FIThydro

Fishfriendly Innovative Technologies for Hydropower

Funded by the Horizon 2020 Framework Programme of the European Union

D5.2 Stakeholder feedback on tools and products of FIThydro

Part 1: Summary report of the 1st FIThydro regional stakeholder workshop for France/Belgium

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1. Introduction

1.1 FIThydro background

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

FIThydro brings together 26 partners (13 research, 13 industrial) from 10 countries, involving several of the leading companies in the renewable and hydropower energy sector in Europe. Methods, tools and devices are applied and evaluated at 17 test sites all over Europe, covering four regions: Alpine region, Scandinavia, north-west Europe and the Iberian Peninsula). Scenario modelling in the four different geographic, climatic and topographic regions will allow the quantification of effects, resulting costs and comparisons of the test case regions to draw conclusions about future hydropower production mitigation options in Europe.

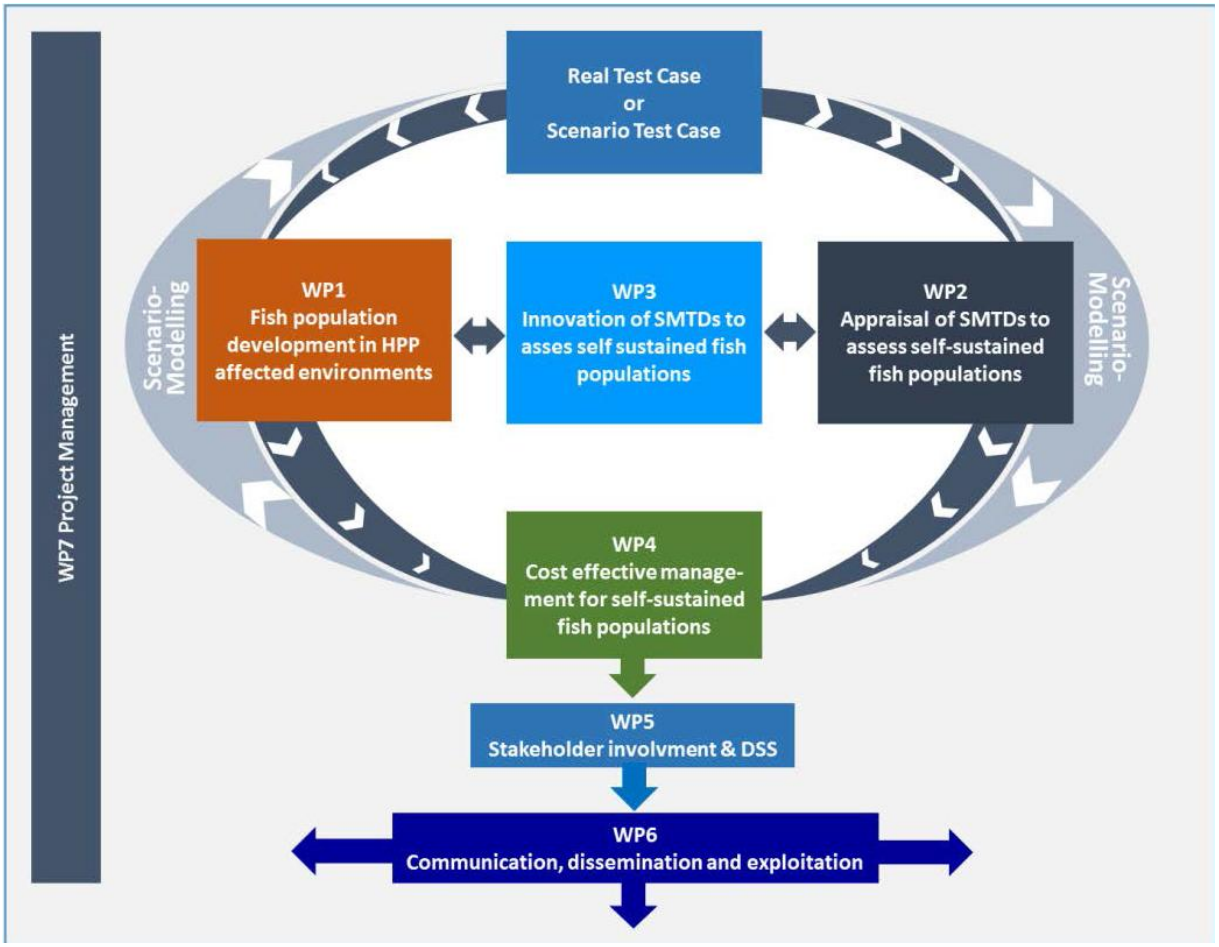

Figure 1 FIThydro approach and key work-packages

1.2 Aims of the stakeholder workshop

The 1st FIThydro Regional Stakeholder Workshop on Fish-friendly Hydropower took place on 24-25 January 2018, at the CNRS Meudon-Bellevue in Paris.

The workshop was the first in a series of 4 regional workshops and served as a platform for consultation and exchange between FIThydro scientists, stakeholders and water users on key open issues and possible solutions relevant to the assessment and planning of ecologically compatible hydropower production in the region of north-west Europe. The workshop mainly addressed authorities involved in HPP authorization processes, HPP operators, environmental NGOs, consultants, planners, fisheries associations and the research community.

The workshop and the FIThydro project as a whole are key to support the implementation of the Water Framework Directive (WFD) as well as meeting the objectives of energy policy.

Presentations were given by the FIThydro team as well as energy providers, legislators and scientists involved in the field of hydropower in France and Belgium.

At this workshop, key aspects of the FIThydro work-program were presented and participants were invited to give their feedback and highlight, from their perspective, the key open issues on the assessment and planning of ecologically compatible hydropower production.

39 participants attended the workshop, out of which 28 were stakeholders from France, Belgium and Germany and 11 were scientific partners of the FIThydro consortium.

The key sessions covered the following topics:

- Fish populations and habitats
- Sediment transport
- Existing, innovative methods and technologies for fish-friendly hydropower
- Cost-effectiveness assessment of mitigation strategies and policy/socio-economic challenges for decision-making

The workshop sessions addressed the main pillars of FIThydro's outputs and plans for the next stages of the project and also reflected on relevant activities taking place in the hydropower sector in France and Belgium.

