H-HOPE

Hidden Hydro Oscillating Power for Europe

H-HOPE

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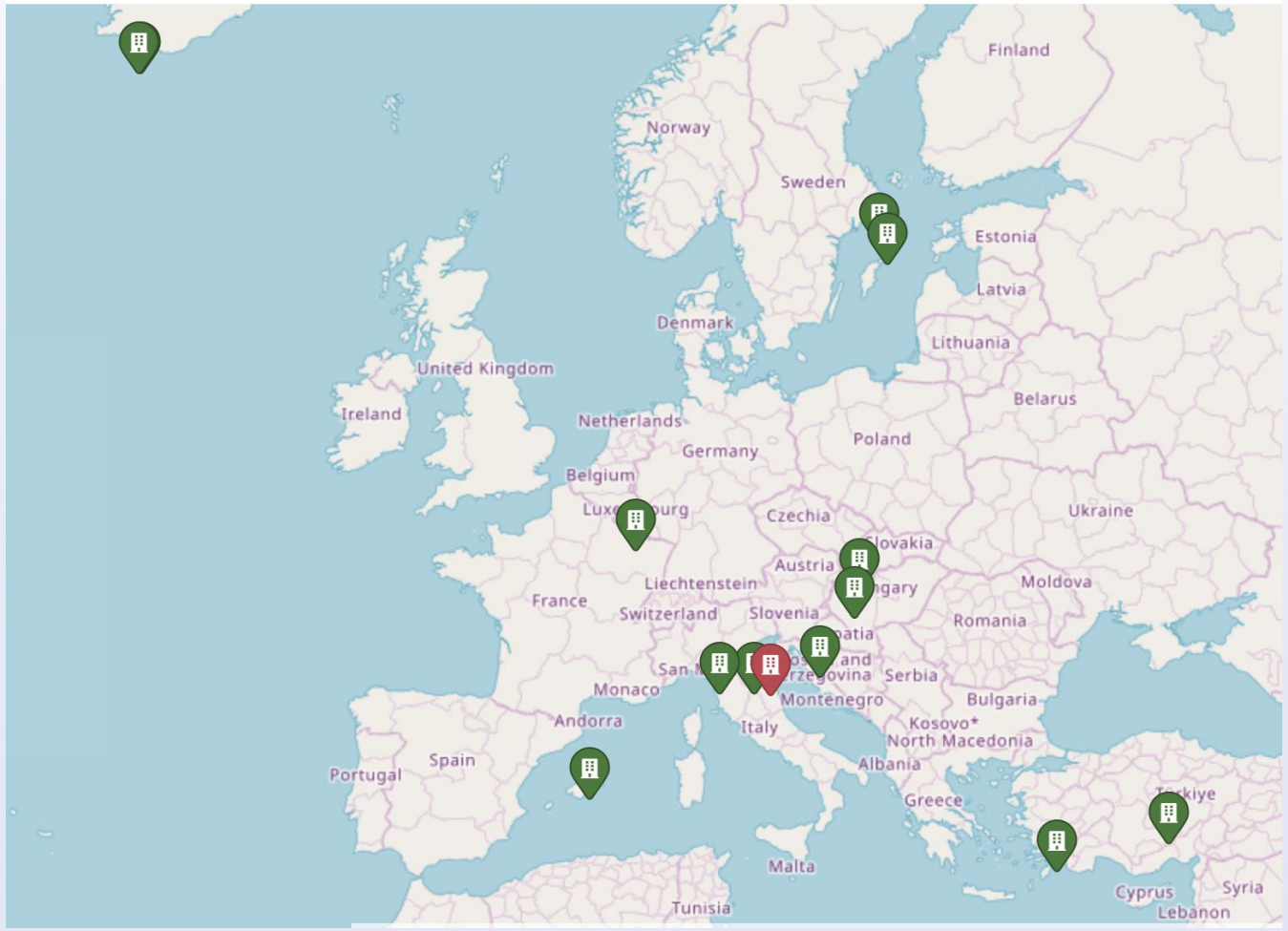
22 26/02/2026

The H-HOPE project

Duration: 11/2022-10/2026

Budget: 4.8M€

Hidden Hydro Oscillating Power for Europe



14 partners

Coordinator

Hidden Hydro Oscillating Power for Europe project has received funding from the European Union's Horizon Europe research and innovation programme under grant agreement n. 101084362

Untapped hydropower potential in natural and artificial water flows

Water distribution networks

Irrigation channels

Waste water treatment channels

Lagoon natural flows

Untapped because of:

- Limited water energy
- Too high cost of traditional technologies

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The state of the art…..not suitable for micro-power solutions

Examples of hidden hydropower innovative technologies

[IEA report, 2023. «IEA Hydropower Task 16 - Hidden and Untapped Hydropower Opportunities at Existing Infrastructure»]

01 La Zour
Municipal water

Head = 217 m
Flow rate= 300 l/s
Power= **465 kW**

02 The Momura (Japan)
Irrigation channels

Power= **120 kW**

03 The Duo-Two axial turbine

Head = **80 m**
Flow rate= 10 l/s
Power= 5 kW

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The H-HOPE concept

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The H-HOPE project: the concept

The idea of H-HOPE is to exploite a phenomenon known as «resonance condition».....

Collapse of the Tahoma bridge

....to produce energy!!

