ETIP HYDROPOWER

ATLE HARBY

SINTEF

Atle Harby is a senior research scientist at SINTEF Energy Research in Norway. He has more than 25 years of experience in research and development with emphasis on environmental impacts of hydropower and the role of hydropower in energy systems. He is coordinating IEA Hydro Task "Valuing hydropower services", works part-time for the World Bank and is coordinating the recently funded EU research project "ReHydro" on Demonstration of Sustainable Hydropower Refurbishment.

Funded by the European Union

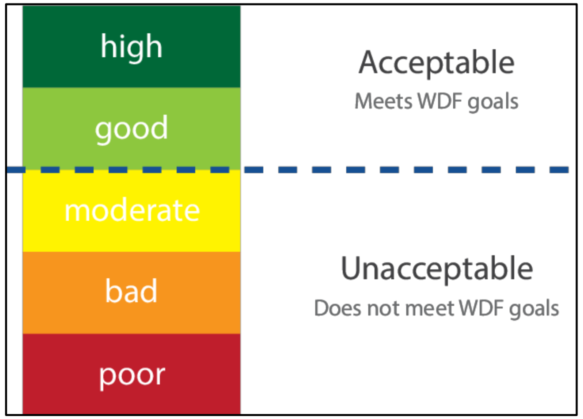
Upgrading of hydropower in Europe to increase flexibility and decrease biodiversity impact

Atle Harby, SINTEF Energy Research

Hydropower Day, Brussels, 16 April 2024

SINTEF ReHydro HydroCen

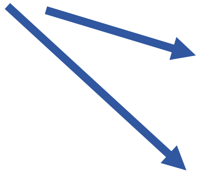
What is sustainable hydropower?

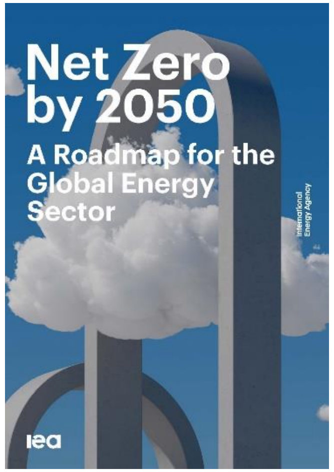


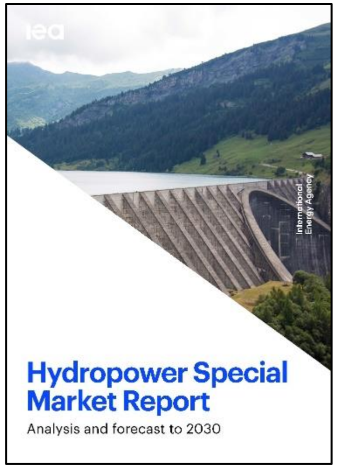
WFD

IHA

1. Social
2. Economical
3. Environmental







We have the tools – but do we apply them?

NTNU SINTEF HydroCen

What is sustainable hydropower?

- Sustainable hydropower leads to:
  - Energy for all
  - Clean water and sanitation
  - Zero hunger
  - Economic growth
  - Sustainable communities
  - Life on land (including freshwater)

