in operation in Gengenbach and Offenburg at the river Kinzing (Baden-Wuerttemberg, Germany).

Experiences:

Bad Sulza / Sophienwehr:

- Very good efficiency at part load
- Facility is acoustically not noticeable
- No vibrations noticeable so far
- Efficient cleaning of the screen
- Technical basics are promising

Facilities at the river Kinzing in Gengenbach and Offenburg:

- EU award for best environmental project 2011

- Biological fish monitoring (funded from EU-Life Program) undertaken but does not deliver clear results until the current stage regarding the efficiency specifically for downstream migration
- Potential need for technical and in case operational modifications – appropriate technical adaptations, specifically regarding downstream migration, are currently under elaboration in cooperation with fishery authority
- Improved and easier sediment transport constitutes advisable advancement for river ecology

Pilot projects in Bavaria are under consideration.

<u>More information can be obtained from:</u>

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Zehntstraße 2
76227 Karlsruhe
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www.hydroenergie.de
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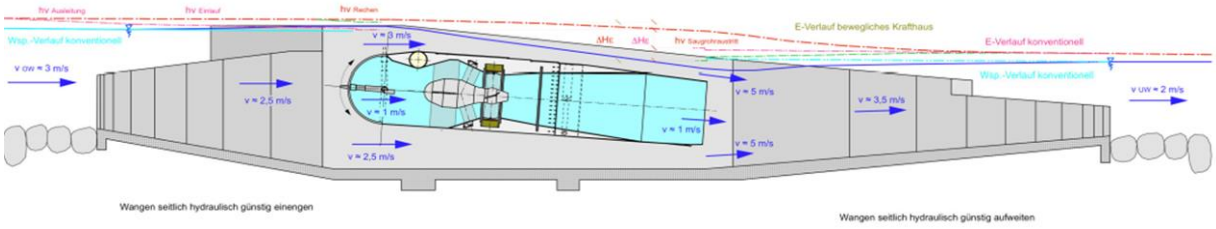
For further information please visit:

http://www.hydroenergie.de/bewegliche-wka#2
http://www.e-werk-mittelbaden.de



Movable hydropower plant

Norway

Norwegian Protection Plans and Master Plans– planning tools of water resources and hydropower licensing in Norway

Country: Norway **Province/region/town:** **Status:**

Topic: Planning for new hydropower

Description:

Protection Plans for Watercourses

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 (covering 40% of the catchment areas of Norway) have been protected against hydropower development and the hydro power production potential in these watercourses is close to 50 TWh. 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.

Master Plan for Hydropower Development

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 with a total production of 40 TWh 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.

Regional Plans for Small Hydropower

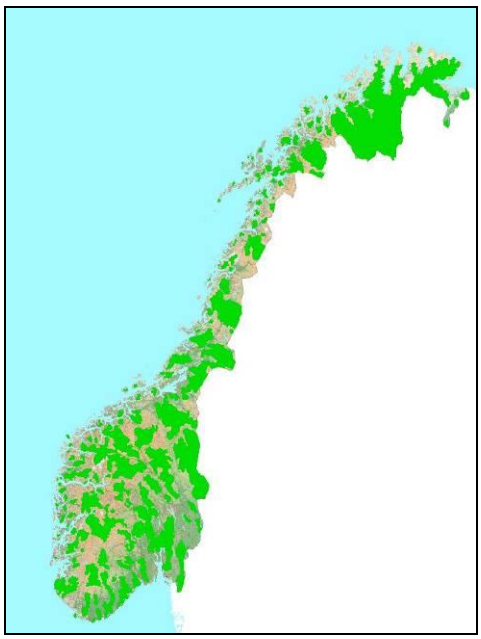
In Norway, the interest for small hydropower (1-10 MW) is growing rapidly, and more than 700 applications are currently in some stage of the licensing process. The licensing follows the regulations in the Water Resources Act, but is simplified compared to larger projects. A general description of

possible environmental impacts and conflicts is required, and a separate and more detailed report on biodiversity with focus on red listed 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. Mechanisms for proper coordination with other plans, such as the river basin management plans under the WFD, will be included.

As a basis for the regional planning, the Ministry of Oil and Energy, together with the Ministry of Environment, will provide for national guidelines as a tool for the regional authorities for development of plans and to promote harmonisation of the planning procedures. Draft guidelines have been prepared by a committee consisting of representatives from various agencies, including the Water Resources and Energy Directorate, the Directorate for Nature Management and the Directorate for Cultural Heritage, and also with input from the regional authorities.

The first step in the planning process will be 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.



Permanent protected rivers in Norway: 388 rivers/parts of rivers are protected from hydropower development (green areas). Estimated potential in protected areas: 50 TWh

Slovenia

Ch2oice project (Certification for HydrO: Improving Clean Energy)

Country: Slovenia **Province/region/town:** Ljubljana **Status:** Realized

Topic: Refurbishment of existing plants and strategic planning approaches for hydropower development with a help of results of the CH2OICE project.

Within European Project CH2OICE (September 2008–February 2011) a technically and economically feasible certification procedure for hydro power generation facilities of high environmental standard was developed, which is being explicitly coherent with the requirements of the Water Framework Directive, to be implemented in "green labelled" electricity products, and being integrated, as much as possible, with existing EU tools, such as EIA and SEA. Certification procedure includes potential impacts matrix, which describes potential impacts of pressure factors related to HPP production on different environmental quality elements, possible mitigation measures and objectives for each environmental quality element. In Slovenia the certification procedure was tested on case hydropower plants: HPP Doblar I and II, SHP Gradišče and SHP Možnica.

Description:

CH2OICE Project – started in September 2008 and finished in February 2011 – aimed at developing a technically and economically feasible certification procedure for hydro power generation facilities of high environmental standard, being explicitly coherent with the requirements of the Water Framework Directive, to be implemented in "green labelled" electricity products, and being integrated, as much as possible, with existing EU tools, such as Ecolabel, EMAS, EIA and SEA. In order to be certified, a given HPP has to commit to carry out appropriate measures in order to mitigate its impacts on specified environmental objectives, in such a way to fulfil predefined environmental objectives and prescriptions. These measures have to be described through a specific management programme, based upon a dedicated environmental study, supported mainly by existing data, but complemented by ad-hoc assessment/monitoring when necessary. The realization of both the environmental study and the management programme must be supported by public consultation; both documents must be approved through an auditing process.