A cover note was prepared for the workshop participants. The purpose of the cover note was to stimulate dialogue by outlining the key topics and by proposing some key questions to guide the discussions in the main sessions.

For each of the 4 specific topics of the workshop, which are outlined further below, the following were proposed as **guiding questions** for interactive exchange with the participating stakeholders:

Guiding questions for discussion with stakeholders

a) What do you consider as the **major issues (key problems, open questions)** relevant to the assessment and planning of ecologically compatible hydropower production in the region of north-west Europe (France/Belgium) (specifically on the 4 key topics below)?
b) What **approaches and solutions** are applied **to address the key problems and**

open issues in the region of north-west Europe (France/Belgium)?
c) What are your **recommendations or requests to the work-programme of FIThydro** (with specific relevance to the 4 key topics below)?

These questions were used to structure the interactive discussion after the presentations in each session of the workshop. Participants also received a paper hand-out to provide voluntary written feedback to these questions during the workshop, so that each participant had the opportunity to make a contribution to each topic.

1.3 About this summary report

Sections 2 to 4 of this report present a summary of the discussions and key conclusions of the workshop based on the presentations and ensuing discussions, as well as the participant feedback forms collected for each session.

Please note that the FIThydro consortium plans to give written feedback to the recommendations made by stakeholders during this workshop in Paris. This written feedback is expected to be provided in autumn 2018 in order to take into account stakeholder recommendations raised in the following three regional stakeholder events scheduled until October 2018 in the Iberian Peninsula, in the Scandinavian and Alpine regions.

The Annexes to this report include all detailed feedback provided by participants via the participant feedback forms, the programme of the workshop and list of participants.

2. Introductory session

To open the workshop, welcome and brief introductions were given by Peter Rutschmann - TUM (coordinator of FIThydro), Laurent David - CNRS (FIThydro regional case leader for France) and Johan Coeck - INBO (FIThydro regional case leader for Belgium).

The introductory talks introduced the FIThydro project, including an overview of the project's test cases and the challenges at these sites. The objectives of the workshop and the programme for the upcoming sessions were also presented. Furthermore, a brief overview of the workshop participants and stakeholders was given. In addition to the FIThydro team, stakeholders present at the workshop included: hydropower producers (i.e. Électricité de France, France Hydro Électricité = French association of small producers), research institutes (i.e. Agence Française pour la Biodiversité, IRSTEA, CNRS), technical consultants (i.e. ECOGEA, 3D Eau), as well as technical companies (e.g. Profish),…

3. Fish populations and habitats (session 1)

This session covered key issues regarding river fish population ecology, the challenges fish populations are exposed to in regulated rivers as well as fish response and resilience to river fragmentation and hydropower. From the FIThydro work-programme, first steps towards a fish population hazard index for hydropower were also presented. In addition, methods for defining ecological flows and effects of minimum flow conditions on fish were addressed.

In session 1, the presentations given covered the following:

- **FIThydro activities related to Session 1 (Christian Wolter, IGB)**. This addressed among others species hazard/biological sensitivity, type-specific and site-specific mortality as well as population effects.
- **Application of methods for definition of ecological flows in hydropower context (Philippe Baran, Ecogea)**
    - This presentation addressed among others the question of how to quantify biological changes related to low flow. It addressed the necessity for multicriteria analysis (based on hydrological, morphological, and habitat modification induced by hydropower) and an instream flow methodology.
- **How to identify, in a multifactorial context, necessary and sufficient levers to ensure the resilience capacity of fish population? (Véronique Gouraud & Agnès Barillier, EDF R&D)**
    - The presentation raised the question of how we can measure the efficiency of mitigation measures in a multi-stressor context. Concerning mitigation measures related to flow, biological monitoring can be used to assess the ecological response to minimum flow. In addition, habitat models are appropriate to assess minimum flow, but need to be improved.
- **The effects of the installation of minimum flow conditions on fish population dynamic in a small stream (Michael Ovidio, University of Liège)**
    - This presentation offered an analysis of the effects of the installation of the new HPP on the fish population dynamic in the reach of the river impacted by the installation of the minimum flow.

3.1 Discussion during the session

The key issues raised during questions and discussions between the participants in this session addressed the following:

- Further work is needed on **uniform biological indicators and links to hydrology**, in order to:
    - Ensure more transferability (from local to regional to European level, but also from water basin level to ecosystem level);
    - Measure the efficiency of mitigation measures more homogenously;
    - In addition, it is important to take the evolution of indicators in time into account.
- **Assessment of fish populations and habitats**
    - There is a need for developing new models on the biological preference of certain species;
    - The issue of natural mortality vs. extra mortality is also one which needs consideration in assessing fish sensitivity;
    - Fish length is considered as a fundamental factor for sensitivity – longer fish are more sensitive, but this can (to a certain extent) be mitigated with narrow screens;
    - An open question is how to consider new target species in existing methods, as well as the adaptation of species (i.e. increased resilience);
    - There is a need to be clear about the limits of tools/methods and how to apply them in specific cases;

  - While some metric methods can be transposed to other cases, others cannot due to the nature of the site or the methodology. An index or database of transposable methods could be useful;
  - It is important to define reference sites for future monitoring.
- **Multiple-pressure setting**:
  - A key open question is how to disentangle the effects of mitigation measures from other effects. In this context, monitoring is of high importance;
  - For example, for site-specific problems, there is the issue of isolating effects of HPP from the effects of other activities such as navigation, other intakes, or downstream predation;
  - Further knowledge and proof are needed on the effects of measures and their efficiency;
  - It is necessary to evaluate the cost of the mitigation measures regarding the ecological gain and explore other levers to improve the function of the environment.
- **Flow conditions:**
  - With regards to the use of multi-criteria methods, it is important that **the choice of criteria** is an adaptive and coordinated approach between the administration and the "petitioner";
  - There is little flexibility in terms of storage of HPP's energy, particularly due to navigation, and so the "battery" concept (variable resource) does not work well in practice.
- **Data collection:**
  - Another general point relates to the frequent lack of historical data, and so the installation of **data collection points** along rivers could be an important development for many stakeholders.

