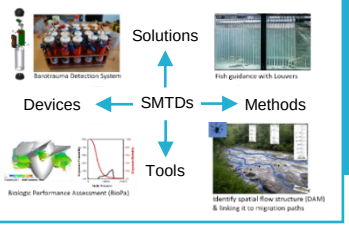
Fish-friendly Innovative Technologies for Hydropower
FIThydro

FIThydro

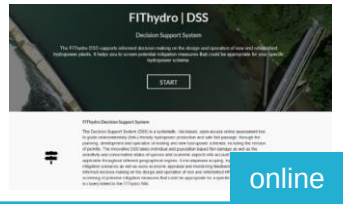
SINTEF

SMTDs



Policy requirements and public acceptance review

Decision Support System



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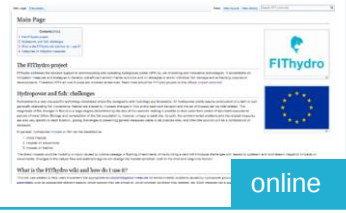
FIThydro wiki



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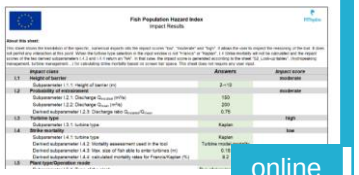
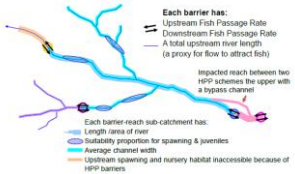
Fish Population Hazard Index

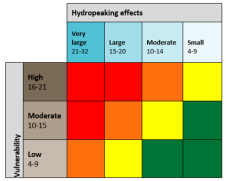


online

Cumulative Impact Assessment



Hydropeaking Impact Assessment tool



ETIP Hydropower Webinar

26th Februray 2025

Atle Harby, SINTEF Energy Research

Peter Rutschmann and Lea Berg, Technische Universität München

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This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 727830

KEY FACTS

26 PARTNERS: 13 from research, 13 industry from 10 EU countries

PROJECT AIM:

* Development of cost-efficient environmental solutions for sustainable and fish-friendly hydropower by investigating mitigation measures and strategies
* Development of decision support tools for commissioning and operating hydropower plants by use of existing and innovative technologies

15 TEST CASES: Germany, Austria, Switzerland, France, Spain, Portugal, Belgium and Sweden

BUDGET: 7.2 Mio. €

DURATION: November 2018 – April 2021

UPSTREAM MIGRATION

INVESTIGATION OF:

* Fish swimming path and attraction flow
* Fishway entrance and preferences
* Fishway function


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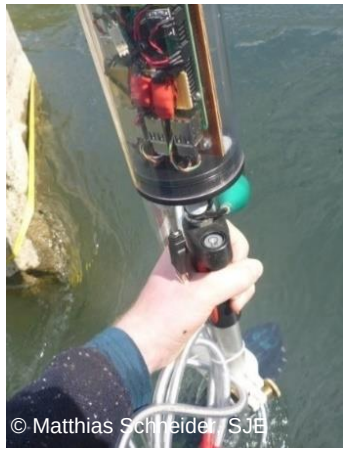
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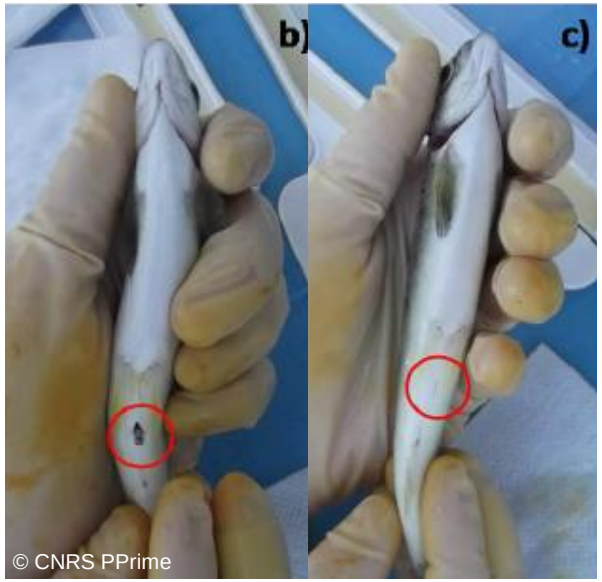
DOWNSTREAM MIGRATION

