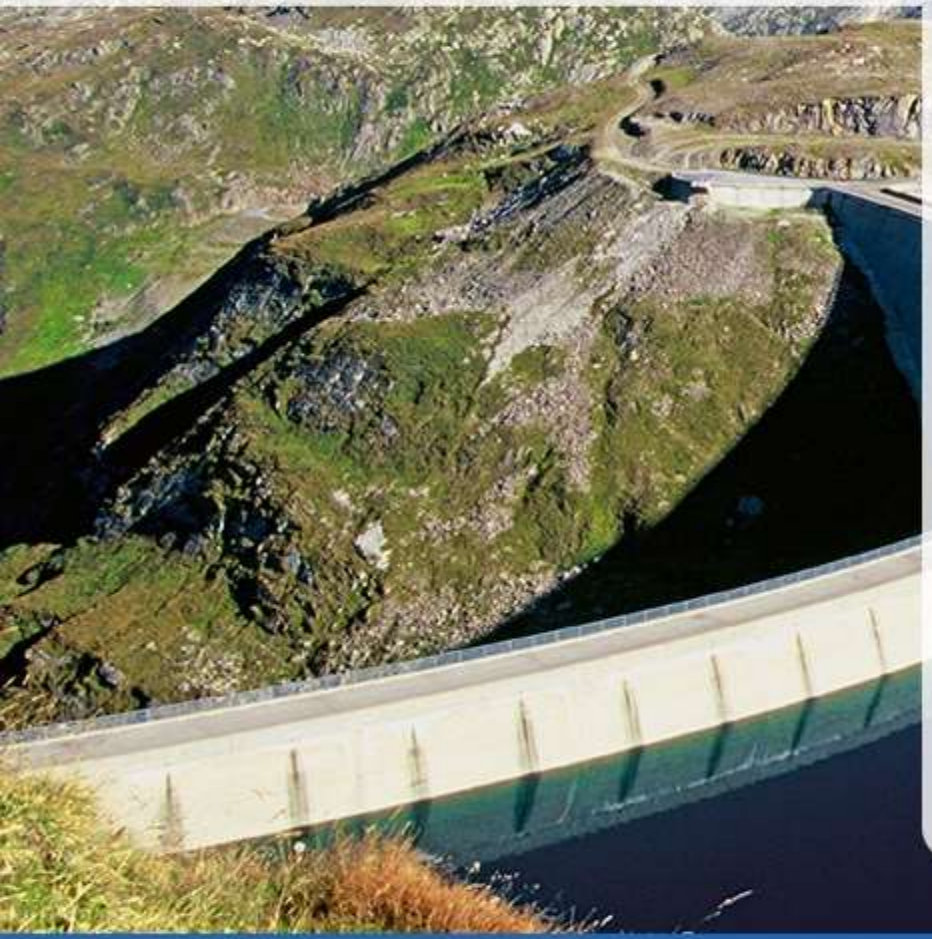
The important role of hydropower in the energy transition



Key results from the Strategic Industry Roadmap (SIR)

Dr. Jean-Jacques FRY

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Coordinating team of HYDROPOWER EUROPE

HYDROPOWER EUROPE Forum Online Event
February 23, 2022

The HYDROPOWER EUROPE Forum is supported by a project that has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 826010