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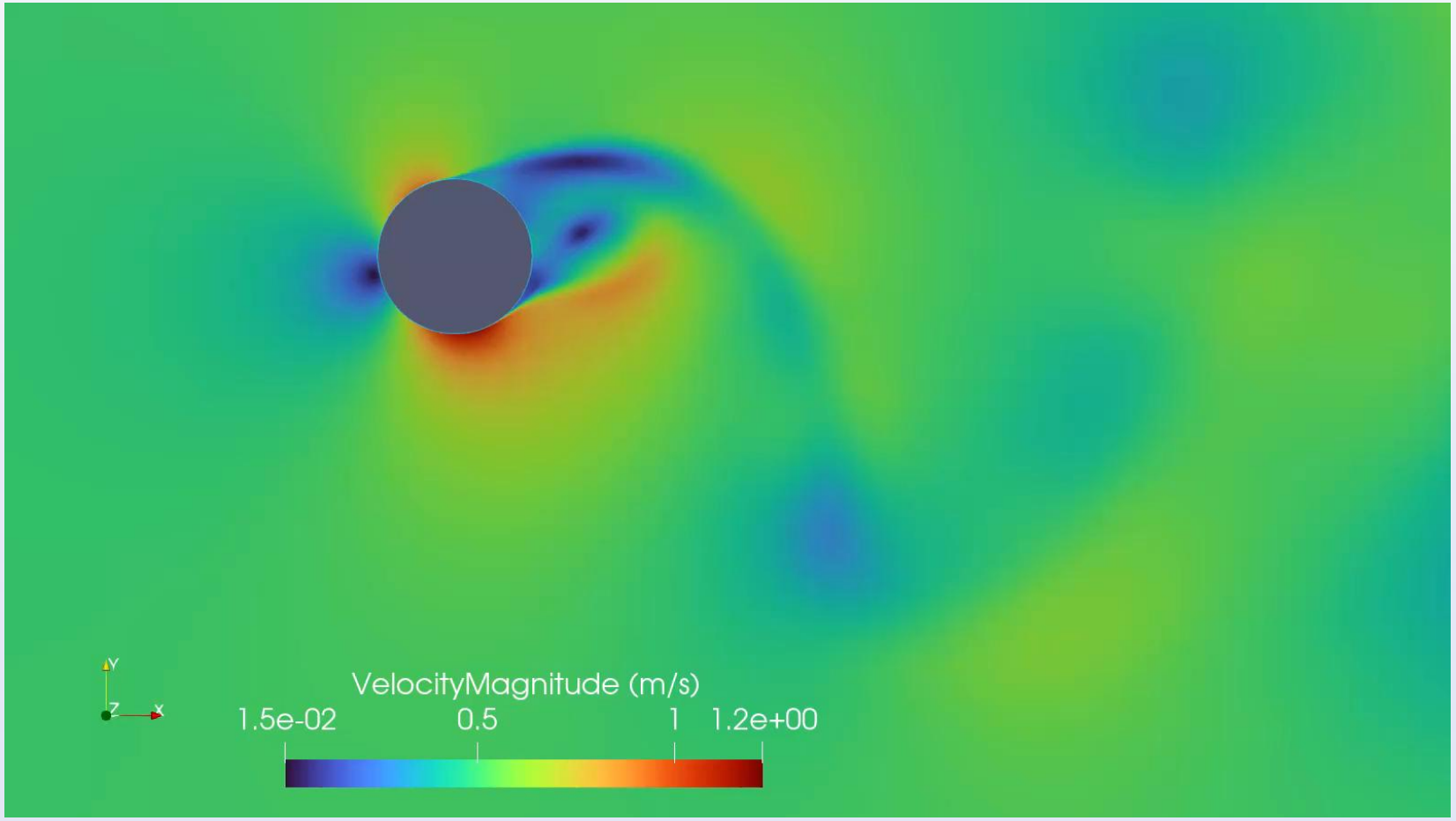
The H-HOPE project: the concept

H-HOPE has developed an **innovative technology** capable of extracting energy from the **vibrations** induced by fluid vortexes on a body immersed in the fluid



- Vibrations are amplified by the resonance condition, which requires a complex **synchronization** between the water **vortex** shedding frequency and the natural **system** frequency.

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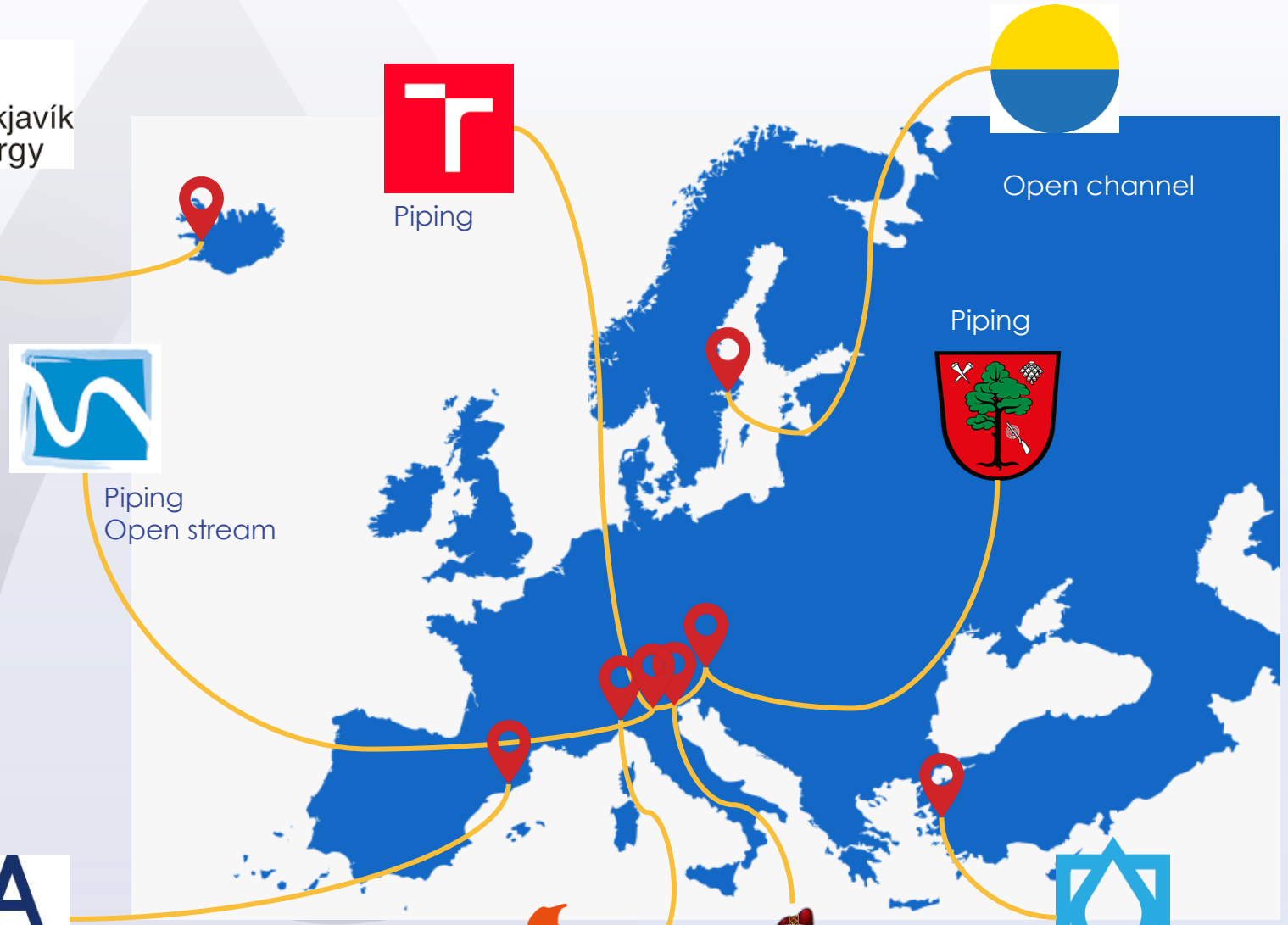
The case studies

