

The European Union – Uzbekistan: Sustainable Energy Days 2024

Workshop: Unlocking EU-CA Research Cooperation under Horizon Europe
Tashkent, 21 November 2024

Success story:

Hydro4U- Sustainable small-scale hydropower in Central Asia Project funded by Horizon 2020

Prof., Dr. Bakhtiyor Karimov

“Tashkent Institute of Irrigation and Agricultural Mechanization Engineers”
National Research University

Development history of “Hydro4U- Sustainable small-scale hydropower in Central Asia” Project funded by Horizon 2020

Horizon 2020 - Research and Innovation Framework Programme;

Call: H2020-LC-SC3-2018-2019-2020 (BUILDING A LOW-CARBON, CLIMATE RESILIENT FUTURE: SECURE, CLEAN AND EFFICIENT ENERGY)

Type of action: Innovation actions.

Proposal title: Hydropower For You (Hydro4U)

Preparation of project proposal as started in early 2020.

Evaluation Summary Report:

Total score: 14.50 (Threshold: 10; Maximum: 15);

Criterion 1 – Excellence: Score: 5.00

Criterion 2 – Impact: Score: 5.00

**Criterion 3 - Quality and efficiency of the implementation: Score: 4.50
Score: 4.50**



Overview

Project Type:
Innovation Action

Consortium Partners:
10 from Europe, 3 from Central Asia

Total Budget:
~ 11.5 Mio. € (EU Contribution ~ 9.95 Mio. €)

Duration:
June 2021 – May 2026



Objectives

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

Impact

All in all, Hydro4U will contribute to the following impacts:

- Support the competitiveness of the European hydropower technology sector as a responsible actor in global markets in the long-term
- Promote the overall sustainability of the provided hydropower solutions within the Water-Food-Energy-Climate nexus in Central Asia
- Strengthen the worldwide leadership of the European hydropower industry in providing innovative and sustainable hydropower solutions
- Support international cooperation with developing countries to reach together the UN Sustainable Development Goals
- Increase energy security in remote areas
- Reduce carbon emissions
- Elaborate new standards that are both cost-efficient and sustainable
- Enhance the international cooperation with developing countries in terms of (scientific) knowledge exchange and technology support

Project Structure

WP1

Analysis of unexploited small hydropower potential

WP2

Engineering:

Potential Calculation

Natural Sciences

Hydrology & Climate Change
Morphology and Ecology

Socio-Economics:

Water-Energy-Food-Climate-Nexus

WP3 Development and Implementation of Innovative & sustainable SHP technology and methods

WP4

Technology Development

Two technologies for low and for
medium-head

Planning: Holistic approach including
technical, economic, ecological and social
aspects

Assessment: of performed
methods and
implemented technologies

WP5

Replication, Dissemination & Exploitation

WP6

Replication: Feasibility studies for
further project development
Guidance and Decision Support

Dissemination

Communication of results
Capacity Building

Exploitation: Support

commercialisation of developed
technologies and methods

Project Overview

Modular solution

The Hydro4U project will adapt European technologies to Central Asia, demonstrating viability in a forward-looking cross-border water-food-energy-climate nexus. Price competitiveness will be assured through design alterations based on a prior analysis of unexploited sustainable small-scale hydropower potential in Central Asia. Hydro4U will install and assess two demo plants: an eco-friendly low-head run-of-river plant and a medium-head plant, both with radically reduced planning and construction costs that do not compromise efficiency. These solutions will be fit-for-purpose based on innovation, and modularization, meaning a radically simplified structural concept, with longevity, eco-compatibility, and socio-political acceptance.

Replication in Central Asia

A replication model will be developed to address all small-scale hydropower potential in Central Asia. This will demonstrate EU quality standards and create entry points in developing markets for the entire European small-scale hydropower industry. This will be supported by a Web-based Decision Support System for sustainable exploitation of the hidden small hydropower potential in Central Asia to generate impact beyond the project.

