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Small Scale Solution for Energy Transfer using Pump-Turbines

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Introduction

Due to the massive penetration of new renewable energies (NRE), energy storage is required to stabilize the Swiss electrical power network. Among the various available solutions, pump storage power plant (PSPs) represents 99% of the world storage capacity.

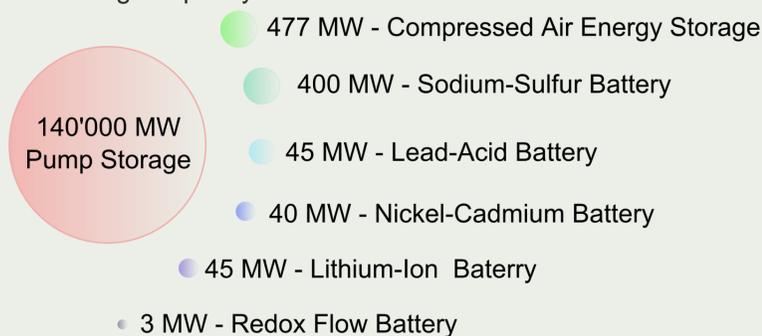


Fig. 1 – Storage capacity set up in the world (ref. Guide ENR, 2012)

Small PSPs, with a capacity below 10 MW, to provide local voltage control and line congestion management to low-voltage and medium-voltage active distribution networks is one of the competitive solution among the decentralized storage technical options.

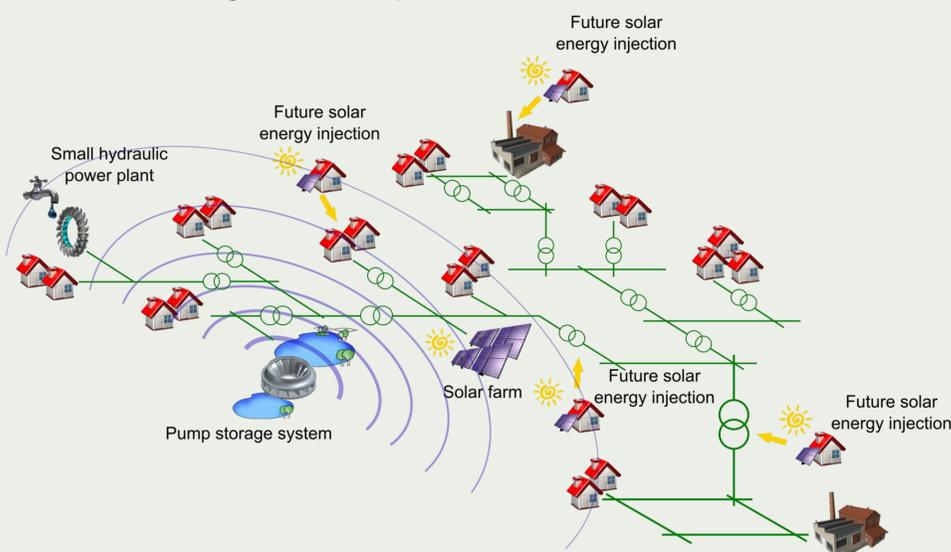


Fig. 2 – Schematic representation of a medium voltage electrical network including NRE.

Objectives

The objectives of the project is to identify potential sites in Switzerland, mainly in Wallis and Vaud cantons, and to provide a guide for districts to assess the technical and economical possibilities to install small PSPs on their territories.

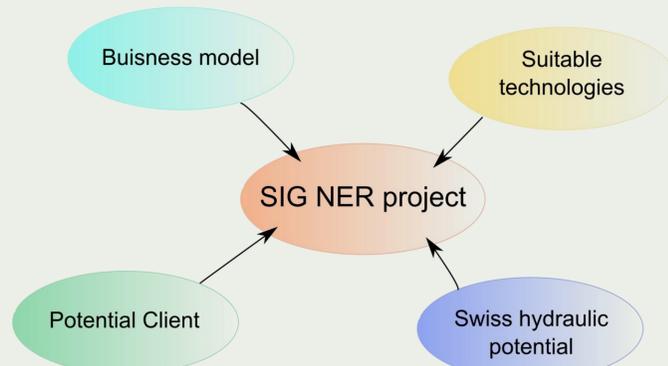


Fig. 3 – Field of study covered by the SIG NER project

Hydraulic potential study in Wallis

Wallis counts lots of lakes and artificial reservoirs used for tourism, drinking water, irrigation, artificial snow cover or hydro-electricity production. For the study, only the sites with an existing reservoir and a potential of 250 kWh are considered.

