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## ▶ To cite this version:

Maël Le Marre, Philippe Mandin, Praveen Thappily, Erik Zlliox, Jean-Louis Lanoisellé, et al.. Coupling Micro-Hydropower with electrolyzing, case study. 2020. hal-02915949

HAL Id: hal-02915949

https://hal.science/hal-02915949

Preprint submitted on 17 Aug 2020

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## Coupling Micro-Hydropower with electrolyzing, case study

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The energy used to pump and treat water for residents and industry represents between – and 3% of the world's energy consumption {1}. The consumption can be reduced by 25% trough solutions like microhydropower (MHP). Pressure reducing valve (PRV) are installed in the water distribution network (WDN) to reduce the leakage losses, which is directly related to the pressure in pipe {2}. The reducing of pressure in PRVs lead to hydraulic losses into thermal losses, replace PRV with MHP system is a good solution to recover a part of those losses. On the other hand, the transport area, with thermal motor, is one of the main issues for slowing the global warming. Replace thermal motor with electrical motor supplied by fuel cells is a good solution. One of the biggest water tanks in Rennes (France) called "Les Gallets" is an interesting site to implement MHP installation, the huge site area allows to implement a electrolyze installation to supply hydrogen cars. Coupling the production of hydrogen with MHP system is a solution to get a green energy production. The scheme of the installation is presented in figure 1.



Figure 1: Installation's scheme

The site "Les Gallets" is composed of two water tanks, one is called "Les Gallets Haut", the other one is called "Les Gallets Bas". Two MHP systems can be installed, one upstream the first water tank, and one between both water tanks. Conventional turbines are not massively available on the market, hence they are expensive and lead to strong payback periods for MHP, to face this problem, the use of pumps in reverse mode (pumps as turbines) is a solution {3}. Indeed, those pumps have a good accuracy (between 50 to 85%) and can divided by 10 times the payback period of an installation compared to conventional turbines installations. For this study, an average efficiency of 65% for Pumps as turbines installations is considered.

Flow conditions of both installations are detailed in table 1.

Site	Flow rate (I/s)	Head (m)	Load factor (h/year)	E <sub>lost</sub> (MWh/year)	Producible (MWh/year)	H <sub>2</sub> Producible (kg H <sub>2</sub> /year)
Gallets Haut	208	11	7366	165,7	107,705	1795
Gallets Bas	100	19	6647	137,6	89,44	1490

Table 1: Flow conditions of Gallets sites

The total electricity production in "Les Gallets" will reach about 197MWh per year. Considering that the electrolyzer absorb 60 kWh of electricity to create 1kg of Hydrogen. The electrolyzer will be able to produce about 3285kg of  $\rm H_2$  per year. Considering a conventional Hydrogen car, with an autonomy of 500km, and a Hydrogen's consumption of 1kg of  $\rm H_2/100km$ , it will be possible to load the car's fuel cell 625 times per year.

## References:

- 1}: De Marchis et al., 2014, *Procedia Engineering*: "Energy recovery in water distribution networks. Implementation of pumps as turbine in a dynamic numerical mode"
- {2}: Colombo et al., 2002, Water Resour. Plan. Manag, 128, 441-450: "Energy and costs of leaky pipes: Toward Comprehensive Picture"
- {3}: Chappallaz et al., 1992, "Manual on pumps used as turbines"







