H2020 PROJECT XFLEX n° 857832

XFLEX HYDROPOWER EXTENDING POWER SYSTEM FLEXIBILITY

Grant Agreement with **European Commission**
Innovation and Networks Executive Agency (INEA)

THE CHALLENGE

By 2030

RENEWABLE ENERGY

27%

Renewable share
in energy consumption

By 2050

RENEWABLE ELECTRICITY

64% **97%**

High renewable energy
sources scenario

THE CALL

"**Demonstration** of solutions based on renewable sources that provide **flexibility to the energy system**. Supporting the power grid balancing and increasing the flexibility of the energy system is possible by means of dispatchable renewable energy sources…"

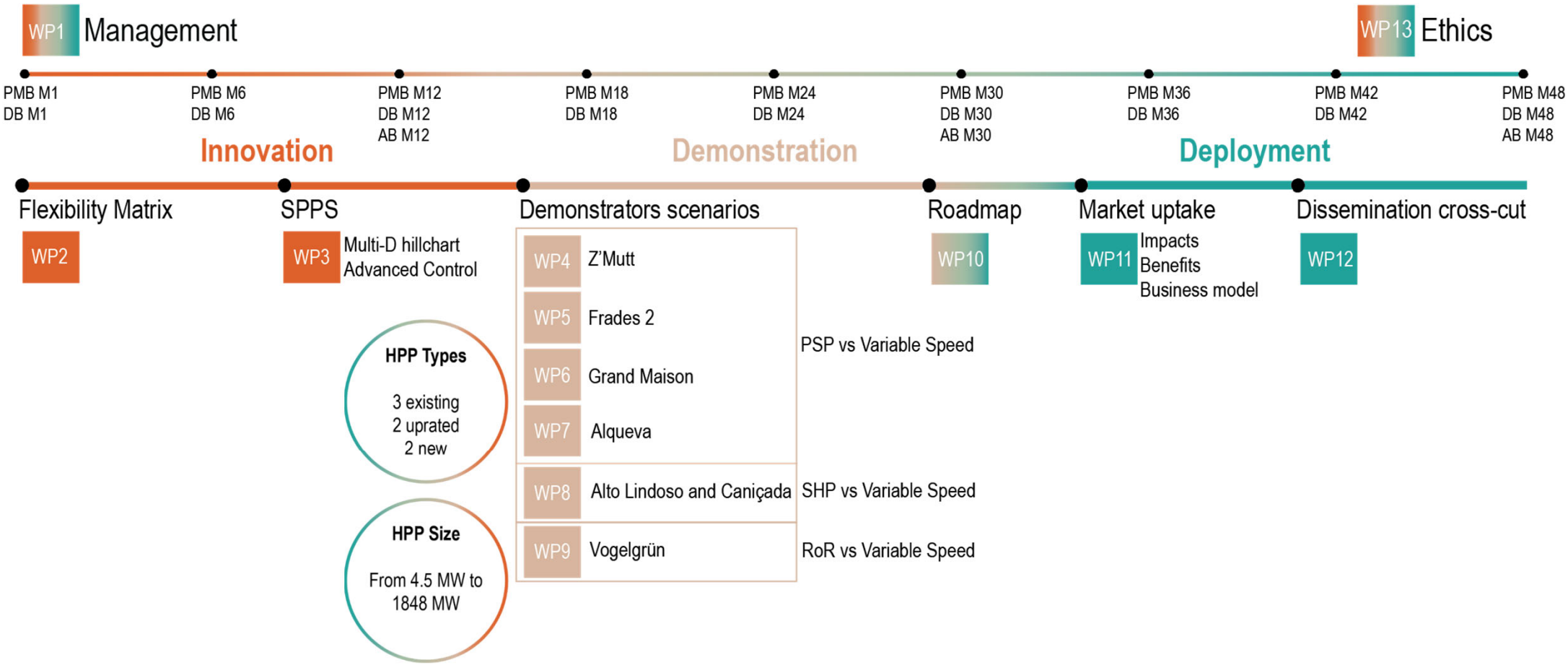
Topic LC-SC3-RES-17-2019
Building a low-carbon, climate resilient future

THE CALL

"… Focus will be on the **improvement of the average annual overall efficiency** of hydroelectric machinery. Projects are expected to provide **high availability** of hydropower plants and to **maximise performance** of hydropower plants of **all sizes**. The aim is adapting to **variable speed generation** the hydropower plants (new, refurbished and uprated and especially existing ones); it is important that by **optimising maintenance intervals** for **all hydro plants** (especially those delivering balancing power because of the related dynamic operation, dynamic loads and increased wear and tear) the outage time will be minimised. **Digitalisation measures** to increase the potential of hydropower in providing flexibility to the energy system can be included."

