



4th Brussels Hydropower Day

Energy security and digitalisation in Europe's power system

8 SEPTEMBER 2026 | BIP Brussels



ORGANIZED BY



IN PARTNERSHIP WITH



H-HOPE



Joint White Paper on Hydro Digitalisation

08.09.2026

Ingo Ball



This project has received funding from the European Union's Horizon Europe research and innovation programme under grant agreement No. 101122167.



An interactive discussion

- Mission: Deliver a White Paper for iAMP-Hydro
- Do that together with other colleagues, initiatives > Joint White Paper on Hydro Digitalisation
- Today at 4th Hydropower Day > your chance to contribute



Intended scope – key words/topics to be addressed

- **Introduction**
- **Short description of hydro services** with focus on digitalisation
- **Overview of best practices in the field (real world experiences)**
- **Summary of what is possible today and where in our opinion the journey shall end**
- **Acknowledge the EU project funding besides the three “Digitalisation Sister Projects”**
- **Share outlook**
- **Conclusion**



Intended scope – some more details

- Introduction
- Short description of hydro services (flexibility), with focus on digitalisation
 - ETIP Hydro WG1
 - ETIP SNET White Paper "Flexibility as a Service (FaaS)"
 - COST Action PEN@Hydropower



Intended scope – some more details

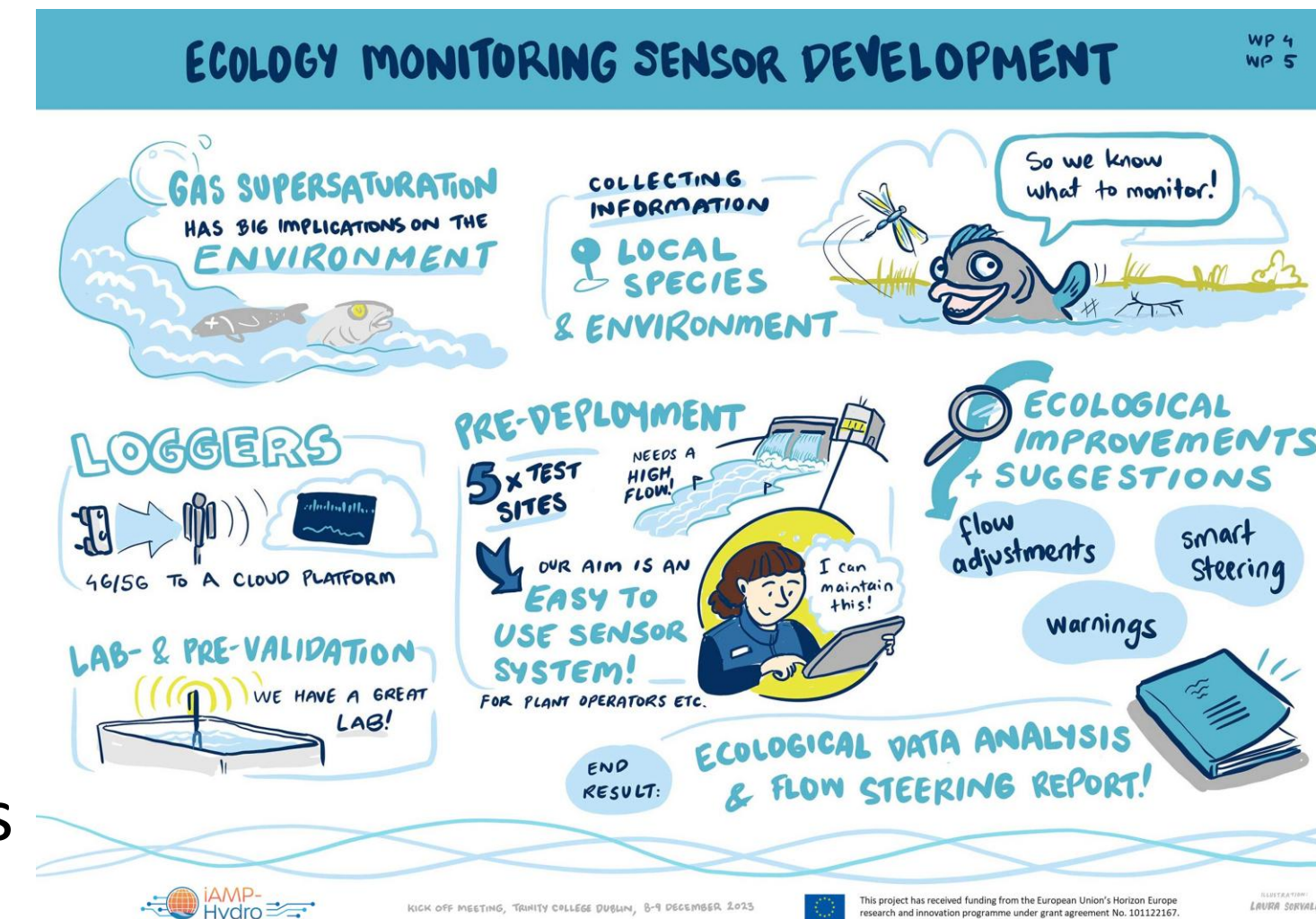
- **Overview of best practices in the field**