- **4** water distribution networks;
- **1** hot water distribution network;
- **1** waste-water treatment network;
- **2** open channels
- **1** lagoon

Determine the water flow characteristics and the real operating conditions



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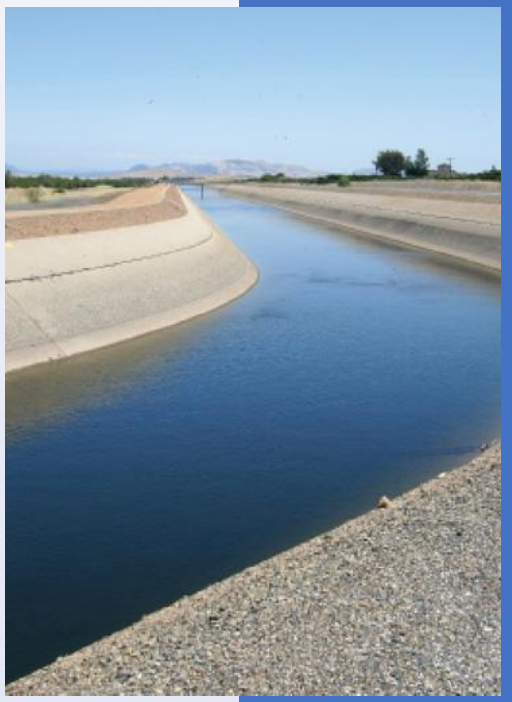

Operator's business interests and concerns

- Sensoring distribution networks
- Monitoring remote locations
- Replace battery sensors

- CAPEX and OPEX
- Endurance and reliability
- Effects of hydraulic fluctuations
- Effects of pollutants

11

Individual meetings

12

Identified potential pilots for piping and open channel/stream

7

Data sets from piping and open channel/stream

1

Stakeholder event

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General process to 1D modelling