The groundwork for development of methodology for certification of HPP was potential impacts matrix, which describes impact of pressure factors related to HPP production on different environmental quality elements. Pressure factors are divided on those that are caused by presence of structures/ infrastructures (dam, derivation structures, power plant, transmission lines and access ways) and to management variables (flow management, sediment management, management of dam, intake and outlet structure, management of fish passes). Environmental quality elements are divided into elements of aquatic environment (biological elements, hydromorphological elements and chemical/ physico-chemical elements), semi-aquatic and terrestrial environment, priority habitat types and priority species. 4 different matrixes were made, for each section of impacted area of HPP separately: (1) river section from the end of a reservoir upstream (in the direction towards the source of a stream) or from the dam upstream if there is no reservoir; (2) river section with the reservoir; (3) river section from the dam downstream (in the direction of the current in a river or stream) to the inflow where abstracted water is back to the river; (4) river section downstream from the dam where the inflow of abstracted water is flowing back to the river or downstream the dam if there is no abstracted channel.

For each potential impact and each environmental quality element potential mitigation measures were defined.

Objectives for each environmental quality elements were defined at three different levels: at river basin scale, at the water body scale, and at local scale. Objectives were defined separately for HPP

located on natural water bodies, on heavily modified water bodies or artificial water bodies, on small streams and on derivation channels. Description of additional prescriptions for certification related to the pressures caused by HPP production (general and detailed additional prescriptions) for each river section was also defined within the project reports.

Within CH2OICE Project a general, agreed and widely transferable approach for a certification was developed, discussed by all relevant stakeholders, and an operational methodology was developed, which was be tested for 2 partner countries -Italy and Slovenia. The certification methodology is primarily referred to existing plants.

Pilot application of Slovenian certification methodology is good practice example and was made on 3 selected pilot hydropower plants in Slovenia: Small HP Možnica, Small HP Gradišče and HPP Doblar I and II. For each HPP the results of environmental study were collected and the management plan was introduced.

Small HPP Možnica could be certified (CH2OICE) with only few mitigation measures. The constant monitoring of ecologically acceptable flow (EAF) below the dam should be assured and monitoring of the quantities of EAF must be provided, on the inflow to the facility or directly below the facility. On the basis of field examination it should be checked if fish are present in intake and outlet structures. If fish are endangered because of HPP operation the deterrent devices must be placed. There is no need to build fish pass because of natural discontinue on the place where dam is situated.

The mitigation measures for small HPP Gradišče include:

- The constant monitoring of ecologically acceptable flow under the dam should be assured.
- The fish pass / way has to be built to provide up and downstream habitat connectivity.
- On the basis of field examination it should be checked if fish are present in intake and outlet structures. If fish are endangered because of HPP operation the deterrent devices must be placed.
- Sediments directly below the dam must be periodically removed.
- The transport of the sediment and periodically emptying of reservoir has to be assured in accordance with the management plan.
- Water and sediments from reservoir should be discharged gradually and only in small quantities. The management plan must take into account the fish reproduction period.

Beside the mitigation measures to achieve CH2OICE objectives it is also important, that HPP follows the prescriptions defined in Slovene methodology for HPP certification.

HPP Doblar (Doblar I and Doblar II) is a reservoir HPP with average annual production of 349 000 MWh. It is the first HPP in the chain of interconnected HPPs on the Soca River, with a 55m high dam. Results of environmental study showed that HPP Doblar has the impact on environmental indicators which are all the part of the river ecosystem. HPP Doblar could achieve the objectives of certification with mitigation measures, but the feasibility and costs for these, could be very high.

For further information please visit: www.ch2oice.eu

Dam of SHP Gradišče on Vipava river (*additional pictures are available*)

Fish migration aid on the Sava River (HPP Blanca)

Country: Slovenia **Province/region/town:** Dolenjska, Blanca **Status:** Realised

Topic: Good practice in mitigation measures – fish migration aids

Description:

During construction of hydropower plant Blanca on the Sava River also fish migration aid was constructed in 2009. It was designed primary for cyprinid fish species. Total length of fish migration aid is 680 m and enable fishes to pass over 9,4 m high dam. Fish migration aid is constructed form three different parts:

- inflow part, designed as concrete vertical slot pass (length 180 m) divided in two parts that enable fish migration aid functioning under every water level condition in accumulation;
- bypass channel designed as near-natural cascade aid (length 570 m), constructed with 117 sills with interacting distance of 5 m and height of 10 cm; planted with vegetation,
- outflow part, constructed with 16 sills with interacting distance of 4 m and height 10 cm; that is also divided in two parts – one part is presently functioning and another one will be in function after constructed downstream HPP Krško. Outflow part also enable extra fish attraction flow.

Within this project also three year fish monitoring was realised in the period 2009-2012. It was assessed that fish migration aid is working properly, due to the fact that 32 different fish species out of 40 species that are characteristic for this part of the Sava River were identified. Fish species that were not identified in the fish migration aid are very rare in this part of the Sava River. It was also monitored that fish species Chondrostoma nasus is migrating in the highest number and that this fish migration aid is functioning also as spawning ground for the nase. It is proposed that monitoring would be further on executed at least in 2014 and 2016 (Zabric, 2012).

Literature:

Zabric, D., Jenic, A., Videmšek, U. 2012. Ihtiološki pregled na HE Boštanj in HE Blanca v letu 2012. / Ichtyological research at the HPP Boštanj and HPP Blanca in 2012. Report. Ljubljana.

Zabric, D. 2010. Ihtiološki pregled na HE Boštanj in HE Blanca - Monitoring ribje steze HE Blanca. / Ichtyological research at the HPP Boštanj and HPP Blanca – Monitoring of the fish migration aid at HPP Blanca. Report. Ljubljana.

Inflow part (vertical slot) and outflow cascade part

Second, in between cascade part of fish migration aid on the HPP Blanca on the Sava River

Decree on Criteria for Determination and on the Mode of Monitoring and Reporting of Ecologically Acceptable Flow (OG RS, No. 97/2009)

Country: Slovenia	**Province/region/town:** Ljubljana	**Status:** Under Implementation

Topic: Good practices on mitigation measures with a determination and use of the Ecologically Acceptable Flow (EAF)

Description:

The Ecologically Acceptable Flow (EAF) is a tool for finding the balance between nature and human needs and ensuring a long-term water supply: EAF is a tool to balance water needs for achieving good ecological status and also water needs from different users. EAF is the term for the amount of water needed in a river to maintain healthy, natural aquatic and riparian ecosystems and their benefits where there are competing water uses and where flows are regulated.

The need to determine EAF in Slovenia has increased significantly in recent years for a number of reasons. These include the need to protect river ecosystems, a demand to licence water users (e.g. hydropower production, industry, drinking water supply and irrigation for agriculture), and for the implementation of important legislation at both the national (e.g. Environmental Protection Act and the Water Act) and European level (EU Water Framework Directive; The European Parliament and the Council of the European Union, 2000).

