

Synergies des renouvelables pour l'avenir énergétique









générée avec Chat GPT

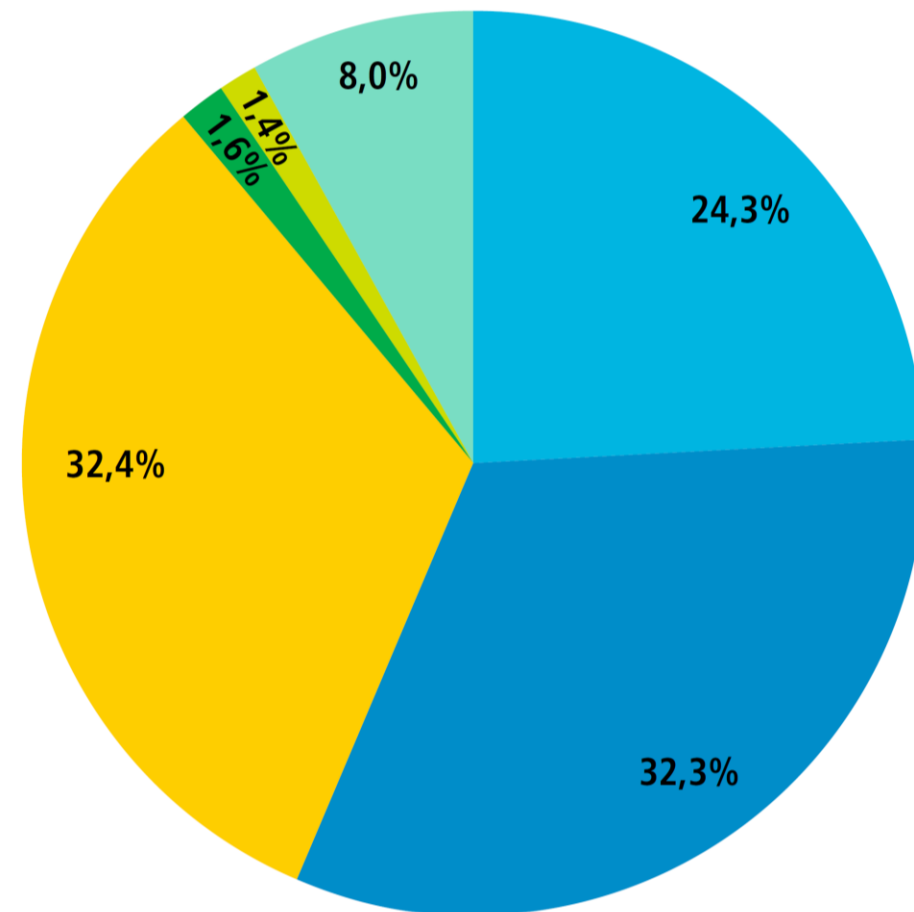
Innovations dans l'hydroélectricité & le photovoltaïque

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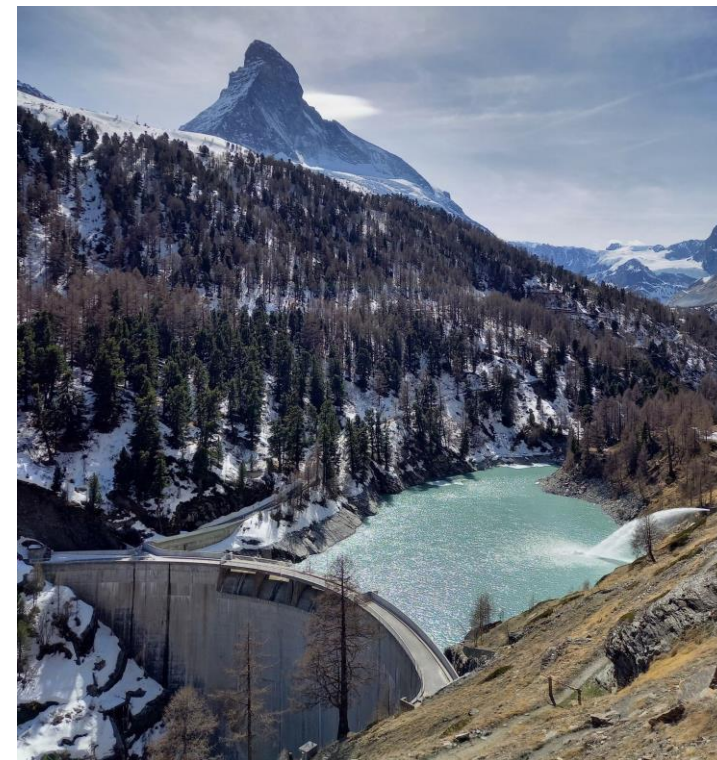
What is the role of Hydropower in Switzerland?