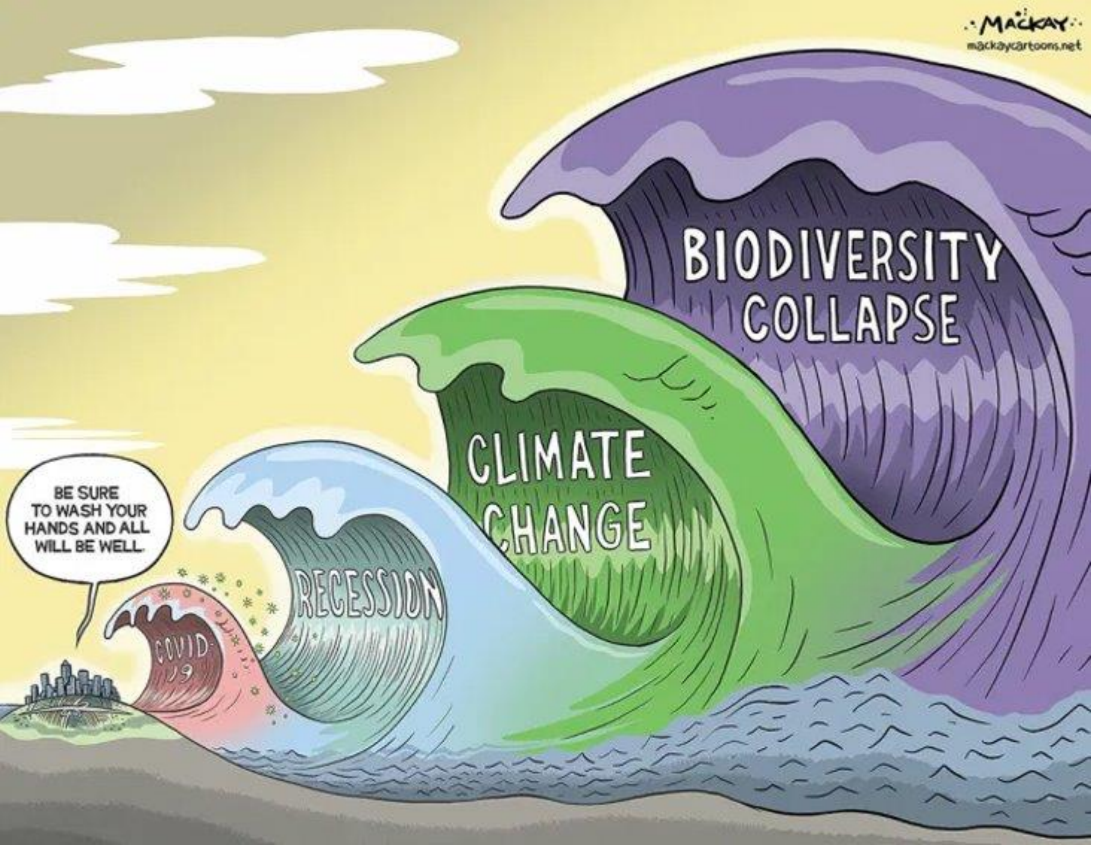
- What is sustainable hydropower?

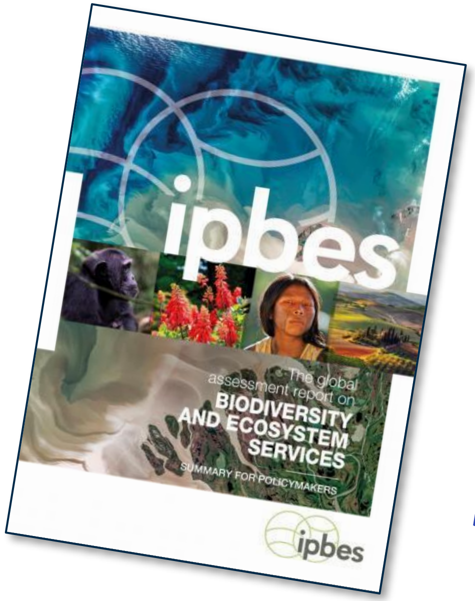
It's the wrong question to ask!

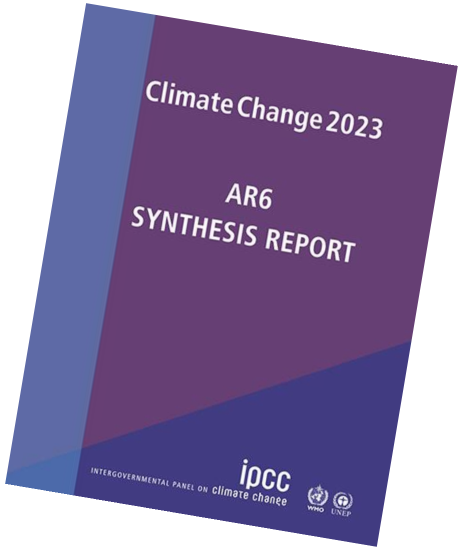
- Sustainable hydropower must not be seen isolated from the society
- Good practice hydropower
  - Adapted to local challenges and needs
  - Meeting global requirements

Hydropower that provides energy, water management for all users and interests and contributes to welfare