Examples from the real world:

- Axpo's Hydro 4.0 initiative in Switzerland
- D-HYDROFLEX, Di-Hydro & iAMP-Hydro proven examples
- ReHydro pilot Roldal – Suldal in Norway

- **Summary of what is possible today and where in our opinion the journey shall end**

- OEM (Original Equipment Manufacturers) offers
- Experienced limits
- Our wish for the future



Intended scope – some more details

- **Acknowledge the EU project funding besides the three “Digitalisation Sister Projects”**
 - ReHydro – Innovation Action
 - SE-Hydro, TIES project, HydroPulse – all Societal Readiness Pilots
- **Share outlook**
 - Horizon Europe – HORIZON-CL5-2027-02-D3-24:
Large-scale operational validation and upscaling of state-of-the-art generative AI tools and models powering a next-generation digital energy system
 - Horizon Europe – HORIZON-CL5-2027-07-D3-11:
Demonstration of hydropower technologies for efficient and forward-looking refurbishment of existing hydropower plants

Intended scope – some more details

- **Conclusion**

Short message is already clear now:

Europe needs a Digital Hydropower Infrastructure capable of simultaneously delivering energy security, flexibility, biodiversity protection, climate adaptation, and efficient water management.

Really Joint White Paper

Your chance to contribute:

If you think that there is something that urgently needs to be addressed in the White Paper, get in contact with us.

Email to: ingo.ball@wip-munich.de

Deadline for contribution: 15 September 2026



Thank you!

...and now let's learn about some
Lessons Learnt from Di-Hydro





Digital maintenance for sustainable and flexible
operation of HYDROpower plant

Shaping the Future of Intelligent Hydropower: Technology and Policy Needs

4th Brussels Hydropower Day - 8th September 2026

Alkiviadis Tromaras - CERTH



This project has received funding by the European Union's Horizon Europe research and innovation programme under Grant Agreement N° 101122311



Core digitisation technologies tested

Environmental & biodiversity monitoring

Examines technologies for continuous observation of water quality, microorganisms & conditions (holographic microscopy, integrated biosensors, biofouling prevention).

Digital twins & simulation technologies

Models reproducing hydrological, mechanical, electrical & control-system behavior supporting forecasting, plant-grid interaction, and scenario evaluation.

Predictive maintenance & health monitoring

Sensors, machine-learning models, and robotic systems to identify equipment degradation, inspect hard-to-access assets, and drive proactive decisions.

Forecasting, hydrology & optimisation

Tools predicting water inflow, organizing hydrological data, and guiding plant operations within efficient decision-support frameworks.

Cybersecurity, data exchange & IoT systems

Digital infrastructures ensuring safe, interoperable operations via context-aware IoT models, federated data architectures, and security protocols.