3.2 Participant feedback via paper forms

Additional feedback was collected from participants through feedback forms distributed during the session on (1) the major issues (key problems, open questions) with regard to fish populations and habitats, (2) approaches and solutions applied in France and Belgium to handle key problems, and (3) recommendations or requests to the work-programme of FIThydro.

Following session 1, a total of six feedback forms were collected.

The following summarizes the issues which the participants considered as important/relevant. The full responses in the feedback forms can be found in the Annex.

Key problems, open questions

1. Fish mortality
2. Fish not reaching spawning grounds due to barrier
3. Changes in habitat up- and downstream of barrier
4. Improve/build biological models of habitat preferences of fish
5. Plasticity of the species; translating local impacts to scale
6. Criteria on status of fish populations pertinent to the scale of works, as well as resilience
7. Definition of indicators to evaluate quality

8. Transferability/duplicability (harmonization)
9. Identifying the impacts of hydropower in the context of other anthropogenic pressures
10. Interactions between hydrological disturbances and other anthropocentric pressures
11. Modelling the exchanges of juvenile fish during hydropeaking
12. Efficiency of impact mitigation measures

Approaches and solutions to handle key problems in France and/or Belgium

1. Fish friendly adaptations
2. Fish passages
3. Combined restoration of flows and substrate (or shelter)
4. Increasing flow (bypassed reach and locks), decreasing the ramping rates of hydropeaking (during key periods of life)
5. Application of microhabitats method to evaluate minimum ecological flow. Improvement of the transferability of preference curves and dynamic preference.
6. Habby platform to determine ecological flows (in development).
7. Evaluation of the impacts of management modes (flow, hydropeaking). Follow-up, up/downstream measures...
8. Methodology for the determination of the reduction of flow without beaching of juveniles on the basis of the 2D hydraulic model from HRR calculations (horizontal ramping rate)

Stakeholder recommendations of general nature

1. Sacrificing some well-chosen rivers in favour of hydropower, and removing all barriers and HPPs in the other rivers would make it possible to combine hydropower practice but also have free flowing rivers of high ecological value.
2. HPPs that don't produce a significant amount of energy should be removed
3. Identify at the European level multiple long-term monitoring sites, sustain them, and analyse with perspectives from multiple teams and different tools. Choose sites with different levels of flows and sediments.
4. Facilitate dialogue between stakeholders through a nomenclature/ rules accepted by everyone.

Stakeholder requests with relevance to FIThydro

1. Consider other factors: thermal, diseases/virus, plasticity of species
2. Long term observations on water catchment (and capitalize every data acquired on sites per biogeographical region)
3. Tools and recommendations: Adaptable to different contexts, pragmatic, taking into account the economical aspects (cost-effective aspects)
4. Feedback, synthesis of the efficiency of mitigation measures (increased instream flow, hydropeaking)
5. Evaluate the combined role of multiple anthropogenic pressures (synergies, conflicts, neutral)
6. Develop tools to evaluate the resilience of populations.

7. Use the results of the European projects MARS and REFORM.
8. Recommended theses or post-doc to determine the Horizontal Ramping Rate limits of different fish species, based on their total length, temperature, period of the day, the substrate
9. Looking for compilation, classification, standardization of approaches and existing data
10. Provide more automatized models

4. Sediment transport (Session 2)

This session covered issues regarding the sedimentary continuity around hydropower dams. The conceptual and operational approaches to manage reservoir sedimentation and sediments in run off river low-head HPP were identified to highlight the main drawbacks and the protocols relevant to solve this problem.

In session II, the presentations given covered the following:

- **FIThydro activities related to Session 2 (Laurent David, CNRS).**
  - The FIThydro project will include in its work-programme some activities on run-off rivers for sediment transport (e.g. in a test site in Switzerland with focus on monitoring bedload transport and assessing ecological effects of re-establishing sediment connectivity). Overall, however, there are only few test cases in FIThydro where the sediment could be considered.
- **Sedimentary continuity and hydropower dams: conceptual and operational approach of an operator, EDF (Jean-René Malavoi, EDF)**
  - This presentation included reflections on the sediment continuity concept (assessment of sediment continuity at the dam level and assessment of sedimentary state downstream of the dam). It also provided examples of operative measures.

4.1 Discussion during the session

The key issues raised during questions and discussions between the participants in this session addressed the following:

- Many operators are now confronted with the issue of sediment transport. There is, thus, an **increasing need for data and feedback from the operators**. There have been cases in which sites with sedimentary actions were being monitored, but there was no data or description of operations like the frequency or duration of dam openings;
- The **legislation is not clear** on what is sufficient sediment transport. There are also **conflicts between the regulatory requirements** for habitat protection and those for sediment transport;
- The **challenges** for sediment transport differ **for large and small dams;**
- Technical and biological challenges also differ for **different sediment sizes;**
- Research so far concentrates on the hydromorphological issues related to sediment transport, while **biological impacts are not yet (or little) considered;**
- There is **little information to the public on operational measures** related to sediment; therefore, this is potentially an issue relevant to the public acceptance of measures;

- Overall, there is less focus on the issue of sediments than there is for topics like flows. Therefore, it could be useful to have sites where there is a **development of sediment transport issues for research**.

4.2 Participant feedback via paper forms

Additional feedback was collected from participants through feedback forms distributed during the session on the (1) major issues (key problems, open questions) with regard to sediment transport, (2) approaches and solutions applied in France and Belgium to handle key problems, and (3) recommendations or requests to the work-programme of FIThydro.

Following session 2, a total of five feedback forms were collected.

The following summarizes the issues which the participants considered as important/relevant. The full responses in the feedback forms can be found in the Annex.