Topic LC-SC3-RES-17-2019
Building a low-carbon, climate resilient future

PROJECT OVERVIEW



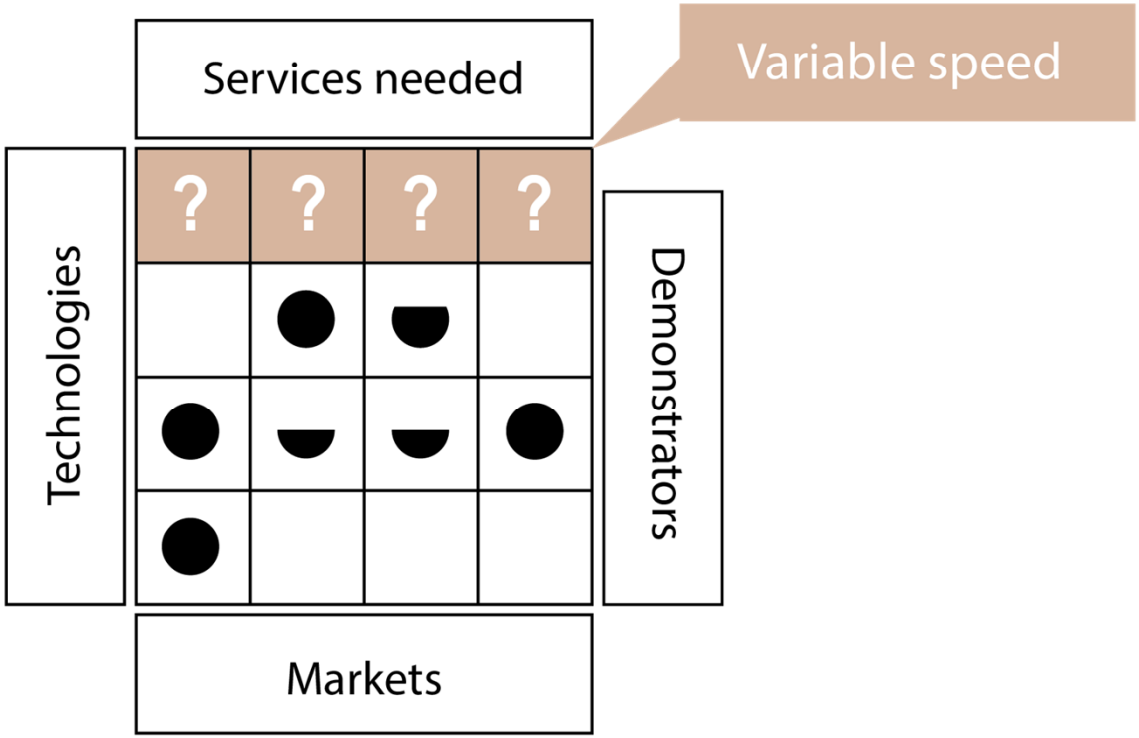
HYDRO TECHNOLOGY SOLUTIONS

3 Smart powerplant supervisor (tool)

Mapping hydro technology to the flexibility service needs in new power markets

"How do different technologies **deliver flexibility?"**

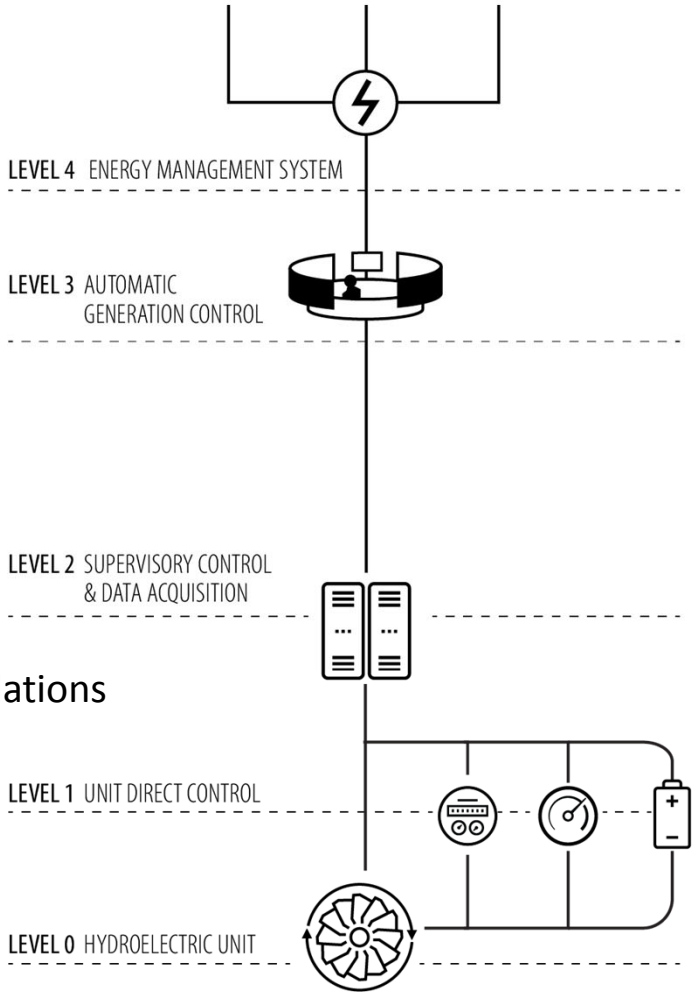
Base Line
Variable Speed DFIM/FSFC
Hydraulic Short Circuit
Battery Hybrid