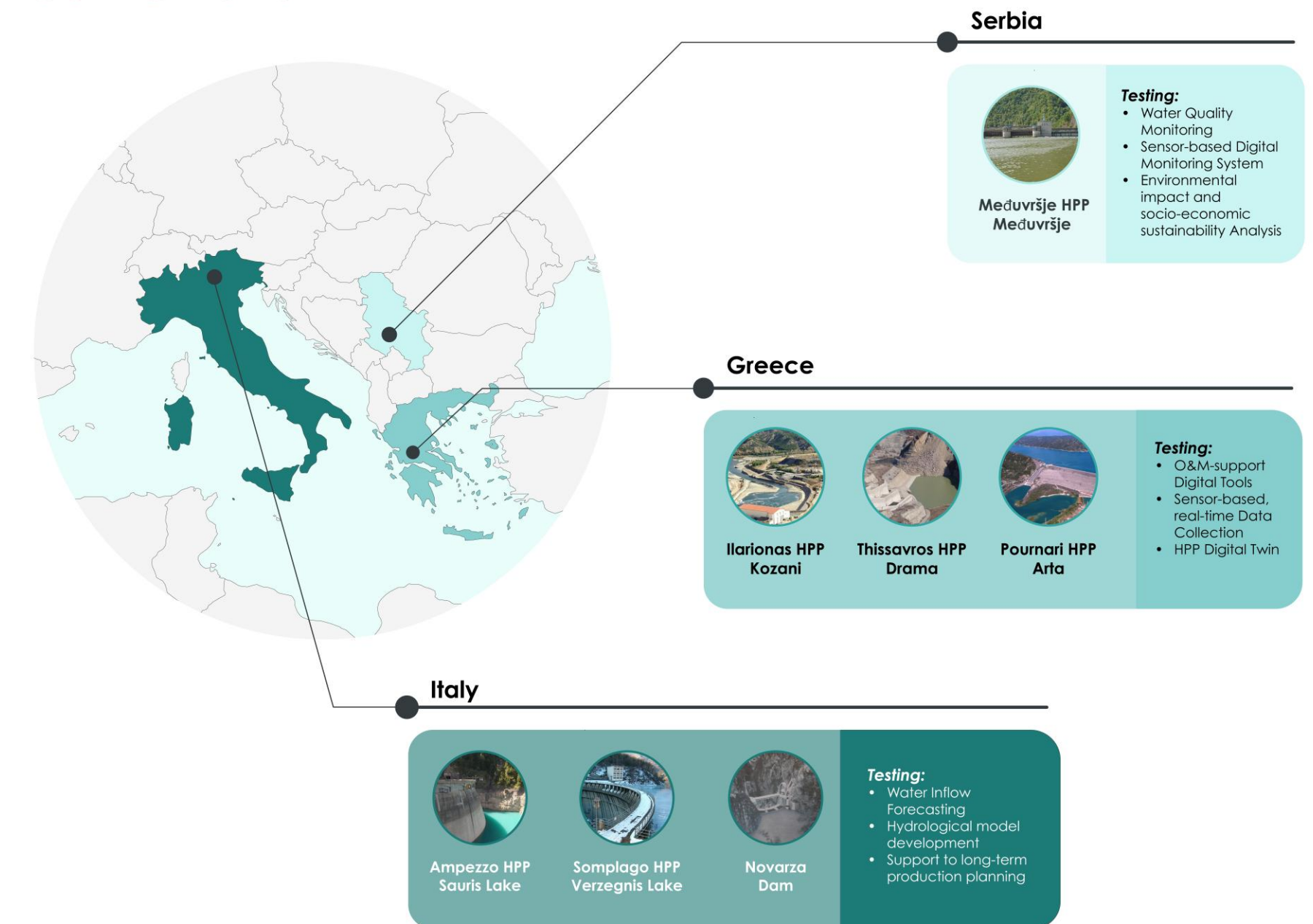
Advanced visualisation, AR & field innovations

Tools enhancing asset inspection and human-machine interaction featuring augmented reality applications for streamlined field operations.