- Fluid velocity $v(t)$

- Profile geometry

Fluid mechanics

$F(t)$

- Profile geometry
- Material

Structural mechanics

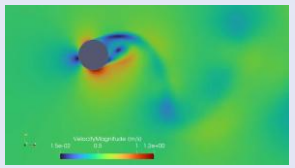
$d(t)$

- Profile geometry
- Material
- PZT properties
- Linear Generator
- Electronics

Piezoelectric/ generator & electronics

Electrical Power

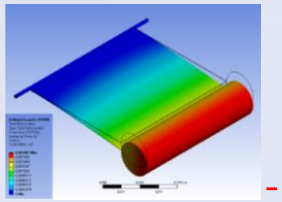
CFD simulations



$f_{fluid}(St, v, h) = f_{struture}(E, I_x, \rho, A)$

Must match for max output

Structural simulations



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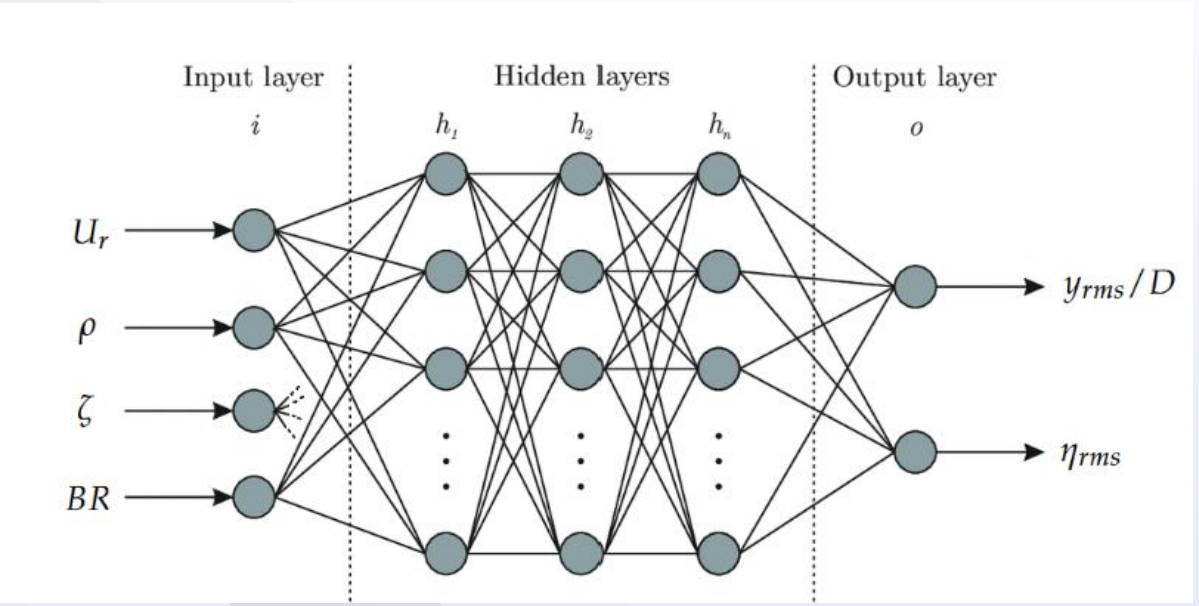
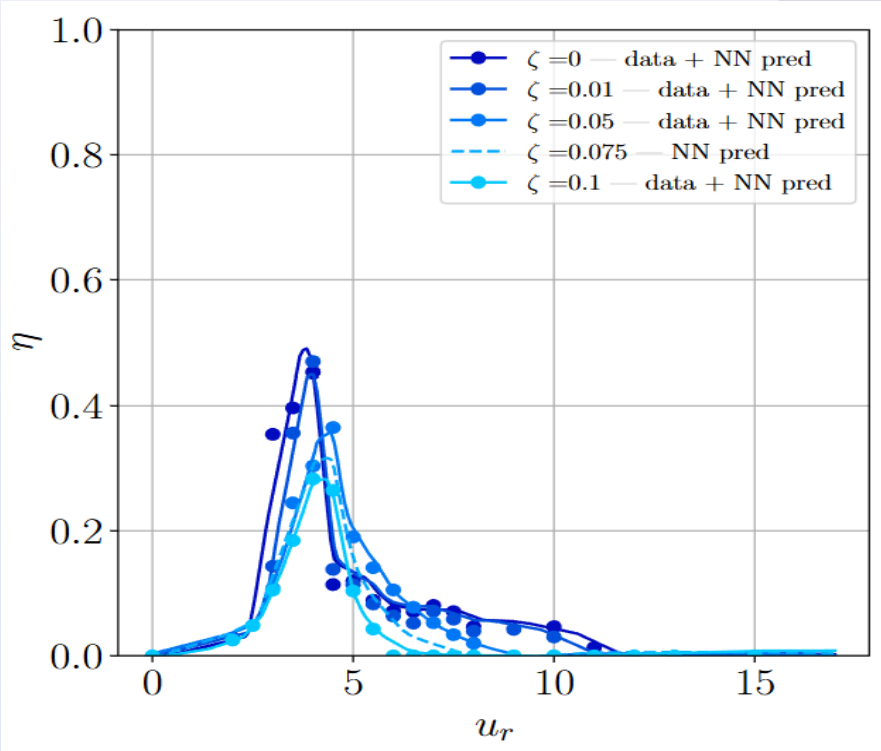
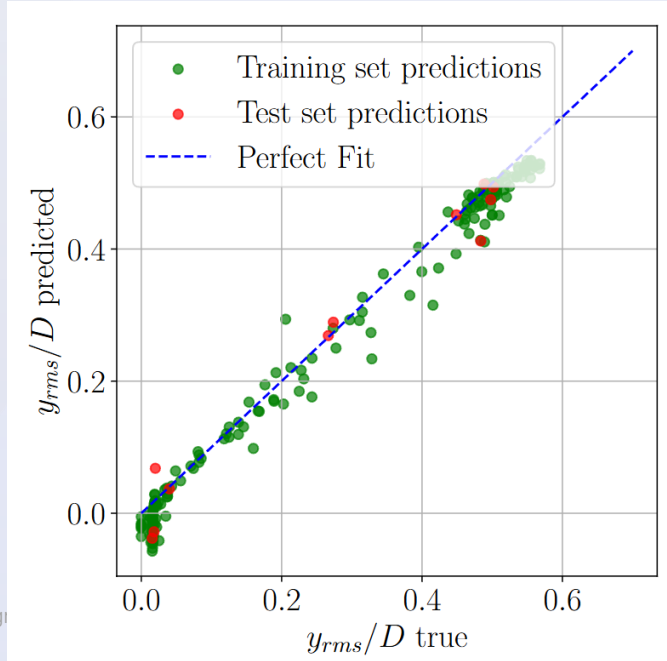
Development of the design procedure: the neural network

- A neural network was adopted to efficiently interpolate the CFD data and capture the underlying relationships
- The NN was trained on a set of predictions and tested on another set





- The NN predicts the behaviour of the harverster even for operating conditions not numerically investigated



e European Union's Horizon Europe research and innovation programme under grant ag

The design procedure

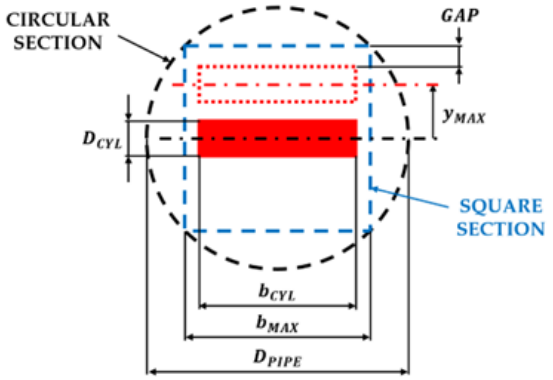
INPUT DATA

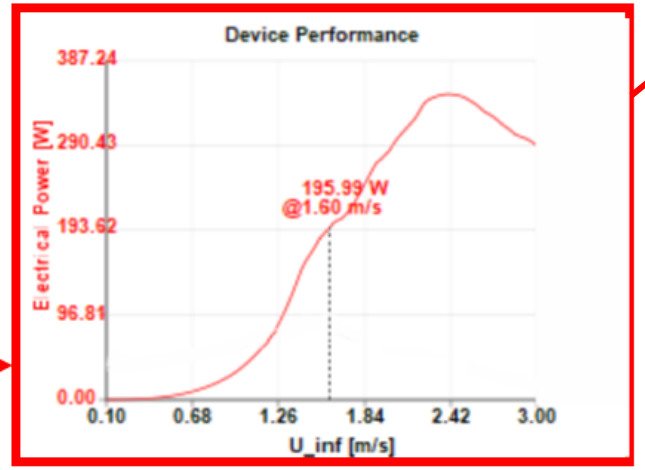
- U_∞ – *flow velocity*
- D_{PIPE} – *pipe diameter*
- m – *system mass*
- c – *system damping*
- k – *system stiffness*
- GAP – *safety gap*