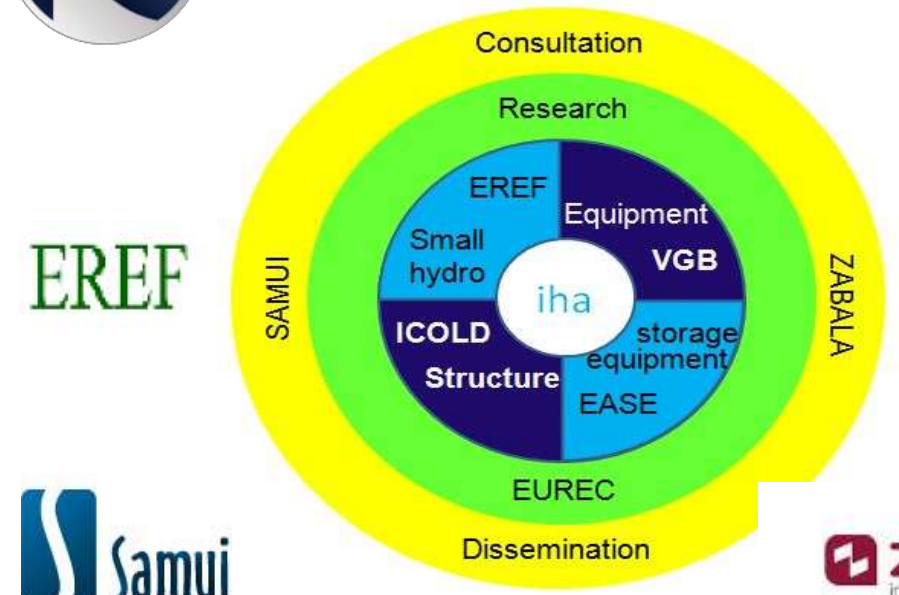
2018 HYDROPOWER EUROPE forum

Call: H2020 call LC-SC3-CC-4-2018: "Support to sectorial fora (b. Hydropower)"

"All relevant stakeholders of the hydropower sector will be brought together in a forum including workshops and online discussion groups in order to identify research and innovation needs and priorities, to share knowledge at the European level…, to support the discussion with up-to-date information.

Target: the forum will produce a synthesis of expected research developments and research needs for the coming decades in a technology roadmap and research and innovation agenda in the hydropower sector, targeting an energy system with high flexibility and renewable share."

Bid: Gathering six International Associations to create the Forum, giving a voice to a large number of members from a wide array of sectors and countries.



The Strategic Industry Roadmap

R&I priorities

RIA Recommendations for R&I EU calls & national calls

Barriers

SIR Steps to new Hydro and dams deployment

Bid: MAJOR BARRIERS to be overcome for the wide hydro deployment of all sizes of hydropower are:

1. **Rejection of new hydropower schemes**
2. **Gap between the parties**
3. **Environmental issues related to water bodies becoming a significant concern**
4. **Concerns of investors financing hydropower including pumped storage**

The Strategic Industry Roadmap

To convince policy makers and civil society, hydro deployment of all sizes needs an innovative roadmap tackling four key challenges:

1 - **Analysing lessons** learnt from unsuccessful projects

2 - **Gathering, promoting and applying best practice** for bridging the gap between parties

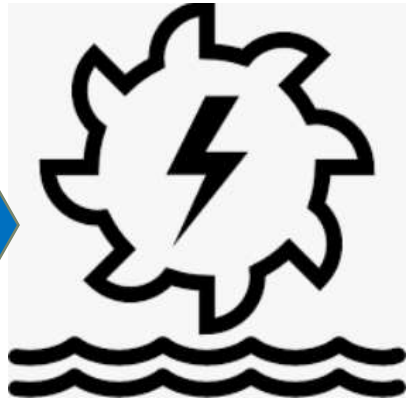
3 - **Solving environmental issues** related to water bodies

4 - Finding finance and new business models for storage and flexibility, fair and open to all technologies

To ensure the reliable and secure provision of affordable electricity, whilst meeting environmental goals

Civil society

To provide relevant framework conditions for the sustainable development of hydropower projects in Europe



