LIFE NEXUS Seminar

First European inventory of Micro-hydroenergy recovery potential in the water industry

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LIFE NEXUS overview

LIFE NEXUS aims to promote the **clean energy transition** in the **urban water cycle** by recovering the **untapped energy** *(pressure or flow)* in existing water networks exploring the potential of **small hydropower** to produce "**green electricity**".

Funding

- **Total funding**: 1.158.188 €
- **EC Contribution**: 677.720 €

Dates

- **Start:** 01/10/2018
- **End**: 31/12/2023
- **Duration**: 63 months

LIFE NEXUS consortium

Coordinator

CARTIF — *Spain*
Technology Centre

Partners

IMP PAN — *Poland*
RTO

Aguas de León — *Spain*
Water utility

Vytautas Magnus University — *Lithuania*
RTO

AQUATEC — *Spain*
SME

…What if urban water networks could become a source of renewable energy?

Urban water cycle: pressures

Demographic changes, economic development, international trade

Hydrological planning policies

Pressures/causes

Climate change: floods

Climate change: droughts, heat waves

Water infrastructure age

Urban **Water** cycle

Increase **energy** consumption and operative costs

Increase water demand

Overexploited aquifers, loss of quality, deterioration of ecosystems, conflicts

Impacts/effects

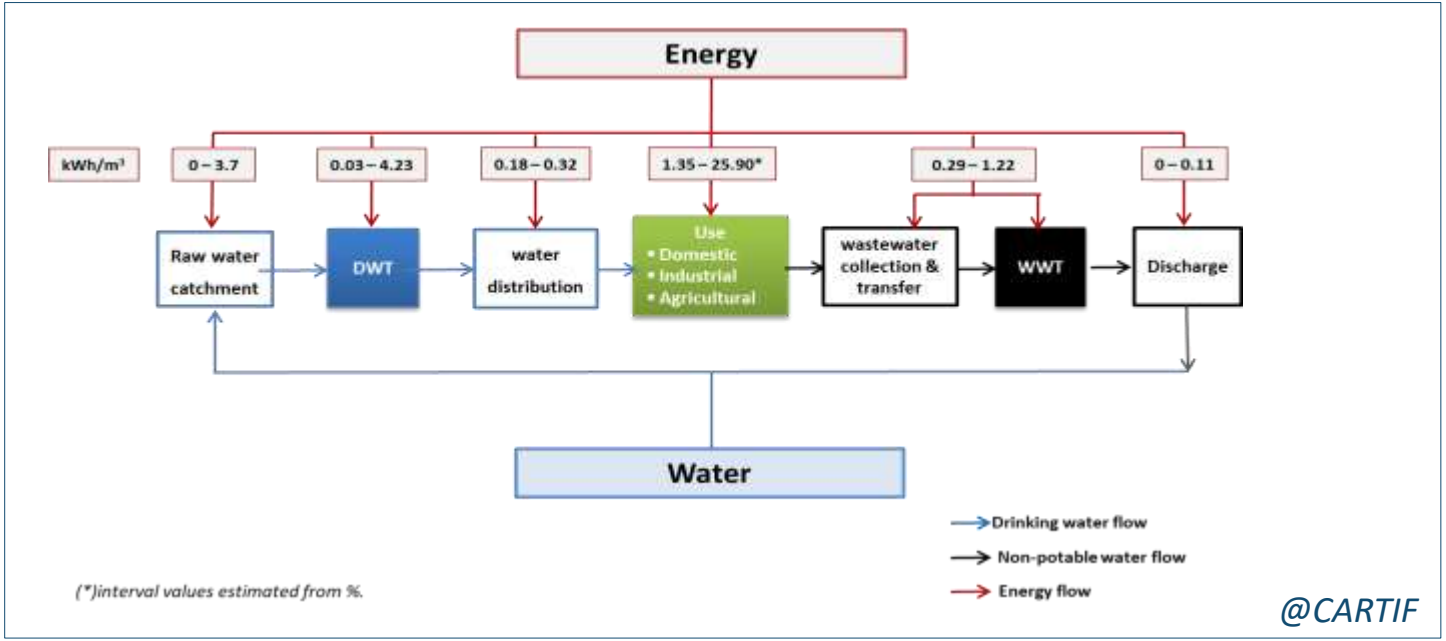
Sewer overflow, sea level rise, coastal erosion, interruptions of water/energy supply