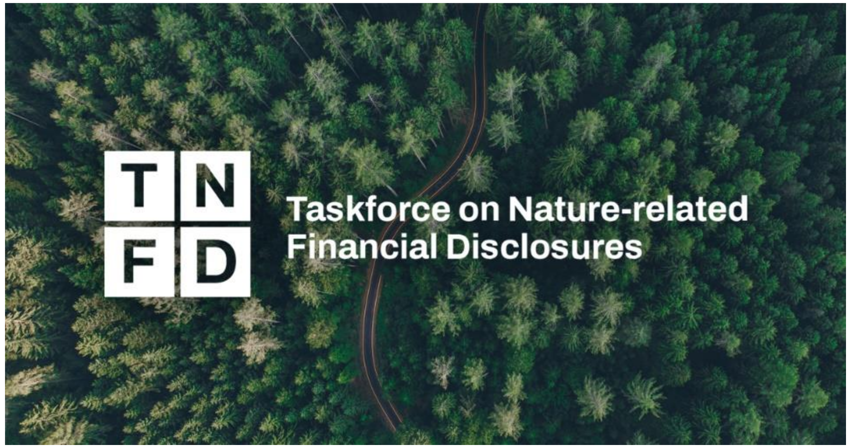
Environmental and social impacts from hydropower





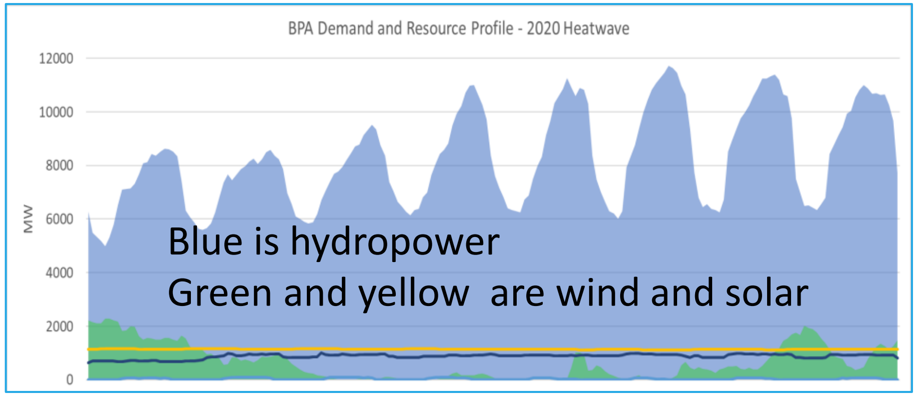


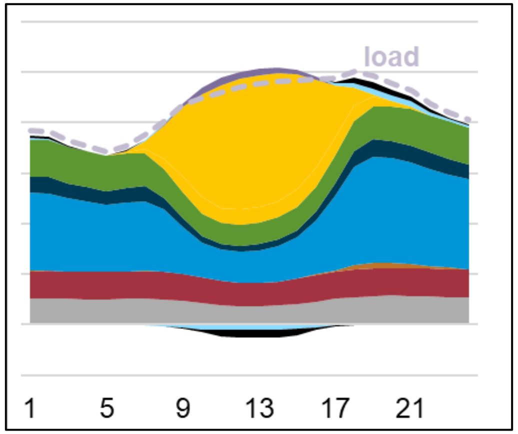
Requires hydropower companies to declare their impact and dependency on nature and climate



Dunkelflaute

- periods with hardly no wind, nor solar power





Surplus periods

- how to use excess energy and avoid curtailing generation?