INVESTIGATION OF:

* Fish swimming path
* Fish guidance efficiency of bar racks
* Attraction of by-pass
* Turbine passage



FLOW & HABITAT

INVESTIGATION OF:

* Habitat distribution and availability
* Environmental flow in bypass reach
* Hydropeaking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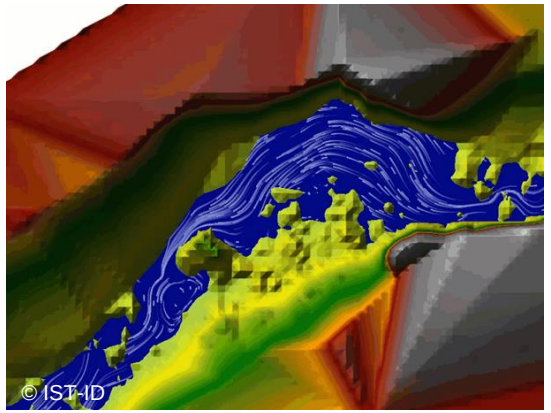
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SEDIMENTS

INVESTIGATION OF:

* Sediment transport and management
* Sediments and habitat availability

RESEARCH & INNOVATION ACROSS EUROPE - SOLUTIONS, METHODS, TOOLS AND DEVICES - SMTDS

SOLUTIONS

* Structural improvements
* Fish guidance and protection
* Efficient fish migration solutions

METHODS

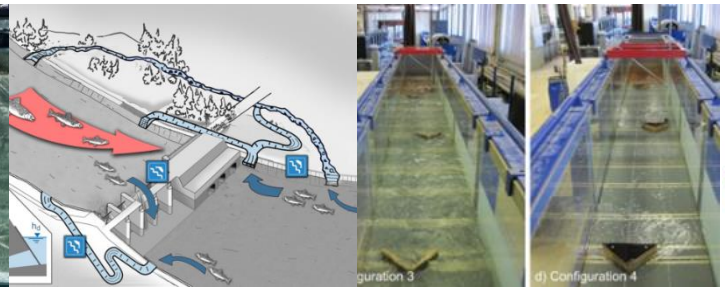
* E-flow assessment
* Sediment management
* Cumulative impact assessment

TOOLS

* Hydropeaking impact assessment
* Turbine fish mortality model BioPA
* An agent-based fish swimming model in CASiMiR

DEVICES

* Barotrauma Detection System
* Lateral Line Probe
* System for 3D optical tracking



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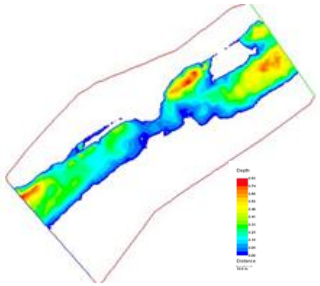

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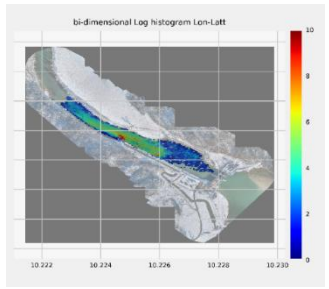

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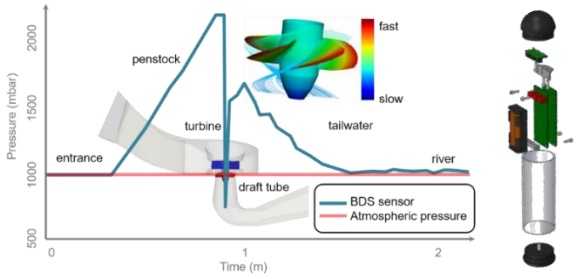

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FITHYDRO WIKI

* **Open-access online** platform www.fithydro.wiki
* **Systematic presentation** of project outputs containing **challenges** and **solutions** to obtain environmentally friendly hydropower
* **Description** of typical challenges for fish in hydropower rivers
* Solutions for **mitigating challenges** including its characteristics, applicability and suitability, its TRL and associated costs
* Methods, tools and devices to help **planning, implementing, maintaining and monitoring** the mitigation measures are presented
* All FIThydro Test Cases are presented with specific information on challenges and **solutions, methods, tools and devices** to mitigate negative impacts on fish

Main challenges:

Habitat

Environmental flows

Sediments

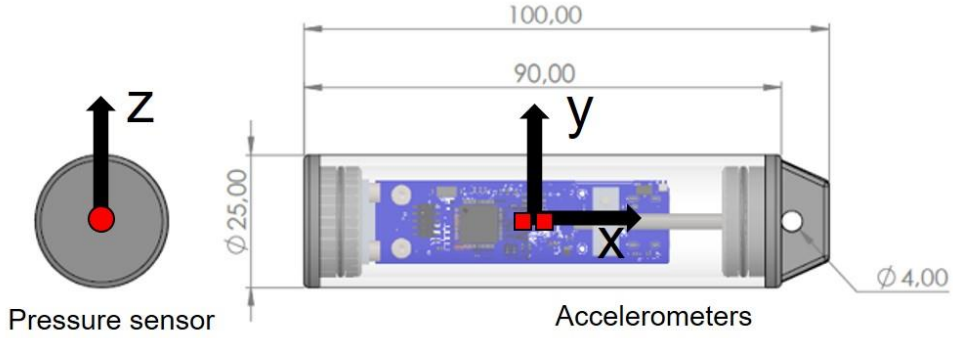
Downstream fish migration

Upstream fish migration

BAROTRAUMA DETECTION SYSTEM

BAROTRAUMA DETECTION SYSTEM (BDS)

* Rugged underwater sensor for hydropower turbine passage
* Measures pressure, acceleration, rate of rotation and magnetic field
* Only existing technology capable of measuring pressure gradients using multi-pressure sensing technology



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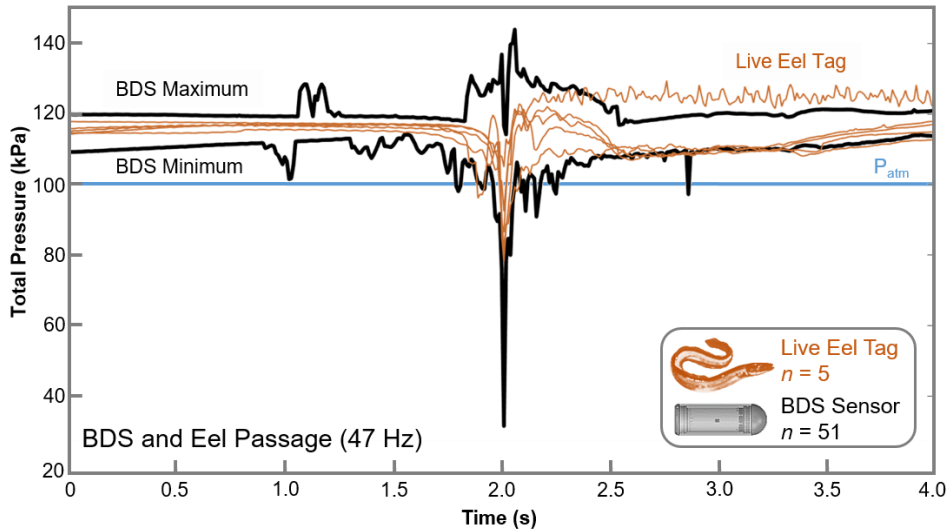

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TALLINN UNIVERSITY OF TECHNOLOGY