Industry

Building the Strategic Industry Roadmap

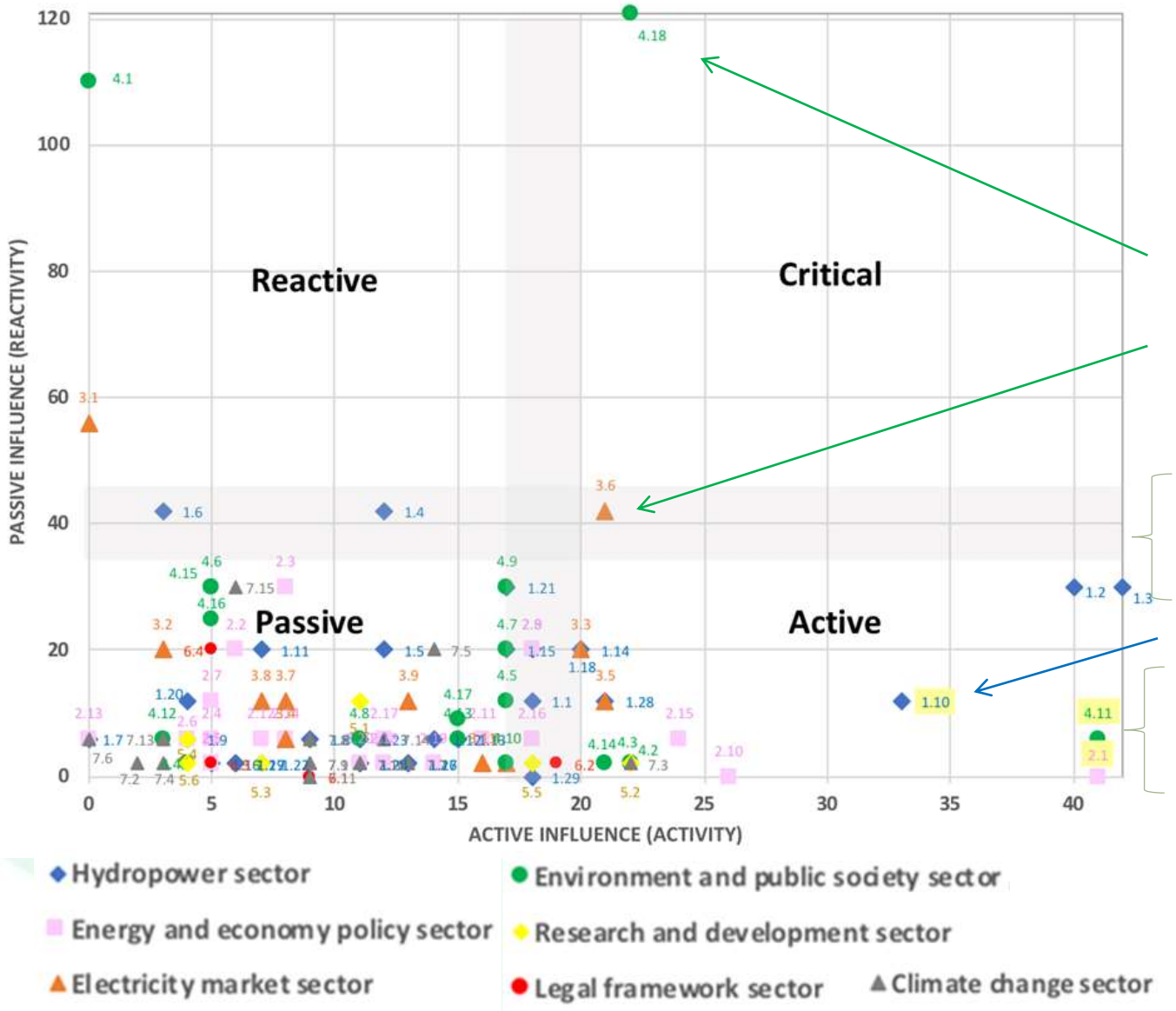
- Perceptions, views and expectations on strategic actions of the hydropower sector through the Consultation process were synthesised in 3 outputs :

- 1 – Output of the SWOT ANALYSIS
- 2 – Output of the GLOBAL SYSTEM ANALYSIS
- 3 – Output of PRIORITISATION of 11 Strategic Directions and 40 Detailed Actions

1- Outputs of the SWOT analysis

R&D	• storage, sustainability, circular economy, design business models, cost effectiveness, resilience of civil works • Big data, Artificial intelligence & Digitalisation
Deployment	• Needs (a) levelized playing field between energies, (b) unified and stable European Energy Policy and (c) new market solutions • The 0 net transition needs significant education, ambitious solutions and communication campaign
Sustainability	• Transparent shared communication to the communities • shared information with transparency about water and energy needs • Governance of water uses with an integrated view
Environment	• Use of R&D outputs, ecosystems monitoring and data mining to reduce environmental impacts, improve mitigation and optimize flexibility • European eco-labels supporting the market uptake of sustainable technology • Development of modelling tools • Supporting long term investment • Developing hidden hydro in existing water infrastructure with low to zero impact.
Competitivity	• interdisciplinary task group to agree on a fair and transparent assessment method for generation costs that takes into account the full lifecycle of the energy generation infrastructure • Advocate public awareness at the EU level, highlighting the advantages of hydropower to develop remuneration schemes for providing grid support and multi-purpose services

2 -Outputs of the global system analysis



Result of the matrix analysis of the network representing the complex situation of hydropower in Europe

Key critical factors:

4.18 Public Awareness Hydro

3.6 Volatility of the Electricity Generation

Key active factors:

1.3 Electricity Generation Hydro

1.2 Reservoir volume

1.10 Hydropower Benefits

4.11 Environmental Mitigation Measures

2.1 European Green Deal

3 – Output of the Prioritisation of Strategic actions

Out of 40 strategic actions rated from 1 to 10 by the stakeholders through the 2nd wider Stakeholders Consultation, 38 were rated as high priority!

