The Crisis within the Energy Crisis

Need for Long Duration Storage

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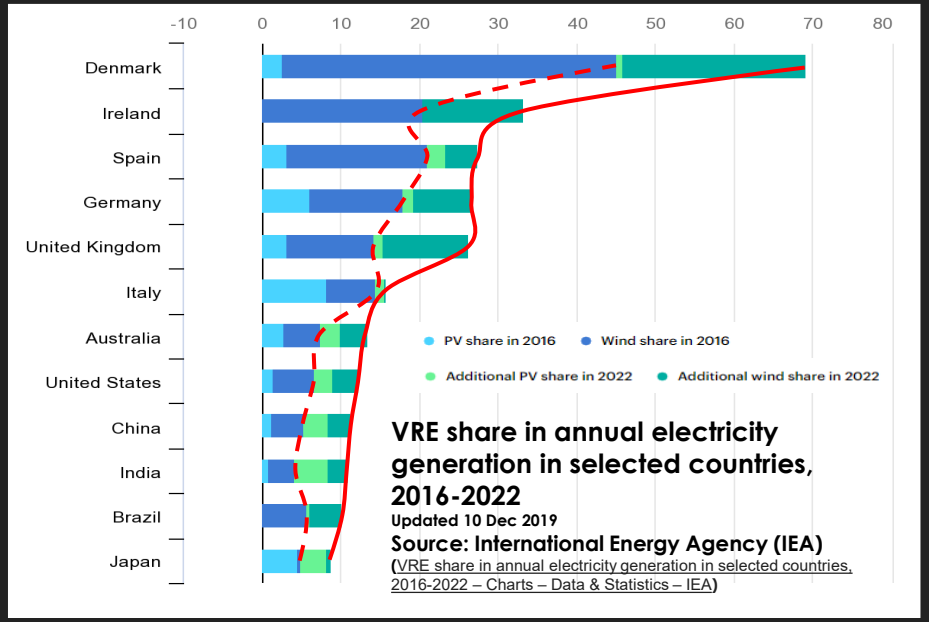
Agenda

1. The Crisis within The Energy Crisis
2. International Forum on Pumped Storage Hydropower (IFPSH)
3. Working Groups Summaries
4. IFPSH Reports

“The Crisis within the Energy Crisis”

- Climate change is driving the need for rapid transition of the electricity sector from fossil fuels to low carbon sources of power.
- Variable Renewable Energy (VRE) - wind and solar power is being deployed at a huge scale - cheapest source of electricity in many countries
- Variability of these sources means storage becomes more important



"The Crisis within the Energy Crisis"

- Climate change is driving the need for rapid transition of the electricity sector from fossil fuels to low carbon sources of power.
- Variable Renewable Energy (VRE) - wind and solar power is being deployed at a huge scale - cheapest source of electricity in many countries
- Variability of these sources means storage becomes more important
- Real risk that electricity grids of the future will be unable to provide reliable power without recourse to high carbon sources of back-up (gas turbines)
- For short durations (<4 hours) – Batteries will play an important role
- Long duration storage will be essential
- The Crisis – deployment of PSH not keeping pace with increasing demand for both long term duration and other services required for system flexibility and stability

International Forum on Pumped Storage Hydropower (IFPSH)

- Launched in November 2020
- Initiative of the International Hydropower Association (IHA)
- Chaired by U.S. Department of Energy

Mission:

- To provide a multi-stakeholder platform to shape and enhance the role of pumped storage hydropower (PSH) in future power systems
- To expand and transfer best practice and experience with the aim of delivering sustainable, affordable and reliable power for all, while contributing to climate mitigation goals.

IFPSH Working Groups

Policy and Market Frameworks

Sustainability

Capabilities, Costs and Innovation

IFPSH Working Groups

Policy and Market Frameworks

While PSH will be critical in maintaining power system stability under high levels of variable renewable energy, many of its services are not fully recognized nor adequately remunerated.
Most policy and market frameworks do not adequately incentivise investment in greenfield PSH development.

Working Group objective:

- explore the various services and markets to highlight the current investment barriers but also emerging opportunities for PSH development.
- Develop country and regional specific policy recommendations for government decision makers and regulators that de-risk development.