INNOVATIVE FISH PROTECTION AND GUIDANCE STRUCTURES

CURVED-BAR RACK – BYPASS SYSTEM (CBR-BS)

* CBR-BS: mechanical behavioral fish guidance structure
* Technical solution for downstream fish passage at HPPs
* Innovative curved-bars improving the hydraulic performance:
  * Flow straightening effect → symmetric turbine admission
  * 4.2 times lower head losses compared to straight bar shapes
  * New head loss factors
* High fish guidance efficiencies for Spirlin, Barbel, Salmon & Nase

Fish: nase (*TL*:7.5 cm)

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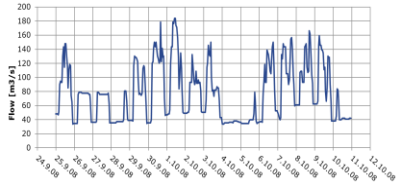
ETH Eidgenössische Technische Hochschule Zürich Swiss Federal Institute of Technology Zurich

VAW Laboratory of Hydraulics, Hydrology and Glaciology

HYDROPEAKING IMPACT ASSESSMENT

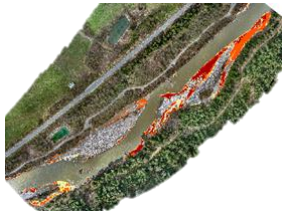
INPUT DATA



Flow records

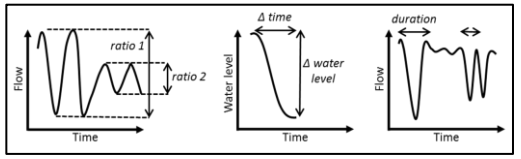
COSH Tool

Field measurements



CASIMIR habitat model

Fish population data



Rate of change, ratio, frequency & timing of water level and flow

Change in habitats

Fish population vulnerability

OUTPUT: COMBINED ASSESSMENT

- The Hydropeaking Tool classifies the impact and gives direction for mitigation

Vulnerability	Hydropeaking effects: Very large 21-32	Large 15-20	Moderate 10-14	Small 4-9
High 16-21				
Moderate 10-15				
Low 4-9				