Target Group

Hydro4U brings together industry, politics, science, and stakeholders from both Central Asia and the European Union to contribute to a sustainable and climate-resilient future for the region by demonstrating European small hydropower equipment and technologies. Close cooperation with hydropower actors and investors from both regions are an essential part of Hydro4U.

Technologies: Shaft Power Plant

Application Range:

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

Net Head:

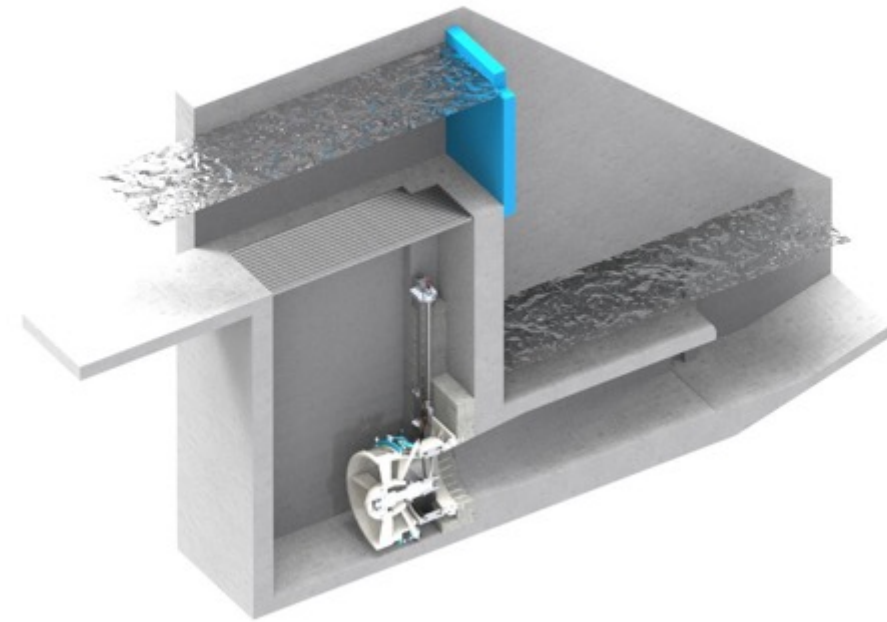
2 - 12 m

Discharge (per module):

1.5 – 20 m³/s

Power output (per module):

20 kW – 2 MW



Technologies: Francis Container

Application Range:

Standardised and modular medium head power solution

Net Head:

30 - 130 m

Discharge (per module):

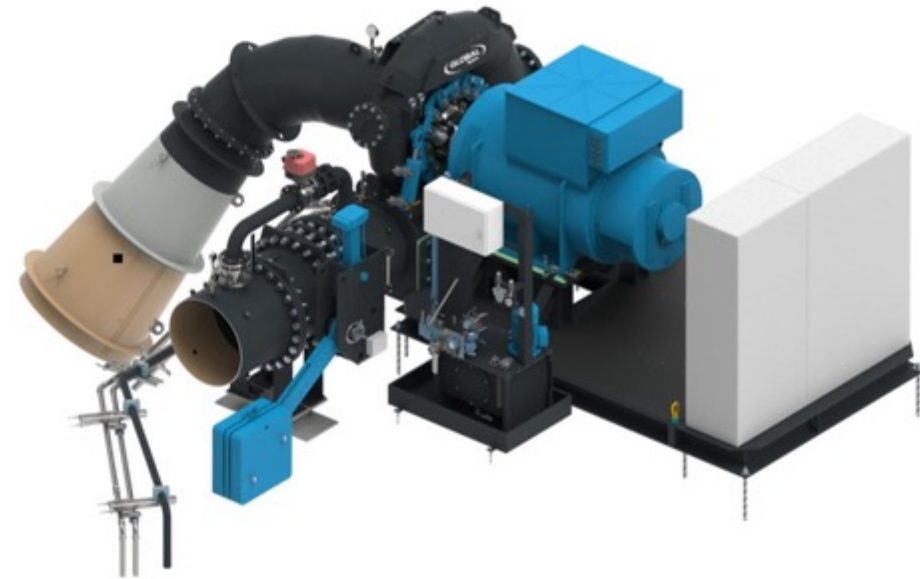
0.2 – 2.4 m³/s

Power output (per module):