Score	Priority
> 8.0	Very High
7.6 to 8.0	High to very High
7.0 to 7.5	High

The 2nd Wider Stakeholders Consultation confirms the outputs of the 1st Wider Stakeholders Consultation

All the strategic actions scored by the stakeholders have been assessed and validated by the Consultation Experts Panel

The very high priority strategic actions (1/5)

To better Deploy Hydropower

Pumped Storage Hydropower at Revin
(Photo EDF)

Solve the “missing money” issue with adequate remunerations in future flexibility markets

Contribute to supply security, decentralisation and independence of the European energy system with PSH

Increase resilience by mitigating the impact of ageing and maintaining the high safety level of power plants

The very high priority strategic actions (2/5)

To Increase Investment thanks to New Business Models

Research and development (R&D) for mechanisms of enhanced revenues and market structures (identification of market mechanisms and regulatory frameworks necessary to create attractive investment conditions)

R&D for re-evaluation of the market design and its ability to provide signals for investments and electricity supply security

R&D for identification of new financing schemes (green bonds, non-conventional project evaluation approaches, long term investments, etc.)

The very high priority strategic actions (3/5)

To Increase Social Awareness

Collect a catalogue of examples of best practice of successful multi-purpose projects creating a win-win situation between all stakeholders

Develop innovative approaches to address environmental issues and biodiversity protection with comprehensive approaches allowing compromises

Increase awareness of European citizens of the importance of hydropower development

The very high priority strategic actions (4/5)

To Develop Environmental Mitigation Measures

- Develop sustainability best practices with the help of international associations including taxonomy for sustainable finance and biodiversity strategies
- Develop sustainable sediment management strategies for ensuring sustainable reservoir capacity and sediment dynamics in rivers
- Protection of biodiversity in hydropower projects by innovative compensation measures
- Collect experience with Water Framework Directive and lessons learnt solutions to maintain or improve water quality in rivers and reservoirs
- Provide hydropower with environmental innovations thanks to large investments, such as investment in flexibility, to comply with the European Green Deal

The very high priority strategic actions (5/5)

To Adapt Regulation to Energy Transition

Research and development for regulation improvements (increase CO_2 cost, abolishment of the double taxation of pumped storage hydropower, long term concessions, safety, taxes, etc)

Development of a more stable regulation framework which promotes green renewable power with a fair price, tax policy and subsidy model designed for a level playing field amongst different technologies, based on a comprehensive analysis of the carbon footprint and life cycle

To Simplify Approval Procedures and Legislation

Enhanced dialogue between civil society and the European commission to define appropriate ways and tools to deploy more hydropower and to balance environmental protection legislation and climate friendly energy legislation

Implementation of the roadmap

3 key strategic directions

Providing economic and legal support for flexibility and storage

1. Improvement of flexibility markets
2. Best practice for investing under uncertainties
3. Development of a more pertinent regulation framework