Digitisation- from innovation to implementation

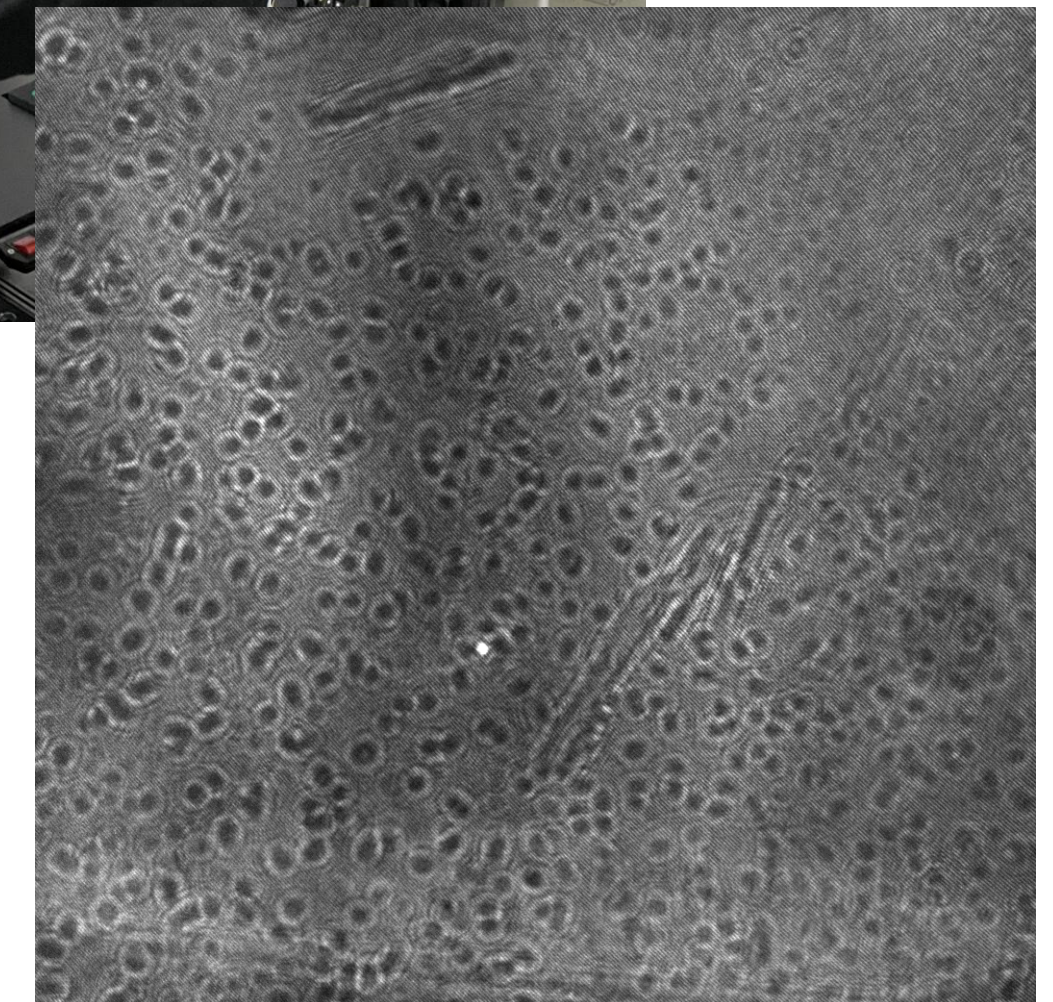
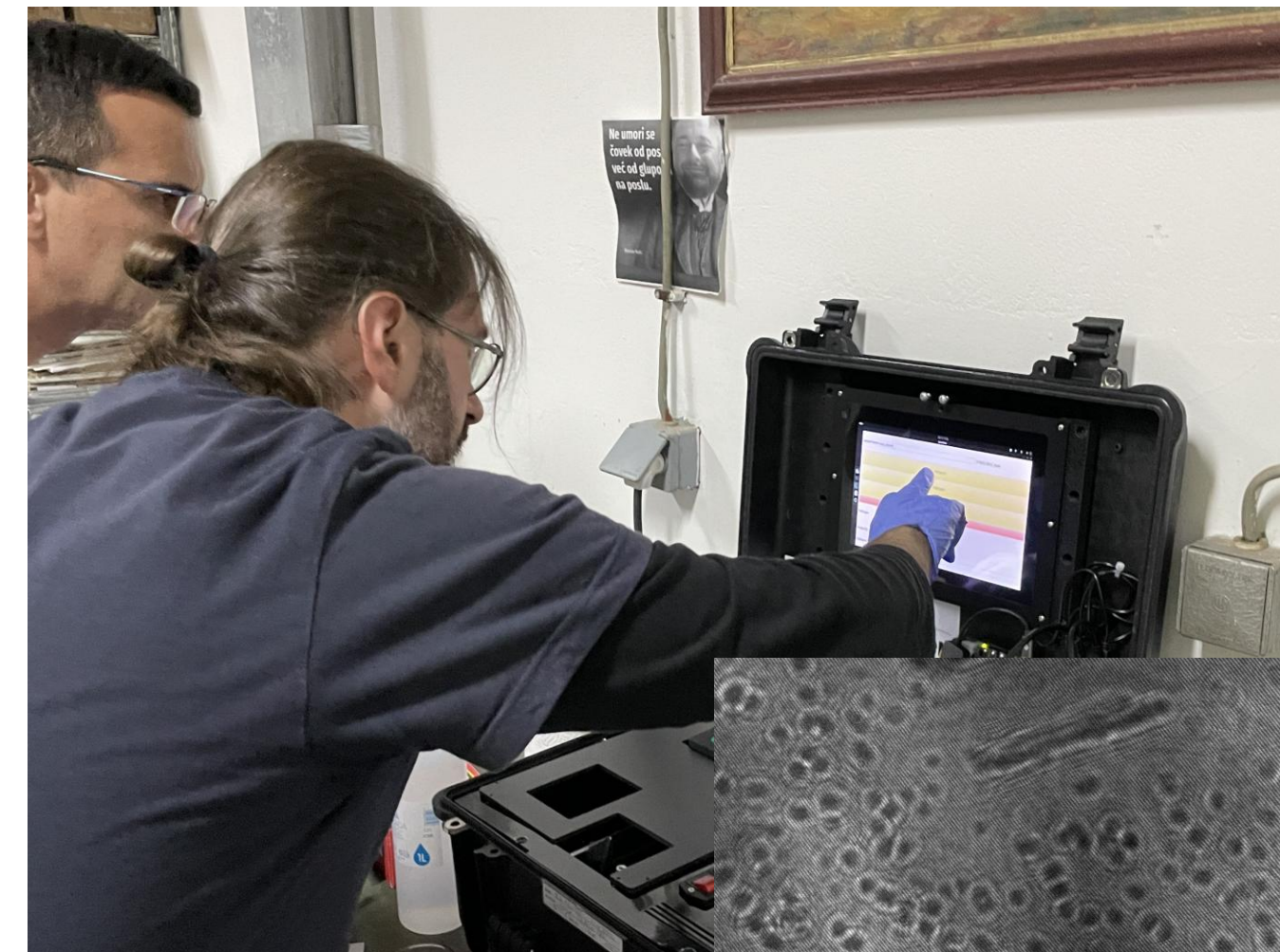
- During our project, we tested different digitisation technologies across **3 diverse Uses Cases**.
- 3 uses cases with different plants and different operational needs.
- One solution that fits all is rare. **Taylor-made solutions are required.**
- One common denominator across the implementation of technologies was **availability of data**.