With the implementation of Water Framework Directive, a new Water Act in Slovenia was accepted in 2002 (OG RS No. 67/2002, amended by Nos. 110/2002-GZO-1, 2/2004-ZZdrI-A, 41/2004.ZVO-1, 57/2008). On the basis of Article 71 of the Water Act, the Decree on Criteria for Determination and on the Mode of Monitoring and Reporting of Ecologically Acceptable Flow (EAF) was adopted in 2009 (OG RS No. 97/2009). The decree consists of 6 chapters including general provisions, criteria, the mode of monitoring, supervision, penal provisions and transitional provisions. The values of EAF should maintain the river ecosystem to achieve good ecological status.

The Decree prescribes the hydrological and holistic approach of EAF determination. The hydrological approach is based on the reversibility, quantity, length and duration of water abstraction, the ecological type group of watercourses, and the ratio between the mean flow and mean low flow. The EAF may be determined on the basis of a holistic approach study after the initiative or application, by an initiator or applicant for water right. The study should contain the hydro-morphological, biological and chemical characteristics of the river reach where is water diversion/abstraction. The minimum requirements for the preparation of a study for the determination of ecologically acceptable flow are (Annex 3 of OG RS No. 97/2009):

- Description of the intended encroachment
- Justification for a different determination of EAF
- Characterization of the watercourse
- Definition of the micro location (s) within the section under consideration
- Description of the status of surface WB and the status at the abstraction site
- Description of hydromorphological characteristics
- Review of the sources of pollution upstream
- Review of other uses
- Proposal of the environmental objectives
- Expert opinion on the value of EAF
- Data sources and literature used in the preparation of the expert opinion on the EAF

The final determination of EAF should also include the protection arrangements.

The approach for EAF assessment in Slovenia presents the characteristics of the hydrological methods, but in the case if EAF is assessed according to Annex 3 it represents the characteristics of holistic approach. The main advantages of the hydrological method are that it is a simple, fast and cheap method, it is general, and useful for different types of rivers and partly it consider the sensitivity of different river types and it is based on hydrological data. The main advantage of the EAF assessment according to holistic approach is that include the whole river and riparian ecosystem, with interdisciplinary team of experts, but the main disadvantage is that it is very expensive and for EAF assessment you need at least half a year to one year.

For further information please visit: www.uradni-list.si/1/content?id=94816

Importance of achieving balance between ecology (water for rivers) and economy (water use)

Bank revitalisation on the Ptujsko jezero accumulation (HPP Formin)

Country: Slovenia **Province/region/town:** Štajerska, Maribor **Status:** Under construction

Topic: Good practice in mitigation measures – impoundment improvement

Description:

Ptujsko jezero accumulation is located on the Drava River downstream from Maribor and is the largest accumulation in Slovenia. It was built in 1979 for the purpose of hydropower production (HPP Formin). Accumulation was built with hard engineering materials – banks were reinforced with asphalt bank protection.

Due to the fact that on this part of the Drava River numerous endangered species are living (especially bird species) and that habitats were greatly altered, currently ecological improvement on the Ptujsko jezero accumulation is under implementation.

The main objectives of this project are:

- to stop further degradation of existing bank protection due to water level fluctuation,
- to minimize amount of silt sediment in accumulation,
- to improve habitats for key animal and plant species,
- to increase aesthetic value of accumulation (higher potential for recreation and tourism).

Within project different type of measures for habitat improvement are foreseen, such as:

- asphalt bank revitalisation with accumulated silt planted with specific vegetation (at first wall of wood is set few meters away from the bank, further on silt is pumped on the bank and planted with riparian vegetation; after time - wall of wood decompose and riparian vegetation assure additional bank stabilization) (see pictures below),
- construction of hiding places and spawning grounds for fishes,
- construction of islands made from wood boxes filled with silt and covered with gravel (especially important for terns),
- construction of shallows planted with reeds,
- construction of banks covered with silt and planted with grass.

Asphalt bank protection before revitalisation and revitalised bank protection

Sustainable planning and management of HPP at Dravske elektrarne Maribor (DEM)

Country: Slovenia	**Province/region/town:**	**Status:**
Topic:		

Description:

Sustainable development became a fundamental doctrine of the EU in last decade, encouraging economic development, social equity and environmental protection in order to ensure future generations at least the same living conditions, as we have today. Managing and building hydropower plants is one of the fields with biggest impact on environment, rivers and people living nearby, and is becoming also an important part of climate engineering. started to implement sustainable approach in planning process as early as 2006, and in 2012 they started the process of introduction of sustainable principles in the management of existing infrastructure.

Planning future HP projects – HPP Mura River

At present it's not possible to assess all the implications of future energy exploitation of Mura River, therefore DEM (Drava River electricity producer) decided to create a comprehensive study of sustainable development of area along the Mura River. For this purpose a methodology of sustainable development study was developed, following the guidelines of EU and UNDP. The overall objective of the impact assessment on sustainable development (Sustainability Impact Assessment -SIA) is to help ensure the sustainability of cooperation areas between the EU and other countries with economic, social and environmental point of view, in order to improve the EU's negotiating position. To achieve this, SIA assesses the potential impacts of various scenarios on sustainable development using indicators of sustainability and measures to prevent or reduce the negative impacts and maximize positive ones. Comparative assessment of sustainable development shows the situation in the case of different choices (predictions) on basis of which it can produce medium and long term forecast scenarios.

Study of sustainable development was implemented by DEM between 2006 and 2010 in order to show the impact of river energy use on the sustainable development of influenced area – Pomurje. Unlike the environmental impact assessment, the main focus of SIA as a development document is the creation of local development partnership. The study provides the insight into long-term impact of the investment on development indicators of Pomurje and exposes measures for establishment or maintenance of balanced future development of the region. The general results of the SIA of hydropower exploitation of River Mura, point out possible positive impact on the sustainable development of Pomurje, but only if carried out with the accompanying mitigation measures. It is of utmost importance to note, that positive effects can also be achieved without the hydropower exploitation project of the Mura River, but the likelihood of achieving those investments by fiscal mechanisms is minimal.

Managing existing HPP chain on Drava River

Following the positive reactions of the concessionaire and best practices in field an integrated sustainable model for the existing plants was proposed. The purpose of the Supporting system to River Drava concessionaire was to provide support for the regular maintenance activities and coordination of obligations in accordance with the requirements of the WFD. As a result a sustainable management model for existing infrastructure was proposed. Main usage of the model is devoted to the situation and problems analysis in the field of concession, preparation of measures to improve the situation, assessment of possible solutions and performance monitoring after implementation of solutions.

Model was tested on pilot area of HPP Formin reservoir (Lake Ptuj), where the analysis of the current situation resulted in exposing of silting problem (the reduction of active storage of power reservoirs) and importance of the site as Natura 2000 area and Important Bird Area. During the Analysis and assessment of proposed measures the most optimal solutions for the use of redundant lake sediment

were found: building new artificial breeding island for Common Terns, covering of artificial lake banks and creating new reed bed areas.