Water scarcity

Increase water leakages

Urban water cycle: water-energy nexus

Urban water strategies: energy use rarely mentioned and limited analyses of the energy implications



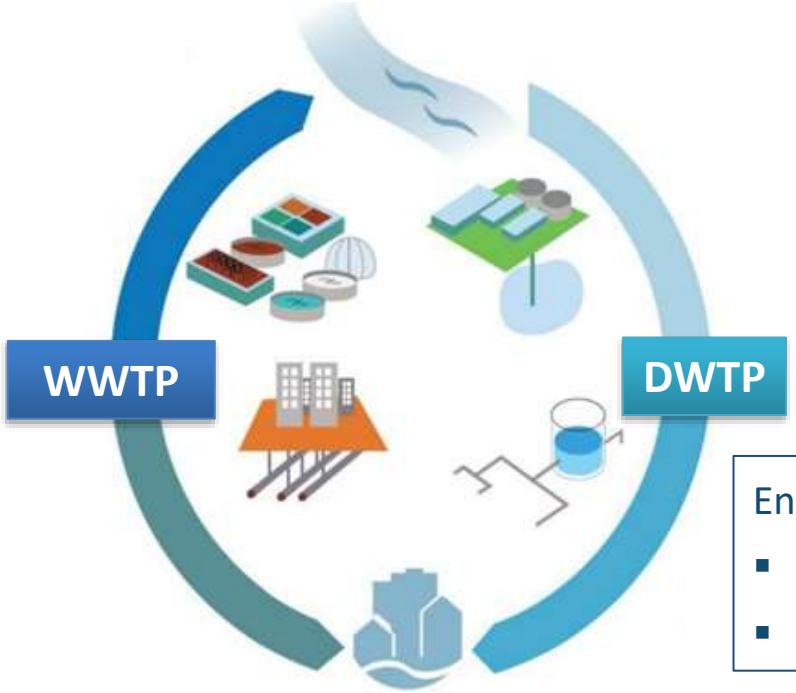
Lofman, D., Petersen, M. and Bower, A. (2002) Water, Energy and Environment Nexus: The California Experience. Int. J. Water Resour. Dev., 18 (1), 73–85

LIFE NEXUS approach

Sustainable **solutions** to improve the **resilience** of urban water provision services need to be:

- ✓ Sensitive to long-term investment needs and increasing energy prices
- ✓ Low carbon intensity to reduce GHG emissions

LIFE NEXUS approach



Normally, energy efficiency measures focus on DWTP and WWTP

LIFE NEXUS approach

Energy harvest from **water transport stages**:

- Pressured piping grids (supply) or gravity (drain and sewage)
- Untapped energy: pressure or flow

LIFE NEXUS approach

Potential energy recovery locations :

Locations with excess of energy:

- ✓ **Entrance to the DWTP** when raw water network is located in upland areas
- ✓ **Storage/service reservoirs** (SRV) gravity fed

Devices installed to dissipate energy:

- ✓ **Pressure reduction valves** (PRV)
- ✓ **Break pressure tanks** (BPT)

No systematic assessment has been done till the date in European cities

LIFE NEXUS objectives and outcomes

Objective 1: Explore the potential for **mini-hydropower** in European water industry. Inventory of sites with basic data based on **head and flow** (GIS-database).

Objective 2: For the more promising locations from the general inventory: Assessment of the technical and economic feasibility of **new mini-hydraulic projects**, considering **regulatory and policy context** of each country.