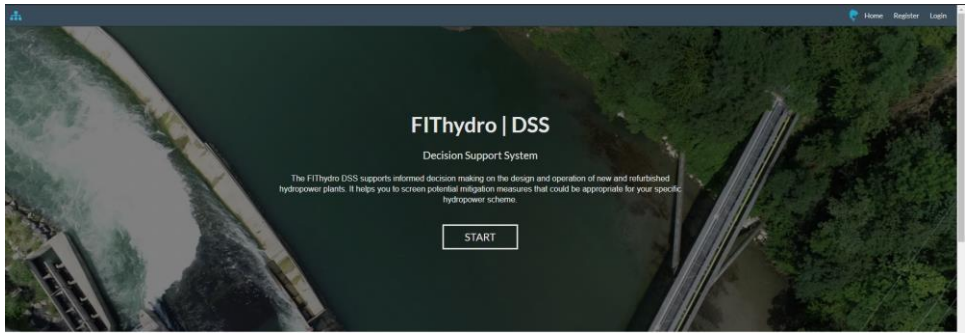
TARGET SPECIES

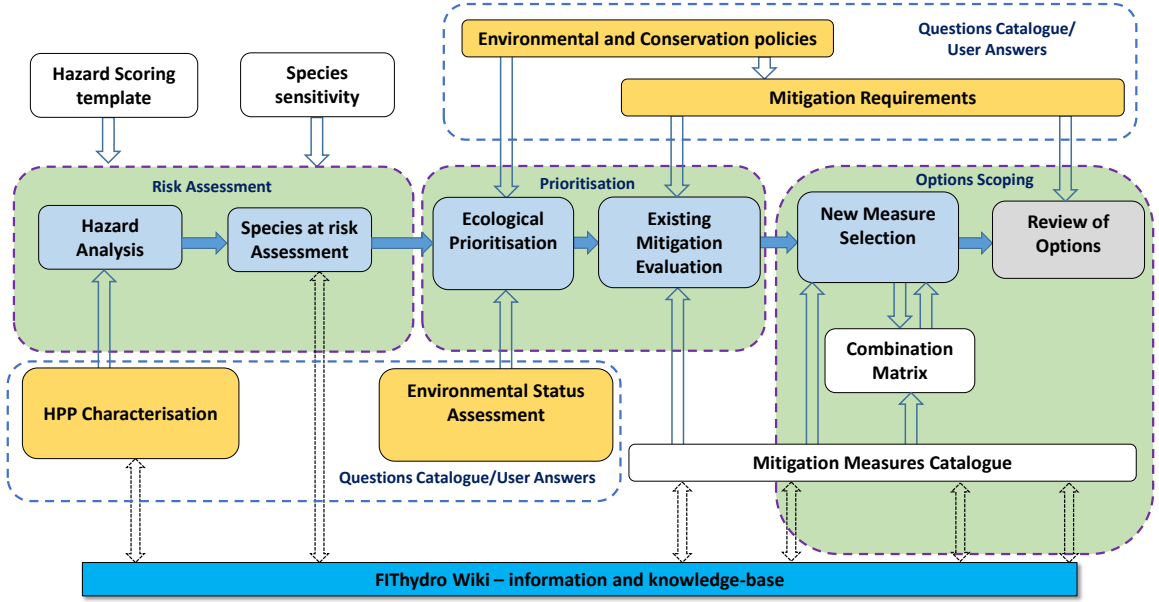
* Salmon
* Grayling
* Iberian cyprinids

FITHYDRO DECISION SUPPORT SYSTEM (DSS)

FITHYDRO DSS:

* Support evidence-based decision-making regarding mitigation for impacts of hydropower on fish
* High-level scoping tool to complement current planning tools and protocols (IHA, EIA)
* Open access online tool: **https://www.dss.fithydro.wb.bgu.tum.de**
* For use by regulators, operators, researchers and consultants
* A risk-based approach and decision framework
* Fully integrated with FIThydro Wiki

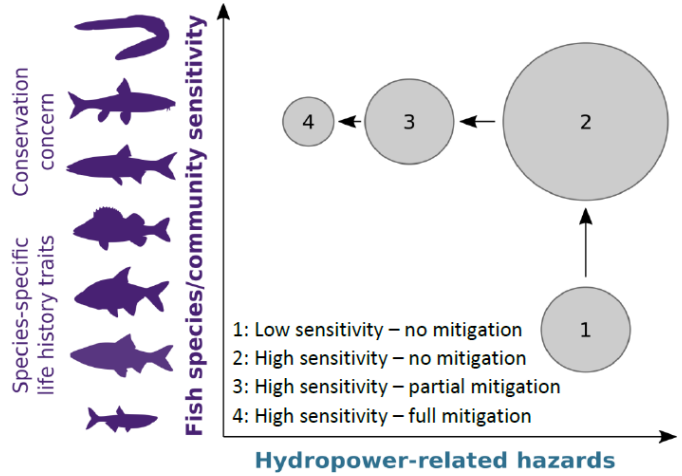


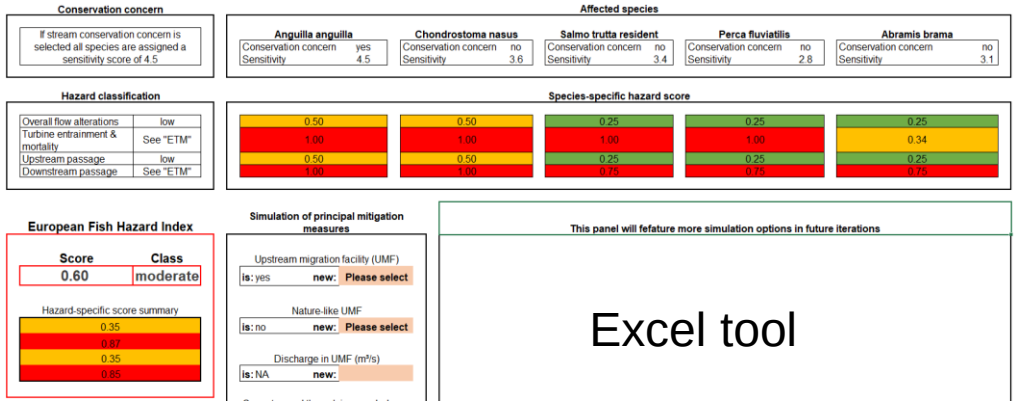


EUROPEAN FISH HAZARD INDEX (EFHI)

Risk Factors Fish Experience during Hydropower Passage

* Hazards are related to
  * flow alterations
  * turbine passage
  * upstream and downstream passage facilities.
* EFHI uses generic knowledge of these risk factors as well as the ambient fish assemblage and computes a **risk score** between 0 to 1.
* EFHI serves as a first approach to identify risk factors or “risky constellations“ of hydropower plants
* Input data:
  * Power plant specifications
  * Stream discharge metrics
  * Downstream migration & turbine-deflection measures
  * Upstream passage facilities & design discharge
  * Fish assemblage





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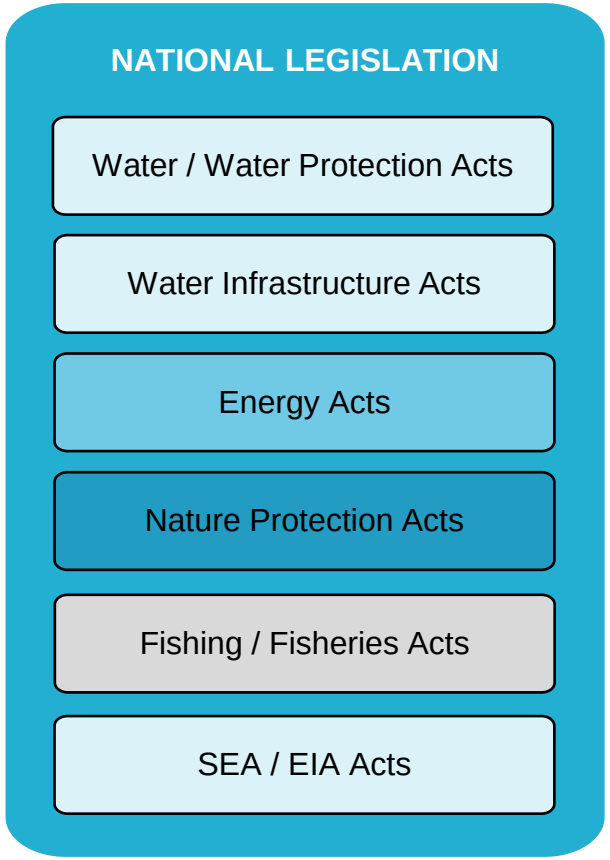
REVIEW OF NATIONAL POLICY REQUIREMENTS

Policy Review in Eight Countries

* Countries: Norway, Sweden, France, Portugal, Spain, Germany, Switzerland, Austria
* WFD and recently revised national acts as strong drivers for modifying the commissioning and permitting procedures for HPP (inclusion of mitigation measure requirements).
* Mitigation of disrupted upstream fish migration and modified flows usually based on laws. Still widespread lack of policy requirements to mitigate impacts on sediment transport, downstream fish migration and from hydropeaking (ongoing research/pilots to close knowledge gaps).
* Uncertainties in policy framework, e.g. on outcome of permit renewal processes, interpretation of WFD by authorities and courts, no clear specified timeframe for implementing measures in existing HPP