-  Laufkraftwerke
Centrales au fil de l'eau
-  Speicherkraftwerke
Centrales à accumulation
-  Kernkraftwerke
Centrales nucléaires
-  Konventionell-thermische Kraft- und Fernheizkraftwerke (nicht erneuerbar)
Centrales thermiques classiques et centrales chaleur-force (non renouvelable)
-  Konventionell-thermische Kraft- und Fernheizkraftwerke (erneuerbar)
Centrales thermiques classiques et centrales chaleur-force (renouvelable)
-  Diverse erneuerbare Energien
Energies renouvelables diverses



Hydropower Generation & Storage

- ~ 700 hydropower plants (over 300 kW)
- Annual production > 37 TWh/year
- Installed capacity ~ 18 GW
- Well balanced between storage and run-of-river power plants
- Estimated potential of ~ +3 TWh/year
- Storage capacity in our dams ~ 9 TWh
- Installed capacity in our pumped storage plants ~ 4.4 GW



Source: D. Biner, HES SO Valais, Z'Mutt Reservoir, Grande Dixence.

- High energy density
- High efficiency $\eta > 90\%$
- High availability $> 90\%$
- Long service life ~ 90 years
- Very low GHG
- Good LCA

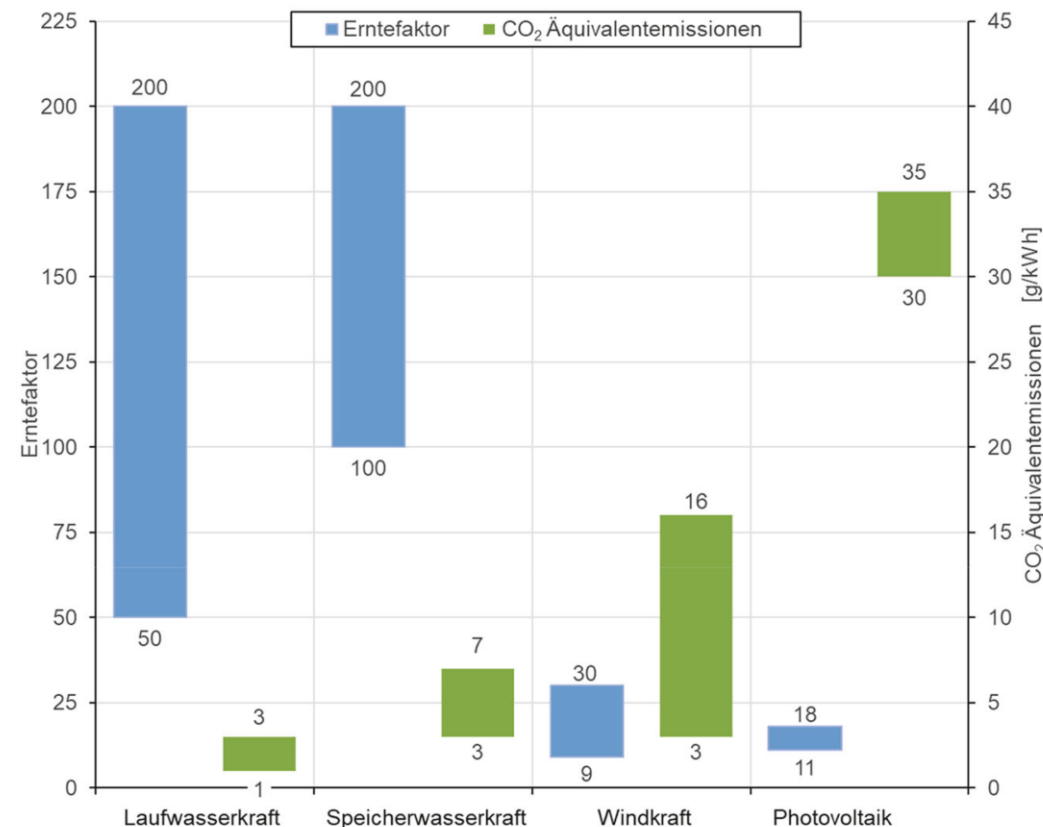
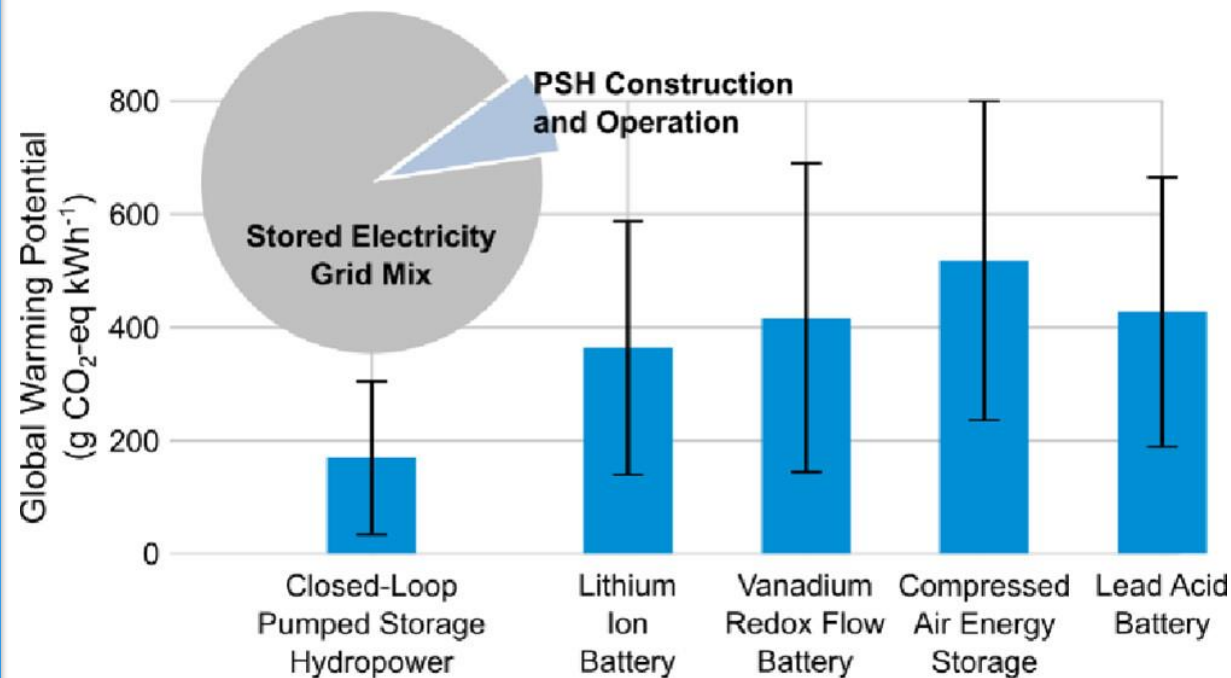