Key problems, open questions

1. Reducing spawning grounds from covered gravel due to impoundment and canalization
2. Evaluate and quantify the needs of different species in terms of large sediments and their resistance to fine sediment
3. Evaluate the effectiveness of mitigation measures and/or the impact of different management approaches
4. Treat the question of flow and sediment management together
5. Consequences of the modification of management modes for HPP
6. Cross-reference the different aspects of sediment transport (reservoir, biology, hydraulic)
7. Multi-scale view (local, median, river)

Approaches and solutions to handle key problems in France and/or Belgium

1. River restoration
2. Diagnostic of sedimentary state and sediment transport
3. Evaluation of the degree of clogging
4. Evaluation of the favourable granulometric surface
5. “DECOLOFOND” (bottom remover) approach, which allowed knowing the limit for putting into motion of substrate in installing a mobile pump system to simulate flood conditions

Stakeholder recommendations of general nature

1. Remove artificial structures from rivers, some can be sacrificed for hydropower
2. How to access the information

Stakeholder requests with relevance to FIThydro

1. Characterize the link between fish species and large sediment

2. Implement follow-up protocols at different sites characterizing large sediments and functionality of patches of large sediments
3. Characterize the difference of hydrosedimentary regimes (large scale)
4. Build on proven and existing hydraulic basis and extrapolate in terms of biological interest

5. Existing and innovative methods/technologies for fish-friendly hydropower (Session 3)

This session addressed solutions, models, tools and devices for a comprehensive assessment of self-sustained fish populations affected by hydropower. Specific items addressed included technical solutions or devices for fish passage (upstream and downstream) and fish protection, monitoring and observation methods as well as transdisciplinary software tools. Current solutions were also presented from the point of view of a hydroelectricity producer, in order to discuss trade-offs between ecological needs and economic constraints.

In session 3, the presentations given covered the following:

- **FIThydro activities related to Session 3 (Antonio Pinheiro, IST)**
  - FIThydro is carrying out work on solutions, methods, tools, and devices (SMTDs) for fish-friendly hydropower. These are investigated in labs and test cases using numerical modelling as well as knowledge and ideas.
  - Some key open questions are whether the SMTDs related with downstream migration seem to be appropriate to improve problems that stakeholders are dealing with and whether the SMTDs should be made public and available to better guarantee their usefulness.
- **Solutions to provide safe fish passage at hydropower facilities (Pierre Sagnes, Pôle écohydraulique – AFB)**
  - The presentation covered how to make an initial diagnosis of the specific situation and reviewed the solutions for upstream and downstream migration (from fish passes to inclined trashracks);
  - The presentation suggested that fish passage solutions only reduce impacts, as they partly re-establish ecological continuity (selectivity, not 100% efficient, do not improve sediment transport);
  - There is a need for an accurate diagnosis to provide the best solution;
  - Field approaches to study fish survival after turbine passage become more challenging for capacities above 100 m3/s.
- **Recommendations in order to optimize the compliance of hydropower infrastructures in accordance with the production (Christine Etchegoyhen – France Hydroélectricité)**
  - This presentation offered the view of an operator regarding the legislative obligation to ensure compliance;
  - The producers are willing to do what is necessary and environmentally justified with respect to their financial capabilities, while preserving and optimizing hydropower production.
- **Field monitoring of the migration success of European silver eels and Atlantic salmon smolts along 6 successive dams in the Belgian River Meuse: global and**

a local scale approach (Damien Sonny, EDF-Luminus/Profish Technologies/Arcadis)
    - This presentation addressed field approaches to study fish survival after turbine passage, acoustic telemetry techniques as well as observations related to the effect of very low spring discharge with closed spillways on salmon smolts.
- **Protocols for sustainable rehabilitation of a hydropower plant – Monsin's case study (Olivier Machiels, Arcadis)**, with focus of the presentation being on results related to eco-sustainable turbines and a downstream migration model.

5.1 Discussion during the session

The key issues raised during questions and discussions between the participants in this session addressed the following:

- The **context of technical solutions should be clear**, in particular for large HPP. It was clarified that the FIThydro project concentrates mainly on small/medium-sized HPP;
- In addition to the efficiency of technical devices, it is important to have also a more **global view on fish mortality**;
- More studies are needed on:
    - Fish passage through turbines, including a cost-benefit analysis
    - Solutions for short-distance migrators (need for more field studies)
- **Site-specific aspects are critical** in the selection of technical solutions. Overall, integrative solutions are necessary;
- Also the role of **fish migration** in fish populations should be considered in studies related to rehabilitating HPP;

5.2 Participant feedback via paper forms

Additional feedback was collected from participants through feedback forms distributed during the session on the (1) major issues (key problems, open questions) with regard to methods and technologies, (2) approaches and solutions applied in France and Belgium to handle key problems, and (3) recommendations or requests to the work-programme of FIThydro.

Following session 3, a total of seven feedback forms were collected.

The following summarizes the issues which the participants considered as important/relevant. The full responses in the feedback forms can be found in the Annex.

Key problems, open questions

1. Finding systems which are both functional and easy to use
2. Solutions for crossing large HPP
3. Assessment of passageways and crossing devices (local scale)
4. Consider the priority to equip HPP for the target species
5. Role of migration in the population dynamics
6. Matching between taxes for the protection of fauna and green production
7. Put in place the best available technologies

8. Creation of a database of operators relative to tests and solutions for fish-friendly production
9. Downstream migration on large rivers
10. Biological response to hydraulic conditions

Approaches and solutions to handle key problems in France and/or Belgium

1. Crossing devices both up/downstream, follow the behaviour of the fish ahead of each device
2. Model of population dynamics
3. Up/downstream migration of trouts
4. Habby platform
5. Establishment of validated protocols
6. Implementation of the protection of salmons and eels in downstream migration on site

Stakeholder recommendations of general nature

1. Put in place long-term monitoring near the devices or improvement of fish continuity.
2. Dissemination/outreach, exchanges of information related to results of research, state of progress, feedback on past actions, etc.

Stakeholder requests with relevance to FIThydro

1. Find systems which work equally well for allowing fish downstream migration and taking in the water (trashracks reach their functional limit for flows above 60m3/s)
2. Quantify the gains brought by crossing structures on stocks of different species.
3. Robust assessment of the efficiency of mitigation measures
4. Understanding of why a solution works (or not), the link between biological response and stimuli created by the solution

6. Cost-effectiveness assessment of mitigation strategies and policy/socio-economic challenges (Session 4)

This session covered issues concerning the design of mitigation strategies for achieving self-sustained fish population in regulated rivers and ways to estimate their effectiveness and costs (costs of implementation and operation). This session also covered issues with regard to opportunities and challenges of the regulatory policy framework and financial mechanisms for planning and operating hydropower plants as well as social aspects, especially the public acceptance of hydropower.