Preserving biodiversity and improving river ecosystems

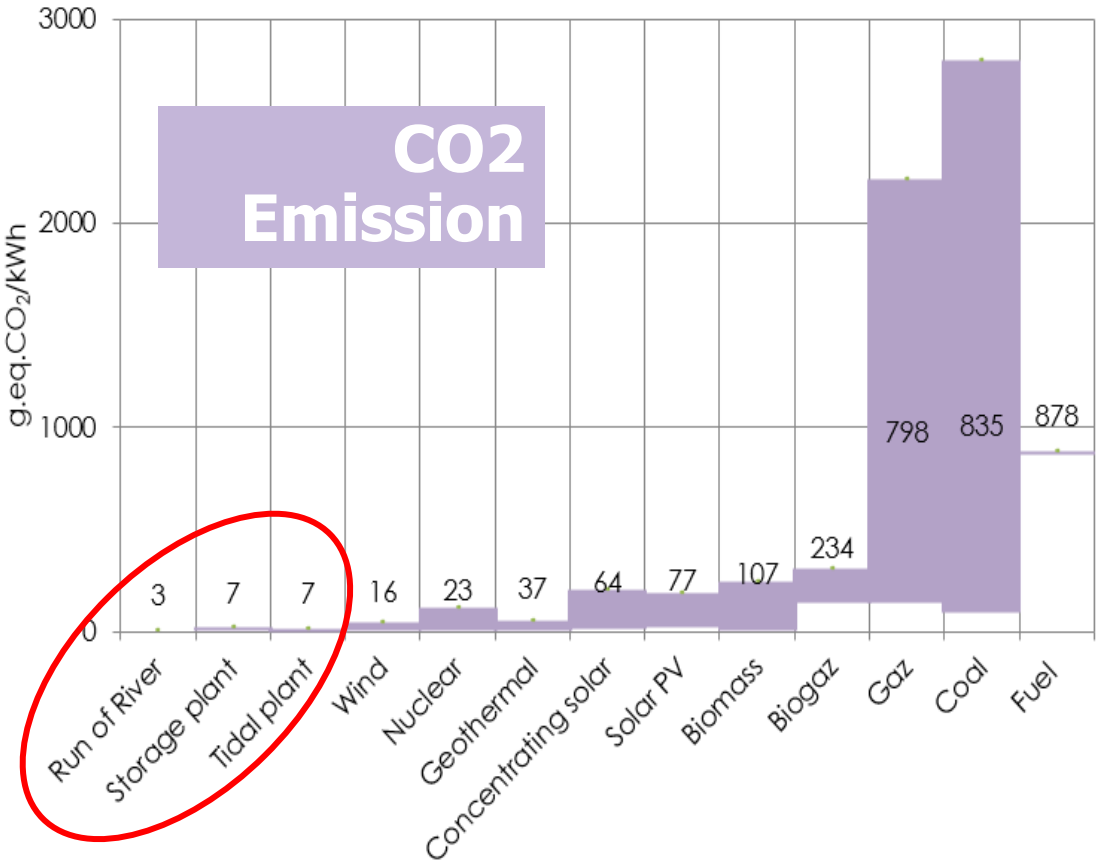
1. Collect best practice for sustainability and biodiversity protection
2. Increase the knowledge on environmental impacts
3. Develop innovative compensation measures for the protection of biodiversity
4. Develop comprehensive approaches allowing compromises

Raising public awareness, increasing societal resilience and local employment

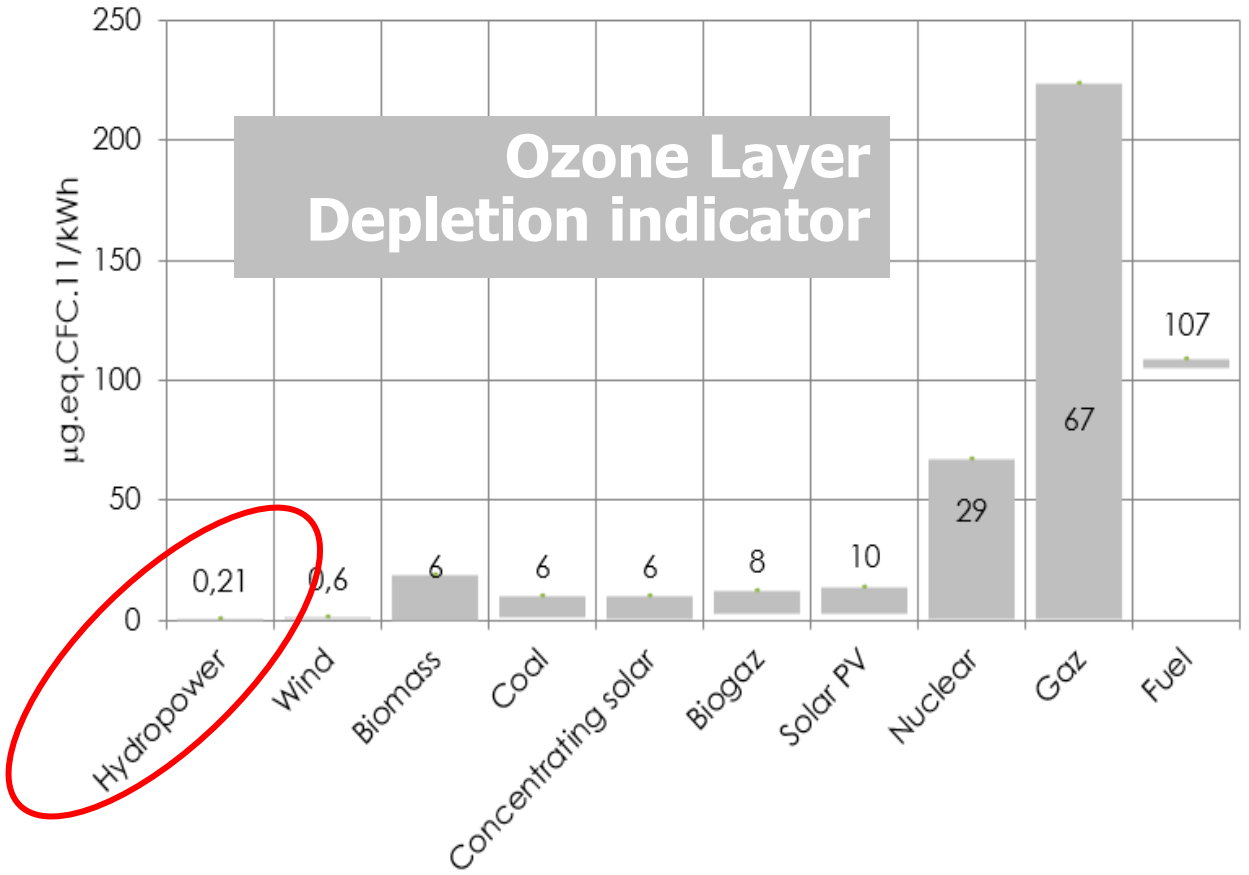
1. Increase public awareness with communication and dissemination
2. Develop best practices for sustainability for successful projects and win-win situations
3. Increase security, decentralization and independence of the European energy system with PSH
4. Give a collaborative platform to the hydro sector