IFPSH - Key Recommendations

Policy and Market Frameworks

1. Policymakers should **assess the long-term storage needs** of their future power system ***now***, so that the **most efficient options**, which may take longer to build, **are not lost**.
2. Comparisons between energy storage and flexibility options must follow a consistent, technology neutral approach that considers all impacts and benefits.
3. Providers of essential electricity grid, storage, and flexibility services **should be remunerated for all services that they provide**.
4. Licensing and permitting arrangements must be timely, proportionate and take advantage of the range of internationally recognised sustainability tools.
5. Investors in long lasting assets, such as PSH, must have long-term visibility of revenues, with risk that is shared fairly to deliver the lowest overall cost to society in the long term.
6. Existing hydropower assets and prospective sites should be assessed and mapped for their potential to provide the most efficient long duration storage.
7. Green recovery programmes should include and support PSH, and green finance mechanisms should incentivise PSH.

IFPSH Working Groups

Sustainability

Like any large-scale energy infrastructure project, pumped storage development can have environmental and social impacts as well as benefits.
It is critically important that these are well understood, and measures are taken to avoid, minimize, and mitigate any impacts.

Working Group objective:

- To promote and deepen the wider sector's understanding on pumped storage's sustainability profile
- Focus on both benefits and impacts of development by testing PSH projects against existing sustainability tools like the Hydropower Sustainability ESG Gap Analysis Tool and assessing the territorial value creation for local communities

Hydropower Sustainability

IFPSH - Key Recommendations

Sustainability

1. PSH **should be considered as a key enabler of the clean energy transition**, alongside other energy storage technologies.
2. The development of PSH projects should rely on a multi-level approach:
   - assessment of storage, flexibility, and ancillary services needed by the power system;
   - assessment of available options to meet those needs; and
   - PSH project optimisation to manage, avoid, minimise and mitigate environmental and social impacts.
3. **PSH projects are site-specific** and sustainability cannot be defined by a simplistic classification. Existing sustainability tools for conventional hydropower projects are flexible and sophisticated to allow for these nuances.
4. The application of Life Cycle Analysis to PSH projects is emerging. Specific attention is required to avoid misleading conclusions. No evidence to suggest a material difference in GHG emissions from PSH reservoirs compared to conventional hydropower reservoirs which, on average, fall between those of wind and solar power.
5. PSH projects, as with many hydropower projects, can generate one-time or permanent local benefits, which should be considered in their sustainability profile assessment.

IFPSH Working Groups

Capabilities, Costs and Innovation

PSH is often absent in discussions concerning the need and deployment of energy storage due to lack of understanding about its potential, capabilities, costs, and innovations.

Working Group objective:

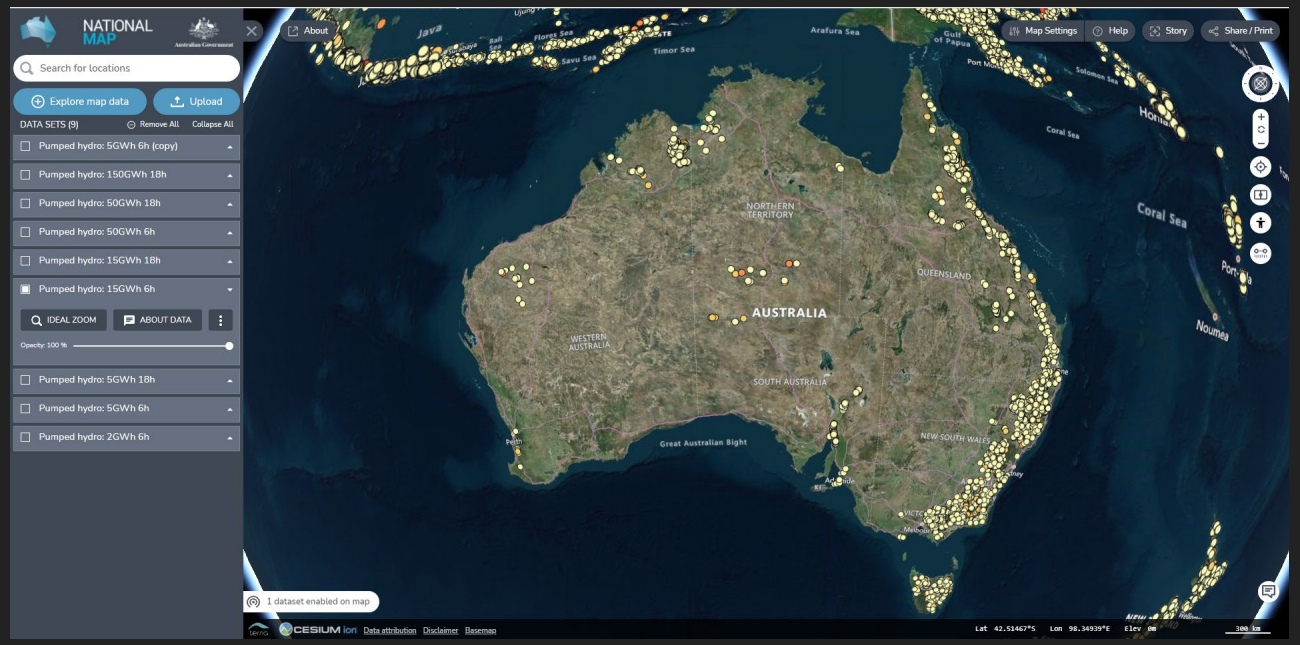
- To raise the awareness of PSH by undertaking several initiatives focusing on promoting its critical role in the energy transition
- Focus on comparing PSH with other sources of system flexibility, further investigation of potential sites
- Highlight the latest technological developments