As a result of the developed sustainable management model for existing infrastructure DEM fulfilled the first reporting obligation on WFD.

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Method to support efficient hydropower implementation harmonized with environmental objectives

Country: Slovenia **Province/region/town:** Alpine space **Status:** Under development

Topic: Method development to support strategic planning

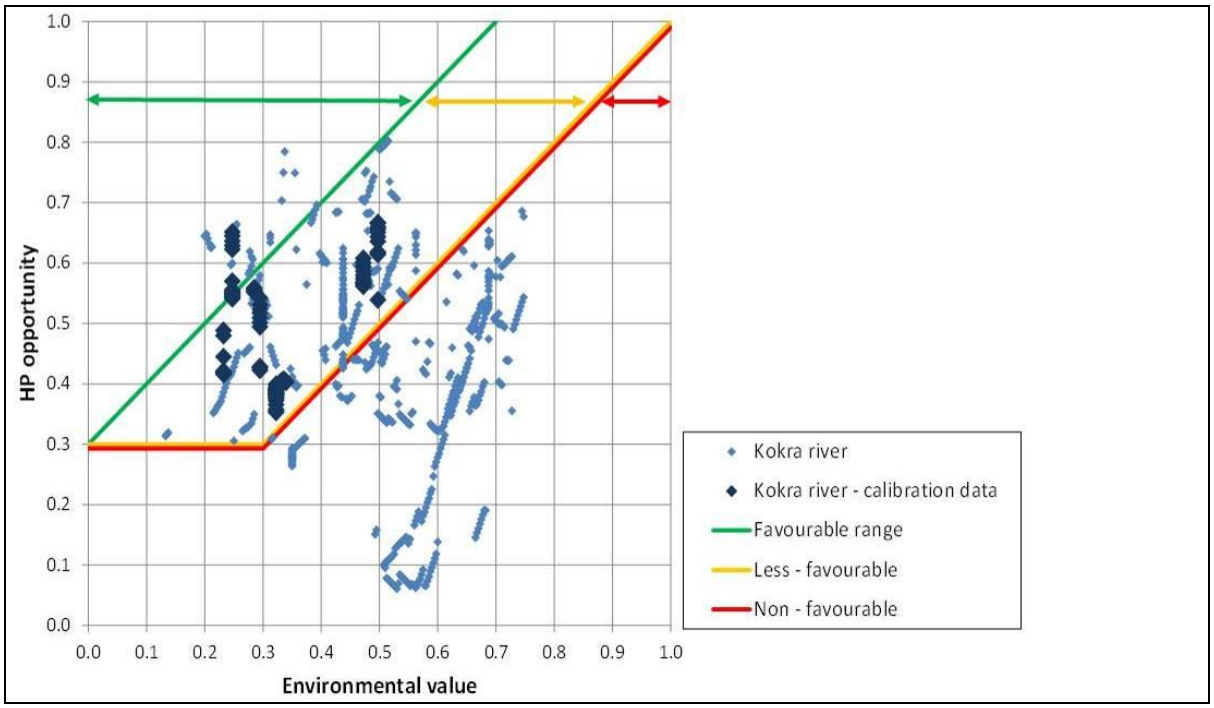
Description:

To support the objective of increasing the share of renewable energy sources (RES), where hydropower has one of the leading role and also to assure reaching other water related or depended objectives (Habitat Directive, Water Framework Directive, …) a method to support decision making at strategic level is under development. Development of the method, which started under the SEE HYDROPOWER project (www.seehydropower.eu), follows Common guidelines on the use of small hydropower adopted by the Alpine Convention - Platform Water Management in the Alp.

Method development bases on Multi Criteria Analysis approach, where next main steps should be considered:

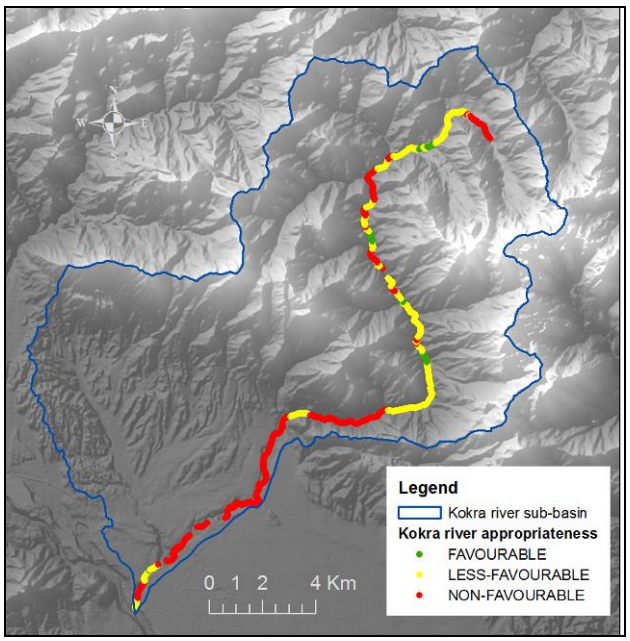
- Recognition or formulation of alternatives
- Criteria and indicators selection with performance functions determination
- Scoring method, criteria/ indicator weighting and acceptance levels determination
- Method application on analysed area
- Evaluation of results
- Agreement or repetition of the process

To assure the **objectivity** in the process a calibration, verification and sensitivity analysis of indicators performance functions and weighting should be performed. To assure **efficiency** the analysis should base on indicators which are representative and data for their evaluation is available.



Comparison of environmental objectives with HP opportunity or attraction of alternatives and process of determination of ranges of suitability based on calibration data – case study area of Kokra river, Slovenia

The final results overview should provide information which river sections are suitable (favourable), which less suitable (additional mitigation measures are required) and which are not suitable for further hydropower planning and implementation.



Hydropower suitability for case study area of Kokra river based on determined ranges of suitability

The map of hydropower suitability can provide information for strategy development and legislative adoption on larger scale (catchment, region, basin, state, …) and indication information for potential investors which river sections has higher probability for successful hydropower implementation.

Method is open for changing of selected indicators, performance functions and weighting determination. It can be applied for more detailed planning (spatial planning and EIA) and for evaluation of suitability of other water uses (fish farming, irrigation, recreational water uses, water supply etc.). The latter is planned to be performed in within the project CAMIS under the cross border cooperation programme Slovenia – Italy.

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Switzerland

New Ways to Solve Water Conflicts – Strategy for Hydropower Development in Switzerland

Countries: Switzerland **Province/region/town:** Canton Bern **Status:** Realized

Topic: Conflict resolution

Description:

The canton of Bern - an important water region in Switzerland

The canton of Bern is a prominent water region in Switzerland. It has a surface area of 6.000 km2 and with a river network of 12.500 km approximately 100 lakes, out of which three are larger than 30 km2, which are regulated. The canton holds about 20% of the water resources of Switzerland. This area is populated by around 1 million people. The topography includes alpine and pre-alpine regions as well as flat country side.