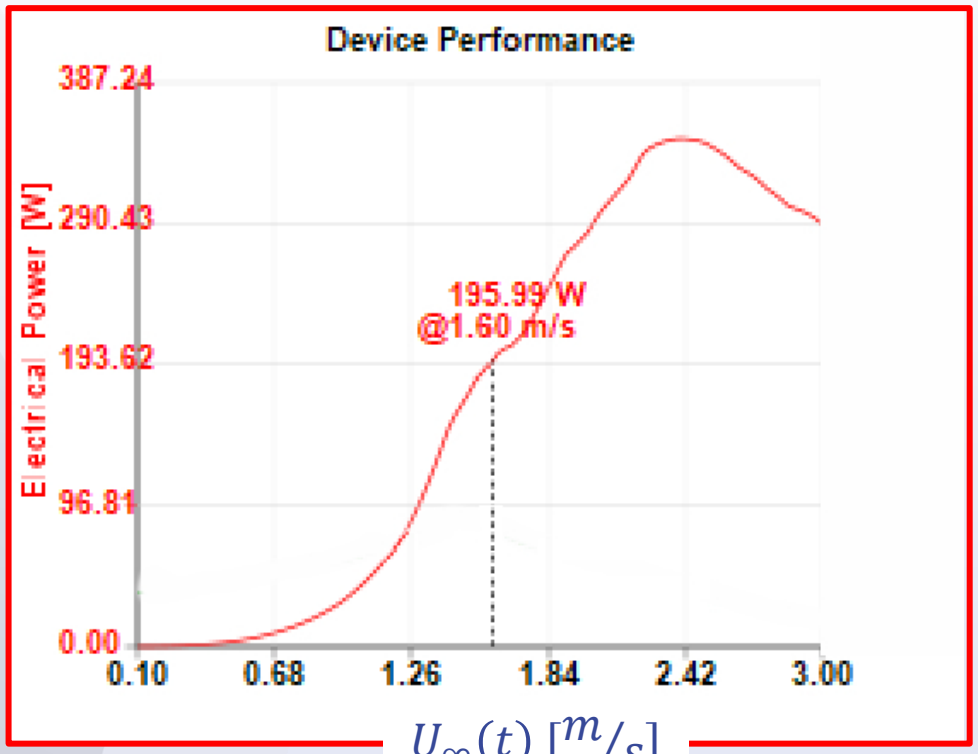
1-D MODEL

OUTPUT DATA

- D_{CYL} – *cylinder diameter*
- $y_{MAX}(U_\infty)$ – *oscillation amplitude*
- $c_L(U_\infty)$ – *lift coefficient*
- $P(U_\infty)$ – *Power*
- $\eta\ (U_\infty)$- *efficiency*







- The lock-in condition is not reached only for one single velocity but it is maintained in a range of velocities around the design one.

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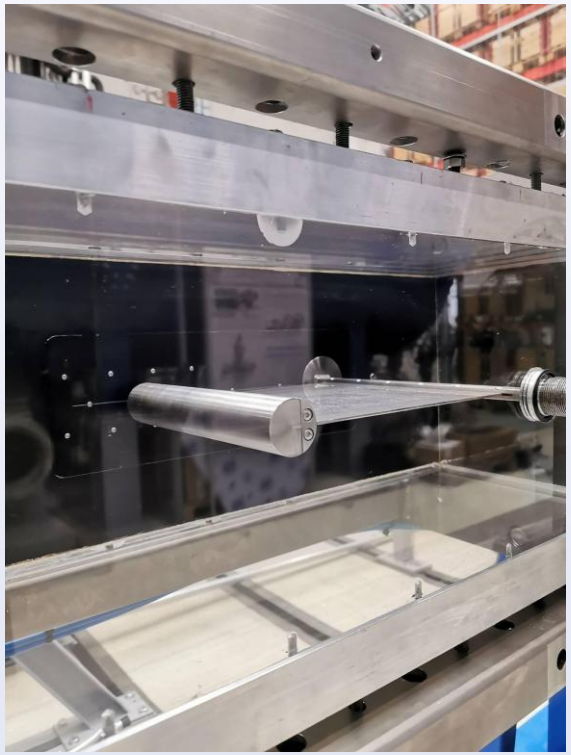
Piping prototype



$$P_{el,out} = 140\ mW$$

- Depending on the characteristics of the application, **different configurations** have been proposed and tested in **real operating conditions**