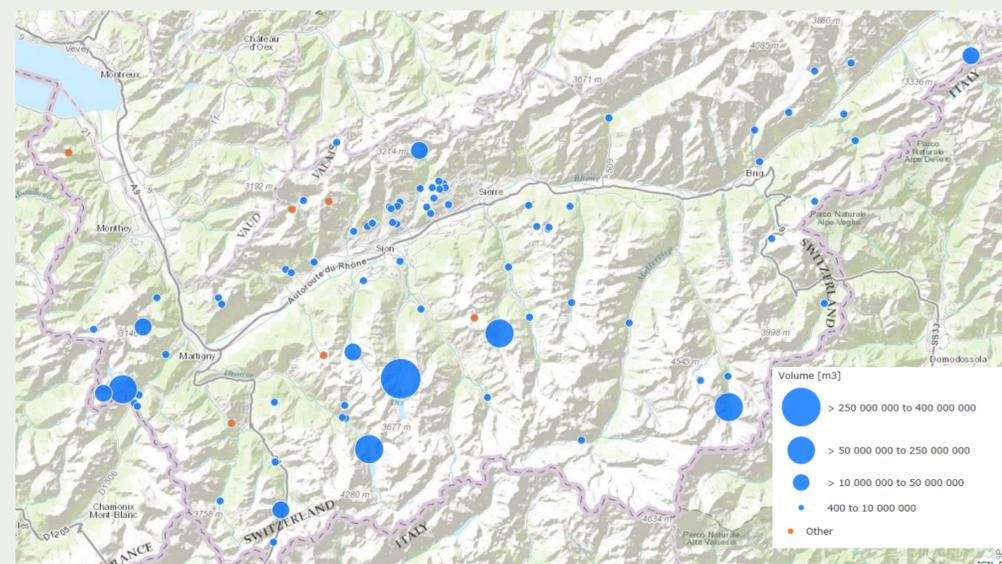


Fig. 4 – Lakes and artificial in Wallis

Potential clients

Interviews of distribution system operators (DSO) have been conducted to identify and discuss their potential interest. An economic model for such a storage system is not straightforward to design, however the main interest is for:

A global storage capacity of half a day for a cycle of 6 hours and at least a power of 5MW

Technologies

Several options are available for PSPs : reversible pump-turbines with variable speed, ternary groups or separated units. For small power, a study on the suitable technical and economic options according to the hydraulic potential is on-going. A focus on medium head situations is proposed in this project by assessing the possibility to use a double regulated Diagonal pump-turbines with moving guide vanes and runner blades.

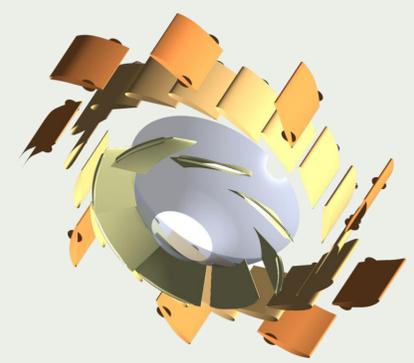
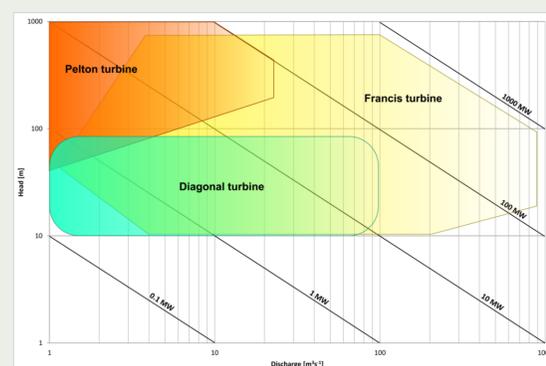


Fig. 5 – Operating ranges covered by Pelton, Francis and Diagonal turbines (left) and design of the diagonal turbine produced by MhyLab (right).

References:

Shadya Gabathuler, Davide Pavanello, Cécile Münch-Alligné, 2015, «Le pompage-turbinage à petite échelle pour le stockage local d'énergie», Bulletin Electro-Suisse, 2/2015, pp. 49-54.

Partners:

