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THE INTERNATIONAL ENERGY AGENCY TECHNOLOGY COLLABORATION PROGRAMME ON HYDROPOWER

IEA Hydropower


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IEA Hydro – Roadmap for best practise solutions for hydropower and fish

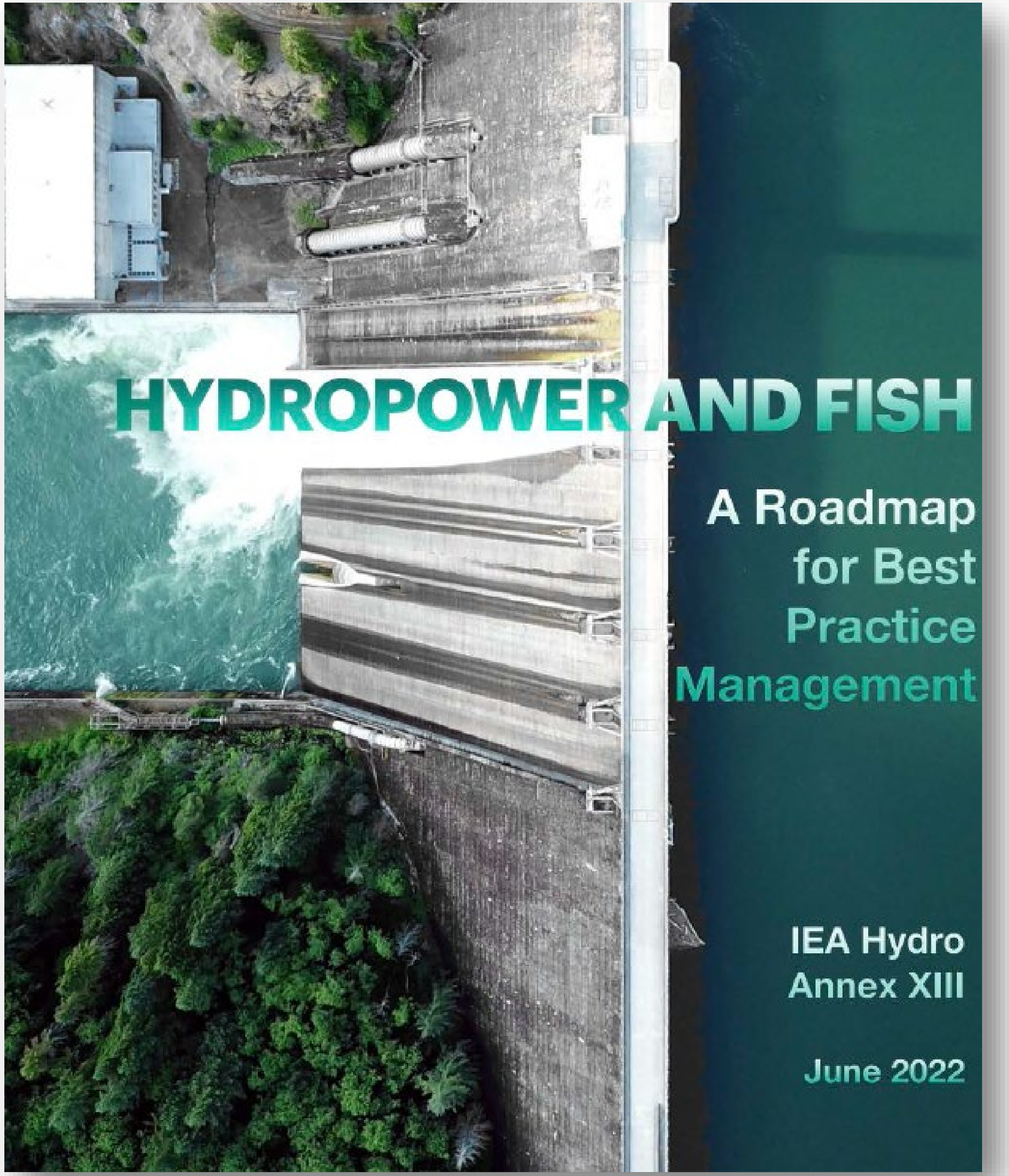
Ana Adeva Bustos, and
Marcell Szabo-Meszaros,
SINTEF Energy Research, Norway

Commitment towards sustainable hydropower

Dedicated working group for Hydropower and Fish within IEA Hydro

- Main objective was to provide a better understanding **of the effect of hydropower on fish**
- Closing phase of Annex XIII (2020-2022), with one objective,

to compile and transfer knowledge in a Roadmap format



Joint collaboration

Editors:

Niels ***Nielsen***, Former Executive Committee Secretary of IEA Hydro TCP, Consultant, Kator Research,
Marcell ***Szabo-Meszaros***, Operating Agent of Annex XIII, Research Scientist, SINTEF Energy Research, Norway

Authors:

Ismail ***Albayrak***	Senior Scientist, ETH Zürich, Switzerland
Lee ***Baumgartner***	Professor of Fisheries and River Management and Director of Gulbali Institute, Charles Sturt University, Australia
Robert ***Boes***	Professor, ETH Zürich, Switzerland
Jeanne ***Boughaba***	Policy Officer, European Commission, Belgium
Ana ***Adeva Bustos***	Research Scientist, SINTEF Energy Research, Norway
Zhiqun (Daniel) ***Deng***	Laboratory Fellow, Pacific Northwest National Laboratory, U.S.A
Hans-Petter ***Fjeldstad***	Senior Research Scientist, SINTEF Energy Research, Norway
Jo Halvard ***Halleraker***	Guest Scientist, Department of Civil and Environmental Engineering, NTNU, Norway
Atle ***Harby***	Senior Research Scientist, SINTEF Energy Research, Norway
David ***Ikedife***	Senior Environmental Scientist, Hydro Tasmania, Australia
Christos ***Katopodis***	Consultant, Katopodis Ecohydraulics Ltd, Canada
Alban ***Kuriqi***	Research Scientist, CERIS, Instituto Superior Técnico, Universidade de Lisboa, Portugal
Markku ***Lahti***	Environmental expert, Fortum Power and Heat Ltd, Finland
Dana ***McCoskey***	Environmental Technologies Manager, U.S. Department of Energy, U.S.A.
Katherine ***Morrice***	Marine Scientist, U.S. Department of Energy, U.S.A.[1]
Piotr ***Parasiewicz***	Head of River Fisheries Department, S. Sakowicz Inland Fisheries Institute, Poland
Emanuele ***Quaranta***	Scientific Officer, European Commission, Joint Research Centre, Italy
Thomas ***Schleker***	Policy Officer, European Commission, Belgium
Luiz G.M. ***Silva***	Senior Scientist, ETH Zürich, Switzerland

Reviewers:

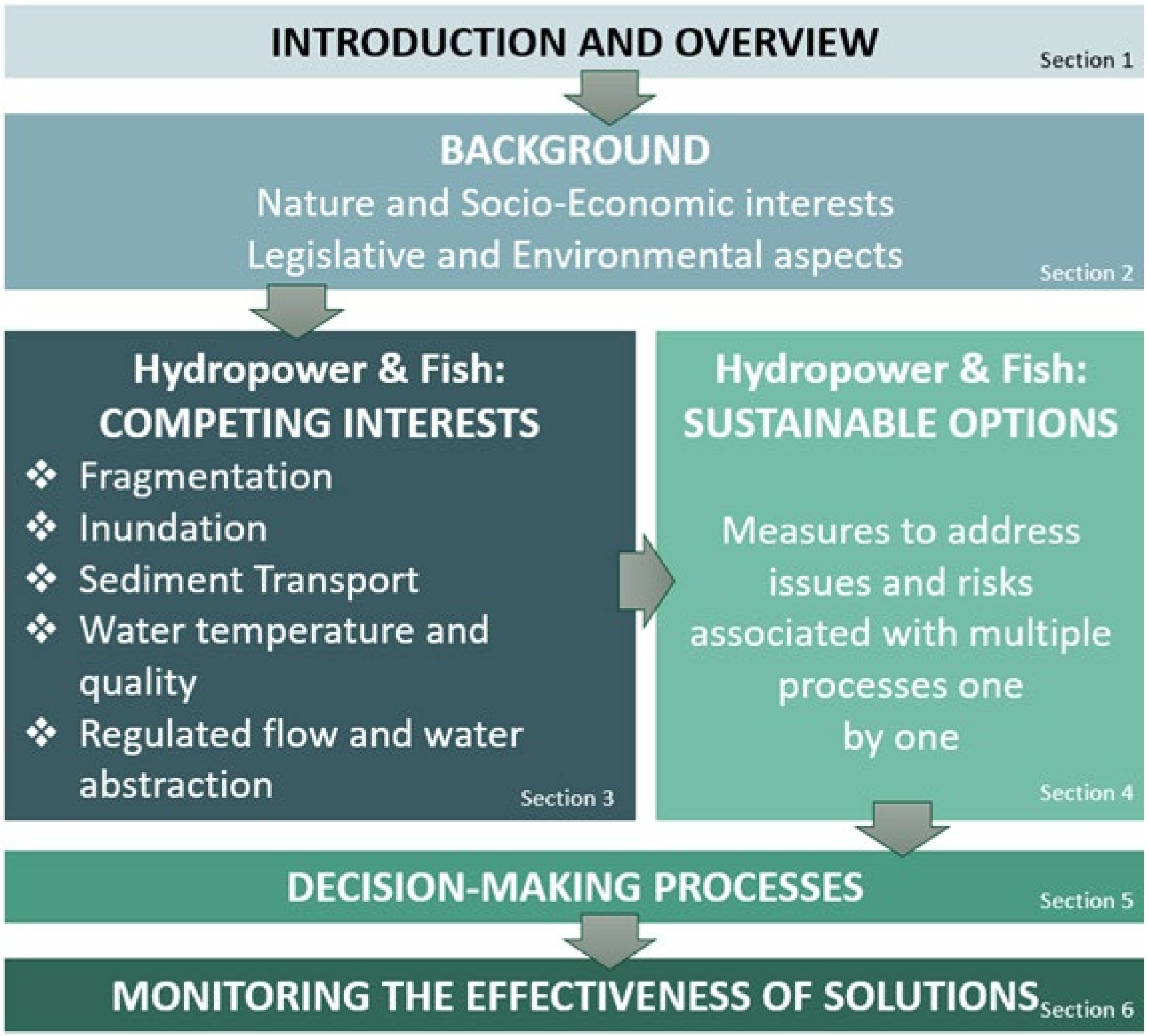
Markus ***Auflager***	Professor, University of Innsbruck, Austria
Tor Haakon ***Bakken***	Professor, Department of Civil and Environmental Engineering, NTNU, Norway
Isabel ***Boavida***	Research Scientist, CERIS, Instituto Superior Técnico, Universidade de Lisboa, Portugal
Barbara ***Brinkmeier***	Consultant, HyFish GmbH Innsbruck, Austria
Paulo ***Branco***	Research Scientist, Forest Research Centre, School of Agronomy, University of Lisbon, Portugal
Maria João ***Costa***	Research Scientist, CERIS, Instituto Superior Técnico, Universidade de Lisboa, Portugal
Gabriela-Elena ***Dumitran***	Associate Professor, Department of Hydraulics, University Politehnica of Bucharest, Romania
Brett ***Fflugrath***	Earth scientist, Pacific Northwest National Laboratory, U.S.A.
Marie-Pierre ***Gosselin***	Research Scientist, Department of Aquatic Biodiversity, NINA, Norway
Svein ***Haugland***	Environmental Specialist, Agder Energi Vannkraft, Norway
Torodd ***Jensen***	Chief Engineer, NVE, Norway
Klaus ***Jorde***	Secretary of IEA Hydro TCP, Director of KJ Consulting, Austria
Morten ***Kraabøl***	Department head of Aquatic Ecology, MultiConsult, Norway
Jayson ***Martinez***	Mechanical Engineer, Pacific Northwest National Laboratory, U.S.A.
Bogdan ***Popa***	Associate Professor, Department of Hydraulics, University Politehnica of Bucharest, Romania
Ana L. ***Quaresma***	Research Scientist, CERIS, Instituto Superior Técnico, Universidade de Lisboa, Portugal
Helena M. ***Ramos***	Professor, CERIS, Instituto Superior Técnico, Universidade de Lisboa, Portugal
José Maria ***Santos***	Professor, Forest Research Centre, School of Agronomy, University of Lisbon
Fjola Gudrun ***Sigtryggsdottir***	Professor, Department of Civil and Environmental Engineering, NTNU, Norway
Sebastian Franz ***Stranzl***	Research Scientist, LFI / Division of Climate and Environment, NORCE Research, Norway
Liana Ioana ***Vuta***	Associate Professor, Department of Hydraulics, University Politehnica of Bucharest, Romania

Roadmap overview

Knowledge basis on hydropower and fish interactions, discussed in the following parts:

- Background
- Problems and Solutions
- Decision-making processes
- Monitoring tools

Holistic approach to address key components



Background

- Presents socio-economic and nature’s interest for water resource management
- Discuss the need for legislative practices that may set the maximum impact of hydropower on target species


SECTION 2. BACKGROUND

Section 2 presents the impacts of hydropower developments on fish. It starts with notes on social and natural aspects relative to watercourses, followed by a brief overview of the main interactions. The next part presents the policies and regulations that must be addressed, depending on the relevant jurisdictions. This is interlinked with environmental impact assessment and its role in evaluating the degree of hydropower impact on local fish. Based on the previous subsections, the final part discusses ecological aims: mitigation and conservation targets.

2.1 Socio-economic Interests: The Present and Future of Hydropower as a Renewable Energy Source

The rationale for hydropower is based on its past and present a significant contribution to global energy and its future importance towards a post-carbon civilization.

Hydropower is a long-standing, reliable, safe, and cost-competitive renewable energy source. It is essential in today's electricity mix, contributing more than 17% of electricity generation worldwide and about 85% of global renewable electricity (International Renewable Energy Agency). The contribution of hydropower is twofold: the primary benefit is the generation of clean, low-carbon, and renewable electricity. The secondary benefit is that hydropower complements the intermittency and uncertainty of wind and solar energy.