METHODOLOGY TO MAXIMISE FLEXIBILITY

3 Smart powerplant supervisor (tool)

"How do different technologies **deliver flexibility?**"

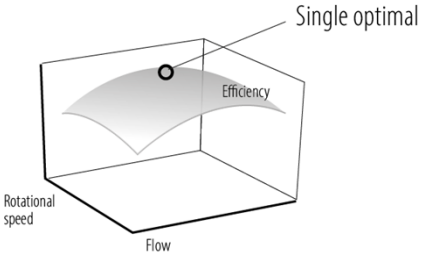


Developing an innovative methodology to utilise the demonstrated hydro technologies at new and existing hydropower assets

Digitalization
CFD & FEM Numerical Simulations
Model Tests
Advanced Monitoring
Unit Control

BEFORE

Limited range of operation based on functions that exclude grid needs



METHODOLOGY TO MAXIMISE FLEXIBILITY

3 Smart powerplant supervisor (tool)

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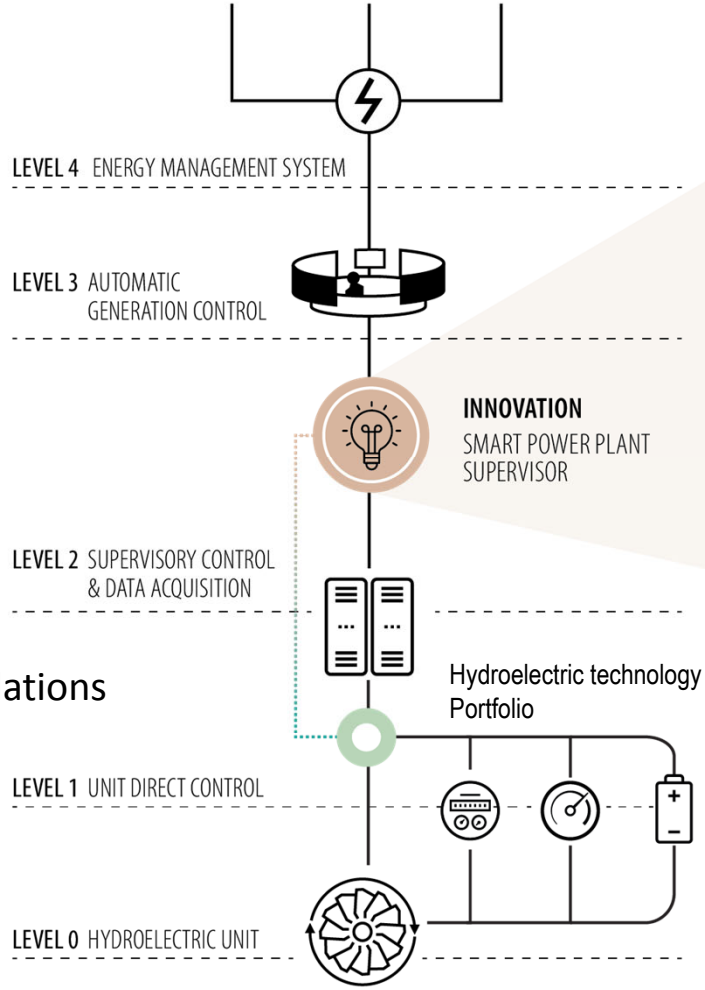
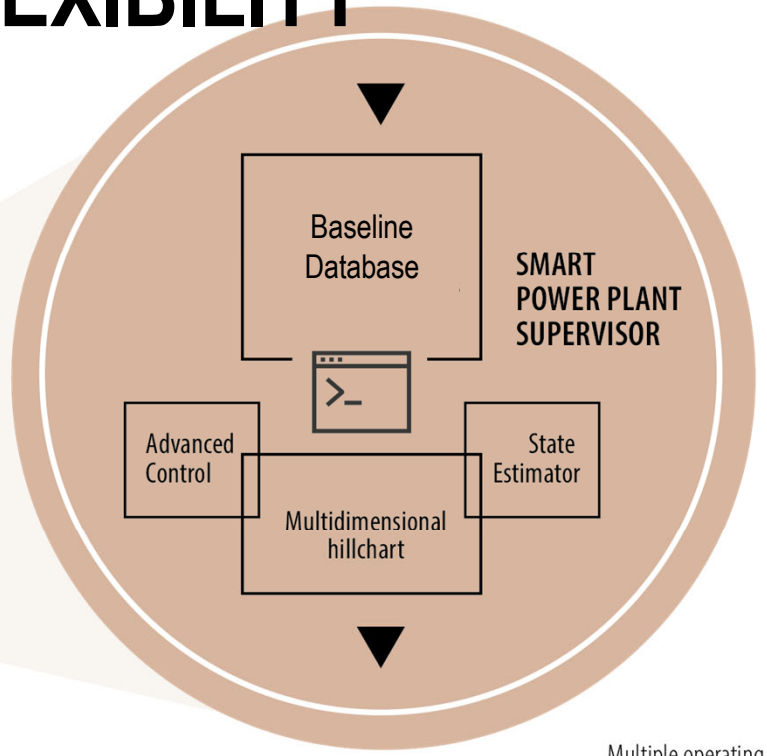
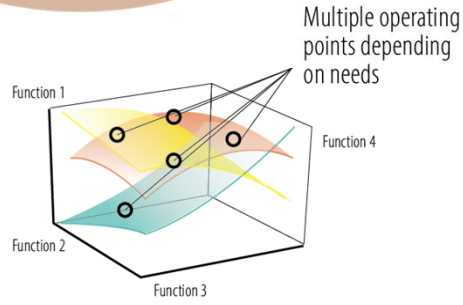