USE CASES



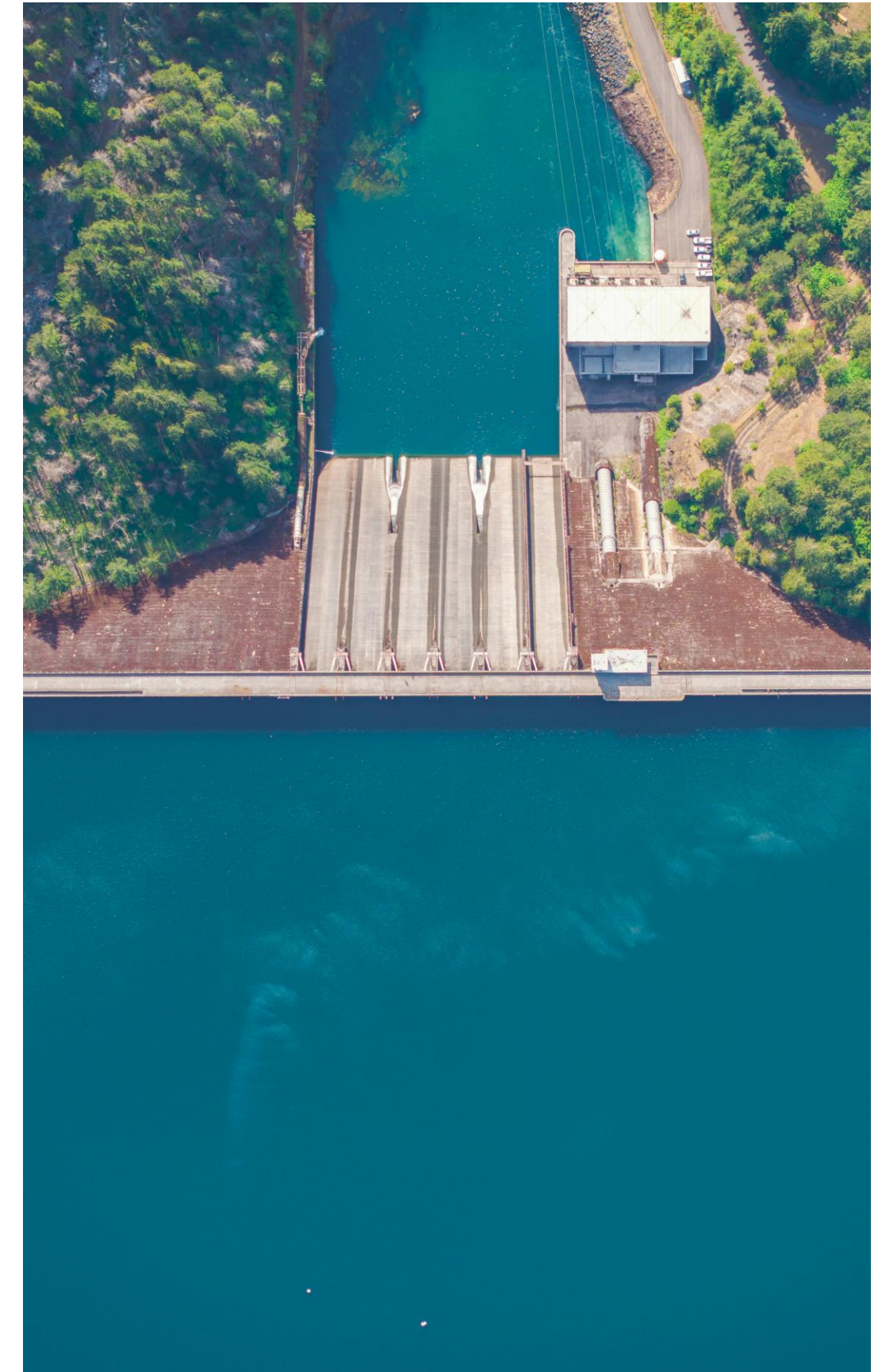
Lessons learnt- Environmental and biodiversity monitoring

- Environmental and biodiversity monitoring **increases awareness** of water quality, microorganisms, reservoir conditions, and biofouling risks.
- Real time monitoring and automated, portable sampling systems can **reduce the cost of sampling and the time of water analysis** from days to minutes.
- However, accuracy and reliability of the systems **require large amounts of data for ML training**
- Monitoring data can be then used to train models that can make correlations between HPP operation and water quality change