100 kW – 1 MW

Annual Energy Generation: 14000MWh

People supplied with electricity: 8500



Tools & Methods: Electrofishing and Radiotelemetry

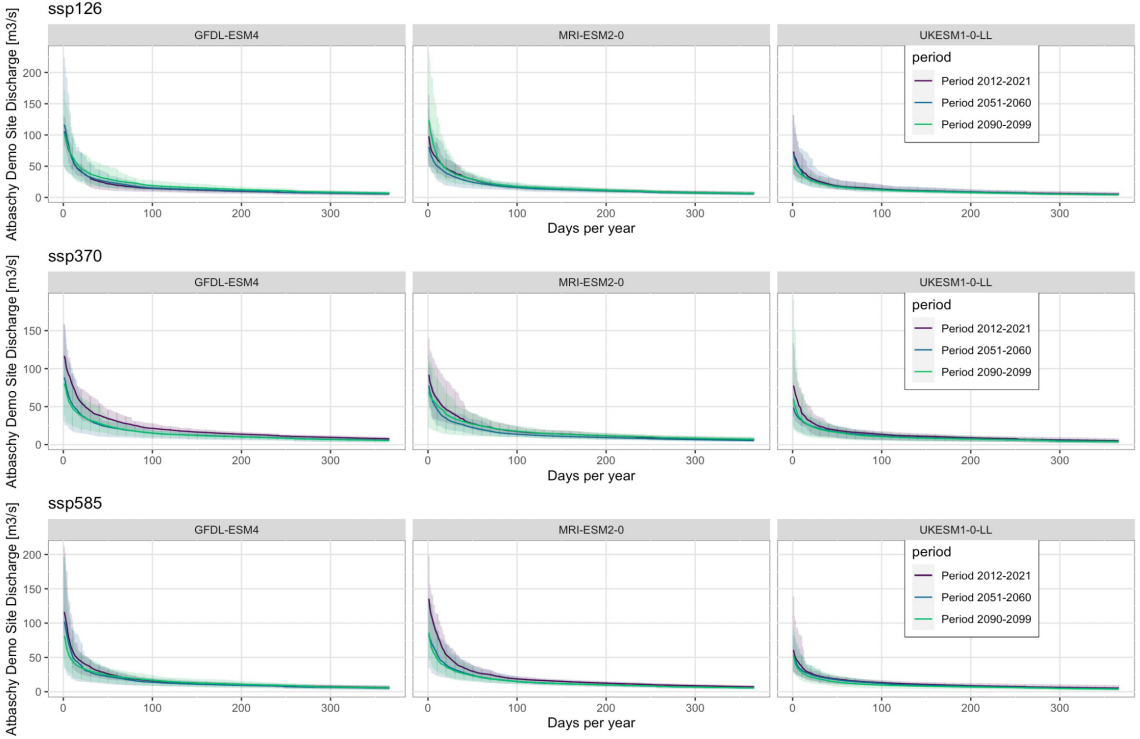
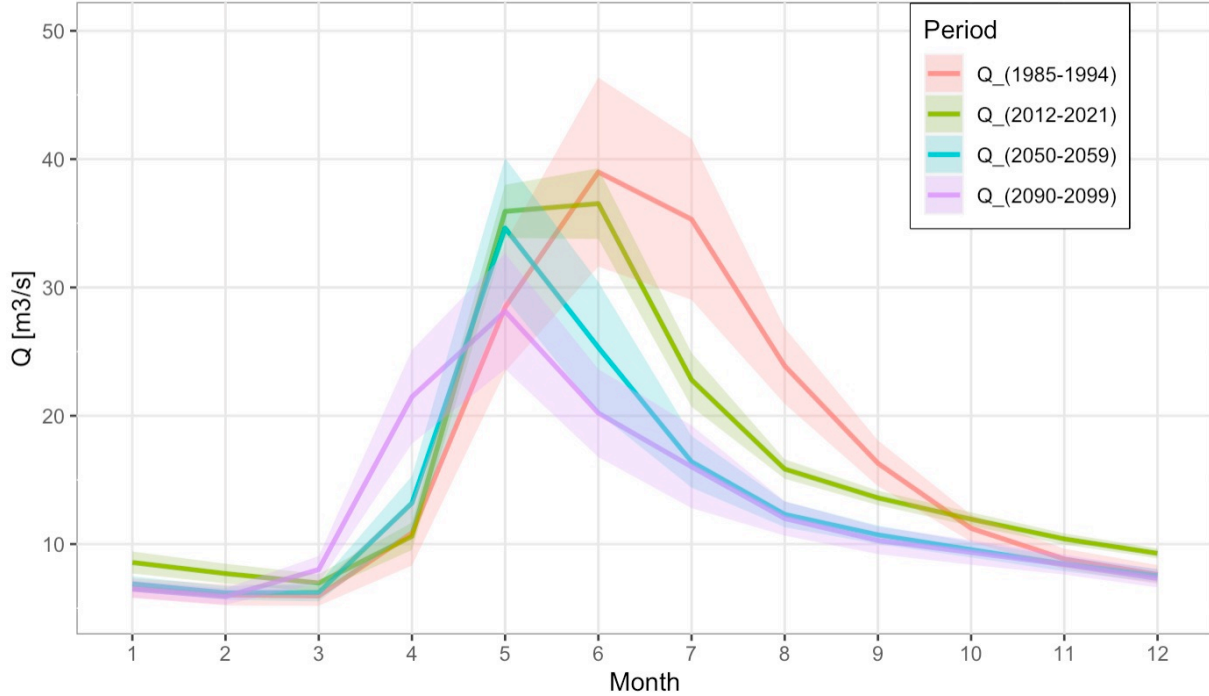


