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Hydrokinetic & Solar energy contribution to a reliable energy supply

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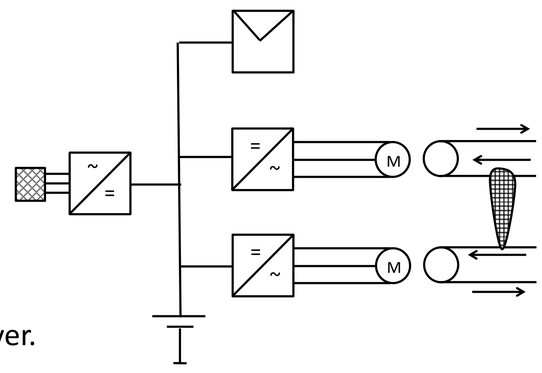
Motivation

The increasing share of renewable resources in the European electricity system leads to instabilities of the whole system due to fluctuating renewable power outputs. Furthermore new lines have to be build to distribute the unevenly distributed generation. Decentralized controllable micro generation can be used to damp these effects.

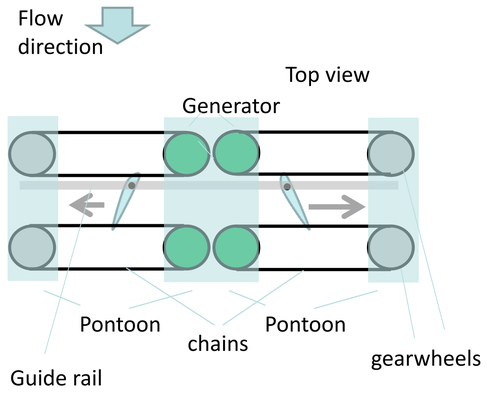
Concept

In our study we consider a controllable hydrokinetic micro turbine, based on an oscillating hydrofoil which extracts kinetic energy from a rivers current.
The advantages:

- Controllable power output over each period.
- Simple combination with other Renewable sources (solar, wind).
- Improved concept with adaptable operation depth of the foils.
- Predictable power output, due to slowly alternating rivers speed.
- Low impact on the nature, since device is connected to removable raft in a river.
- Due to slow motion of the foil not harming the aquatic life.
- Easily removable in case of flooding.
- Simple maintenance.
- Needs relatively small rivers (min 3m width).



Electrical concept of solar and hydro combination.



Mechanical concept of the hydro Turbine.

Potential

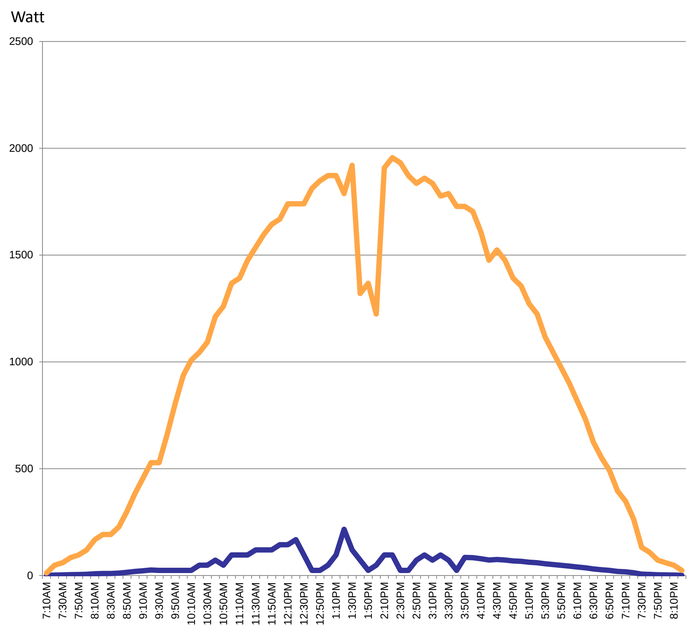
The system can be used decentralized to supply the electricity consumption of private households in the low kW range

Sample household in Luxembourg
Consumption for the 11th of December, taken for summer and winter (average 2,015kW)