Our Key Messages (1/7)

Hydropower has the best climate indicators



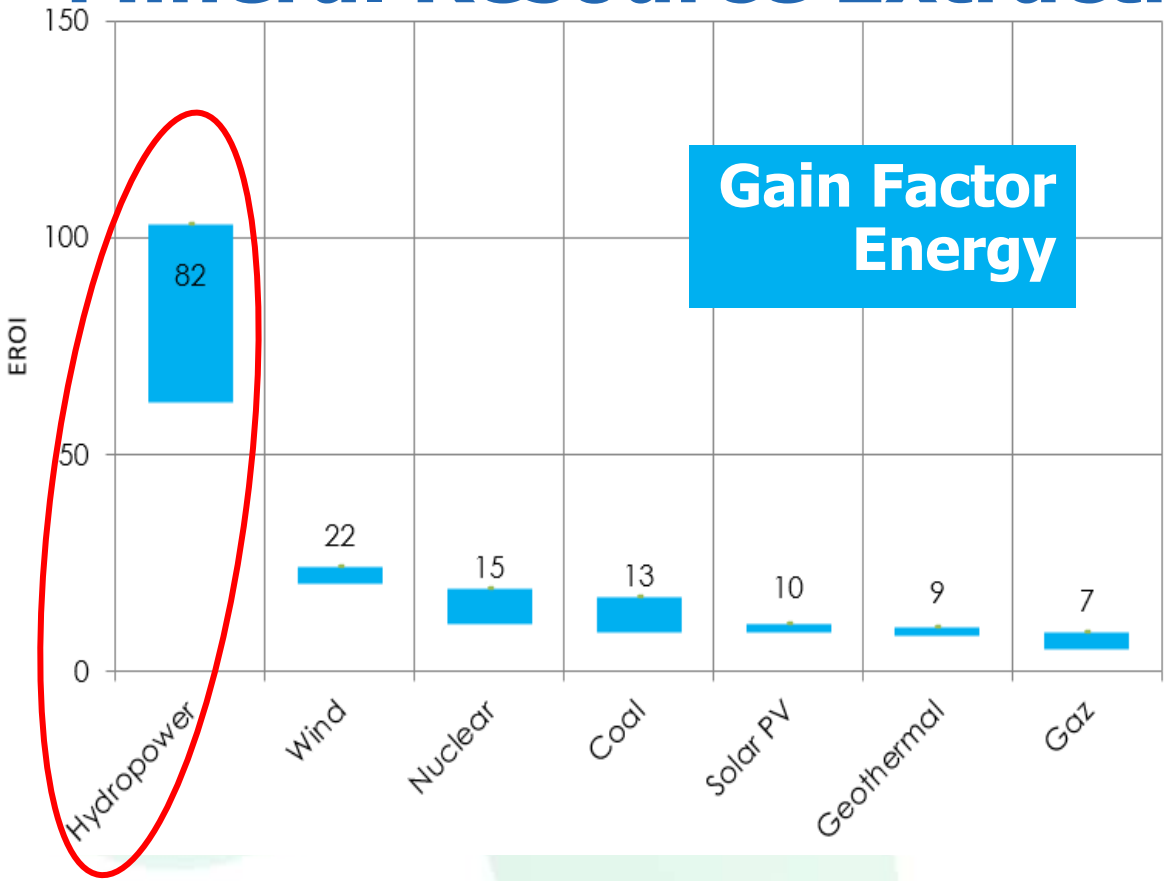
The CO2 emissions in Nordic countries (CIRAIG 2014)