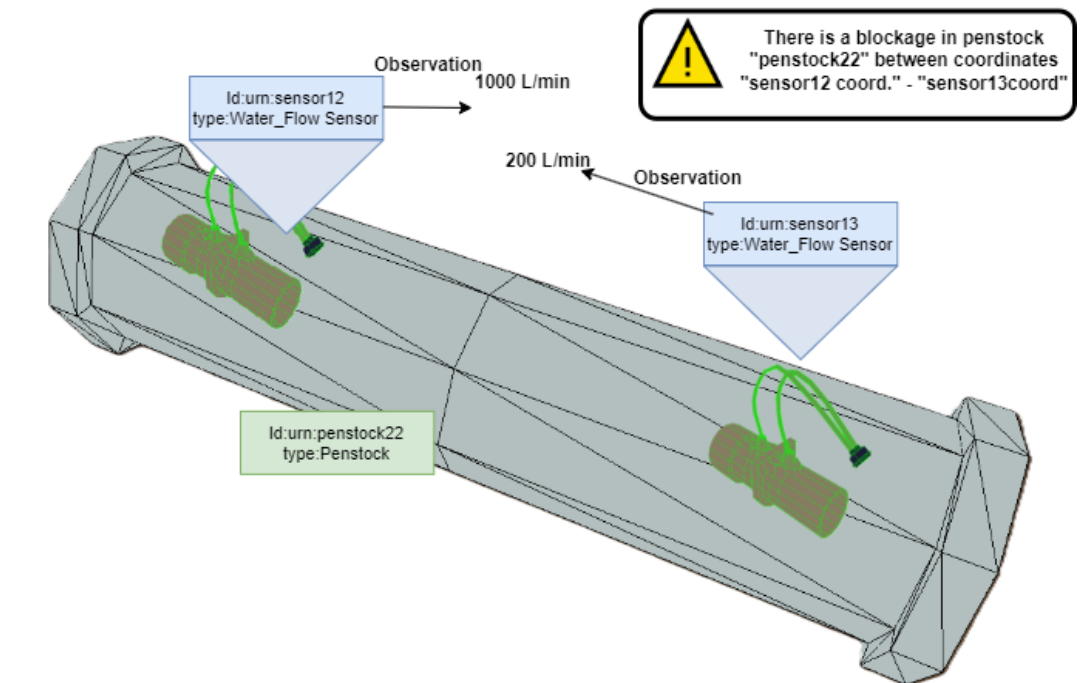
Lessons learnt-Hydrological and Forecasting Models

- Traditionally, hydropower operators have relied on approaches based on **historical data** (such as using the historical mean as a predictor) to anticipate water inflows.
- To overcome the limitations of backward looking data, a **physically-based hydrological modelling and forecasting operational service** has been deployed.
- Once again to develop such models it requires data:
 - by **combining meteorological data** (including ground station data and weather forecasts),
 - **snow cover satellite images**
 - **historical hydropower system data** (reservoir volumes and turbined flow timeseries)
- Inflow forecasts achieved an **average reduction of error of approximately 70%** (overall, considering all the monthly-issued forecasts) compared to the baseline historical mean predictor.
- HPP operators implementing inflow forecasting should **prioritise the deployment of physically-based hydrological models** combined with weather forecasts.