IFPSH – PSH Technologies

Further PSH Potential

1. Off-river PSH (Closed-loop)

Matthew Stocks & Andrew Blakers, Australian National University



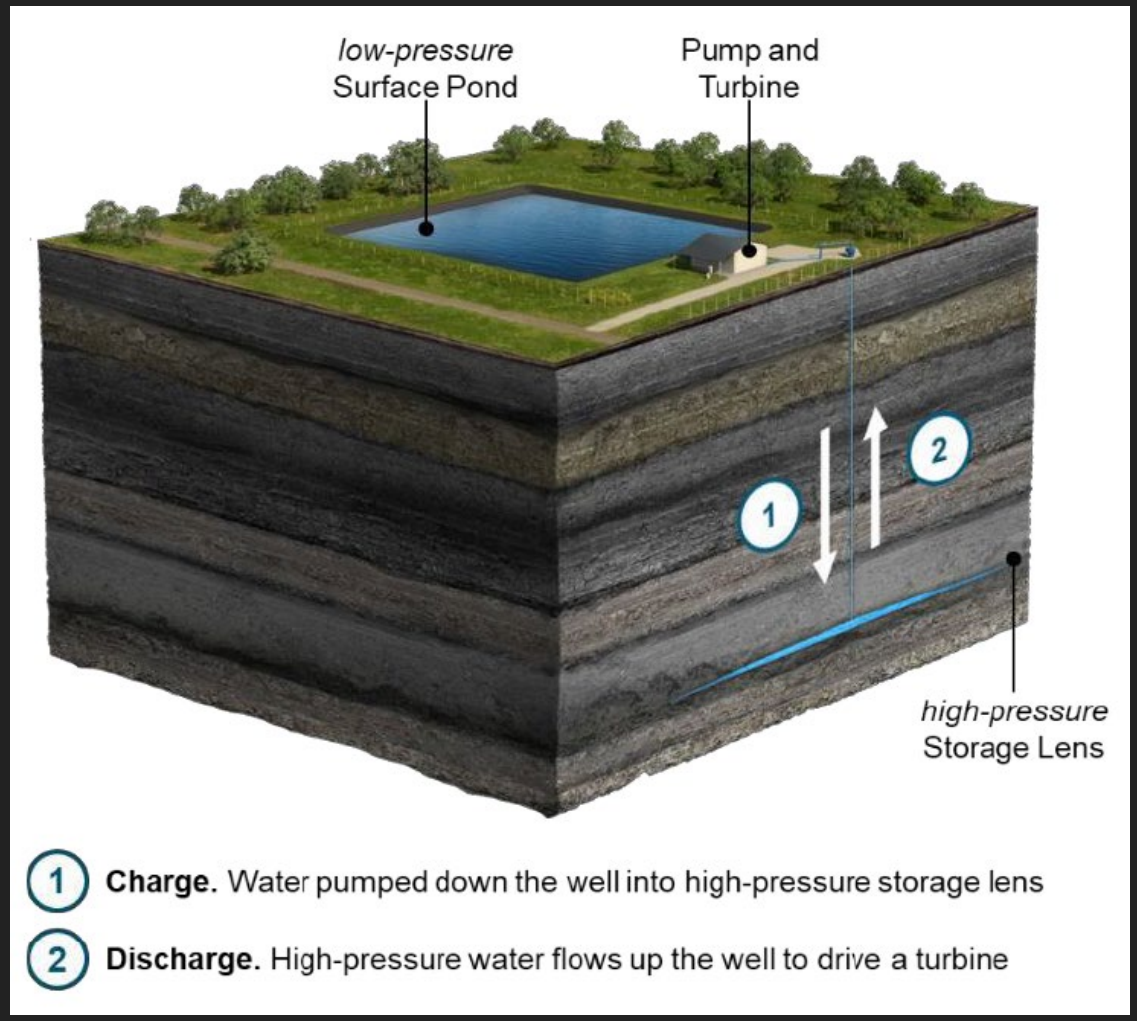
An online global off-river PSH atlas has identified 616,000 potential storage sites around the world with a combined storage potential of 23,000 TWh, which is two orders of magnitude more than required to support large fractions of renewable electricity.
http://re100.eng.anu.edu.au/global/index.php