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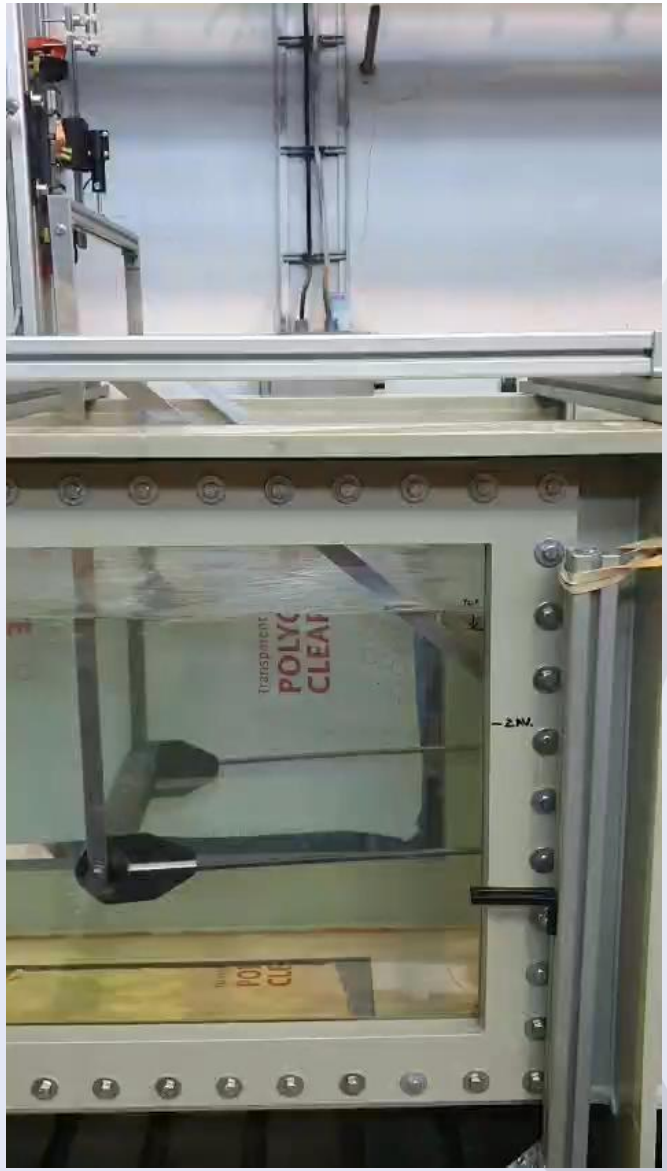
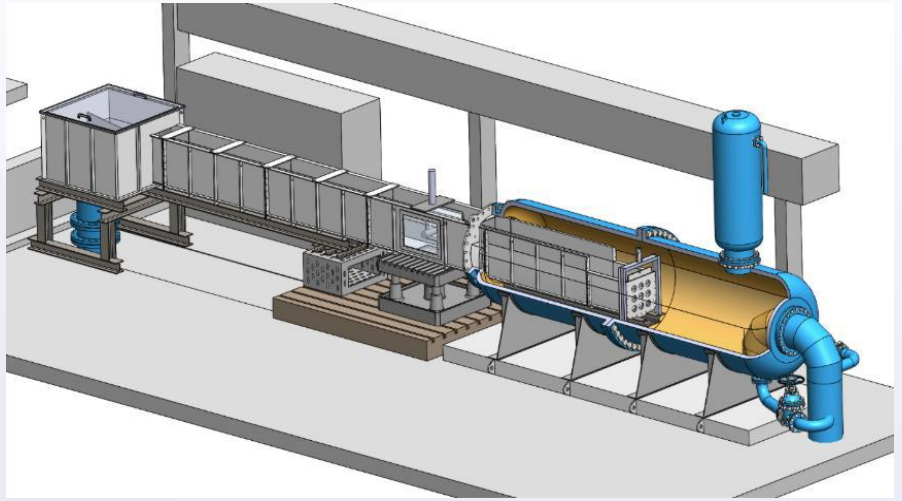
Open channels

$$P_{el,out} = 1\ W$$





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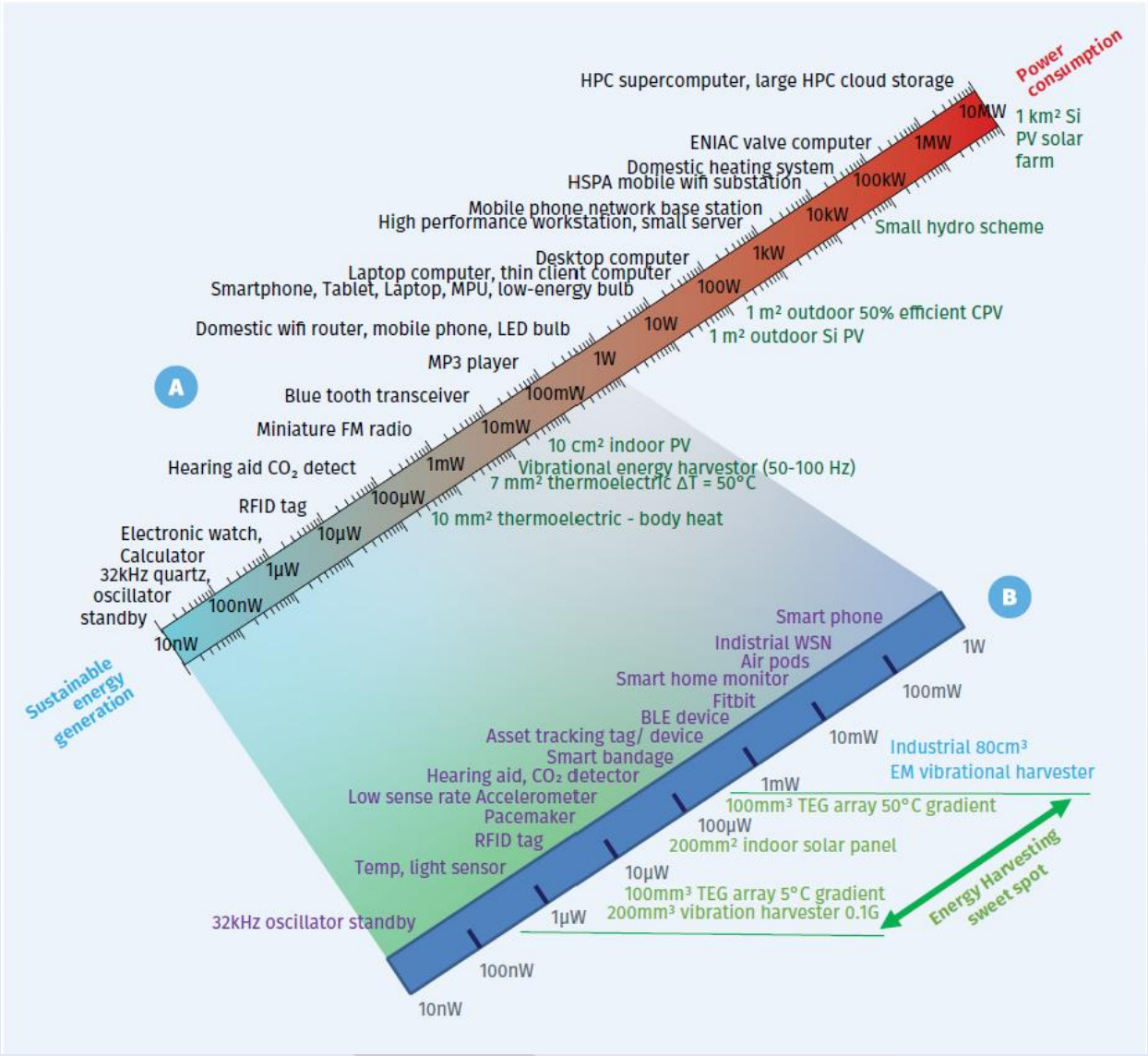
Harvesters and sensors



Enables project. Research Infrastructure to Power the Internet of Things.