Digitalization
CFD & FEM Numerical Simulations
Model Tests
Advanced Monitoring
Unit Control

AFTER

Flexible range of operation based on a multidimensional analysis including energy grid needs



Demonstrate flexible technologies in PSP

Z'Mutt (ALPIQ) Unit 5, Switzerland

- FSFC variable speed reversible pump-turbine
- P = 5 MW, H = 115 m, Q = 3.6 m^3/s

Variable Speed

FRADES 2 (EDP), Portugal

- Two DFIM variable speed reversible, OEM: Voith Hydro
- P_{Turb} = 190 MW ÷ 400 MW, H_{Turb} = 407 m ÷ 430 m, Q_{Turb} = 100 m^3/s,
  P_{Pump} = 300 MW ÷ 390 MW, H_{Pump} = 414 m ÷ 437 m, Q_{Pump} = 89 m^3/s

Short Circuit

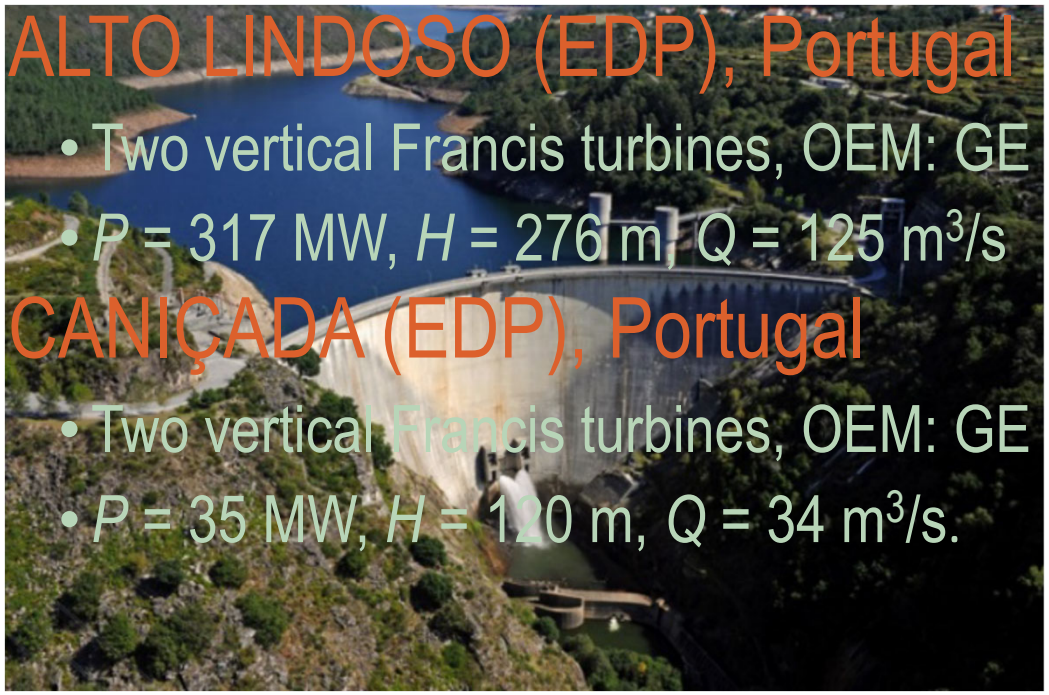
GRAND-MAISON (EDF), France

- Eight 140 MW reversible 4 stage pump-turbine units, OEM: GE
- Four 150 MW Pelton turbine units, 5 jets, OEM: GE, H = 900 m