Figure 2.1 Spill over run-of-river hydropower dam at Hunderfossen on River Gudbrandsdalslågen, Norway (photo credit: jstuij/shutterstock.com)

Hydroelectricity presents several advantages over most other electrical power sources (Figure 2.1). It has a high level of reliability, is a proven technology, has high efficiency, relatively low operating and

Hydropower and Fish: A Roadmap for Best Practice Management

Background 21

Figure 2.2 Lifecycle of catadromous European Eel (Anguilla anguilla) (Source: EreborMountain/shutterstock.com)

Awareness of Fish and Hydropower Interactions

Environmental Aspects

Background 24

Hydropower and Science-Policy interface

Decision-Making Framework

Background 27

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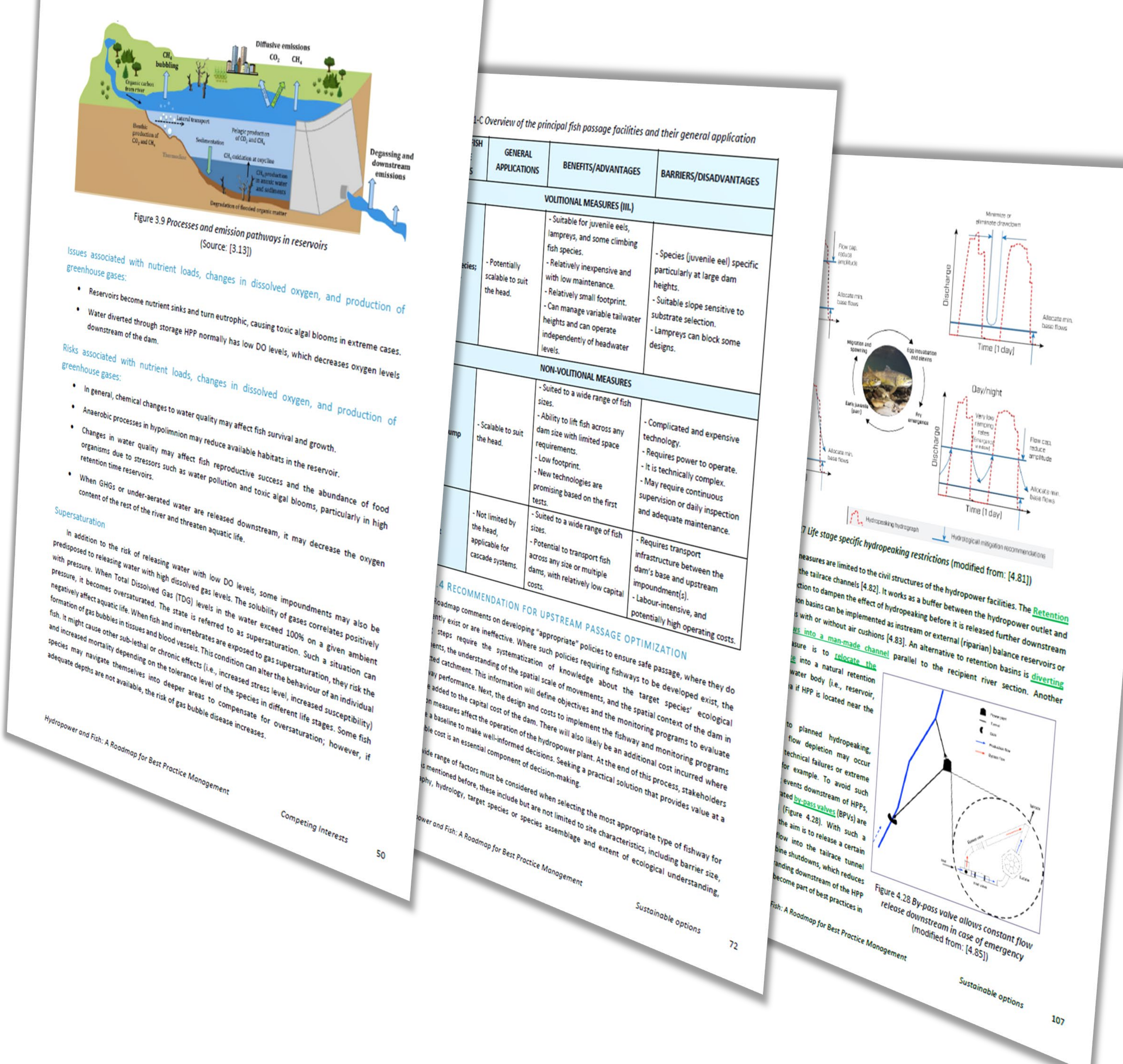
Problems and Solutions