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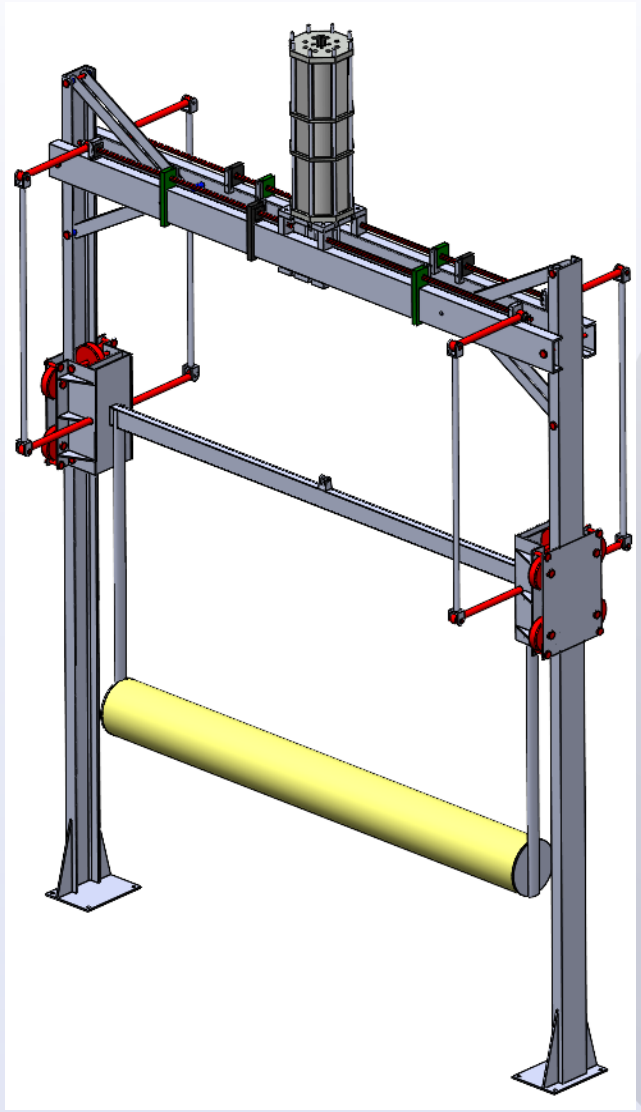
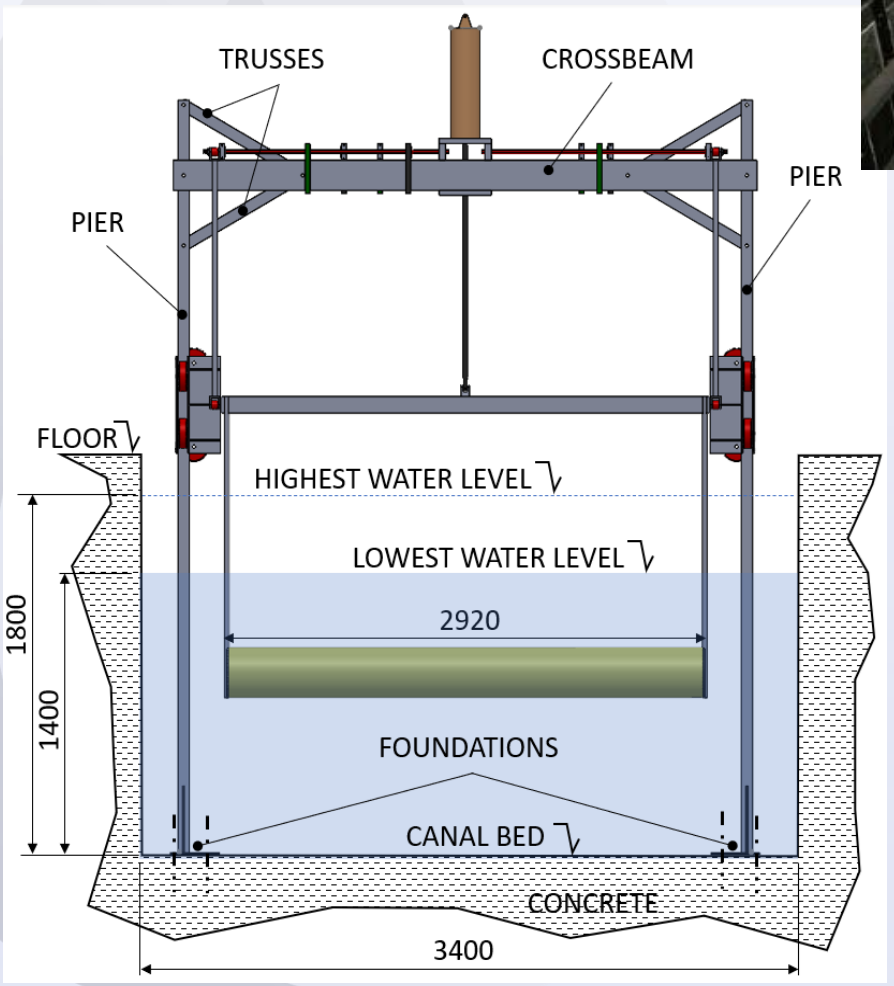
Scaled-up tests