A multitude of water conflicts

Because of the variety of its regions, the canton of Bern has to face many water conflicts. Here are some examples:

- **The utilisation of hydraulic energy:** In this area around 50% of the energy is produced by hydropower. According this energy resource is very important. But the canton of Bern, in particular the Bernese Oberland, is also a famous tourist destination. Therefore new projects in the field of hydropower create conflicts between the energy industry and the environmental and tourism organisations. Here, the question of the residual water plays an important role.
- **The regulation of the water level in large lakes:** The water levels of the lakes are regulated, for reasons of flood prevention, by sluices (watergates) and at the lake of Thun also with a flood tunnel. Fixing the water level leads to conflicts between the party responsible for the flood prevention, the operators of the shipping on the lake and the environmental and fishing organisations.
- **The utilisation of the groundwater for the drinking water abstraction:** 90% of the drinking water is gained from the groundwater. Many water intakes for the water supply are near an ecological protected wetland or the course of a river, so conflicts occur between users and protectors.
- **Irrigation and drainage of the agricultural area:** In one part of the canton vegetable gardening is intensely cultivated. In this region there is a canal system for irrigation and drainage. This leads to a potential conflict between the agricultural and the environmental organisations. Here the contentious point is how the water management and the maintenance of this canal system should be organized.
- Furthermore, diverse additional conflicts exist, as for example in the **production of artificial snow**, in agricultural **irrigation** as well with reference to the protection of ground water.

The integral water strategy - a new approach to solve these conflicts

As an answer to all these different conflicts the canton of Bern has in the years 2009 and 2010 developed a water strategy, which contains three parts: Water Use Strategy, Drinking Water Strategy und Water Protection Strategy.

The Water Use Strategy has the goal of weighing the different interests against each other. To provide more transparency for investors, public authorities and all parties who are involved in the management of water, a concrete protection and utilisation plan for hydropower use areas was made.

For example, there a map was made, on which all rivers with a certain potential for hydropower were dived into utilisation categories. These are the utilisation categories: „Hydropower intended“, „hydropower with limited possible use“ and „no use possible“. This map, supplemented with further agreements was discussed with all stakeholders and has built now a negotiated compromise. Because the whole strategy was bargained in a broad participative process, it is now accepted by many involved parties. The main advantage of this strategy is, that the conflicts were discussed and regulated on a higher level, so they don't have to be settled in every individual project.

New methods lead faster conflict resolutions in power station projects

A new approach in the administrative procedure led to the break through in a big power station project. One of the biggest energy companies in Switzerland had tried more than twenty years to realise a new project, without any success. Due to a new approach, the negotiations were conducted and the authorizations granted within 2 ½ years. The project includes a pump storage plant (660 MW), the expansion of a hydropower station (240 MW) (a compensating reservoir of 80,000 m3 included) as well as the enlargement of an artificial lake (170 Mio. m3). The overall investment volume ranges approximately around 1.3 Billion CHF.

The new approach was to conduct a preprocedure before the official authorisation procedure (a two-step procedure). In this preprocedure all solutions were worked out by a negotiation board. The results then were verified by a political board of thirty people. The following factors were the key to success: The negotiating committee had the right size; it comprised six people. The committee was professionally chaired and as these people had the necessary competences, the results had a corresponding commitment. In addition, the members were prepared to spend the necessary time and effort. A further advantage was, that the official procedure had not yet been started. Due to this, the procedure was still free from any legal requirements, so the team could work even more creatively.

This writer led the negotiating committee and was in charge of the subsequent legal process i.e. of the grant of the license.

Conclusion

To solve water conflicts in particular in the sector of hydropower two elements are needed: Instruments (for example a water strategy) and negotiation processes. So that the instruments are effective, they have to be balanced out and discussed in a participative process with all the stakeholders. Negotiation processes – for elaborate instruments as well as within the framework of a concrete project – have to be conducted in a constructive and professional way. Here the focus has to be on combined interests.

For further information please visit: www.be.ch/awa (Wasserstrategie)

Protection and utilisation plan:

www.bve.be.ch/bve/de/index/direktion/ueber-die-direktion/dossiers/wasserstrategie.assetref/content/dam/documents/BVE/AWA/de/Wasserstrategie/Gew%C3%A4sserkarte_Nutzungskategorien_Wasserkraft_d.pdf

Publication by the Swiss Association for Environmental Law (VUR): „Instrument alternativer Konfliktlösungs-mechanismen: Kooperation statt Verfahren (am Beispiel der KWOplus, den Ausbauprojekten der Kraftwerke Oberhasli)“, Heinz Habegger (E-mail: Heinz.habegger@bve.be.ch / Phone: +41 79 439 74 84)

Reactivation of sediment transport across a series of 11 hydropower stations along the transboundary High Rhine (132 km) – *Preliminary unauthorized draft*

Countries: Switzerland & Germany	**Province/region/town:** High Rhine between Switzerland and Germany	**Status:** Under Implementation

Topic: Sediment transport

Description:

In total 73 km of the whole Rhine River from Lake Constance to Basel are impounded, and only three free flowing stretches provide more near natural conditions. The sediment transport and balance are disrupted and highly disturbed not only by the dams and weirs in the main river, but also by the highly reduced sediment input from major tributaries such as the Rivers Aare and Thur, and from bank erosion due to extensive rip-rap constructions.

From 1990, during the long process of issuing new concessions for individual hydropower plants the problem of bed load sediment transport across the weirs was debated only within the concession perimeter. However, river sediment transport is clearly a large-scale, basin wide issue, and if there is a chain of hydropower stations, it must be tackled in a cooperative manner.

Upon an initiative of the Swiss environmental NGO (Rheinaubund) the 11 hydropower plants, loosely organized in a hydropower association (VAR, Verband der Aare-Rhein-Kraftwerke), decided in 2006 to form a common platform (PGG, Projekt-Gruppe Geschiebe) and, together with the responsible governmental authorities (Bundesamt für Energie, BFE, Switzerland and Regierungspräsidium Freiburg, RPF, Germany), to launch and finance a Master Plan (MP) for the reactivation of sediment transport and ecological revitalization in the High Rhine. The PGG has only advisory function, but the MP is admitted by national and regional authorities as an expert study.

The organization is as follows: (1) the PGG-Core Group of experts is responsible for preparing the tender and contract, and the scientific/technical review of the MP; (2) the PGG-Forum encompassing the delegates of various key stakeholders is reviewing the process of the Core Group and drafts of the MP; (3) the PGG-Plenum, composed of all interested stakeholders, is informed in a first workshop about the planned project, then by short reports about the progress of work, and in a final workshop about the end version of the MP.