ALQUEVA (EDP), Portugal

- 2 + 2 reversible single stage pump-turbine units, OEM: GE
- P_{Turb} = 129.6 MW, H_{Turb} = 50.2 m ÷ 76 m, Q_{Turb} = 203.2 m^3/s
  P_{Pump} = 110 MW, H_{Pump} = 50.2 m ÷72 m, Q_{Pump} = 140.2 m^3/s

Demonstrate flexible technologies in Storage HP



Base Line Digitalization

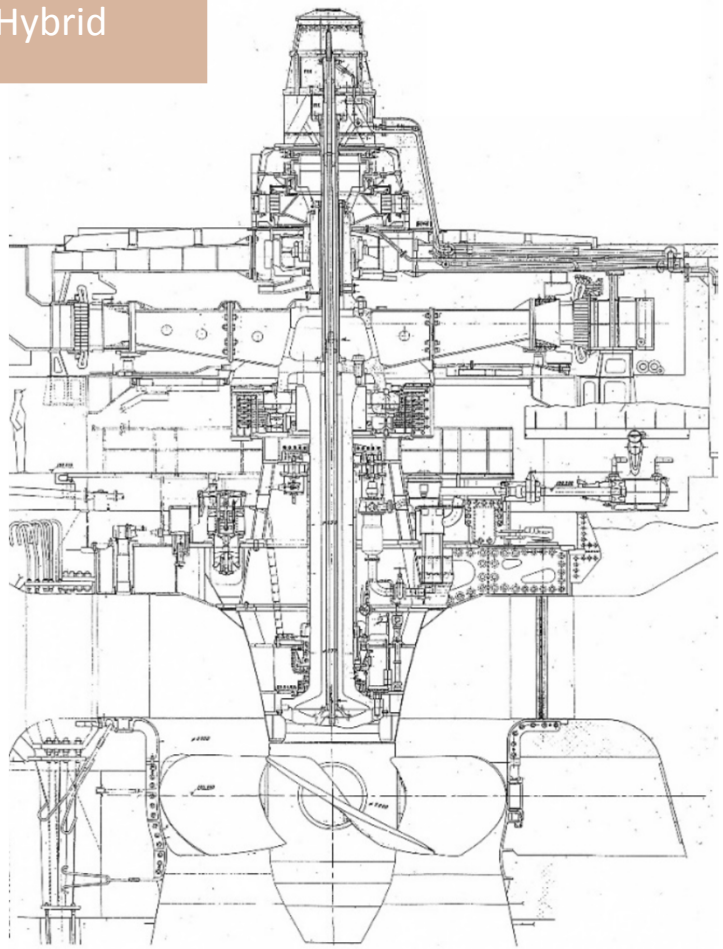
Follower
FSFC Variable Speed

Demonstrate flexible technologies in RoR HP

Battery Hybrid

VOGELGRÜN (EDF), France

- Four vertical Kaplan turbines, OEM: GE
- P = 35 MW, H = 12 m, Q = 325 m^3/s

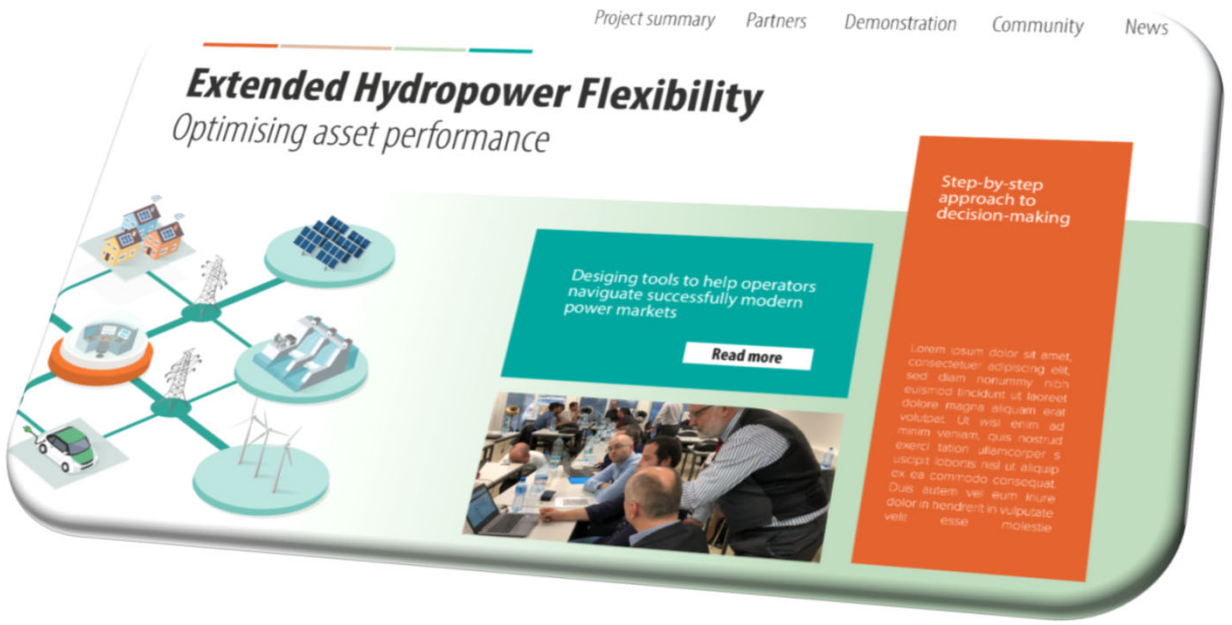


EXPECTED IMPACT

Analyse the impact and cost-benefit of the flexible hydropower technologies

"The developed technologies will allow plant and system operators to **operate successfully** in the **modern power markets** and to make a significant contribution to **European renewable energy objectives and policies**"