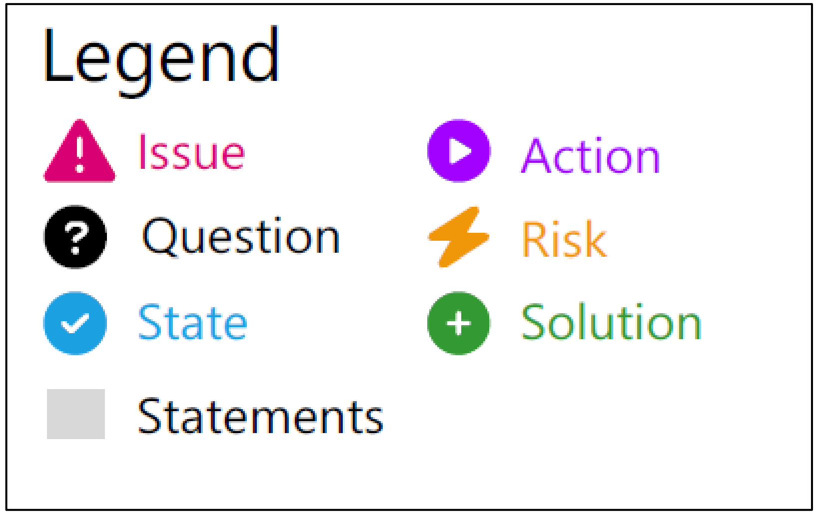
Presented along five processes:

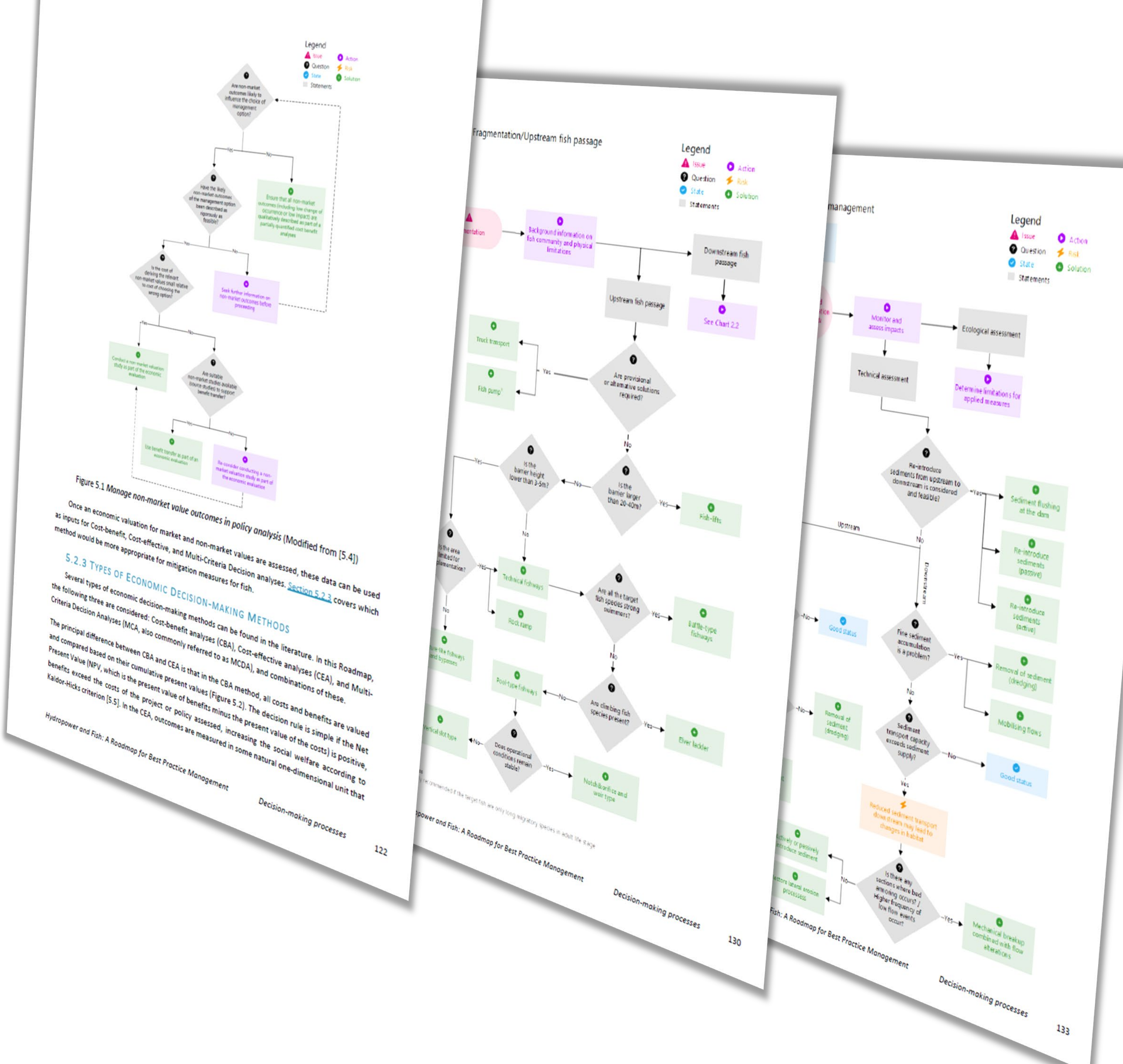
- Fragmentation
- Inundation
- Sediment transport,
- Water temperature and quality
- Regulated flow and water abstraction