The goal of the MP is to give a scientific review of the natural and present status of sediment transport (i.e. without and with hydropower plants), to provide basic scientific background knowledge about sediment transport mechanisms and modelling, to describe all possible and technically feasible measures and scenarios to improve sediment transport and fish habitats along the whole impacted river section.

The first phase (establishing the organization of the PGG and preparing the MP) lasted from 2007 to 2013. In a second phase, under the lead of the Swiss and German authorities, the Plenum should discuss the political feasibility of recommended individual or combined measures, and find solutions to implement certain measures in follow-up actions, step-by-step, according to priority, restoration potential, cost-benefit analysis and risk assessment.

For further information please visit: www.energiedienst.de

Public participation process in the new concession procedure of the hydropower plant Ryburg-Schwörstadt (KRS) in the transboundary High Rhine (132 km)– *Preliminary unauthorized draft*

Countries: Switzerland & Germany	**Province/region/town:** High Rhine between Switzerland and Germany	**Status:** Under Implementation

Topic: Public participation

Description:

In both countries, laws are in force to allow authorized environmental NGOs objections/complaints against infrastructure projects such as hydropower plants seemingly offending respective laws on environmental protection (CH: Verbandsbeschwerderecht, www.verbandsbeschwerde.ch – DE: Umwelt-Rechtsbehelf-Gesetz, http://www.bmu.de/bmu/parlamentarische-vorgaenge/detailansicht/artikel/umwelt-rechtsbehelfsgesetz/). In Switzerland, this right is cautiously and efficiently used, proven by official and published annual monitoring. Its existence ensures a considerable quality standard of EIA and submitted hydropower projects (both for new and renewing concessions).

The concession of 1931 expired after 80 years (the maximum period according to Swiss law). The EIA was performed during 2005-2007 according to a politically changed one step procedure (replacing the former two step procedure with concession / authorization of construction). The concession was renewed in 2010 for 60 years. Since the power station is on the Swiss side, the Swiss authority (BFE) had the lead in close cooperation with the German authority (Baden-Württemberg, RPF). Major environmental issues and compensation measures respecting flood protection were: a functional fish migration aid on both river sides, restoration of sediment transport by respecting flood protection, connecting small tributaries, and diverse ecological improvements along the banks. The electrical power is sold as eco-labelled product (…).

After objections of various NGOs in 2007, and in order to prevent long-lasting and expensive juristic complaints by affected stakeholders, the directory of the KRS decided from the beginning to initiate an open and transparent public participation (organized as ÖBK = ökologische Begleitkommission, encompassing the authorities, plant operators and all relevant stakeholders: NGOs, local communities). The procedure, described in more detail below, is exemplary for the concession process and is highly recommended. Prerequisites are: the actual laws of water/environment protection and water use, the balance of interests, and the commensurability in terms of economic feasibility.

On average, the ÖBK meetings took place twice a year, in principle when new reports were elaborated or, later, when new milestones of the project were realized. The meetings consisted of an information/discussion part in an auditorium and an in site excursion / inspection.

The strategy of the hydropower plant was to build trust in realizing the optimum environmental measures. These are in need of scientific justification. For example, to plan and realize a functional fish pass / by-pass on the right bank, hydrological measurements and 3D modeling was urgently needed; the power plant offered such modelling and invited experts of NGOs to cooperate, e.g. organized joint visits at the university in charge. By 2013, most of the requested and planned environmental mitigation/compensation measures were realized; however, the planning of the fish migration aid (a combination of technical fish pass with entrance on the Swiss side and a by-pass river on the German side) needed more detailed investigation. Construction starts in 2013. The reactivation of sediment transport is linked to the Masterplan of PGG and therefore postponed, but requested in the concession.

Alpine Convention

Common Guidelines for the use of Small Hydropower

Countries: Austria, France, Germany, Italy, Liechtenstein, Monaco, Slovenia, Switzerland

Province/region/town: Alpine region

Status: Realized

Topic: Strategic planning approaches for hydropower development, good practice examples

Description:

Based on the outcomes of the Second Report on the State of the Alps and a broad public debate of this report at the Conference in Munich 2008 decision was taken to set up the platform ”Water Management in the Alps” in at the 10th Alpine Conference held in Evian, France, March 2009.

The platform ”Water Management in the Alps” was mandated to develop recommendations for the sustainable and balanced use of hydropower in the Alpine Area. While results are representative and applicable for the entire sector (with the exception of pump – storage schemes) particular consideration is given to provide guidance for the use of small hydro power. The main task was to develop and to find consensus upon general principles and common criteria for the use of small hydropower in the Alpine region. As guidelines they have the character of recommendations but do not exert any legally binding force.

Objective

Derived from both the Energy and Environmental legislation, the global objectives with respect to the use of small hydropower are

- Increasing the production of renewable energy from hydropower generation,
- Minimizing the impairment of the aquatic ecosystem and landscape.

This represents in most cases a conflict of interests requiring an optimization task between these overriding objectives. It implies the question about potential appropriate locations for hydropower respectively locations which may be considered to be rather sensitive thus making them less favorable for hydropower. The decision needs to be based on a holistic evaluation, i.e. considering socio-economic and ecological criteria.

Since the decision on a new project is usually within the responsibility of the public authority based on a request by the applicant, the optimization task of the overriding objectives is also within the responsibility of the public authority. This requires assistance for the public authority responsible for taking the decision on a new project. On the other hand guidelines also give support to potential applicants by making the decision process transparent already in advance and providing indications on the chances for the realization of projects.

In general terms the specific objective of the guidelines is therefore to provide guidance for the identification of potential appropriate locations for small hydropower plants and the subsequent authorization decision under consideration of the sustainability principles.

The common guidelines

The guidelines include common principles and recommendations, an outline for an assessment procedure, as well as a pool of criteria for evaluation of sites. However, no concrete methodology is proposed since sufficient flexibility for the implementation of guidelines is needed in order to pay attention to regional differences and varying national conditions.

The in total 16 recommendations cover a broad range of issues, starting with more general principles as well as covering plants already in place and their refurbishment. However, core part of the

guideline is the recommendation to proceed with strategic planning on a regional level by assessing the potential appropriateness of river stretches for hydropower generation. This is proposed to be done by classifying river stretches with regard to their hydro-electrical potential as well as with regard to their ecological and landscape value (see figure 2); results of this evaluation can be shown in a transparent manner in tables or maps (see figure 3) in order to answer the question, where new installations would be most favourable to reach the national targets in order to enhance the share of renewables.

A comprehensive, but non exhaustive list of criteria for assessing the theoretical hydro-electrical potential as well as the ecological and landscape value is also part of the guideline. Last but not least installation and site - specific criteria as well as socio-economic criteria helpful for the local assessment of new installations complement the guideline.