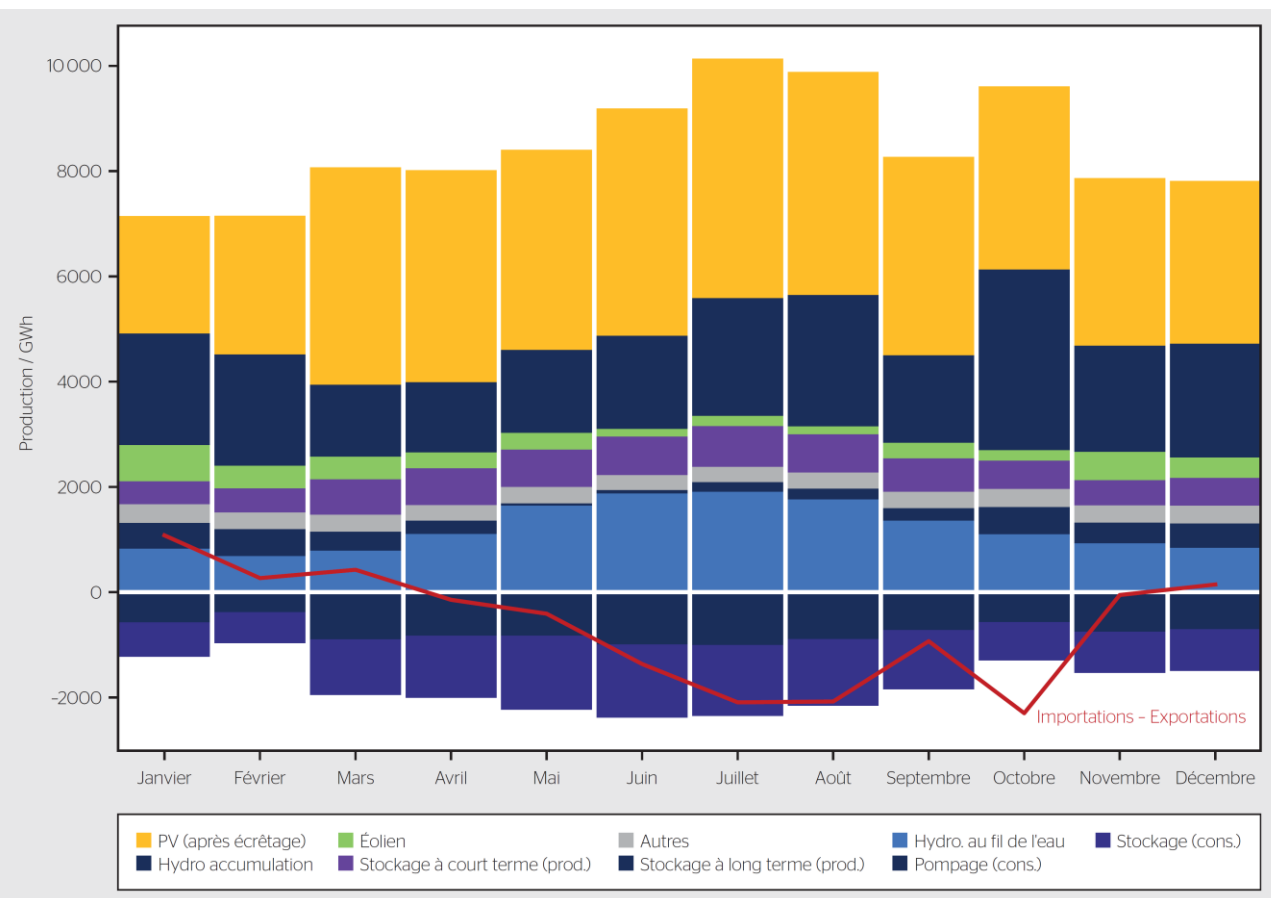
Abb. 1 Spanne des Erntefaktors (blau) und Spanne der CO₂-Äquivalentemission (grün) für verschiedene erneuerbare Energiequellen (Datenquellen: (Giesecke und Heimerl 2014; Fry et al. 2022; Fraunhofer ISE 2024))

Source: R. Boes, «Beitrag der Wasserkraft zur Energieversorgung», Energy week 2024, ETHZ & Jähnel, C., et al. (2024). Sohlstabilisierung, Gewässerökologie und Wasserkraft: Die Sanierungsvariante E1+ „Mehr Fluss “an der Unteren Salzach. *Österreichische Wasser-und Abfallwirtschaft*, 1-10.

- High energy density
- High efficiency $\eta > 90\%$
- High availability $> 90\%$
- Long service life ~ 90 years
- Very low GHG
- Good LCA



What is the future role of Hydropower in Switzerland?