In session IV, the presentations given covered the following:

- **FIThydro activities related to Session 4 (Atle Harby, SINTEF)**
    - The main groups of mitigation measures to be addressed in FIThydro include flow release, habitat adjustments, fish migration, and sediment management.

The work of FIThydro on the cost-effectiveness of mitigation measures will address among other things how to determine the best economic choice when comparing very different mitigation methods;
    - FIThydro will systematically develop guidance for diagnosis of bottlenecks, and finding cost-effective mitigation solutions.
- **Regulatory and financial aspects related to restoration of ecological continuity and hydropower (Claire-Cécile Garnier, DEB)**
    - This presentation gave an overview of how French legislation addresses the physical restoration of aquatic environment, with emphasis on the ranking of water courses and ecological continuity;
    - The presentation also gave a summary of different financial support schemes for hydropower in France.
- **The EU Life 4 Fish project description (L4F): safe downstream migration along the low Meuse River (Pierre Theunissen, EDF Luminus)**.
    - This presentation gave details on the main actors involved, the timeline and key content of this EU Life project on HPPs in the Meuse basin in Belgium.
- **FIThydro Public Acceptance Survey (Manon Dewitte, CNRS)**
    - Brief presentation of the survey and explanation of what is needed from the participants for its validation.

6.1 Discussion during the session

The key issues raised during questions and discussions between the participants in this session addressed the following:

- FIThydro work on the cost-effectiveness of mitigation strategies is an important contribution to decisions on how to combine different technical solutions. To support this work, there is a **need for data and operator feedback on costs and applicability of measures** and technical solutions;
- Often, **costs** are **prohibitive** for operators who want to carry out mitigation but do not have solutions or approved plans (specifically in France);
- **Slow impact assessment processes** also sometimes hinder mitigation projects;
- An issue was raised related to the consideration of non-production costs associated with greenhouse gases (i.e. offset costs of burning fossil fuels), which could be interesting for future studies, but is outside the scope of FIThydro;
- In terms of the relevant policies, **legislation on WFD implementation differs between France and Belgium**. While in France, the WFD is implemented via a specific law, in Belgium, there is a more case-by-case interpretation of the Directive relevant requirements.

6.2 Participant feedback via paper forms

Additional feedback was collected from participants through feedback forms distributed during the session on the (1) major issues (key problems, open questions) with regard to methods and technologies, (2) approaches and solutions applied in France and Belgium to handle key problems, and (3) recommendations or requests to the work-programme of FIThydro.

Following session 4, a total of six feedback forms were collected.

The following summarizes the issues which the participants considered as important/relevant. The full responses in the feedback forms can be found in the Annex.

Key problems, open questions

1. The main principles of sizing fish-friendly water intakes exist, but are not suitable for use in low head HPP with intake above 60 m3/s. Need devices adapted to all plants
2. Facilitate cost-effectiveness analysis of mitigation measures, giving visibility to the advantages/disadvantages offered by different methods (avoided costs, CBA, CEA)
3. The timing for the delivery of pre-project summaries[1] in France is not manageable and there is a need for priorisation, e.g. to allow more time for the most complicated cases
4. There is a need for mediation when the recommendations of the authority (French Agency for Biodiversity) are not acceptable for the producers (due to (loss of production, economic balance, technical impossibility)
5. Action plans at larger scales could be defined locally
6. Define a regulatory basis for the translation of constraints per site
7. Assessment of costs: propose an approach integrating all costs on the duration of the title.
8. Assessment of profits continues to be a challenge (uncertainty, delays)

Approaches and solutions to handle key problems in France and/or Belgium

1. Case-by-case regarding the permits

Stakeholder recommendations or requests relevant to FIThydro

1. Operating costs of mitigation measures should not be neglected
2. Impact of mitigation measures on the output and availability of power plants should be considered
3. Integrate the referencing of downstream migration devices
4. Handbooks for the smart combination of solutions
5. Make a cross-analysis of good/bad practices on the approach of regulatory and socio-economic issues of different member states.

[1] Pre-project summaries are brief studies to define the principal characteristics of the infrastructure and to estimate the budget. These files are studied to consider the launch of projects.

7. Annex 1 – Workshop Programme

Agenda: 1st Regional Stakeholder Workshop – France & Belgium 24th-25th January 2018, Meudon, France

Meeting Information

Meeting: 1st Regional Stakeholder Workshop – France & Belgium	Location: Meudon, France
Initiated by: FIThydro Belgian and French representatives	Date: 24th-25th January 2018
Distribution: FIThydro Steering Committee and French and Belgian Stakeholders	Time: Check detailed program below
Host: CNRS - Agence Française pour la Biodiversité	Venue: CNRS de Meudon-Bellevue, 1 place Aristide Briand, 92195 Meudon, France
Website: http://www.fithydro.eu/workshopfrancebelgium1/	

Agenda

Wednesday, 24th of January

**Note: all presentations will last 15 min*

Time	Item*	Presenter
11:00 - 12:30	Presentation of FIThydro Project and stakeholders	Peter Rutschmann (TUM) Laurent David (CNRS) Johan Coeck (INBO)
	FIThydro activities related to Session 1	Christian Wolter (IGB)

12:30 - 13:30	Lunch	
13:30 - 15:15	**Session 1: Fish populations and habitats: functionality of habitat in bypassed reach or reach influences by hydropeaking** moderation by : Pierre Sagnes - AFB	
	Application of methods for definition of ecological flows in hydropower context	Philippe Baran (Consulting office Ecogea)

Time	**Item***	**Presenter**
13:30 - 15:15	How to identify, in a multifactorial context, necessary and sufficient levers to ensure the resilience capacity of fish population?	Véronique Gouraud & Agnès Barillier (EDF R&D)
	The effects of the installation of minimum flow conditions on fish population dynamic in a small stream	Michael Ovidio (University of Liège)
	Discussion (ca. 45 min)	All
15:15 - 15:45	Coffee Break	
15:45 - 17:30	**Session 2: Sediment transport** moderation by Sylvain Richard - AFB	
	FIThydro activities related to Session 2	Laurent David (CNRS)
	Sedimentary continuity and hydropower dams: conceptual and operational approach of an operator, EDF	Jean-René Malavoi (EDF)
	Discussion (ca. 45 min)	All