This strategic planning is highly recommended in order to support and channel efforts to enhance the share of renewable energy stemming from hydropower within the given short time span.

A set of good practice examples has been collected to provide inspiring examples and to underpin the guideline.

The set of good practice examples covers a broad range and includes:

- hydro power plants in place in various regions which have been refurbished thus producing energy more efficiently as well as meeting at the same time modern environmental requirements,
- regional strategies to enhance refurbishment as well as meeting of modern environmental provisions (Upper Austria) by providing financial incentives,
- innovative hydroelectric concepts with horizontal inlet to the turbines requiring no interventions on the banks nor separate power houses (developed by the TU Munich), and
- a regional strategy of classifying rivers for appropriateness for hydropower generation (Strategy “water use” of the Canton Berne).

Addressees

These guidelines are addressed in the first place to the public bodies in charge of authorizing small hydropower plants

- for strategic planning activities,
- as decision support for individual small hydropower plants.

Besides, they may serve on the one hand as orientation for applicants of small hydropower projects about the chances for getting an authorization and on the other hand as common vision for the realization of small hydropower throughout the Alps.

Link: http://www.alpconv.org/en/organization/groups/WGWater/default.html

WWF

WWF proposal for Austrian pre-planning methodologies

Country: Austria **Province/region/town:** Nationwide **Status:**

Topic: Strategic planning, pre-planning mechanism

Description:

Determining the best locations for new hydropower installations based on ecological, economical and social needs is a crucial element of strategic energy planning. Austria is among the few countries of the EU and the Danube region, where approaches to this type of pre-planning have been developed, two of them under the lead of governmental institutions, on by an NGO, WWF Austria.

WWF Austria created the Ecomasterplan as a planning tool to identify the conservation value of all Austrian rivers larger than 10 km2 with the help of four criteria . Class I and II river stretches as well as river stretches located in a protected area were defined as areas unsuitable for hydropower development. In a next step, WWF calculated the remaining energy potential within the various classes. The Eco Masterplan represents WWF Austria's basis for entering the hydropower discussion with government and industry.

WWF´s Ecomasterplan used the official data base of the Austrian River Basin Management Plan, including Protected Areas of Austria. Four criteria indicate the conservation value of a particular river stretch: (1) ecological status according to the WFD, (2) location of a river within a Protected Area, (3) hydromorphological status according to the WFD and (4) length of free flowing river stretch. All of Austrian river systems with catchment areas larger than 10 km2 were assessed according to these criteria. The result is a map, which shows the conservation values (sensitivities) of Austrian river stretches. WWF is of the opinion, that all Rivers stretches in Austria, which show a very good ecological status (after WFD) or are located within a protected area should be "no go" areas. For other stretches solutions have to be found according to their sensitivity status.

The WWF Ecomasterplan is a pure NGO product, advised by acknowledged scientists of a university institute (BOKU).

WWF Austria has also been among the stakeholders involved in developing the draft Austrian hydropower pre-planning tool Federal Criteria Catalogue (Bundeskriterienkatalog). Although the final and adopted version is not yet published, WWF Austria believes that the process and likely outcome can be regarded good practice and is in line with the rationale of WWF´s "Ecomasterplan".

The Federal Criteria Catalogues is not finished as of December 14. WWF and other NGOs regard the draft as a good product, encompassing appropriate criteria grouped into three different themes: water management, water ecology, and power sector. The catalogue will be made legally binding based on a ministerial decree, requiring all administrations to apply it in all hydropower procedures (new installations, refurbishments, extension of water rights). The catalogue will not indicate "no go" or "go" areas, but allow users to detect "sensible", "less sensible" and "very sensible" river stretches. It is important to note, that the catalogue includes a project level and a strategic level, which means that the criteria have to be applied in various planning procedures, such as river basin management plans as required by the WFD and the Austrian Water Act.

The Austrian region (land) Tyrol has developed its own catalogue, via a transparent process including different stakeholders, on a less intensive level on the Federal level. Application of the Tyrolean criteria catalogue leads to a clear decision on whether the project can be built or not, based on a number of points accumulated for different criteria The calculation modus is quite difficult and needs some experts to judge a project.

Projects can gain points for example based on the criteria "nature protection" and "spatial planning". No go areas are being defined, however, mostly on the basis of the existing nature protection legislation, such as nature reserves or national parks, which means it adds little to existing legal requirements. Furthermore, the catalogue uses a "climate bonus" giving larger projects more bonus points because they save more CO2. In addition, every project can gain points for compensatory measures which provides for loopholes in the opinion of NGOs and is the reason why WWF did not sign off to the final methodology. WWF also criticises the fact that the catalogue is not being applied in a transparent manner.

Having been involved in the development of all three pre-planning mechanisms, WWF can draw the following conclusions:

- Developing hydropower pre-planning mechanisms involving stakeholders can lead to acceptable results.
- In the opinion of NGOs it is crucial, that pre-planning mechanisms are designed in a way that lead to clear results such as the determination of areas unsuitable for hydropower development.
- Pre-planning mechanisms need to acknowledge the fact that mitigation and compensation measures can never fully make up for biodiversity or water status deterioration due to hydropower installations.
- A transparent process of developing pre-planning mechanisms is not enough. The application also needs to be transparent.
- All three mechanisms are based on the data collected for the Austrian river basin management plan. This leads to an acceptable result but better biodiversity data would certainly be of benefit.

For further information please visit:

www.oekomasterplan.at/fileadmin/user_upload/pdf/Oekomasterplan_II.pdf

WWF, International Association for Danube Research (IAD) & European Anglers Alliance (EAA)

Danube NGO approach to pre-planning for hydropower development		
Country: Basin wide	**Province/region/town:** Alpine, Carpathian, Danube and Western Balkan regions	**Status:**
Topic:		

Description:

WWF, the International Association for Danube Research (IAD) and European Anglers Alliance believe that hydropower generation in the Alpine, Carpathian, Danube and Western Balkan regions can only be compatible with EU environmental legislation, the EU Biodiversity Strategy and the Convention on Biological Diversity, if governmental authorities develop pre-planning mechanisms along the following lines:

PRE-PLANNING DEFINITION AND CRITERIA

1.) **Exclusion zones for new hydropower** are to be defined, designated and mapped according to scientifically sound ecological, cultural and social criteria. A limited set of international, Danube basin-wide criteria should be agreed under the auspices of the ICPDR. Complementary criteria specific to the natural and cultural context of countries should be defined at national and where appropriate sub-national level. The protection of exclusion zones is to be ensured through integration into the legislative and policy framework at national and/or at sub-national level, and respective implementation.