Source : La force hydraulique, alliée du photovoltaïque. Bulletin Electrosuisse 10.2022, P.A Alet, T. Gorecki, R. Dassonville, B. Valluy

Tomorrow?



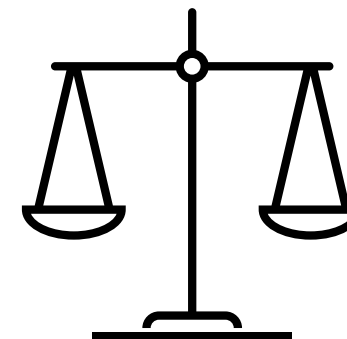
Power & Voltage control



Energy Balance

Storage

Reactivity



Environment

Lifespan

Research and Education in Hydropower ?

Example of a strong partnership between owners, operators & academy

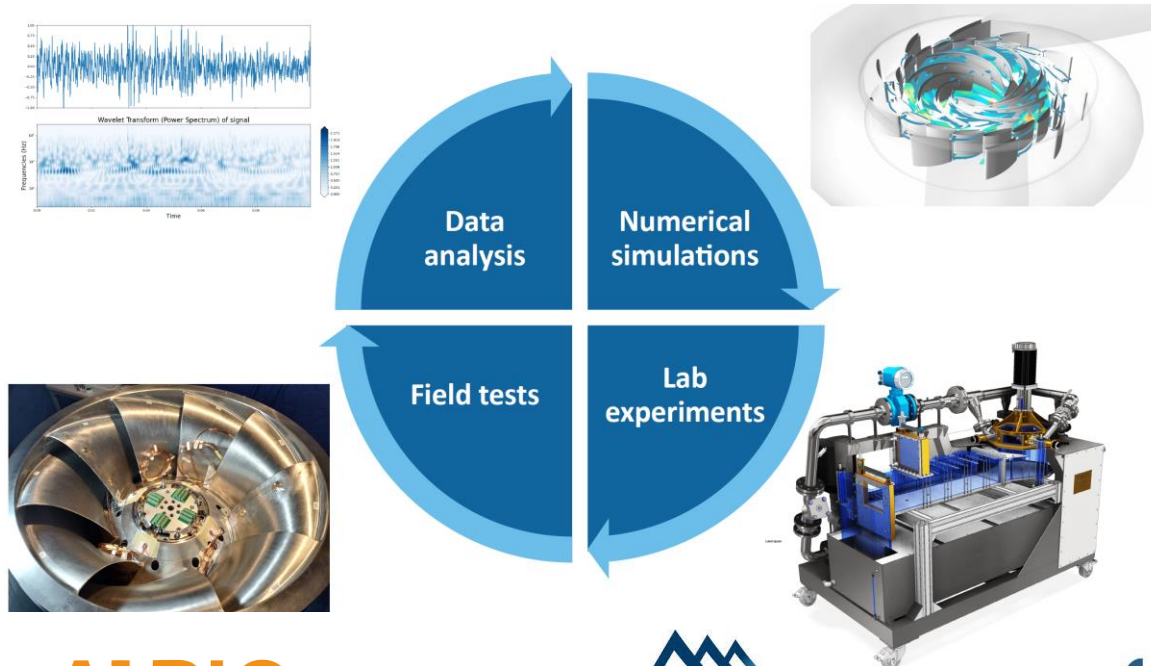
Hydro Alps Lab

Our Vision

Better understand the behaviour of
hydropower plant components ...

... to improve ...