IFPSH – PSH Technologies

Further PSH Potential

1. Off-river PSH (Closed-loop)
2. Geomechanical PSH

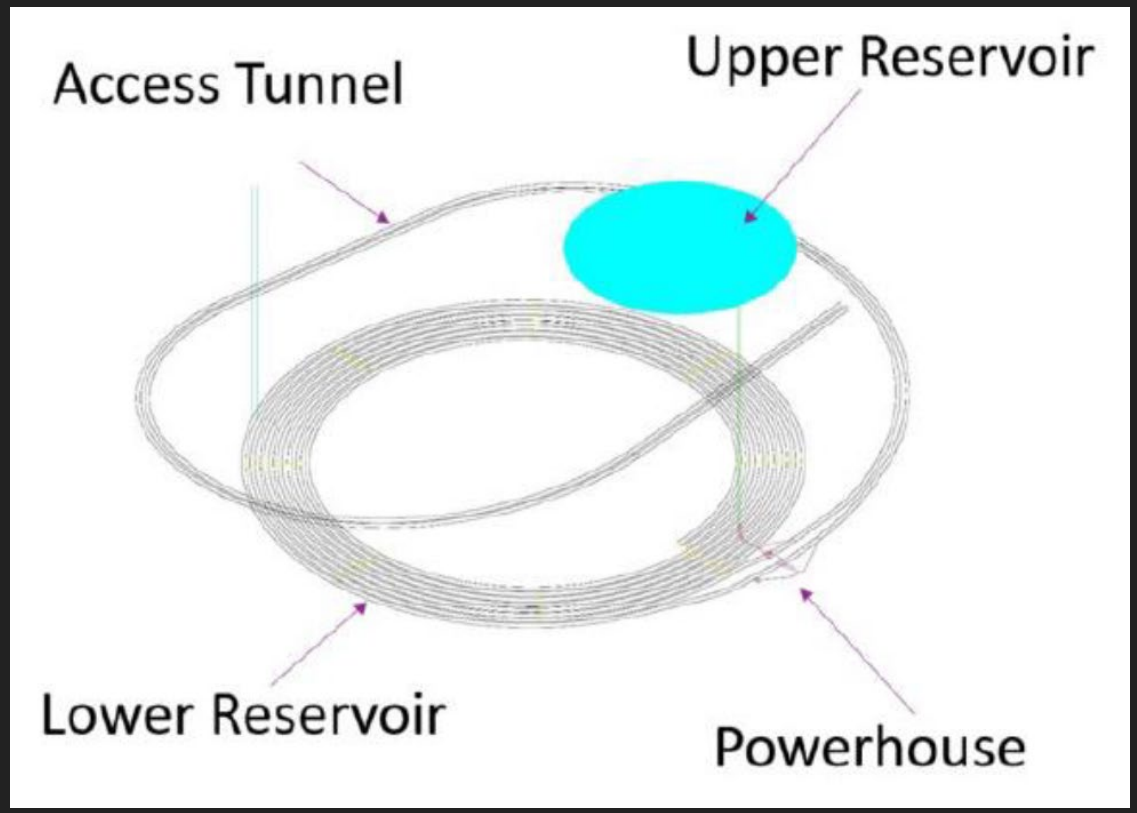
Quidnet Energy Inc.