Basin wide criteria for defining exclusion zones for new hydropower development encompass:

- High ecological status;
- Good ecological status combined with hydromorphological class “slightly altered” or better
- The core zones of protected areas of IUCN category III and IV where river stretches or landscapes/catchments are preconditions for protection status
- River stretches / catchments that fall into core zones of IUCN category I and II protected areas

2.) **Non-favourable areas** are zones of high value for nature and for society through the ecosystem services supplied. Here, new hydropower development should only be allowed in exceptional cases. This may be the case for example if a remote mountain village cannot achieve its sustainable energy security without hydropower.

Basin wide criteria for defining non-favourable areas encompass:

- Good ecological status but hydromorphological class is only “moderate” and there is no impoundment (bottom sills would not count as dams in this context).
- Ecosystem relevant unfragmented rivers or river sections, including those important for continuity (actually and potentially) and for sediment transport and supply
- River stretches and catchment areas earmarked for restoration (e.g. floodplain restoration according to Danube River Basin Management Plan)

- Biodiversity hotspots (e.g. habitats for endemic species; natural reproduction of threatened fish and other species, especially if endemic, is at risk)
- Free flowing sections (as last refuge for fish and benthos) in existing hydropower chains
- Protected areas other than those defined for the exclusion category

3.) **Less-favourable areas** are river stretches and catchment areas of high landscape and/or cultural value (landscape parks; scenic beauty etc)

4.) **Favourable areas** are all those river stretches and catchment areas, where any of the criteria of the other three categories do not apply

5.) **Technical specifications** (operation, lay-out, size etc) for hydropower installations leading to lowest impact are also to be specified per river section.

STRATEGIC ENIVIRONMENTAL ASSESSMENTS

SEAs have to become mandatory for new hydropower development plans irrespective of their size recognising the negative cumulative impact of several hydropower schemes.

PRE-PLANNING PROCESS & TIMELINE

NGOs propose the following process and timeline for making the pre-planning mechanism operational:

a.) For the basin-wide process

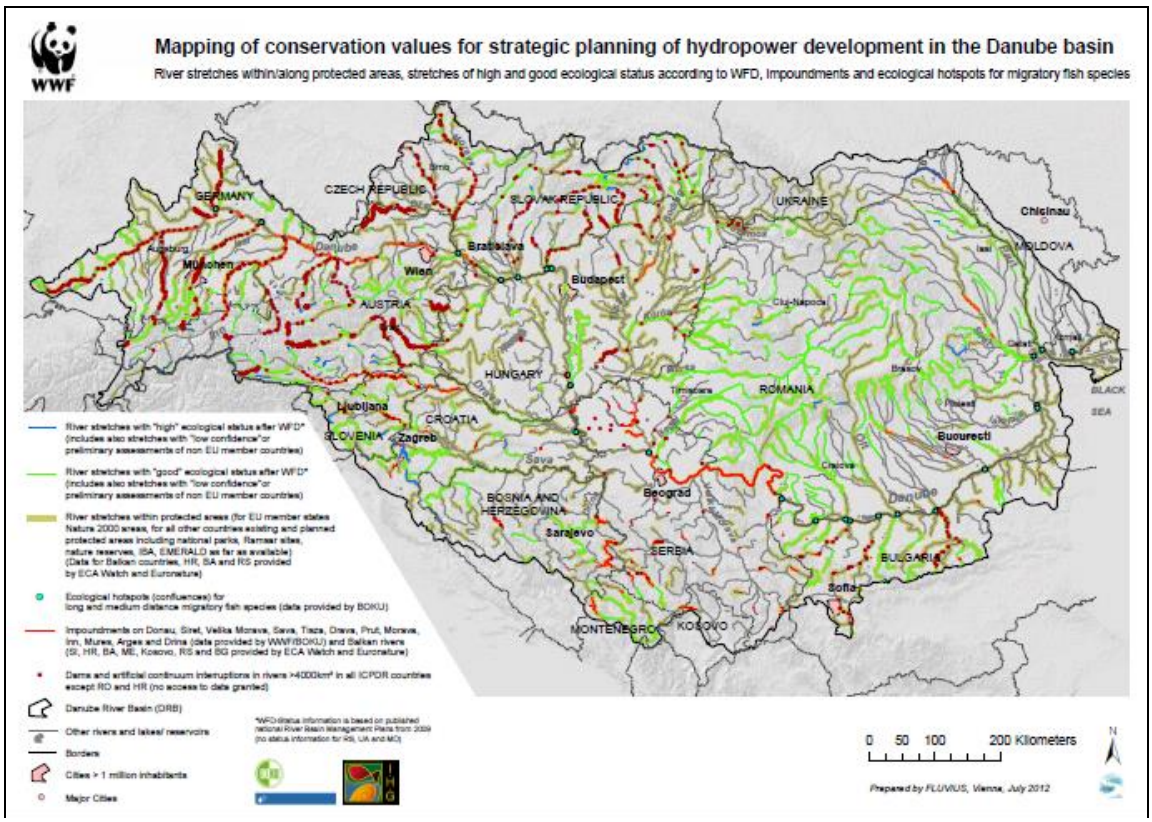
- By December 2013, countries have agreed on geo-referenced information to be collected and mapped at Danube basin-wide scale as a basis for the
- designation of exclusion and non-favourable areas for hydropower development
- By December 2013, at least one opportunity for pilot testing the Guiding Principles has been identified
- By December 2013, Danube countries have agreed on a brief best practice guide for setting up national stakeholder processes to determine national / sub-national criteria (see below)
- The 2nd River Basin Management Plan to be adopted by end of 2015 includes a chapter on the pre-planning methodology complemented by a map (or series thereof) showing areas of highest conservation value at basin-wide scale that mark exclusion and non-favourable areas for hydropower development
- The Ministerial Declaration on the adoption of the 2nd River Basin Management Plan includes a paragraph on how the pre-planning mechanism will be monitored and if necessary refined.

b.) For the national / sub-national level:

- By spring 2014, stakeholder processes have been set up at national / sub-national level for the determination of criteria that define exclusion, non-favourable and less-favourable areas

- By end 2014, national / sub-national criteria for determining exclusion, non-favourable and less-favourable areas have been agreed with stakeholders
- By mid 2015, exclusion, non-favourable and less favourable areas have been mapped and maps prepared as annex to 2nd River Basin Management plans

Progress in applying pre-planning mechanisms at basin-wide scale and in ICPDR countries will be monitored annually. To this aim, ICPDR countries will report on stakeholders involved in determining criteria for zonation, the outcome of the stakeholder process, in particular the criteria for delineating exclusion zones, non-favourable and favourable areas, the outcome of mapping these areas, hydropower projects planned and approved in non-favourable and less-favourable areas, and any lessons learnt worth sharing in the basin-wide context.



Map of the Danube basin showing river stretches of particular ecological value as basis for pre-planning

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