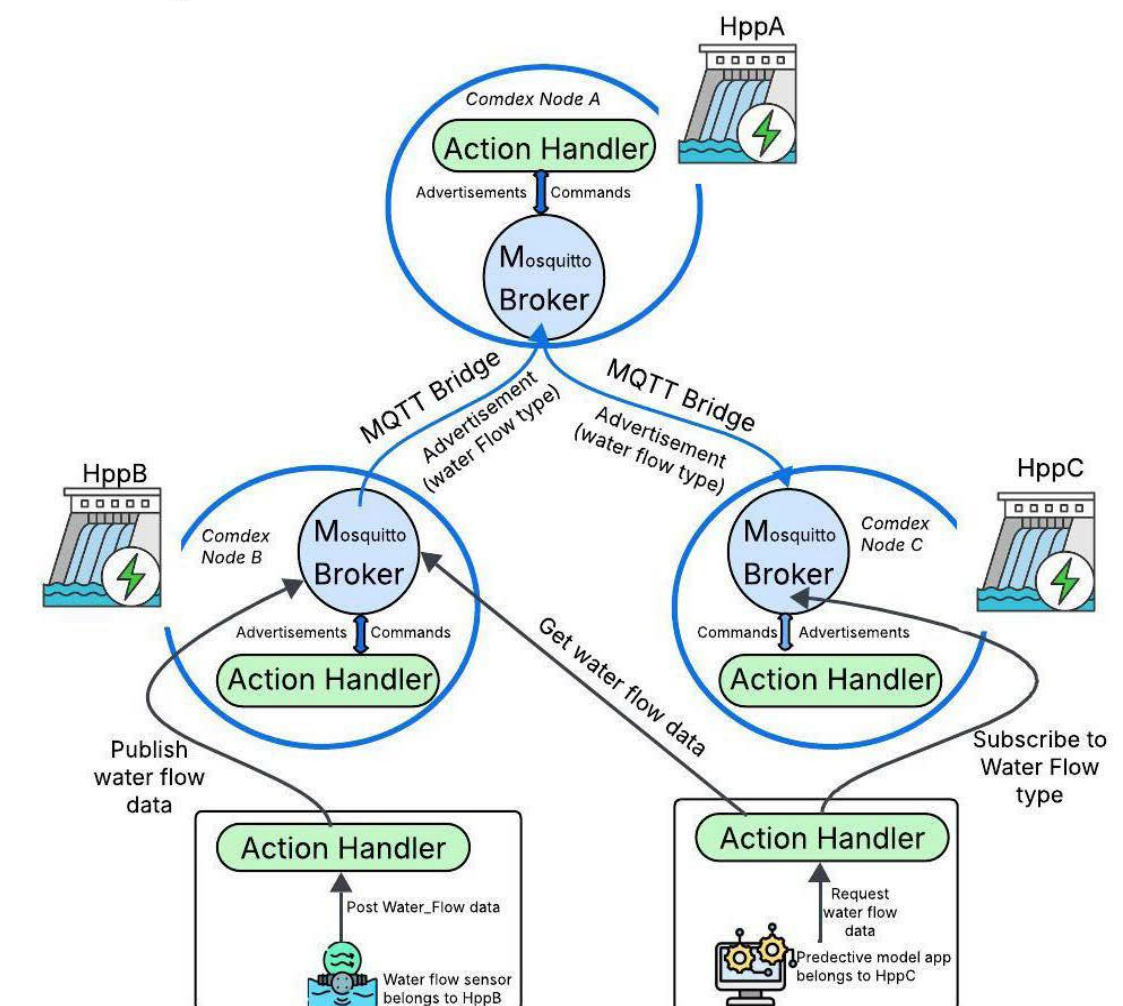


Lessons Learnt-Federated Data Exchange Architecture and data models

- Hydropower data integration relies heavily on proprietary silos or non-semantic formats, making it exceptionally **difficult to link physical infrastructure with modern digital tools**.
- NGSI-LD data models** were used specifically designed for the hydropower sector
- Instead of forcing all data into one centralised location, a **federated architecture** was developed, ensuring all sites speak the same “data language”, allowing systems to interact across a distributed network.
- Organisations wanting to replicate this architecture must **use standardised metadata and NGSI-LD models** from the start to ensure that the federated exchange remains **scalable** as more sites are added
- The greatest challenge is achieving a **balance where security is tight enough to stop threats but flexible enough not to disrupt critical, real-time operations**.



Federation of Comdex nodes



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Check out the
Di-Hydro Innovation Handbook,
featuring the main results from the
project!



Digital maintenance for sustainable and flexible
operation of HYDROpower plant

Thank you.

Dr. Alkiviadis Tromaras

Research Associate

CERTH

atromaras@certh.gr



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