... and to reach



PREDICTION

&

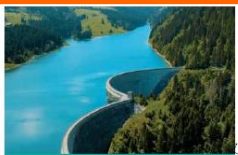
MONITORING

FLEXIBILITY

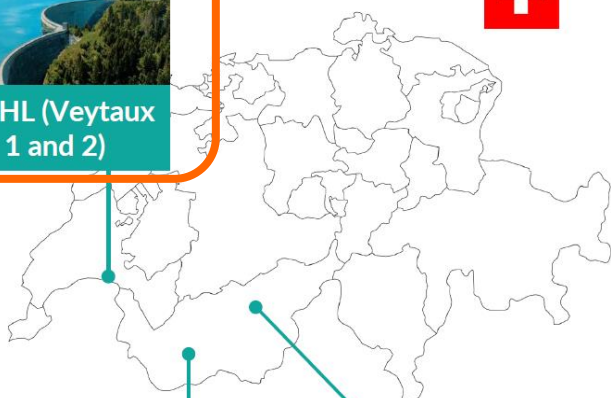
&

DURABILITY

Example of on-going research activities : P+D OFEN projects



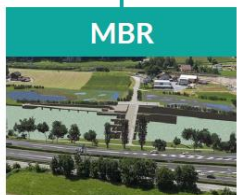
FMHL (Veytaux 1 and 2)



KW ERNEN

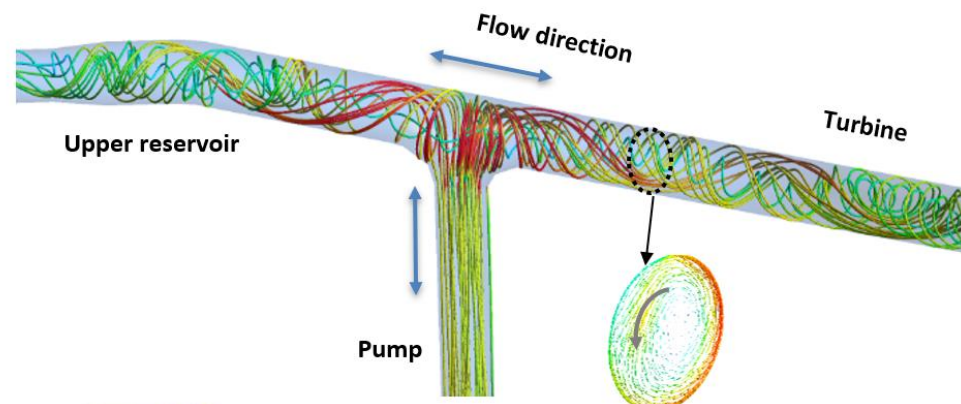


MBR



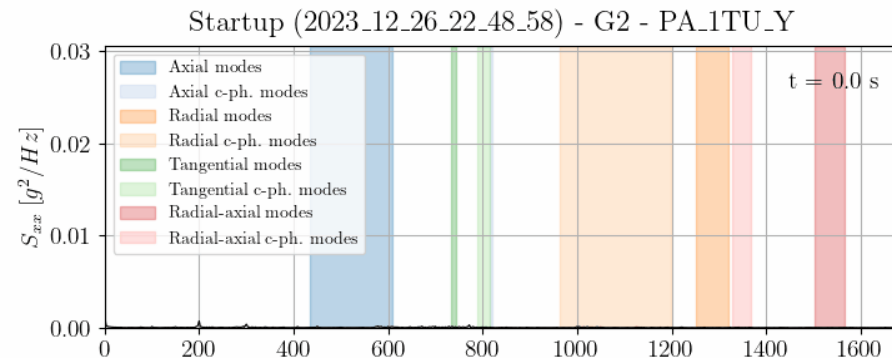
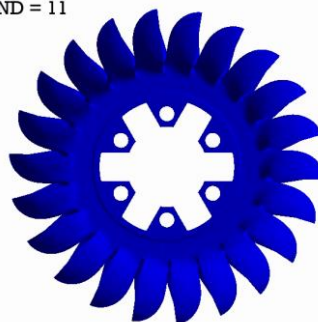
P+D SFOE Project SI/502106

Flexibility : Hydraulic Short Circuit allows pumping and generating modes at the same time to provide new services to the grid