IFPSH – PSH Technologies

Further PSH Potential

1. Off-river PSH (Closed-loop)
2. Geomechanical PSH
3. Location Agnostic PSH
4. Underground PSH



IFPSH – PSH Technologies

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5. Seawater PSH

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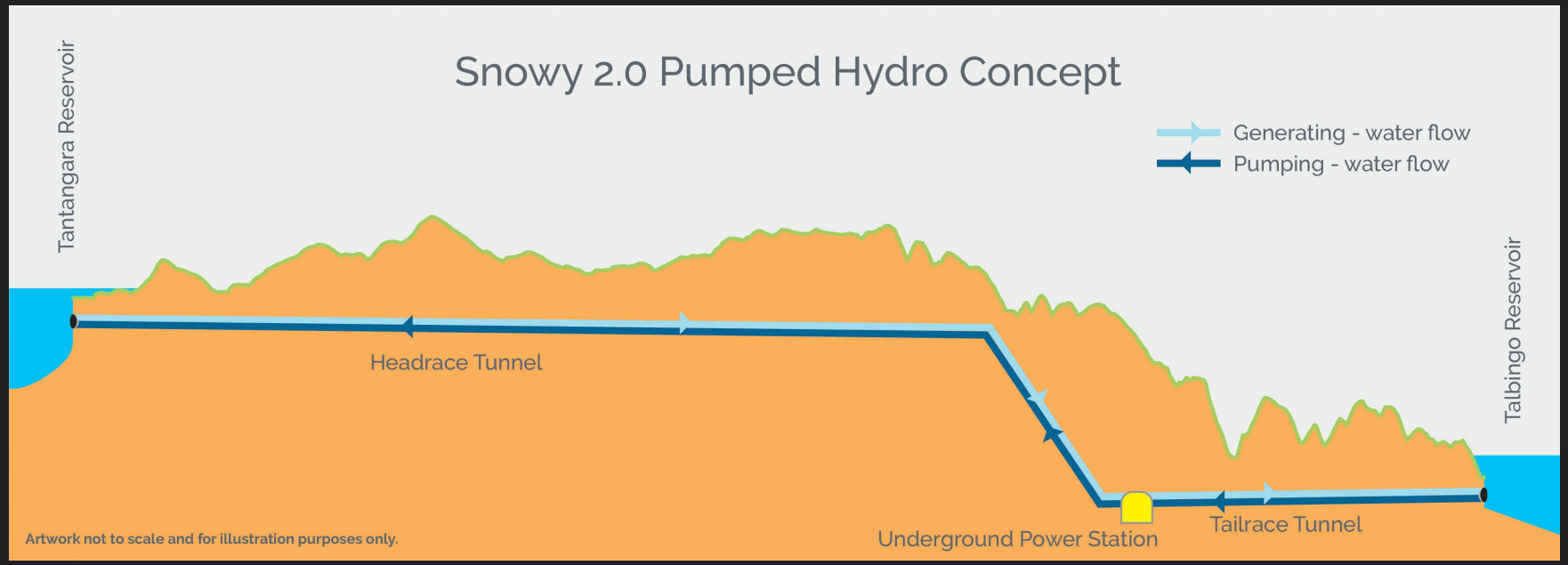
Retrofitting and Upgrading

1. Retrofitting existing Hydropower reservoirs



IFPSH – PSH Technologies

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2. Retrofitting PSH on open pit mine

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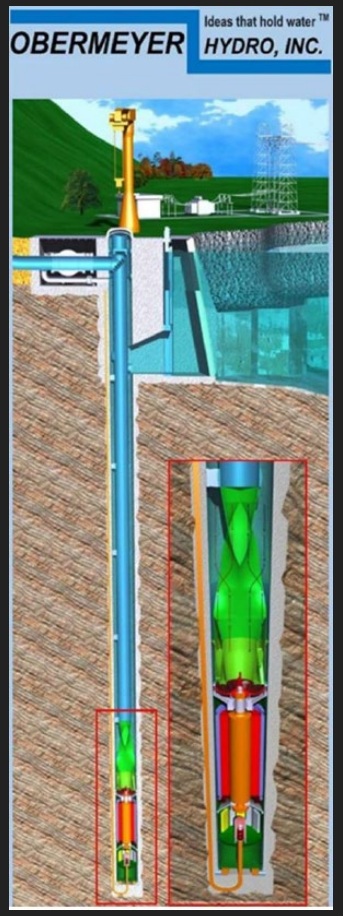

Retrofitting and Upgrading

1. Retrofitting existing Hydropower reservoirs
2. Retrofitting PSH on open pit mine
3. PSH utilizing underground mine
4. Double-fed Induction machines in hydraulic short-circuit operation
5. Hydraulic short-circuit at High Head PSH
6. PSH operating range extension
7. Obermeyer pump turbine

