

## Hydro4U

#### Demonstrating European small hydropower technology and methods in Central Asia

Bertalan Alapfy Project Coordinator TUM Chair of Hydraulic Engineering

**Daniel S. Hayes** Freshwater Ecologist BOKU University



#### **Overview**

#### **Project Type:** Innovation Action

**Consortium Partners:** 10 from Europe, 3 from Central Asia

#### Total Budget:

~ 11.5 Mio. € (EU Contribution ~ 9.9 Mio. €)

#### **Duration:**

June 2021 - May 2026



## **Objectives**

- Develop, demonstrate and assess two innovative European SHP technologies in CA
- Develop a GIS-based decision support system to enhance sustainable exploitation of SHP potentials
- Optimize the climate resilience of SHPs by including climate change scenario analysis
- Develop a scalable Water Accounting System to share energy and agriculture benefits in a climatesensitive manner under the Water-Food-Energy-Climate Nexus context
- Support the competitiveness and market uptake of European SHP technologies and planning & assessment methods in CA
- Enhance problem awareness and objectiveness of policy makers, implementers, NGOs and the public



#### Technologies: Shaft Power Plant

#### Application Range:

Modular low-head run-of-river power system with fish-friendly intake

#### Net Head:

2 - 12 m

Discharge (per module):

 $1.5 - 20 \text{ m}^3/\text{s}$ 

Power output (per module):

20 kW - 2 MW



#### **Technologies: Francis Container**

#### Application Range:

Standardised and modular medium head power solution installed in a standard container

#### Net Head Range:

30 - 130 m

Discharge Range (per module):

 $0.2 - 2.0 \text{ m}^3/\text{s}$ 

Power Output Range (per module):

100 kW – 1 MW



# Tools & Methods: Electrofishing and Radiotelemetry





### **Tools & Methods: Drone Surveys**





# Tools & Methods: Climate Change Impact on Hydrology





- Existing Dam for Irrigation Diversion in need of refurbishment
- 3 gates, suitable for downstream integration of 2 Shaft Power Modules
  - H ~ 7-8 m
  - Q ~ 18 m<sup>3</sup>/s
  - P ~ 1.2 MW
- AEY ~ 6 GWh



2 HPP Modules New Fish Ladder New Stilling Basin Support Walls Optimized Pier Caps















#### **Demo Site – Shakimardan**

- Local Partner: Uzbekgidroenergo (UGE)
- Existing infrastructure (Intake, Penstock) to be combined with new Francis Container solution and ecological facilities.
- Social project, power plant will be able to supply the enclave in Island Operation to enhance development of the area.
- H ~ 85 m
- Q ~ 3 m<sup>3</sup>/s
- P ~ 2 MW
- AEY ~ 14 GWh





#### **Demo Site – Shakimardan**

- Intake and Penstock have been built during Soviet era, but have never been finished.
- Optimal location to demonstrate the Francis Container Soluiton (FCS) within the Hydro4U project, as several years of construction time could be saved.
- H4U team to ensure coherence with European sustainability standards:
  - Development of a seasonal ecological flow release plan for the diverted stretch
  - Construction of a fish ladder at the intake
  - Construction of a guiding rack with a downstream bypass that ensures no fish & sediment get into the penstock
  - Construction of a second fish ladder at an artificial waterfall in the diverted reach to ensure passability



#### Demo Site – Shakimardan, FCS Technical Design





#### **Demo Site – Shakimardan, Assembly Pictures**



#### **Demo Site – Shakimardan, Construction Pictures**







## **Ecological surveys**

• Fundamental and applied knowledge needed











## **Ecological surveys**

- Distribution and ecology of target fish species
- Key questions related to:
  - Snow trout habitats  $\rightarrow$  e-flows
  - Snow trout migration patterns  $\rightarrow$  passability
- Pre-HP & Post-HP sustainability assessments





#### **Capacity building**



Fotos: Daniel S. Hayes (2), Matthias Schneider (1), Tobias Hägele (1)



#### Fish habitats & e-flows determination

- Snow trout habitat preferences
- Fuzzy sets and rules
- Open-access data set available on Zenodo:

https://doi.org/10.5281/zenodo.14887129







#### Fish movements and habitat use

- Fine-scale spatio-temporal individual movement
  - Seasonal migration behavior (>1 year of tracking)
  - Habitat use assessment (Qfield App) through in-field triangulation



Tracking



#### Fotos: EV-INBO







Tagging







# Establishment of a web-based application for decision support

- Interactive tool
  - Spatial information: existing dams, transmission network, ecology, land use, ...







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  - River network information: discharge, head, kW/m, kWh/m, sediment transport, ...
  - Various combined filtering options







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  - Spatial information: existing dams, transmission network, ecology, land use, ...
  - River network information: discharge, head, kW/m, kWh/m, sediment transport, ...
  - Various combined filtering options
  - Spatial operations





The project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101022905.

# Decision support system Story Map Interactive Tool Interactive Tool Interactive Tool Image: Communicate relevant region- specific project results Site-specific assessment

Screenshot: Jan De Kevs



Home Conference Aims Highlights Program Call for Abstracts Key Dates Speakers Ticketing Contact



**3rd International Conference on** 

# Sustainability in Hydropower

2–5 September 2025 BOKU University Vienna, Austria

Solutions for Global Sustainability in Hydropower – Balancing Water Use, Ecology, and Community Benefits



https://sushp2025.boku.ac.at/



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# Thank you for your attention!

Contact:

Bertalan Alapfy, Project Coordinator

bertalan.alapfy@tum.de

Daniel S. Hayes daniel.hayes@boku.ac.at

#### https://sushp2025.boku.ac.at/





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Hydro4U Youtube

Website: <u>hydro4u.eu</u>