Thursday, 25th of January

Time	**Item***	**Presenter**
9:00 -11:00	**Session 3**: **Existing, innovative methods and technologies for fish-friendly hydropower (upstream and downstream migration)** moderation by Laurent David – CNRS P Prime	

	FIThydro activities related to Session 3	Antonio Pinheiro (IST)
	Solutions to provide safe fish passage at hydropower facilities	Pierre Sagnes (Pôle écohydraulique – AFB)
	Recommendations in order to optimize the compliance of hydropower infrastructures in accordance with the production	Christine Etchegoyhen (FHE)
	Field monitoring of the migration success of European silver eels and Atlantic salmon smolts along 6 successive dams in the Belgian River Meuse: global and a local scale approach	Damien Sonny (EDF-Luminus/Profish Technologies/Arcadis)
Time	**Item**	**Attendance**
9:00 -11:00	Protocols for sustainable rehabilitation of a hydropower plant – Monsin's case study	Olivier Machiels (Arcadis)
	Discussion (ca. 30 min)	All
11:00 – 11:30	Coffee Break	
11:30 - 12: 45	**Session 4**: **Cost-effectiveness assessment of mitigation strategies and policy/socio-economic challenges for decision-making** moderation by Dominique Courret - AFB	
	FIThydro activities related to Session 4	Atle Harby (SINTEF)
	Regulatory and financial aspects related to restoration of ecological continuity and hydropower	Claire-Cécile Garnier (DEB)
	Discussion (ca. 30 min)	All
12:45-13:45	Lunch	
13:45 – 14:45	**Session 4 (continued)**	
	The EU Life 4 Fish project description (L4F): safe downstream migration along the low Meuse River	Pierre Theunissen (EDF Luminus)

	FIThydro Public Acceptance Survey	Manon Dewitte (CNRS)
	Discussion (ca. 30 min)	All
14:45-15:30	Final remarks - conclusions	Laurent David (CNRS) Eleftheria Kampa (EI)

8. Annex 2 – List of workshop participants

1st FIThydro regional stakeholder workshop for France and Belgium,

Paris (Meudon), 24-25 January 2018

List of Participants

First Name	Last Name	Institution	Country
Philippe	Baran	ECOGEA	France
Agnès	Barillier	EDF	France
Hervé	Capra	IRSTEA	France
Michel	Carret	Compagnie Nationale du Rhône	France
Johan	Coeck	INBO - Research Institute Nature and Forest	Belgium
Dominique	Courret	Agence Française pour la Biodiversité	France
Thibaut	Da Soller	QUADRAN	France
Laurent	David	CNRS, Pprime Institute	France
Jérôme	Delvaux	Commission Internationale de la Meuse	Belgium
Manon	Dewitte	CNRS	France
Matthieu	Dufresne	3D EAU	France
Christine	Etchegoyhen	France Hydro Electricité	France
Claire-Cecile	Garnier	Direction de l'Eau et de la Biodiversité	France
Véronique	Gouraud	EDF	France
Sylvie	Guillouet	Statkraft	France
Atle	Harby	SINTEF Energi	Norway
Sébastien	Jarny	CNRS, Pprime Institute	France
Eleftheria	Kampa	Ecologic Institute	Germany
Yann	Le Coarer	Irstea Aix en Provence	France
Fatma	Lemkecher	CNRS, Pprime Institute	France
Jean-Marc	Lévy	France Hydro Electricité	France
Olivier	Machiels	Arcadis	Belgium
Jean-René	Malavoi	EDF Division Production Ingénierie Hydraulique	France
Patrice	Orban	Service public de Wallonie - Département de la Ruralité et des cours d'eau	Belgium

First Name	Last Name	Institution	Country
Michael	Ovidio	University of Liege	Belgium
Pierre	Paris	France Hydro Electricité	France
António	Pinheiro	IST-ID	Portugal
Franck	Pressiat	Compagnie Nationale du Rhône	France
Sylvain	Richard	Agence Française pour la Biodiversité	France
Peter	Rutschmann	Technical University of Munich	Germany
Pierre	Sagnes	Agence Française pour la Biodiversité	France
Damien	Sonny	Profish	Belgium
Sonja	Stendera	Statkraft Markets GmbH	Germany
John	Tarpey	Ecologic Institute	Germany
Stéphane	Tétard	EDF R&D	France
Pierre	Theunissen	EDF Luminus	Belgium
Lore	Vandamme	INBO - Research Institute Nature and Forest	Belgium
Kristof	Vlietinck	Nature and Forests Agency - Flemish Government	Belgium
Christian	Wolter	Leibniz-Institute of Freshwater Ecology and Inland Fisheries	Germany

9. Annex 3 – Participant feedback forms

Table 1: Session 1 - Fish populations and habitats

Q1: What do you consider as the **major issues (key problems, open questions)** with regard to **fish populations and habitats in reaches influenced by hydropower** in France/Belgium?	Q2: What **approaches and solutions** are applied in France/Belgium to address the key problems and open issues with regard to **fish populations and habitats in reaches influenced by hydropower**?	Q3: What are your **recommendations or requests to the work-programme of FIThydro** with regard to **fish populations and habitats in reaches influenced by hydropower**?
Mortality of fish that attempt to pass	Fish friendly adaptations	Sacrificing some well-chosen rivers in favour of hydropower, and removing all barriers and HPPs in the other rivers would make it possible to combine hydropower practice but also have free flowing rivers of high ecological value.
The changes in habitat both up- and downstream of the construction.	Fish passages	HPPs that don't produce a significant amount of energy should be removed (e.g. so small HPPs that produce as much energy all together as 1 windmill)
Fish don't reach the spawning grounds because they are not able to pass the barrier.		
Identifying the impacts of hydropower in the global impact of other anthropogenic pressures in order to act on proper levers. The environmental context of species and type of infrastructures has to be taken into account.	Combined restoration of flows and substrate (or shelter)	Consider other factors: thermal, diseases/virus, plasticity of species
Taking into account the plasticity of species: do not set unique steady criteria regardless of the context. Key problem is to manage to "translate" the local impacts observed (mortality for	Increasing the flow (bypassed reach and locks) Decreasing the ramping rates of hydropeaking ➔ During key periods of life	Go to long term observations on water catchment (and capitalize every data acquired on sites per biogeographical regions)