IFPSH – PSH Technologies

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Hybrid Systems

1. Hybrid PSH – Battery Storage
2. Hybrid renewable modular closed-loop scalable PSH
3. Integrated pumped hydro reverse osmosis clean energy system (IPHROCES)
4. Solar PV hybrids
5. Thermal PSH

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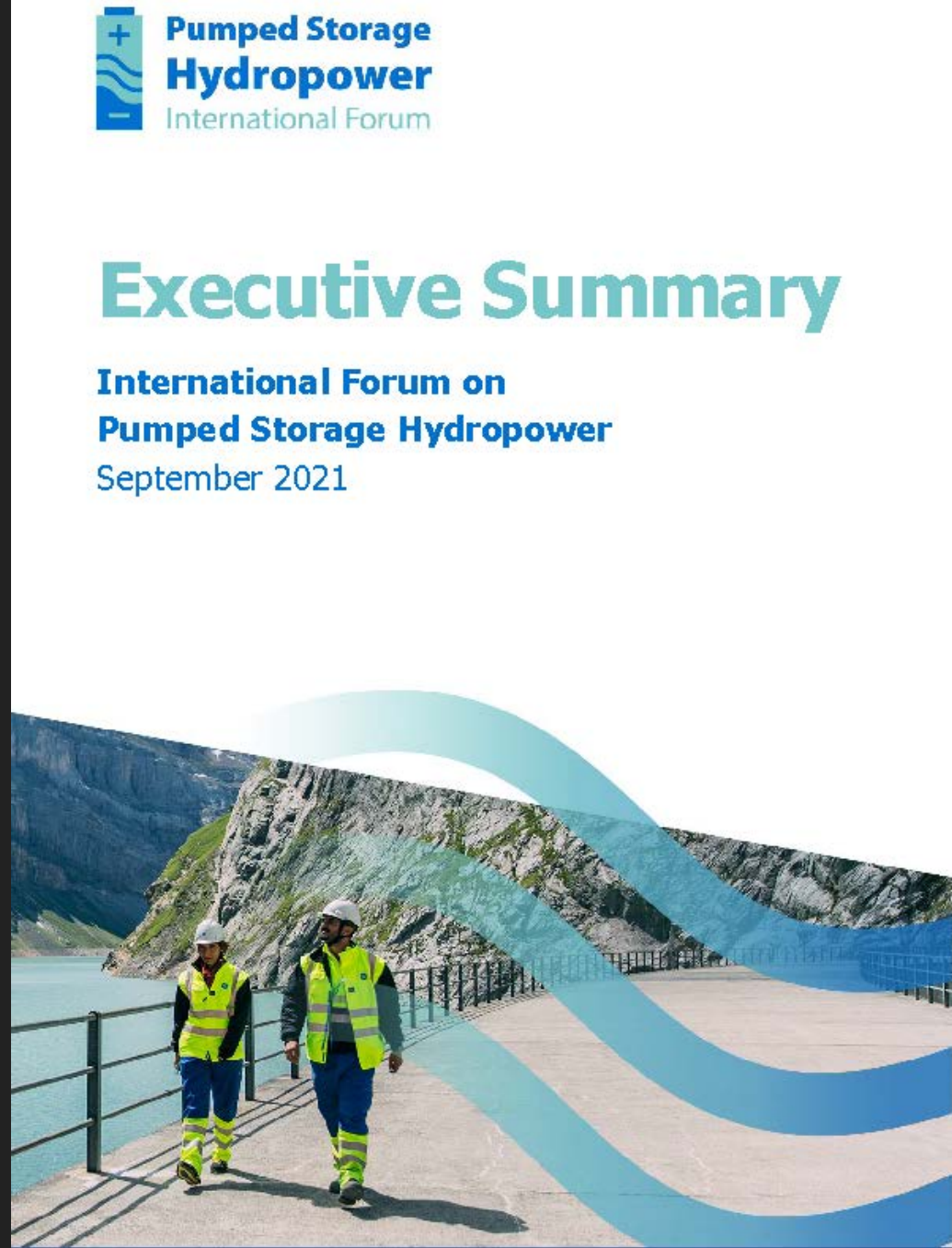
IFPSH Reports



Available to download at:

https://pumped-storage-forum.hydropower.org/resources/publications

Potential Retrofit PSH at an Open Mine Pit?

Thank-you

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