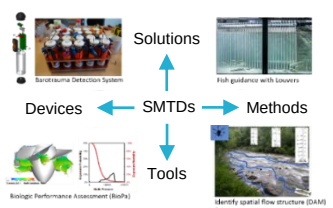


TECHNOLOGICAL IMPACT & KEY OUTPUTS

* **State of the art guidance** on **fish protection facilities, screening**, and **modelling** methods for mitigating environmental impacts of hydropower and minimizing fish losses.
* Planning and implementation procedures to ensure **effective design** and **operation** of hydropower schemes that are **socially** and **environmentally acceptable**.
* Raise the performance of **fish protection** at hydropower plants at the level of **fish populations** by providing the most **cost-effective** ensemble of available mitigation measures.
* Relevant stakeholder **participation** in the **planning, implementation** and **use of technological** options for ecologically compatible hydropower production.

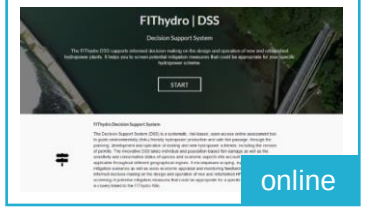
FITHYDRO KEY OUTPUTS

SMTDs



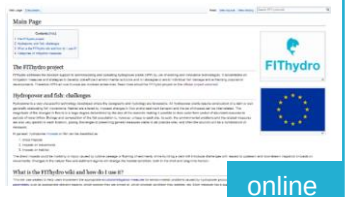
Policy requirements and public acceptance review

Decision Support System



online

FIThydro wiki



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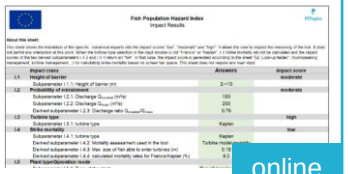
Fish Population Hazard Index



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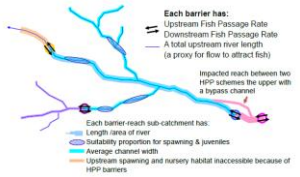
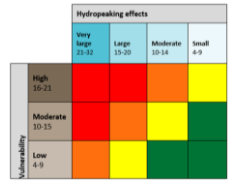
Cumulative Impact Assessment