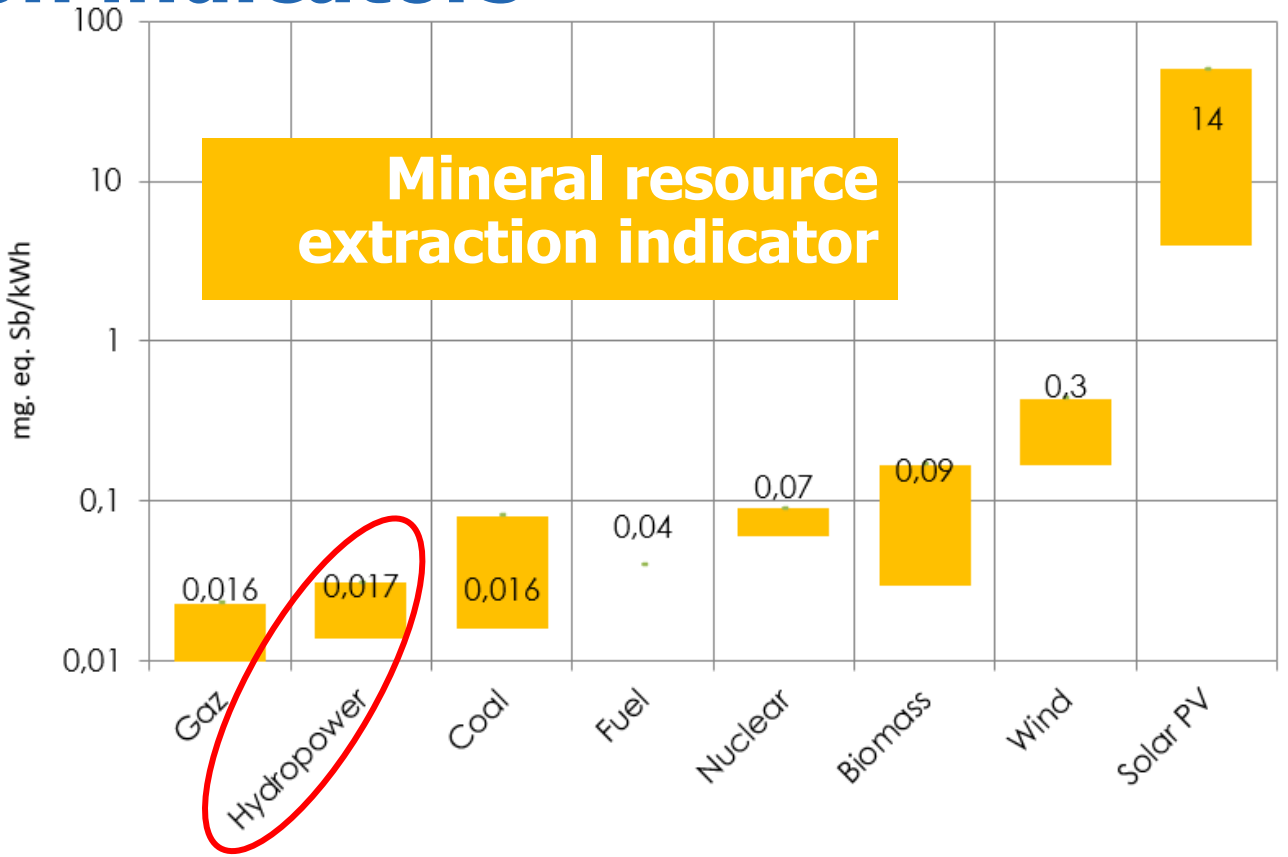
The Ozone Layer Depletion indicator (CIRAIG 2014)

Our Key Messages (2/7)