Ageing : Predictive Maintenance & Vibrational digital twin

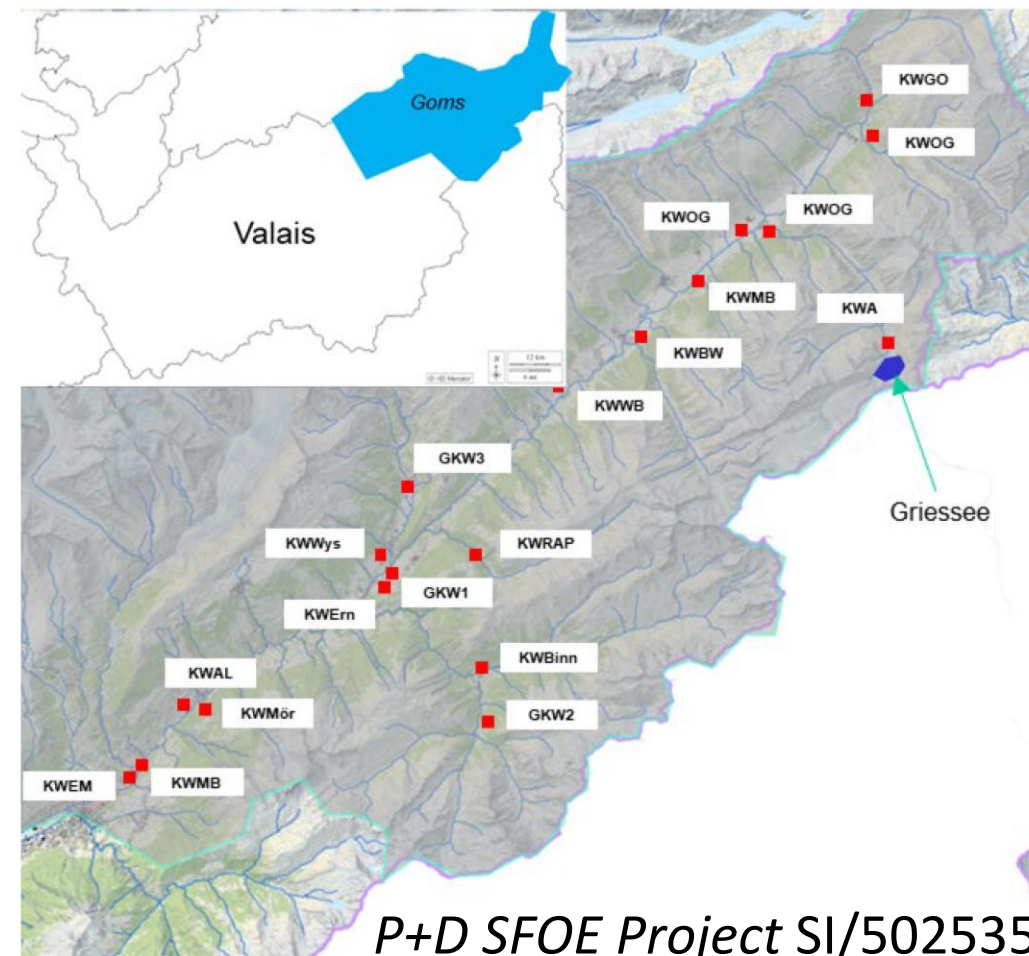
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Example of on-going research activities : P+D OFEN projects

SmallFLEX Goms project : Complementarity between small and medium Hydropower plants with Photovoltaic and Wind production in Goms Region.

- **Long-term monitoring** of new flexible mode at KWGO hydropower plant.
- **Hydraulic analysis** of the technical limits of new flexible operations for a selection of HPPs.
- **Short-term prediction** of the inflow, wind and solar potential.
- Investigation of the **risk of air entrainment**
- **On-site test campaigns**
- **Virtual Power Plant**
- **Business model** of the unlocked flexible modes.



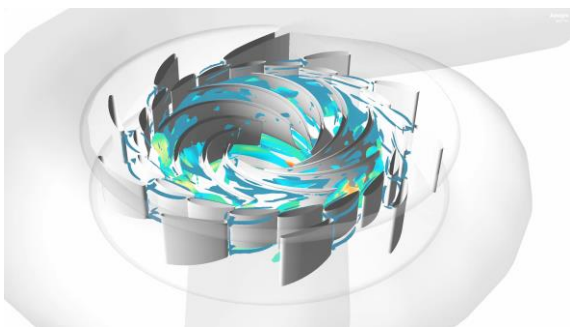
P+D SFOE Project SI/502535

Example of on-going research activities : European projects

XFLEX HYDRO

2019-2024

Demonstrate **the flexibility** of the European hydropower fleet integrating **new technologies** such as **variable speed**, **hybridization with batteries** and **hydraulic short-circuit**.