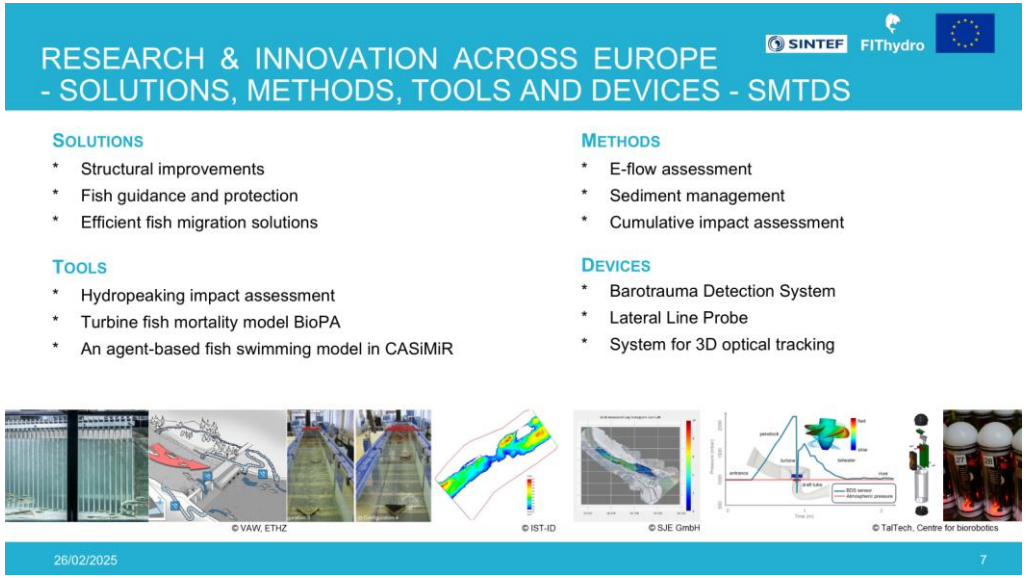


Hydropeaking Impact Assessment Tool



FURTHER INFORMATION:
www.fithydro.wiki

Demonstration of sustainable hydropower refurbishment



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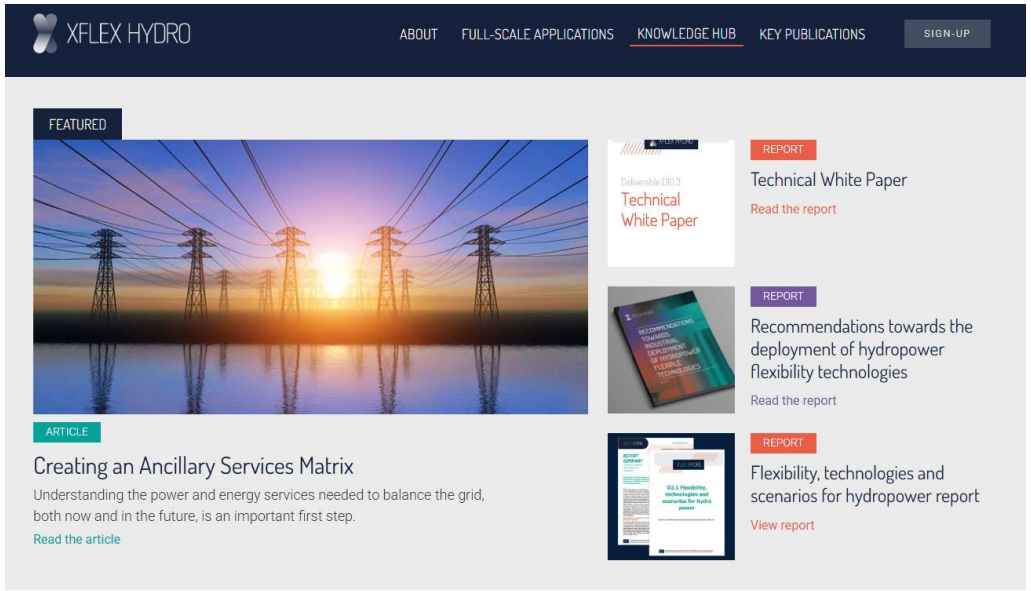
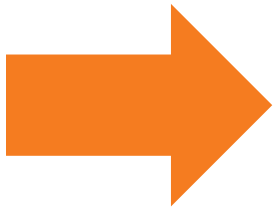
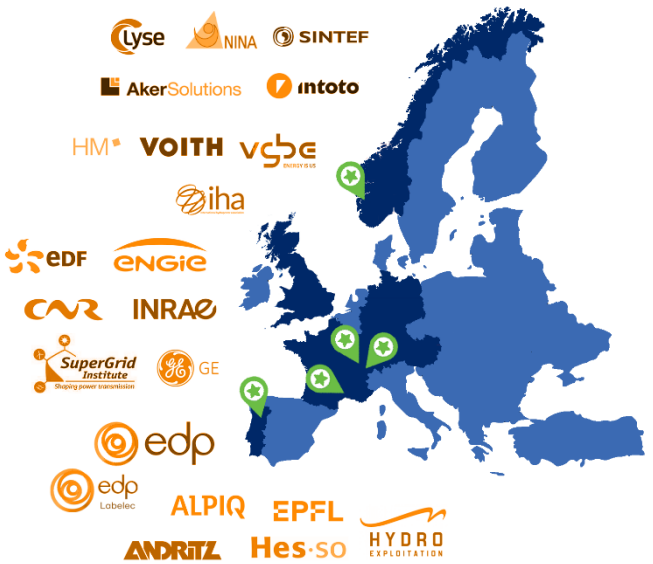
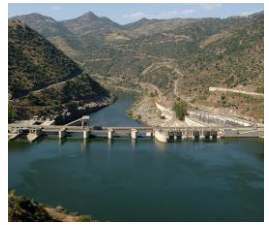


XFLEX Hydro





ReHydro



Funded by the European Union