Tools & Methods: Drone Surveys



Tools & Methods: Climate Change Impact on Hydrology

GCM ensemble mean Q, Scenario ssp585





DEMO SITE – SHAKIMARDAN, UZBEKISTAN



DEMO SITE – SHAKIMARDAN, UZBEKISTAN



Funded by
the European Union

HYDRO4U

Sustainable Small-Scale
Hydropower in Central Asia

Проект Hydro4U предоставляет европейские гидроэнергетические технологии в Центральной Азии. Оборудование для малой гидроэнергетики для различных областей применения было разработано на основе инноваций, стандартизации и модульности. Реализация осуществляется экономически, экологически и социально совместимым способом на основе экологических и социальных исследований, чтобы обеспечить обратное влияние. Демонстрационные проекты проводятся в Узбекистане и Кыргызской Республике.

Periodicity of project: 06/2021 – 05/2026
 Grant of the European Union: 9,311,160 EUR
 Contact: Hydro4U: coordination@hydro4u.eu
 Website: www.hydro4u.eu

Демонстрационная площадка: Шахимардан, река Коксу

Технология: Концепция электростанции Фрэнсис содержит две турбины в преулучшенных адаптированных контейнерах, которые адаптированы к условиям объекта. Инновационное решение этой проблемы для электростанции среднего масштаба было разработано посредством технологии Франсис от Global Hydro Energy GmbH.

Операторы и владельцы объекта являются компаниями UGE.



The Hydro4U project brings European hydropower technologies to Central Asia. Small hydropower equipment for different application ranges have been developed based on innovation, standardisation and modularity. Their implementation is done in an economical, ecologically and socially compatible way based on environmental and social studies to ensure public acceptance. Demonstration sites are located in Uzbekistan and the Kyrgyz Republic.

Duration of project: 06/2021 – 05/2026
 Grant of the European Union: 9,311,160 EUR
 Contact: Hydro4U: coordination@hydro4u.eu
 Website: www.hydro4u.eu

Demonstration site: Shakimardan, Koksu River

The technology: The Francis Container Power Solution contains two turbines in prefabricated containers which are adapted to the conditions of the site. The innovative concept of this medium head power solution has been developed by the technology provider: Global Hydro Energy GmbH.