Variable Speed

Capability of hydroelectric units to produce power at grid frequency regardless of the turbine's rotational speed.

Swiss Demo
Zmutt Pumping
station of GD.

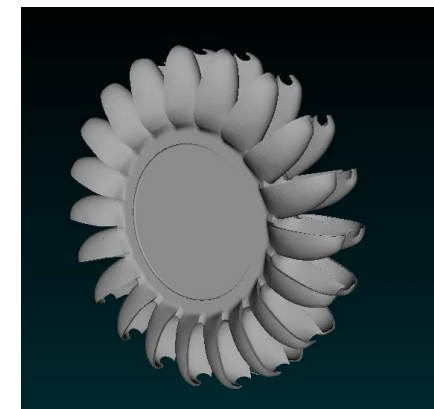


2024 -2028

Demonstrate how European hydropower can be **refurbished and modernized** for the future energy system respecting **sustainability requirements and societal needs** in a climate change context.

Improved refurbishment
performance using numerical
and monitoring tools.

Swiss Demos :
Bitsch & Vissoie HPPs with a
focus in erosion on Pelton
turbines.

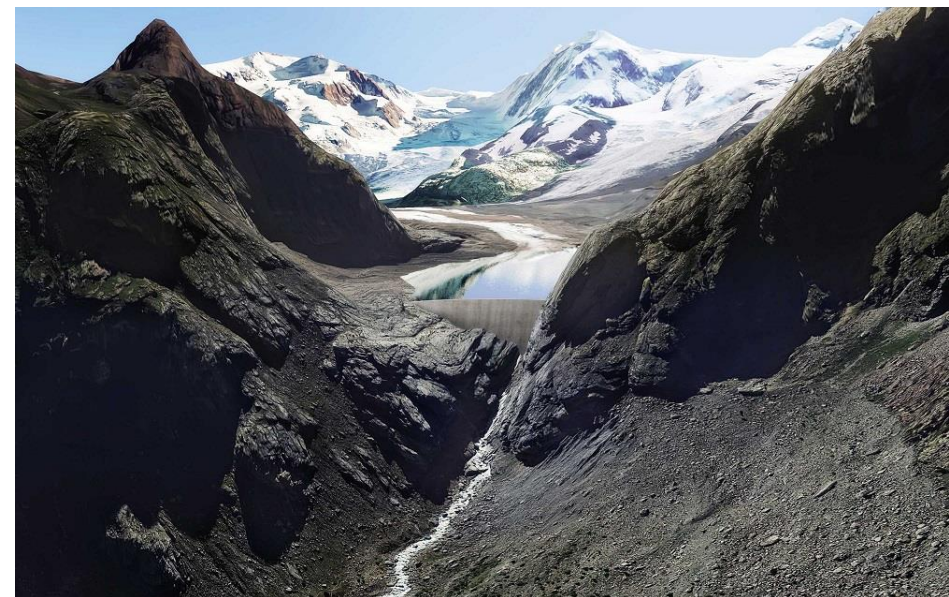


Hydropower is a key asset to enable energy transition *“1TWh of flexible hydropower enables the construction of at least 3.5TWh of intermittent wind or solar”*

Source : EU Hydropower Alliance / Statkraft

Future Challenges & Opportunities

- End of concessions until 2050 for 60% the Swiss hydropower production.
- Optimization of existing infrastructure during refurbishment projects to adapt to ecological requirements & climate change.
- Development of predictive maintenance for our ageing assets.
- Increase of Hydropower Winter Production + 2 TWh.
- Development of synergies with multi-purpose reservoir and hybridization.
- **A secured research funding program for energy is essential.**



Gornerli project

Source : Bonnes intentions et maintenant ... actions !
Bulletin Electosuisse 2022, V. Bourdin