example) on population dynamic at population scale in its water body or its watershed → What mortality (of x %) is "grave" for the species, and/or questions its capacity of adaptation?	(reproduction and emergence)	
		Tools and recommendations: - Adaptable to different contexts - Pragmatic - Taking into account the economical aspects (cost-effective aspects)
Evaluate the efficiency of impact mitigation measures (increased instream flow, variance of flow, limiting the ramping rate of hydropeaking, of their gradient, frequency…)	At the operational level, application of the microhabitats method to evaluate minimum ecological flow while taking into account the environmental context. - Improvement of the transferability of preference curves (thesis Laura Plichard, IRSTEA) and dynamic preference (thesis Clarisse Jude, HYNES). - Habby platform to couple hydraulic models and preference curves.	- Feedback, synthesis of the efficiency of mitigation measures (increased instream flow, hydropeaking). - Evaluate the combined role of multiple anthropogenic pressures (synergies, conflicts, neutral). - Develop tools to evaluate the resilience of populations.
Evaluate the interactions between hydrological disturbances and other anthropic pressures to identify the correct mechanism of action to improve the status of populations.	To evaluate the impacts of management modes (flow, hydropeaking). - Medium/long term follow-up - Up/downstream measures - Before/after - Development of a follow-up analysis tool (dynamic model of fish population -> module to evaluate	Identify at the European level multiple long-term monitoring sites, sustain them, and analyse with perspectives from multiple teams and different tools. Choose sites with different levels of flows and sediments.

	mortality density depending on shelter and thermal regime).	
Have evaluation criteria for the status of fish populations pertinent to the scale of works (not WFD indicators), as well as criteria to evaluate the resilience of the populations.		Use the results of the European projects MARS and REFORM.
Address the question of the management of flows and sediments together.		
Modeling the exchanges of juvenile fish during hydropeaking.	The Habby platform (AFB, IRSTEA, EDF) to determine ecological flows is in the process of development (free, open source).	Recommended theses or post-doc to determine the HRR (Horizontal Ramping Rate) limits of different fish species, based on their total length, temperature, period of the day, the substrate. If this approach were taken, this could help the development of the Habby platform (Q2-1) and of the methodology (Q2-2) to contribute to answer (Q1-1)
Improve or build biological models of habitat preferences of fish. Need of launching thesis and measurements campaign!	Hydropeaking on the low Durance Methodology for the determination of the reduction of flow without beaching of juveniles: on the basis of the 2D hydraulic model and from HRR calculations. (horizontal Ramping rate)	
Agreement between authorities, water stakeholders, and operators for negotiated taxes.		
Obligation for methods instead of obligation for results.		
Definition of indicators to evaluate quality.	Transfer of the studies from the manager to the operator at the same time as permits	Looking for compilation, classification, standardization of approaches and existing data
Data base from the beginning to place a project regarding these indicators	➔ Heterogeneity of methods and	Facilitate dialogue between stakeholders through a nomenclature/ rules accepted by

	results	everyone
Concept of transferability/ duplicability (harmonization)	➔ Compilation by the manager of publishable data for global reporting	Provide models more automatized

Table 2: Session 2 - Sediment transport

Q1: What do you consider as the **major issues (key problems, open questions)** with regard to **sediment transport** in France/Belgium?	Q2: What **approaches and solutions** are applied in France/Belgium to address the key problems and open issues with regard to **sediment transport**?	Q3: What are your **recommendations or requests to the work-programme of FIThydro** with regard to **sediment transport**?
Due to impoundment and canalization, there is a lot of sedimentation. This results in covered gravel and therefore absence of good spawning grounds for chub, dace and trout.	River restoration. In a naturally running river, sediments will be sorted out and spawning grounds will appear where stones are available.	We should remove artificial structures from the rivers. Some rivers can be sacrificed for hydropower.
		A HPP should produce a sufficient amount of energy, otherwise we should consider to remove it and replace it with a more efficient HPP or wind mill, for example.
Evaluate, quantify the needs of different fish species in terms of large sediments (favorable surface, thickness, distribution/arrangement within the sections) and their resistance to fine sediment deposits. Define sufficient sediment transport.	Diagnostic of sedimentary state and sediment transport.	Characterize the link between fish species and large sediment.
Evaluate the effectiveness of mitigation measures and/or the impact of different management approaches (injection of large sediment, management of fishing, transparences).	Evaluation of the degree of clogging (Datry protocol – IRSTEA)	Put in place follow-up protocols at different sites characterizing large sediments and functionality of patches of large sediments.
Treat the question of flow and sediment management together.	Evaluation of the favorable granulometric surface (federation Hauts Pyrennées – Marc Delacoste)	Characterize the difference of hydrosedimentary regimes (large scale).
Consequences of the modification of management modes, technical, economical, social, sedimentary consequences for the		How to access the information? Understanding of sediment transport Which long-term and reliable solutions

HPP		adapted case by case? (technique and financial) ➔ More frequent cases: gravering of water intake and/or channels
	An approach developed a few years ago by Eric Herouine, hydraulic team of IRSTEA Lyon: the “DECOLOFOND” (bottom remover) allowed knowing the limit for putting into motion of substrate in installing a mobile pump system to simulate flood conditions	
Cross-reference the different aspects of sediment transport → management of reservoir, biology and hydraulic	Not so problematic in Belgium (river with transport almost null) → Dredging at navigable zones with extraction	Build on proven and existing hydraulic basis and extrapolate in terms of biological interest
Multi-scale view: - Local (scouring) - Median (roughness, flows) - River (meandering, minor and major river bed)		

Table 3: Session 3 - Existing and innovative methods and technologies for fish-friendly hydropower