Decision-support tool

To guide and assist the users for considering mitigation measures: eight flowcharts with explanations supports this process.



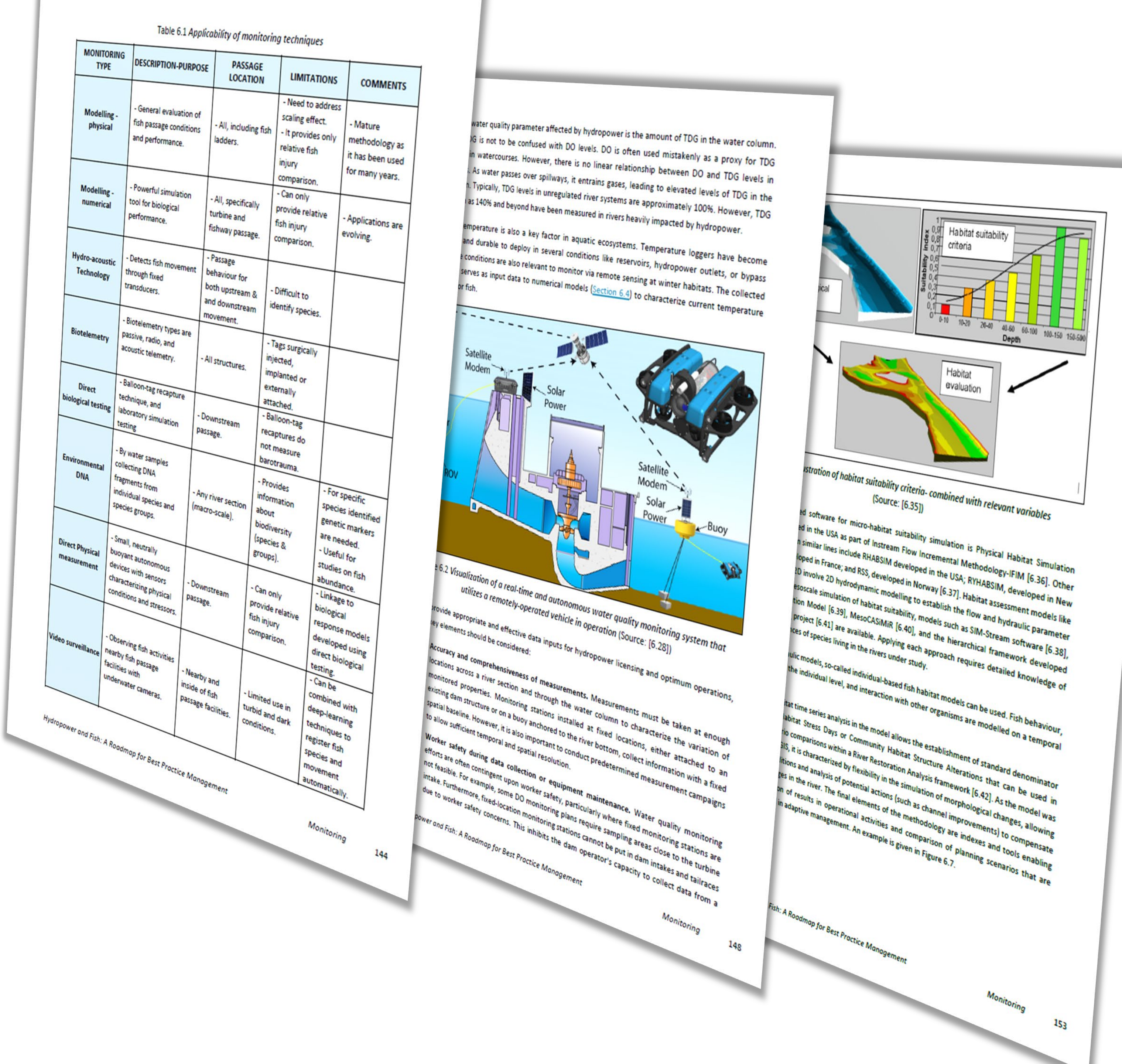


Monitoring

Importance of adequate monitoring programmes to design solutions and to assess their effectiveness.