Hydropower has the best Gain Factor Energy and Mineral Resource Extraction indicators



EROI or gain factor of energy (CIRAIG 2014)



The Mineral Resource Extraction indicator (CIRAIG 2014)

Our Key Messages (3/7)

Hydropower has the best performance for flexibility & storage

Hydropower supplies around 90% of global flexible dispatchable capacity (IEA, 2021)

Technologies		Likelihood to achieve the performance Goals													
Electrochemical (battery)		4	4	1				3	4	3	4	5		4	3
Chemical	P2-Gas-2P	1	3	4		?	?	?	?	?	?	?	?	?	?
	P2-Liquids-2P	1	3	4		?	?	?	?	?	?	?	?	?	?
Chemical	P2-Gas-2Industry (as gas, to heat)	NA				?	?	?	?	?	?	?	?	?	
	P2-Liquid-2Industry (as liquid, to heat)	NA				?	?	?	?	?	?	?	?	?	
Thermal	P2Heat (e.g. heat pump)														
	CSP (Concentrated Solar Power)														
Mechanical	Compressed air (CAES)	NA	4	4	?	?	?	4	3	3	4	3	4	2	4
	Liquid-air (ES 5LAES)														
	Flywheels	5	NA	NA	?	4	4	4	2	3	4	5	4	3	5
	Pumped hydropower (PHS)	5	5	5	5	5	5	5	5	5	5	5	5	3	3
Electromagnetical (Superconducting magnetic ES (SMES)		5	2	1	5	5	?	4	2	3	3	5	3	3	4
Electric (Supercapacitor)		5	3	1	5	4	?	5	4	3	4	5	4	3	5
Performance GOALS		Load response - Short -duration (second - minutes)	Load response - Mid -duration (1 - 18 hours)	Load response - Long -duration (days - weeks)	Power quality: provides smooth electricity supply.	Reliable: - can provide power, even after long inactive periods.	Robust: able to withstand extreme use conditions (e.g temperature)	Long lifetime	Scalable: to cost-effectively build large-scale (MW) systems	Compact: Cost-effective improved Energy&Power density	safe	Efficient: high enough conversion efficiency to cost-effectively integrate with necessary energy sources	High material efficiency and sustainable end of life management	Flexible: able to integrate into infrastructure (boundary constraints assessment)	Modular: can combine with other storage technologies

(ETIP SNET 2022)

Our Key Messages (4/7)

PSH, and particularly PSH off river, charged with green power could comply with all the six environmental objectives of Taxonomy (EC, 2021d) defined in Article 3 of the Climate Law (EC, 2021a)

1. climate change mitigation;
2. climate change adaptation;
3. sustainable use and protection of water and marine resources;
4. transition to a circular economy;
5. pollution prevention and control;
6. protection and restoration of biodiversity and ecosystem

- **Pumped Storage Hydropower could be fully supported by Taxonomy**

Our Key Messages (5/7)

Hydropower is developing ecological continuity

- latest instream and kinetic turbines reaching fish mortality of less than 0.1%
- the Hydroshaft concept (Rutschmann, 2019)
- the active fish path concept (Kalina, 2021) with 2 Archimedes screw
- the "Fishlift®" concept (Pelikan, 2017 & Pelikan, 2021)
- Turbines without oil and grease
- the 3D sensor less ultra-sonic fish tracking 200 m upstream and downstream of HPP
- the IDA concept guiding fish into the turbine and reducing by 50% their injury on small chutes
- the natural fish pass

Our Key Messages (6/7)

Hydropower is a driver for national and regional economies

Reservoirs store a valuable natural resource, the water, and support its use for many services:

- irrigation
- drinking water storage
- sustainable transport
- prevention of flood & drought
- tourism
- recreation and sport
- fisheries
- infrastructures

Our Key Messages (7/7)

Hydropower contributes to Sustainable Development Goals

Ensuring availability and sustainable management of water for all

Providing access to affordable, reliable, sustainable and modern energy for all

Upgrading infrastructure with clean, environmentally sound technologies

Taking action to combat climate change and its impacts

Hydropower directly supports SDG 6, 7, 9 and 13 and also contributes to the other SDG (IHA 2018)

HYDROPOWER EUROPE

HYDROPOWER

as a CATALYST for the ENERGY TRANSITION IN EUROPE

is a pillar for the future Net Zero society

Full report (142 pages) and summary brochure (20 pages) available at

https://hydropower-europe.eu

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