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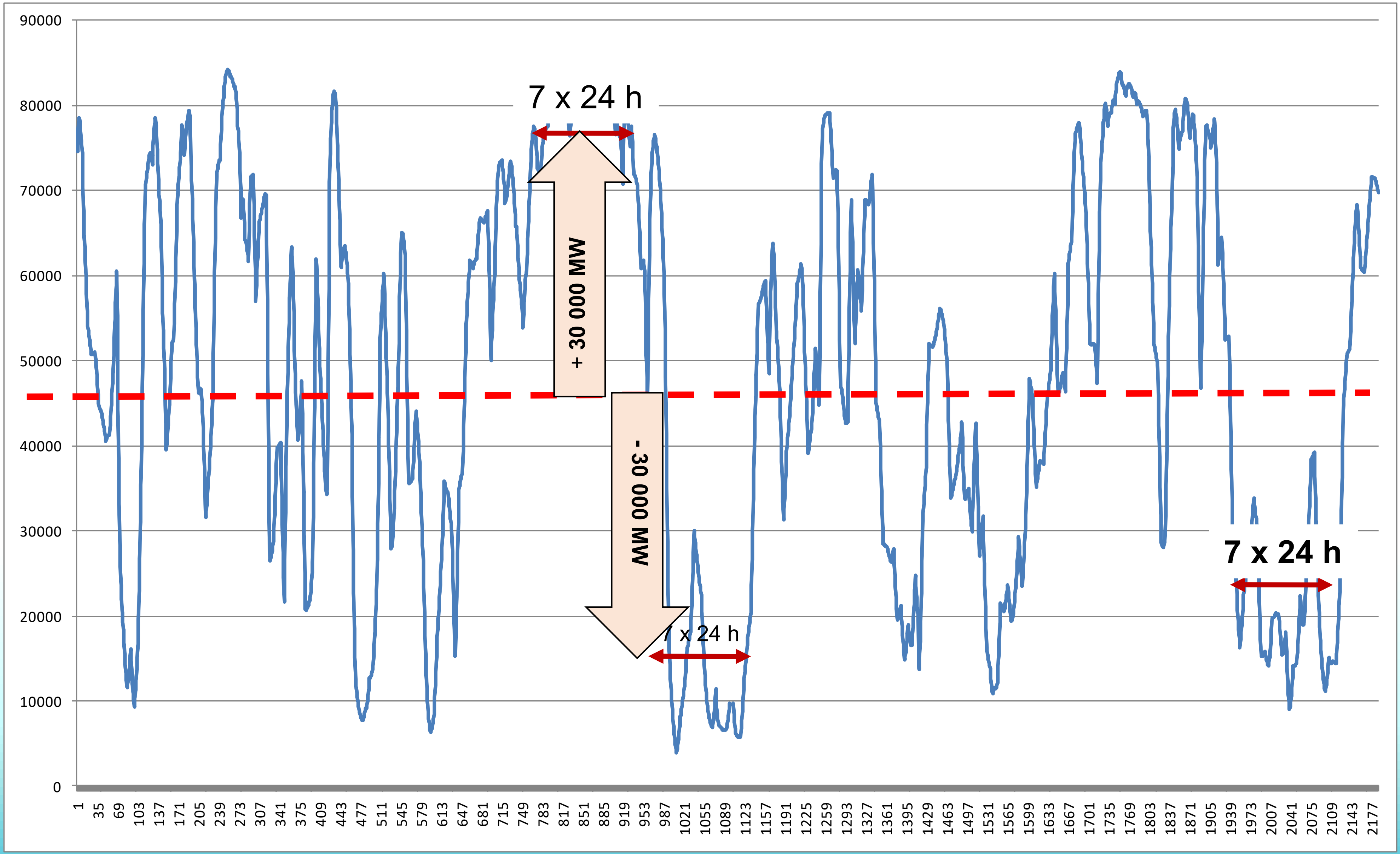
THE INTERNATIONAL ENERGY AGENCY TECHNOLOGY COLLABORATION PROGRAMME ON HYDROPOWER

IEA Hydropower

Simulated wind production in the North Sea area in 2030



One week balancing
= 30 000 MW in 168h
= 5 000 GWh energy

= 1 000 typical PSH

= 38 700 Hornsdale Power Reserve (Elon Musk battery project in Australia)

from IEA TCP Hydropower

Timescales of power system flexibility

Flexibility type	Short-term			Medium term	Long-term	
Time scale	**Sub-seconds to seconds**	**Seconds to minutes**	**Minutes to hours**	**Hours to days**	**Days to months**	**Months to years**
Issue	Ensure system stability	Short term frequency control	More fluctuations in the supply / demand balance	Determining operation schedule in hour- and day-ahead	Longer periods of VRE surplus or deficit	Seasonal and inter-annual availability of VRE
Relevance for system operation and planning	Dynamic stability: inertia response, voltage and frequency	Primary and secondary frequency response	Balancing real time market (power)	Day ahead and intraday balancing of supply and demand (energy)	Scheduling adequacy (energy over longer durations)	Hydro-thermal coordination, adequacy, power system planning (energy over very long durations)

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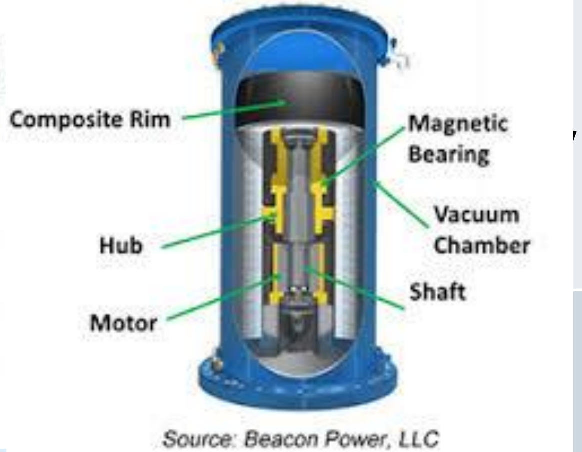