The operator and owner of the facility is UGE.



В консорциум входят 13 партнеров из 8 стран:



The consortium consists of 13 partners from 8 countries



Защита окружающей среды Fish protection

Исследования Hydro4U показали, что в реке Коксу обитают две вида рыб: караска и лещ. В частности, лещ (Diplodus holbrooki) является важным экологическим компонентом для экосистем Центральной Азии. Старинный гидроэнергетический проект Hydro4U должен защитить рыб, сохранив их среду обитания и обеспечить выживание.

Hydro4U studies showed that the Koksu River is inhabited by two fish species: silver bream and larch. Particularly, silver bream (Diplodus holbrooki) is a species of ecological importance for the highlands of Central Asia. Therefore, new find requires appropriate protection measures, safeguarding habitat connectivity and water quality. All aspects have been realized in this state-of-the-art hydropower project.

- Защитная решетка и байпас позволяют рыбе проходить вниз по течению 2, 3
- Рыбоход 1 на водозаборе позволяет рыбе подниматься вверх по течению 1
- Рыбоход 2 на водопаде восстанавливает проницаемость реки вверх и вниз по течению для рыбы и других организмов 4
- Сезонно регулируемый экологический полуск обеспечивает среду обитания в участке реки с повышенной разницей 5
- Tray/fish rack and bypass allow fish to pass downstream 2, 3
- Fish pass 1 at the intake allows fish to pass upstream 1
- Fish pass 2 at the waterfall connects river habitats for fish and other organisms 4
- Seasonally adjusted residual flow allows fish to find habitats and migrate within the river 5

Технические характеристики Technical characteristics

Турбинный модель МТЭС 10 runnerplant model

Head: 81.4 m Net head
 Power: 2 x 1.6 m/s Rated discharge
 Capacity: 2 x 1152 kW Capacity
 Turbine generator power: 54,000 kWh Annual energy generation
 Number of head, electrical generator: 8000 People supplied with electricity

- Решетка предотвращает попадание рыбы и инородных предметов на речные наносы 3
- Вода подводится к электростанции через скважин (стальной малорный трубопровод) диаметром 1.2 м и длиной 2.7 м 8
- Энергия воды преобразуется двумя параллельными турбинами Франсиса в электричество с помощью генераторов 9
- Tray/fish rack protects fish from entering turbines and equipment from sediments 3
- The water is diverted from the intake to the powerhouse through the welded steel penstock with a diameter of 1.2 m and a length of 2.7 m 8
- Energy of water is converted to electricity by two horizontal Francis turbines coupled with synchronous generators 9

The Francis Container Power Solution is part of a project that has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101022895