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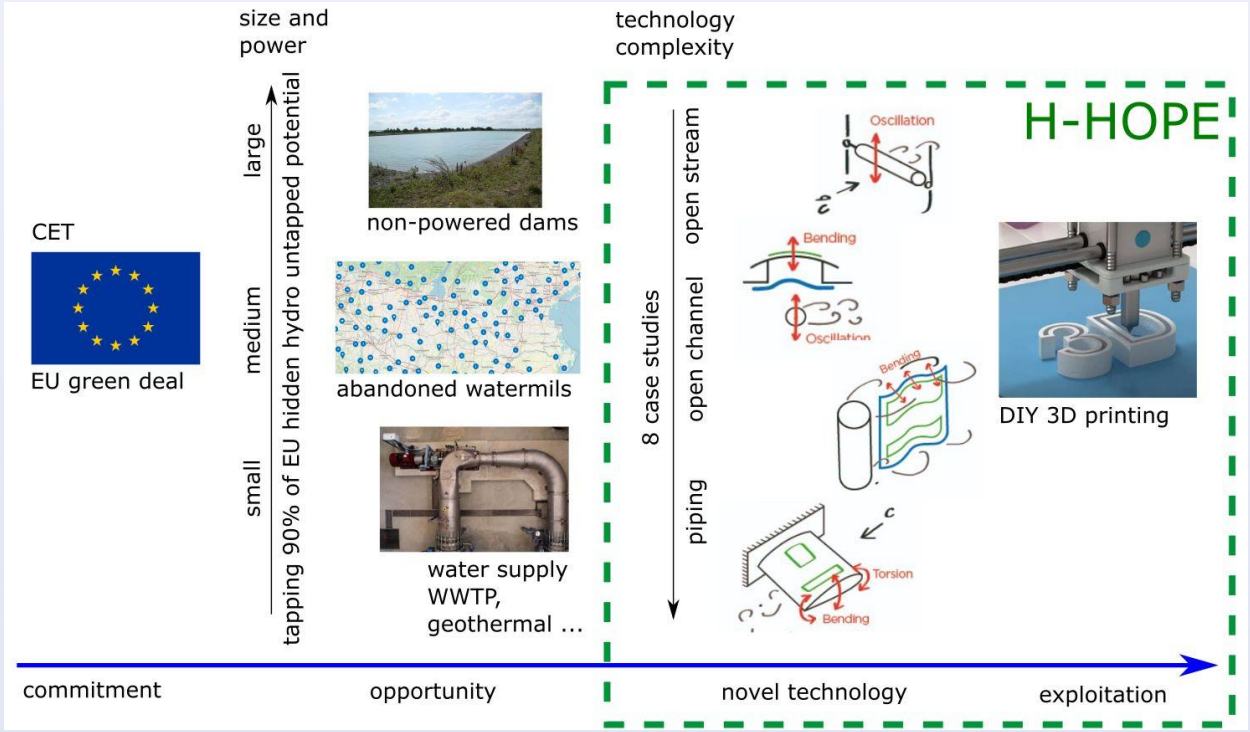
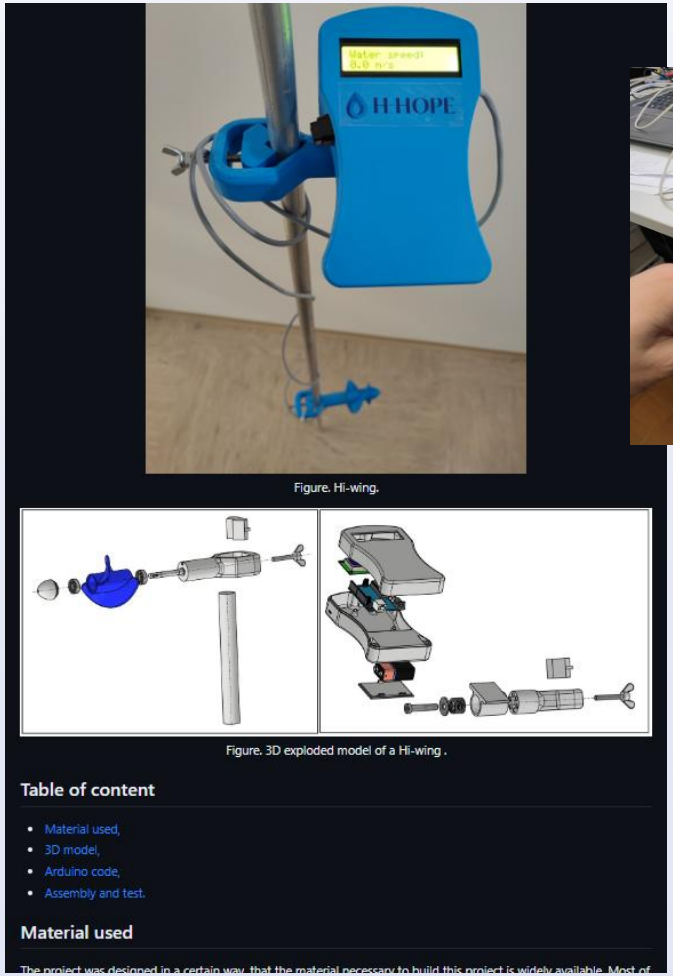
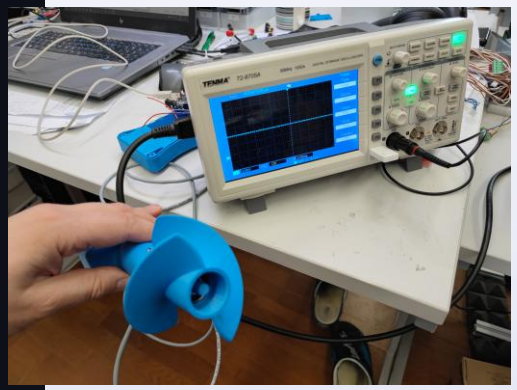
H-HOPE for prosumers

- The **Do-It-Yourself approach** is targeting small prosumers and science enthusiasts, promoting the development of self-made prototypes to be used in domestic context.
- Simple and **low-cost manufacturing** strategies
- **Guidelines** for designing and manufacturing their own device







Do-It-Yourself platform

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Thank you

For updates, follow us on social media or on the project website:

www.h-hope.eu

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