Discuss techniques for:

- Fish movement,
- Habitats,
- Water quality,
- Supplementary tools e.g.: statistical and numerical approaches.



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Summary of the Roadmap

It starts with a broad **background to hydropower and fish**, including **conflict** descriptions between them. Where there are challenges, the Roadmap **provides** options as **mitigation measures** for further consideration. Since there is often more than one suitable alternative, decision-support processes **guide the reader in considering options**. Although the main focus of the Roadmap has been to provide effective solutions for **fish populations**, many of the same measures may also be beneficial for viable **habitats** and for other **aquatic species**.

Available at:

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The future of Hydropower and Fish working programme within IEA Hydro

The work will continue in a new Task within IEA Hydro.

Task 19

Hydropower and Fish 2.0

Task 19: Hydropower and Fish 2.0

https://getthematic.com/

Environmental flows: applied methods on local and regional scale including trade-offs between ecology and power generation

Utilizing advanced techniques for monitoring: data abundancy for enhanced knowledge on fish and their habitats

Risk assessment for hydropower operation and fish: importance of real-time information for mitigation measures

Environmental flows

- E-flows have been at the forefront of Ecohydraulic research for decades
- Several guidelines and international standards from the EU, North America and from the World Bank are available
- In recent years, a new approach has emerged from the EU to develop a **universal method** that can be applied **from a local to regional scale**.
- **The main aim** for the new Task 19 is to draw attention to the next level of e-flows and serve as a valuable forum for discussion and dissemination.
  - Combined with **economic considerations**, will provide an excellent basis for further discussions between the stakeholders

Utilizing advanced techniques for monitoring

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- Monitoring techniques have been in continuous progress for ages.
- For centuries, people wanted to know more about where to find fish and what might indicate their abundance in water.
- In the digital age, technologies have advanced, providing new, unique ways to follow fish's path and characterize their living habitats.
- The aim of Task 19 is to **raise awareness of new technologies**, such as the use and benefit of e-DNA, using AI techniques and new types of devices capable of collecting data from fish and on behalf of the fish (e.g., artificial sensor units).

Risk assessment for hydropower operation and fish

- Risk assessment for hydropower operations is historically focused on preventing failures and securing stable power production.

- Ecohydraulics research tends to apply similar methods to assemble risk matrices for aquatic animals in relation to hydropower operation.

- Following **real-time information** from monitoring stations, such matrices provide valuable information to apply feasible and **cost-effective mitigation measures** at sites to improve the operational protocol of the local hydropower plant.

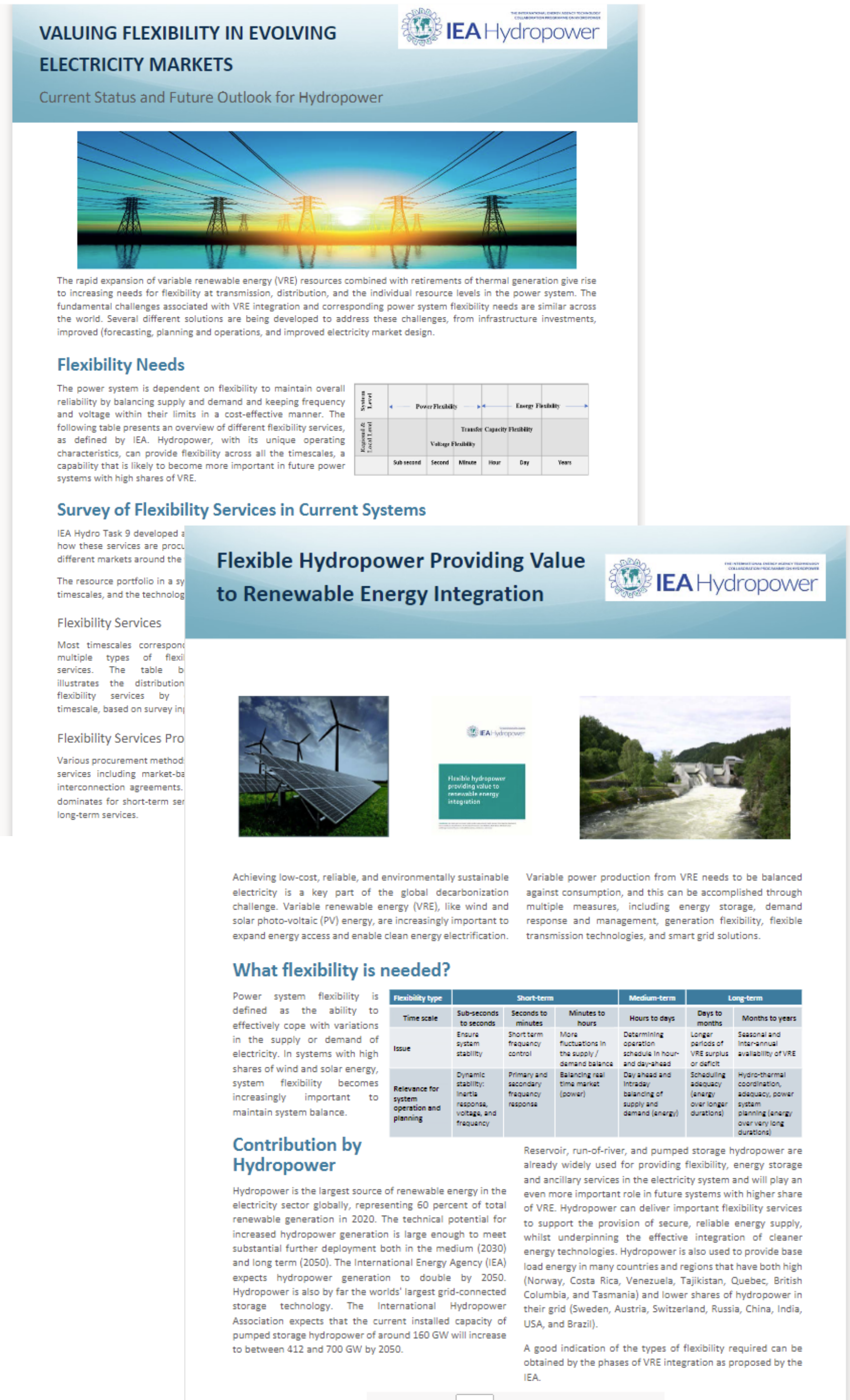
- <u>The goal of Task 19 is to emphasize the benefit of such techniques that can increase social acceptance of hydropower operations in general.</u>