Topic LC-SC3-RES-17-2019
Building a low-carbon, climate resilient future



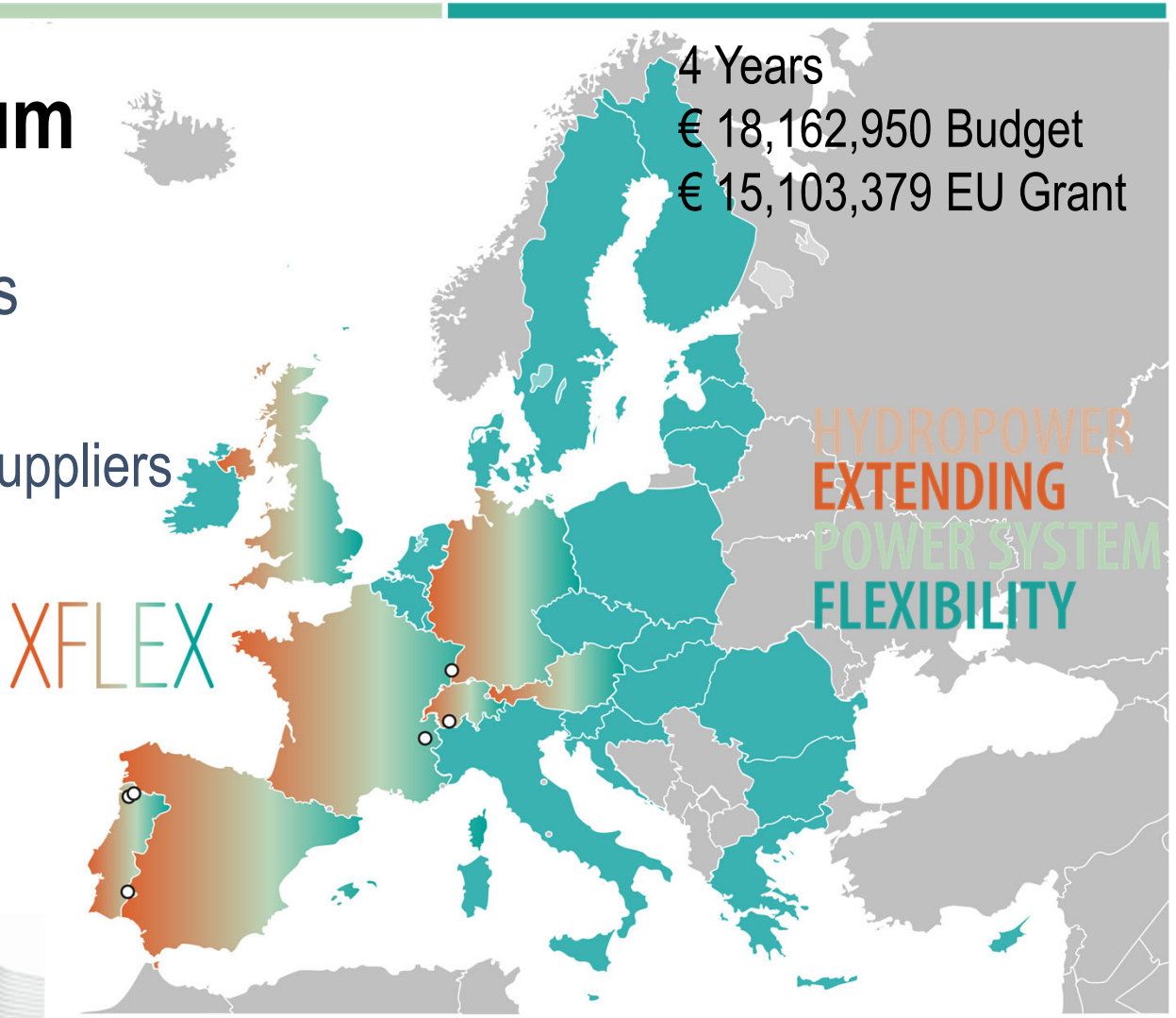
INTERACTIVE KNOWLEDGE HUB

The XFLEX Consortium

4 Years
€ 18,162,950 Budget
€ 15,103,379 EU Grant

18 Partners from 7 Countries

- 3 Electrical Utilities
- 3 Hydroelectric Equipment Suppliers
- 2 Consulting Companies
- 1 International NGO
- 3 Research Institutes