Objective 3: **Demonstration** of a mini-hydraulic prototype (45 kW) at Porma Drinking Water Treatment Plant (DWTP) in Leon (Spain).
Innovative integration of **Pump as Turbine** (PaT) with a **battery storage**.

LIFE NEXUS objectives and outcomes

Objective 1: Explore the potential for **mini-hydropower** in European water industry. Inventory of sites with basic data based on **head and flow** (GIS-database).

MAPPING

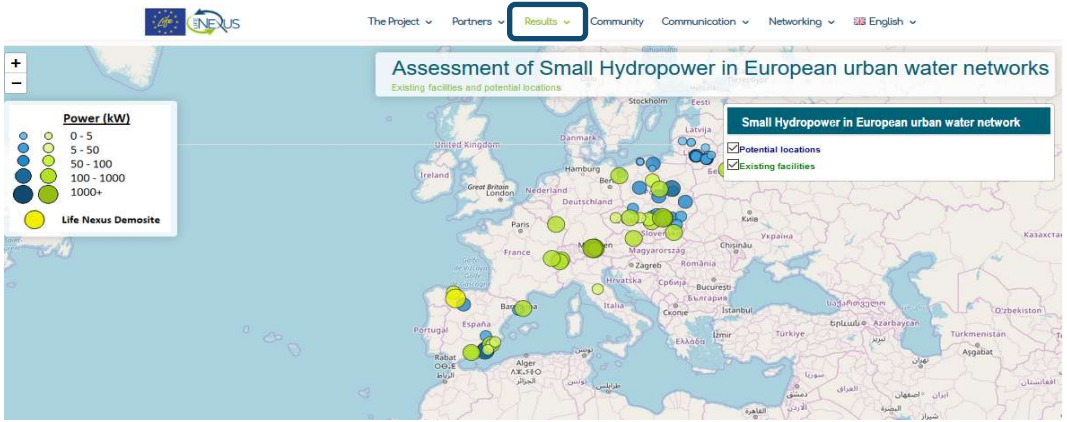
Mapping

Assessment of Small hydropower in European water networks

European inventory with **104 sites:**

- **71 potential locations** from **3** different European countries (Spain, Poland and Lithuania).
- **33 existing hydropower plants** from **9** different European countries (Spain, Poland, Austria, Belarus, Czech Republic, Germany, Italy, Slovakia, and Switzerland).

GIS tool available through Project website



Mapping

Data collection

Questionnaire available through Project website (Water head and flow, etc.)

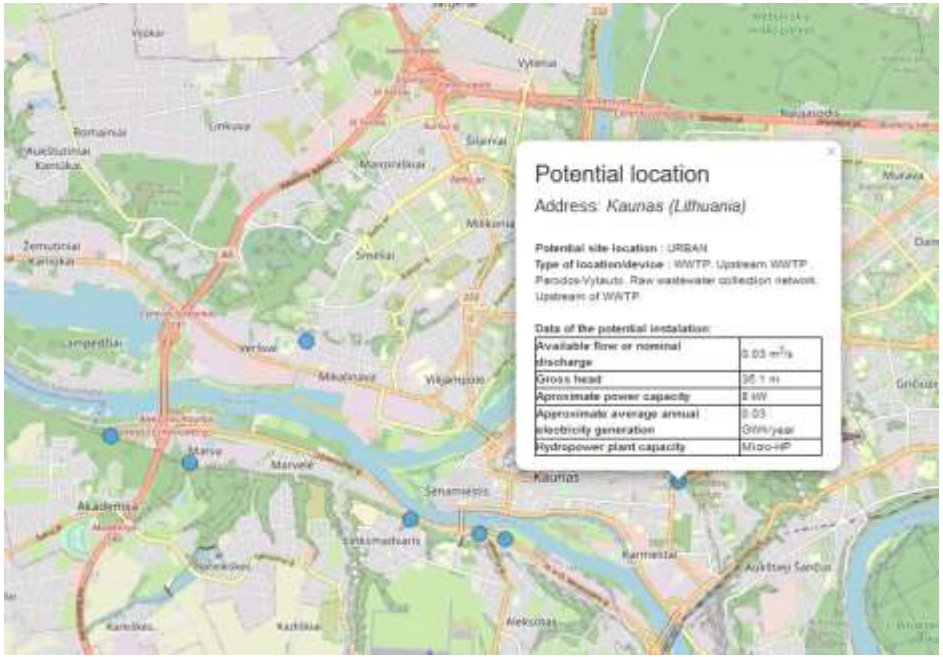
Potential locations: 16 Qs
Existing facilities: 19 Qs