Milestones

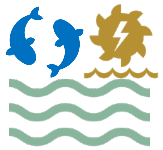
Phase	Description of milestones	Deadline
I	Kick-off meeting	M3
	Launch of Task 19 website	M5
	Proposal Task Force establishment	M6
II	Engage collaboration with IHA	M8
	Organized seminar/special session at a selected international conference	M12-M17
	Organized 1-day meeting (physical) with the expert group associated with an international conference	M20-M23
	Organized 1-day workshop associated with an international conference	M24-M27
III	Organized 1-day workshop to disseminate compiled knowledge of Task 19	M34

Deliverables

Phase	Description of deliverables	Deadline
I	Teaser of IEA Hydro Task 19	M7
II	Factsheet in alignment with the main objective of Task 19	M9
	Factsheet in alignment with the secondary objective 1 of Task 19	M9
	Factsheet in alignment with the secondary objective 2 of Task 19	M9
	Teaser to promote sustainable hydropower, produced together with IHA	M12
	White report on e-flows	M24-M28
	White report on monitoring techniques and risk assessment for hydropower operation	M24-M28
III	Final report from Task 19	M34
	Executive summary of the final report from Task 19	M36



Factsheet coordination



- **Environmental flows:** Marie-Pierre Gosselin (Norwegian Institute for Nature Research)

- **Utilizing advanced techniques for monitoring**: Daniel Deng (PNNL)

- **Risk assessment for hydropower operation and fish:** Shannon Ames and Maryalice Fischer (Low Impact Hydropower Institute)

Flexible Hydropower Providing Value to Renewable Energy Integration

IEA Hydropower

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Contribution by Hydropower

Hydropower is the largest source of renewable energy in the electricity sector globally, representing 60 percent of total renewable generation in 2020. The technical potential for increased hydropower generation is large enough to meet substantial further deployment both in the medium (2030) and long term (2050). The International Energy Agency (IEA) expects hydropower generation to double by 2050. Hydropower is also by far the worlds' largest grid-connected storage technology. The International Hydropower Association expects that the current installed capacity of pumped storage hydropower of around 160 GW will increase to between 412 and 700 GW by 2050.

Reservoir, run-of-river, and pumped storage hydropower are already widely used for providing flexibility, energy storage and ancillary services in the electricity system and will play an even more important role in future systems with higher share of VRE. Hydropower can deliver important flexibility services to support the provision of secure, reliable energy supply, whilst underpinning the effective integration of cleaner energy technologies. Hydropower is also used to provide base load energy in many countries and regions that have both high (Norway, Costa Rica, Venezuela, Tajikistan, Quebec, British Columbia, and Tasmania) and lower shares of hydropower in their grid (Sweden, Austria, Switzerland, Russia, China, India, USA, and Brazil).

A good indication of the types of flexibility required can be obtained by the phases of VRE integration as proposed by the IEA.

1st in-person Meeting Task 19 Edinburgh
19-20 October

Do you want to be part of the working group?

ana.adeva.bustos@sintef.no

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