- 6 Academic Laboratories



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The XFLEX Consortium

4 Years
€ 18,162,950 Budget
€ 15,103,379 EU Grant

Coordinator: EPFL

Utilities

- EDF, EDP, ALPIQ

OEM

- ANDRITZ, GE, VOITH

Consulting

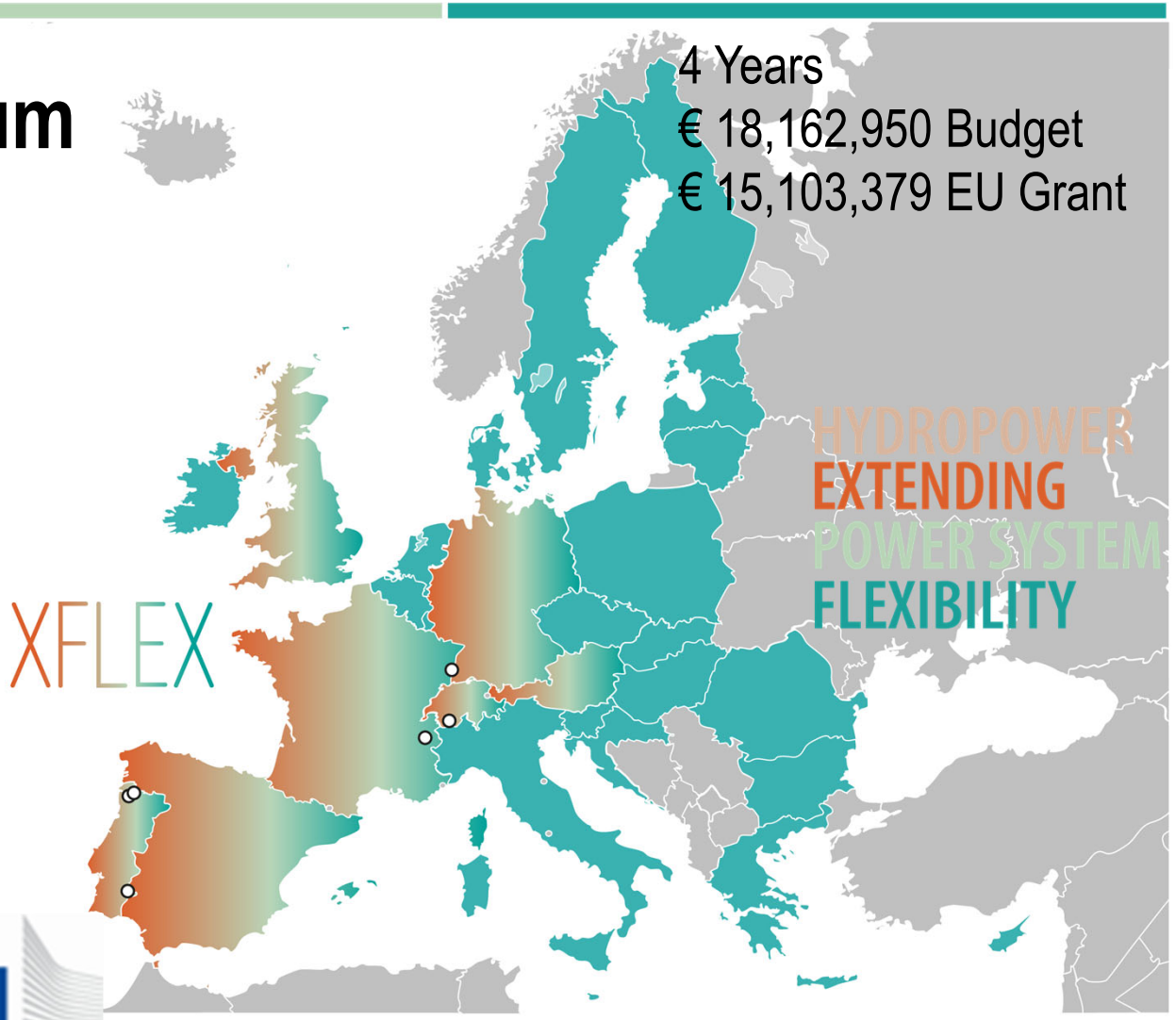
- PVE, Zabala

Universities

- EPFL, HESSO
  UPC, USTUTT

Research Centres:

- Armines, CEA,
  IHA, INESTEC, SuperGrid



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The XFLEX Consortium

Swiss & SCCER Partners

Coordinator: EPFL

Utilities

- ALPIQ, Dr. Chène

OEM

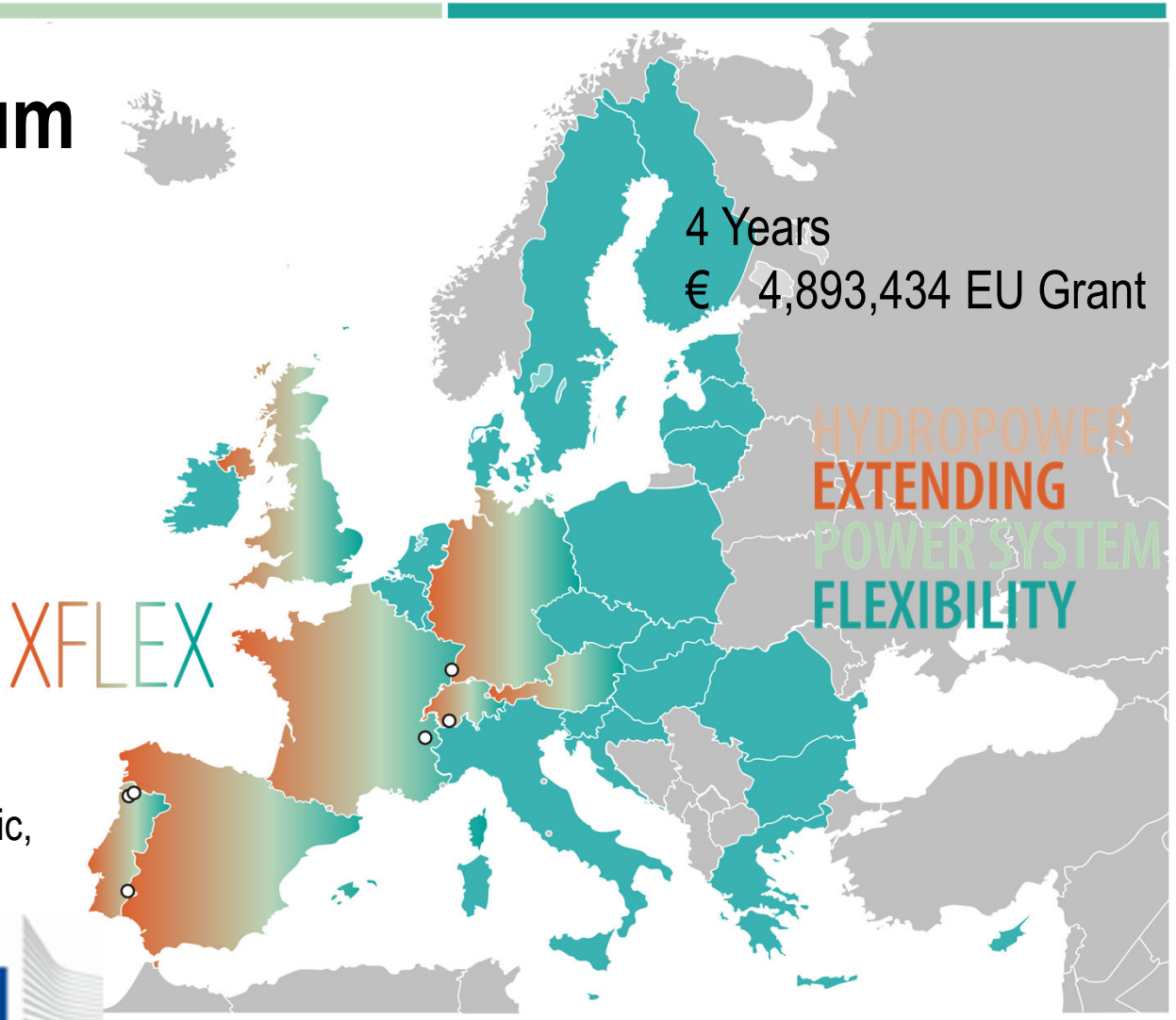
- ANDRITZ AG, Mr. Lais

Consulting

- PVE, Dr. Nicolet

Universities

- EPFL, LMH-Prof. Avellan, PEL-Prof. Dujic, DESL Prof. Paolone
- HESSO Valais Wallis, Prof. Münch



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