Q1: What do you consider as the **major issues (key problems, open questions)** with regard to **existing and innovative methods and technologies for fish-friendly hydropower** in France/Belgium?	Q2: What **approaches and solutions** are applied in France/Belgium to address the key problems and open issues with regard to **existing and innovative methods and technologies for fish-friendly hydropower**?	Q3: What are your **recommendations or requests to the work-programme of FIThydro** with regard to **existing and innovative methods and technologies for fish-friendly hydropower**?
Finding systems which are both functional and easy to use		From on operator point of view, it is essential to find systems which work equally well for allowing fish downstream migration and taking in the water required for the functioning of the turbines. In fact, for HPP with flows above 60 m^3/s, trashracks reach their functional limit. The dimensions of the trashrack do not allow to be easily cleaned and the de-cleaners reach critical sizes which can bring into question the financial viability of the project.
Solutions for crossing large HPP.	Crossing structures both upstream/downstream	Quantify the gains brought by crossing structures on stocks of different species.
Crossing of HPP by fish -> assessment of passageways and crossing devices (local scale)	Crossing devices (upstream/ downstream migration) Follow of the behaviour of fishes ahead each device	Put in place long-term monitoring near the devices or improvement of fish continuity → robust assessment of the efficiency of mitigation measures
Consider the priotity to equip HPP for the target species (water catchment scale)	Models of populations dynamic.	
Role of migration in the population dynamic.	Downstream/upstream migration of trouts	
		Dissemination/ outreach, exchanges of information: results of research or state of progress, feedbacks of past actions, appointment of lacks (estimated planning of research and developments) Regular dissemination (multi-annual) and for

		different publics: scientists, administratives, operators, designers, producers,…
	Remark: In the development of the open-source Habby platform (AFB, IRSTEA, EDF), in the case of joint execution of the 2D hydraulic model and fish telemetry, it is planned to associate local hydraulic values to the position of fish and to make “films” (map of the trajectory of fish, changing hydraulic, zoom, etc)	
- (In Germany) Main issue is the approval of technologies etc. as suitable fish protection measures, especially for downstream migration. - Further there is uncertainty about the functioning and efficiency of existing or just tested methods and technologies (like certain bypasses, fish-friendly intakes, barriers) because of little experience due to site-specific implementation		- More laboratory and field testing to enhance transferability between sites (HPP) for facilitating the generality of results - Exchange between countries/HPP of knowledge and experiences, for instance on turbine passage -> eel-protective turbine management
Matching between taxes for the protection of fauna and green production.		
Put in place the best available technologies.		
Creation of a database of operators relative to tests and solution for fish-friendly production.		
Downstream migration on large river	Establishment of validated protocols (a priori)	Looking to understand why a solution works or not → link between biological response (appeal, repulsion) and stimuli created by the solution
Biological response to hydraulic conditions	Implementation of the protection of salmons	

(pressures, flows, velocity, gradients)	and eels in downstream migration on site	

Table 4: Session 4 - Cost-effectiveness assessment of mitigation strategies and policy/socio-economic challenges for decision-making

Q1: What do you consider as the **major issues (key problems, open questions)** with regard to the **cost-effectiveness assessment of mitigation strategies and the policy/socio-economic setting for decision-making** in France/Belgium?	Q2: What **approaches and solutions** are applied in France/Belgium to address the key problems and open issues with regard to the **cost-effectiveness assessment of mitigation strategies and the policy/socio-economic setting for decision-making**?	Q3: What are your **recommendations or requests to the work-programme of FIThydro** with regard to the **cost-effectiveness assessment of mitigation strategies and the policy/socio-economic setting for decision-making**?
To date in France, the main principles of sizing fish-friendly water intakes exist, but are not suitable for use in low head HPP with an intake above 60 m^3/s. It is therefore necessary to imagine devices adapted to all types of plants.		In addition to the cost of construction, - the operating costs of mitigation measures (particularly for downstream systems) should not be neglected. - it is important not to neglect the impact of the mitigation measures on the output of power plants (headlosses of trashracks, maintenance difficulty in high water…). - it will be important not to neglect the impact of the measures on the availability of the plant. Indeed in some cases the failure of the cleaner can be enough to stop the HPP as the trashrack is clogged quickly. These failures are not acceptable on industrial processes in which investors demand 95% availability comparable to the availability of solar or wind power.
Facilitate cost-effectiveness analysis of mitigation measures. - Give visibility to the advantages/disadvantages of different methods of environmental economy (avoided costs, cost-effectiveness, cost-benefit) - Apply a panel of methods on study		

sites to draw recommendations		
		Integrate the referencing of downstream migration devices
The presentations show that we are progressing in the knowledge but in some cases we still don't know how to do. The APS files (avant projet sommaire) have to be given (the water agency Adour-Garonne requires validated file by the DDT, departmental direction of territory) in 2018 either to guarantee the subventions or to profit of a delay of 5 years → we need time: we proposed a moratorium but at minimum we need derogation for the most complicated cases. 15000 infrastructures/ 600 cases treated in a year = 25 years: why put pressure on the cases which we don't know how to treat → prioritize		See Q1
The AFB – French Agency for Biodiversity has to accept the scientific contradiction, the petitioners pay engineering offices which provide studies and proposals. These are not taken into account by the AFB. The AFB must further justify its choice.		
Need of mediation when the recommendations of the AFB are not acceptable for the producers (loss of production, economic balance, technical impossibility) → blocked files We recall that the producer has an obligation of results and that the AFB requires the ways: what about the consistency? The DDT (departmental direction of territory) doesn't play its role of intermediate between		

the producer and its engineering office and the AFB and the notice of the AFB prevails.		
The action plans at larger scale could be defined locally	Case by case regarding the permits	Handbooks for the smart combination of solutions
Define a regulatory basis for the translation of constraints per site		
Assessment of costs: propose an approach which integrates all costs (investments, exploitation → loss of production, loss of investment, extra cost of maintenance etc) on the duration of the concession of the infrastructure		Make a cross-analysis of good/bad practices on the approach of regulatory and socio-economic issues of different member states, at least within FIThydro → result: recommendations
Assessment of profits: → won't be easy - How to integrate the uncertainty, the delays → importance of well capitalized on the feedback - -develop alternative indicators? (finer that the WFD bio-indicators?)		