DEMO SITE – SHAKIMARDAN UZBEKISTAN

DEMO SITE – SHAKIMARDAN, UZBEKISTAN

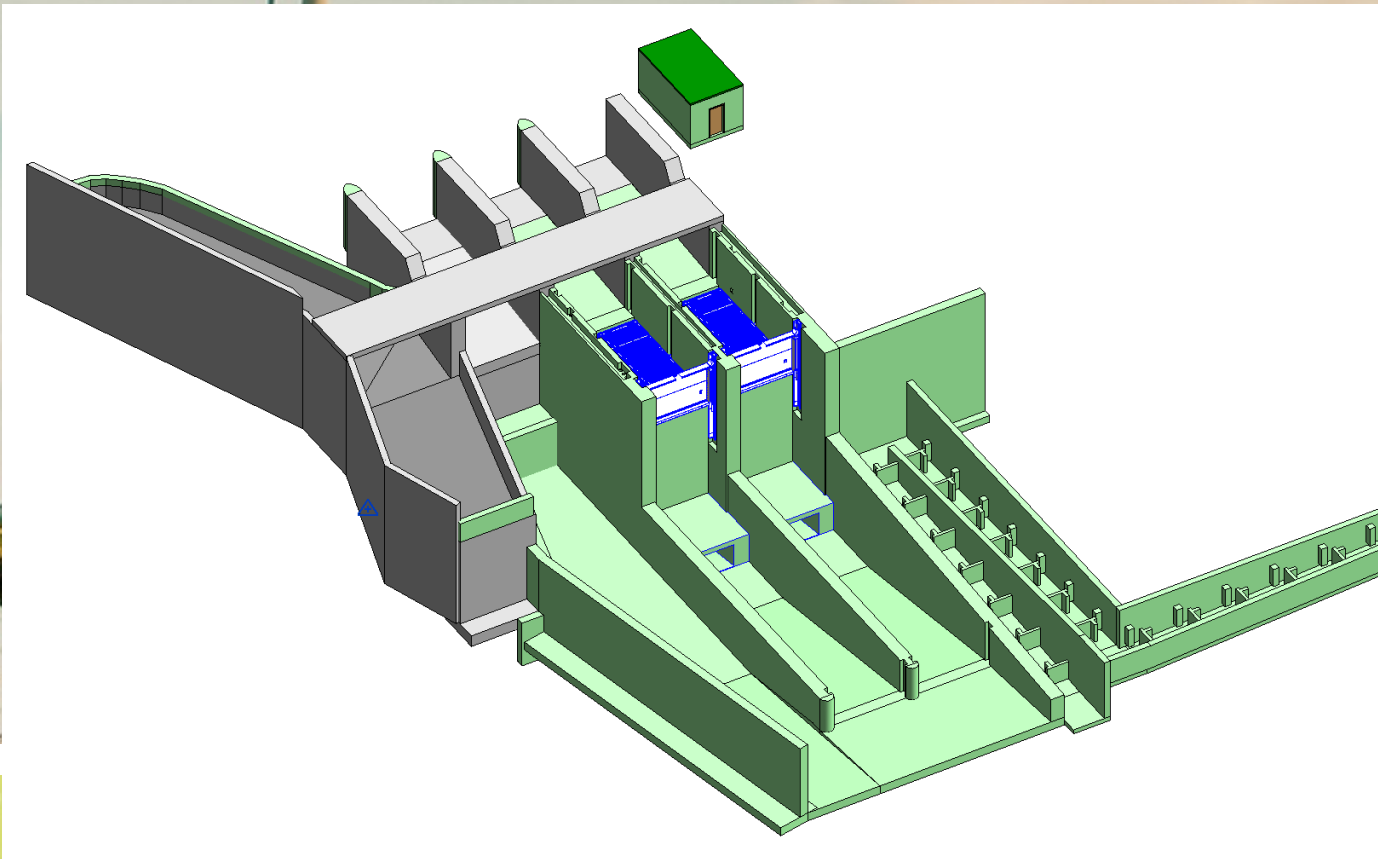
- Existing infrastructure (Intake, Penstock) to be combined with new Francis Container solution
- Social project, power plant will be able to supply the enclave in Island Operation to enhance development of the area
- $H \sim 85 \text{ m}$
- $Q \sim 3 \text{ m}^3/\text{s}$
- $P \sim 2 \text{ MW}$



- 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 m³/s
- P ~ 1.2 MW



DEMO SITE – AT-BASHI, KYRGYZSTAN



DEMO SITE – AT-BASHI, KYRGYZSTAN



DEMO SITE – AT-BASHI, KYRGYZSTAN

OUTLOOK:

FCPS – Commissioning of the HPP in November 2024

- HSPS – Construction works are ongoing, and commissioning is planned for summer 2025
- 3 further bankable feasibility studies for similar-sized projects to be elaborated until 2025 (for subsequent commercial implementation)
- Guidelines and best practices for small hydropower development will be elaborated (replication tool)
- Target: Familiarizing Central Asian Stakeholders with the possibilities of innovative hydropower solutions from Europe → development of partnerships and new, commercial projects



HYDR 4U

Sustainable Small-Scale
Hydropower in Central Asia



THANK YOU VERY MUCH FOR YOUR ATTENTION

Prof., Dr. Bakhtiyor Karimov

**TIIAME National Research
University, Department of
“Ecology and water resources
management”**

E-mail:

bkarimov1960@gmail.com