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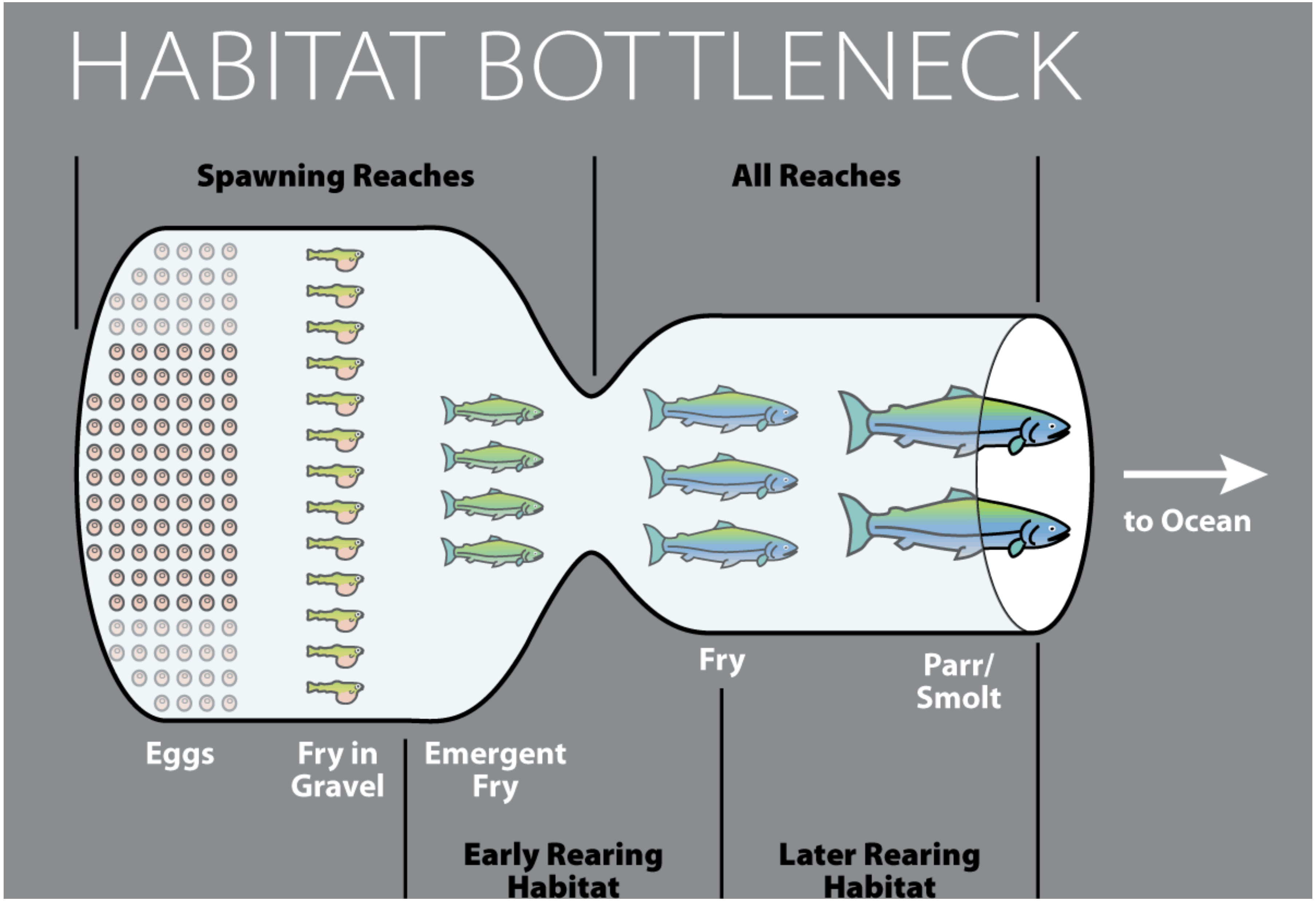

Fish dies only once!

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Mitigation measures – design solutions

Environmental flow release

Stable temperature and ice cover

Introduce "a river in the river" when water is withdrawn

Two-way migration solutions

Improving habitats

"Water bank"

The technology is there – environmental design

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ReHydro

- Demonstration of sustainable hydropower refubishment – 5 demonstration sites
- 22 partners - 7 European countries
- Academic partners, hydropower companies, manufacturing inustry, service-providing companies
- May 2024 – April 2028

- Improve flexibility
- Digital solutions
- Fit for market
- Environmental sustainability
- Non-energy services to the society
- Make European hydropower industry ready for export

Thank you for your attention!

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