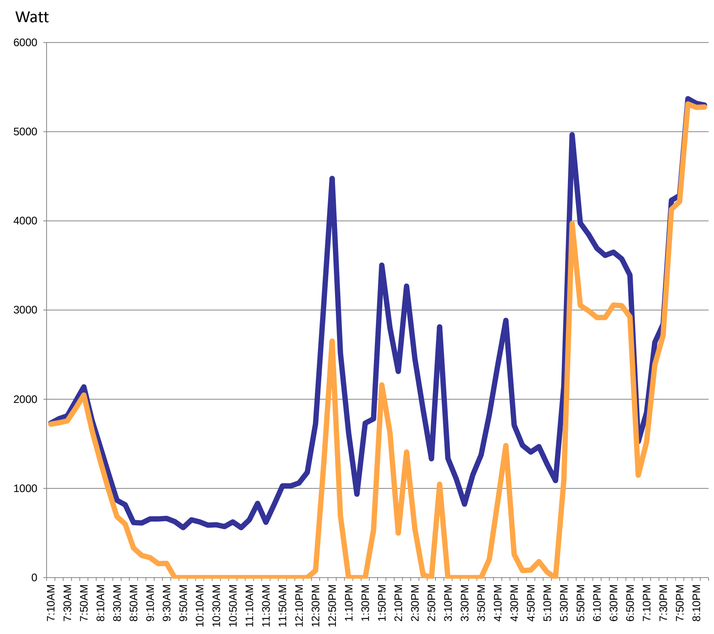
Sizes
Solar PV 2,6 KW
Hydro Gemünd-Location (flow speed 1,8-2,4m/s)
2x foil 1m length moving 1m (0,55-1,42 kW)

Summer (average)
Need 2,015 kW
PV 1,053kW
Hydro needed 0,962kW (2 systems needed)

Winter (average)
Need 2,015 kW
PV 0,052kW
Hydro needed 1,963kW (0,877 kW feed in)

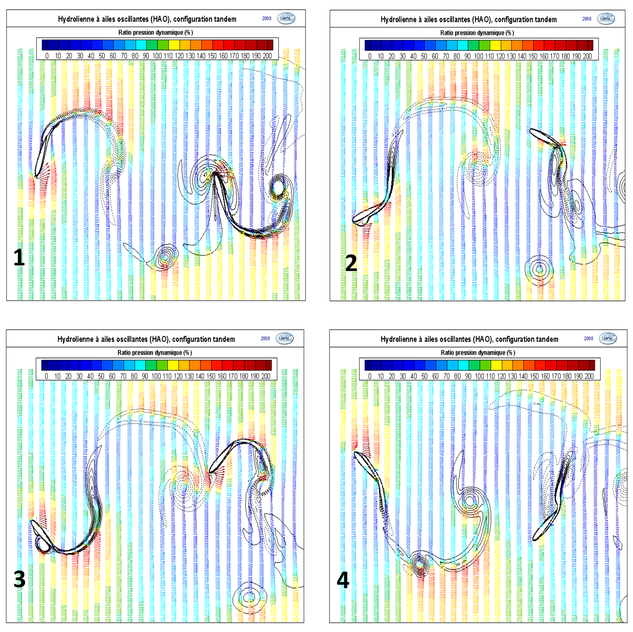


Solar PV (2,6kW peak) summer (yellow) and winter (blue) generation (period 7:10-20:20).

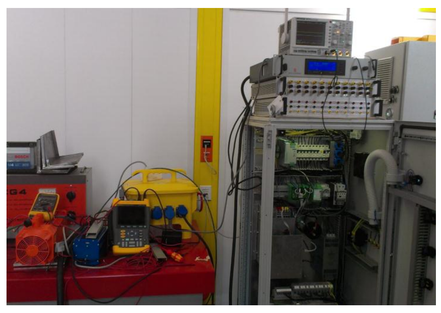


Need of Hydropower (2 systems 1,42 kW average / 5,5 kW peak) summer (yellow) and winter (blue) generation (period 7:10-20:20).

Next steps

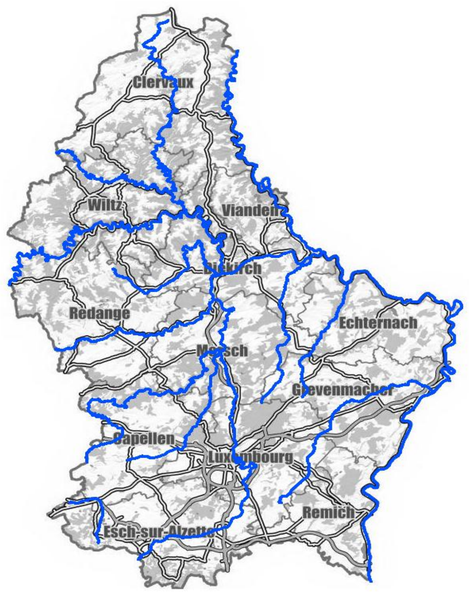


ANSYS Fluent simulation of the tandem Hydrofoil (Université Laval).



NetPower DemoLab Université du Luxembourg.

Field test at the locations of the SEO.



Potential of the turbine for all suitable Luxembourgish rivers using PLEXOS.

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