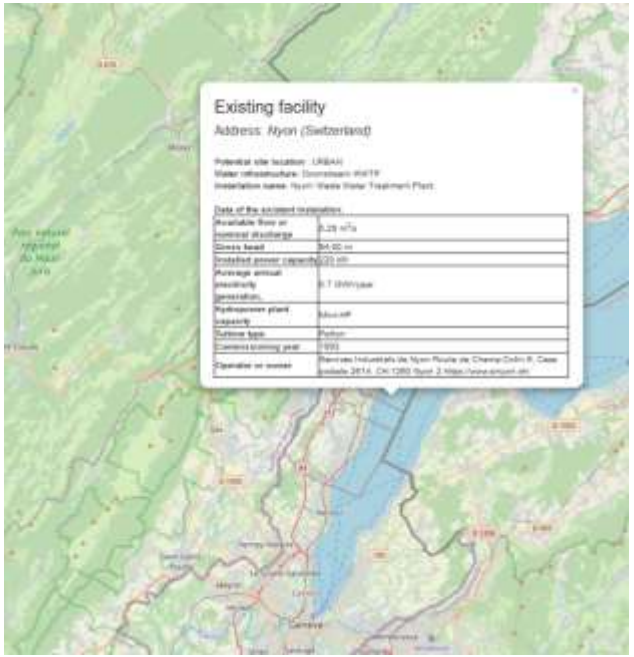
Mapping

Data visualization

Mapping

Data visualization

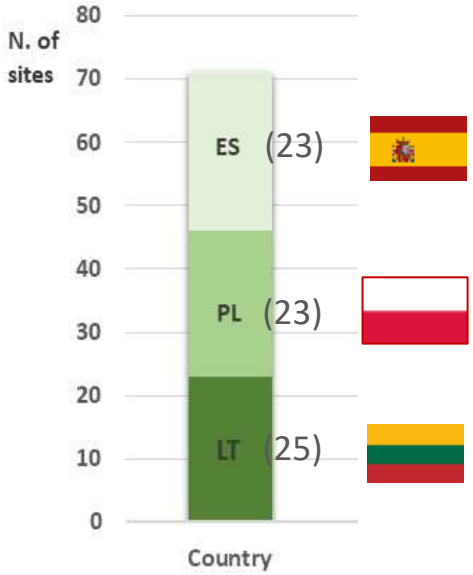




Mapping

Potential locations

71 Potential locations



Urban water cycle (entrace or outlet DWTP) and irrigation channels
Power capacity: four sites above 150 kW. Rest, below 100 kW

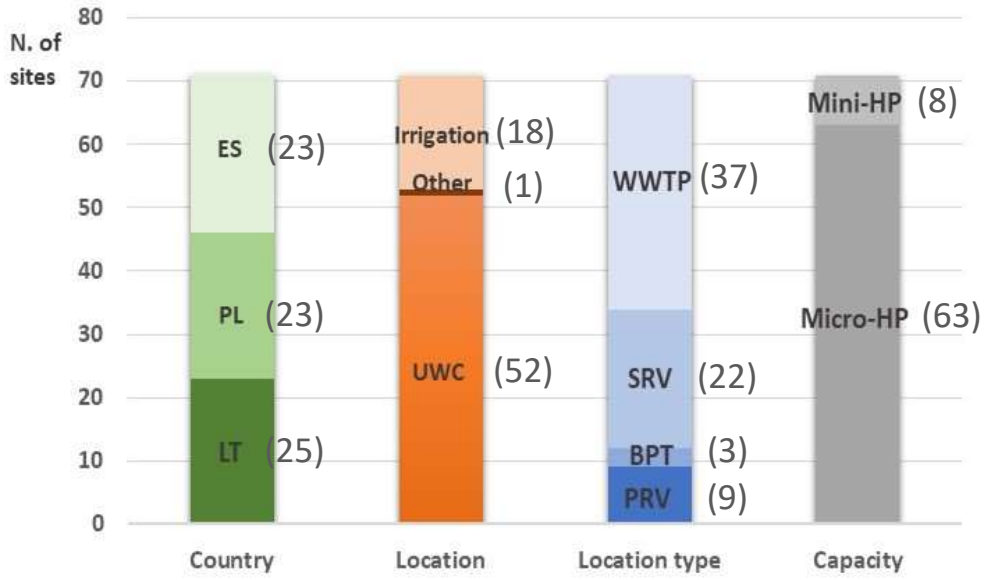
Potential sites only sewage (wastewater) networks with free gravitational flows
Power capacity: two sites with 201 kW and 525 kW. The rest, below 100 kW

Lowland country: only sewage (wastewater) networks with free gravitational flow
All of the power capacities are below 100 kW

Mapping

Potential locations

71 Potential locations



Total power capacity: **2.97 MW**

Electricity generation: **11.87 GWh/year**

PRV: Pressure Reduction Valve
SRV: Storage/service reservoirs
BPT: Break Pressure Tank

Mapping

Potential locations

71 Potential locations

29 on going feasibility studies

Transfer

Technical-economic viability of new mini-hydraulic projects based on PaTs, considering the regulatory and policy context of each country

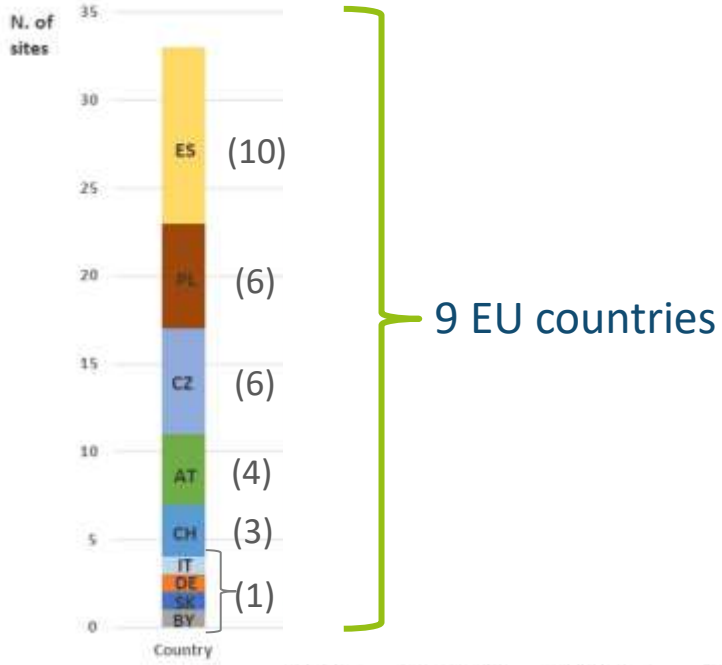
ASU for Lithuanian sites: Punys, P., Jurevičius, L. *Assessment of Hydropower Potential in Wastewater Systems and Application in a Lowland Country, Lithuania*. Energies 15(14), 2022, p.1.

Presentation by Prof. P. Punys (*Session 1*)

Mapping

Existing hydropower plants

33 existing HP Plants



9 EU countries

Mapping

Existing hydropower plants

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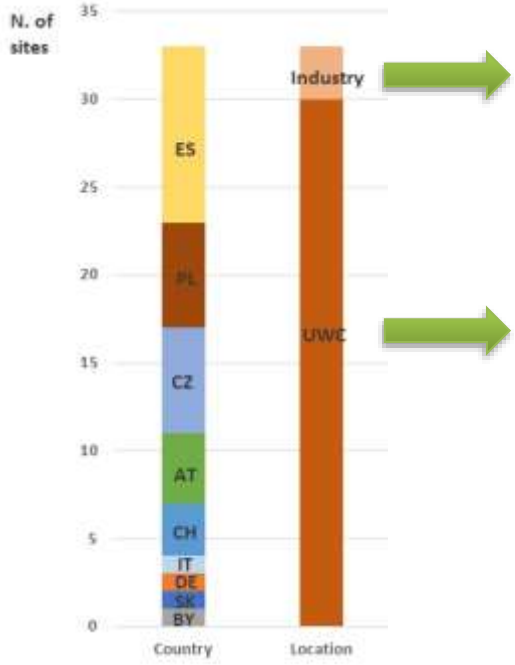


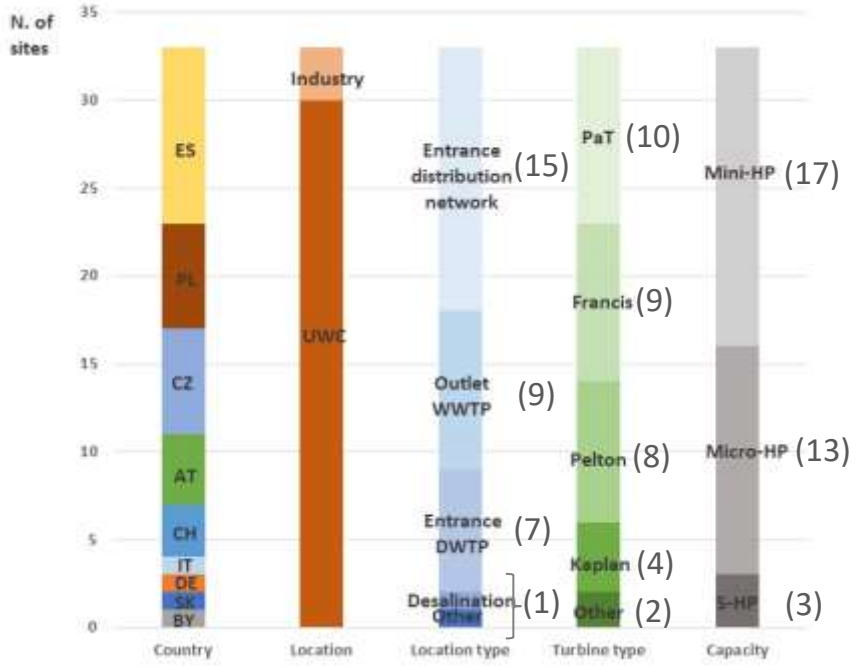
3 HP Plants: cooling system of a metallurgical industry (DE) , downstream WWTP in a power plant (PL) and downstream WWTP in an oil refinery (PL)

30 HPPs

Mapping

Existing hydropower plants

33 existing HP Plants



Total installed power capacity: **14.82 MW**

Electricity generation: **73.8 GWh/year**

Mapping

Existing hydropower plants

33 existing HP Plants

1 on going feasibility study

Transfer




IMP-PAN *(Poland): Rehabilitation of a decommissioned energy recovery installation in an Oil Refinery*

Several alternatives for the substitution of the Francis turbine by other turbines located in different locations of the plant are being studied

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