

Future of Swiss small HydroPower plants

Pr. Cécile Münch-Alligné
10 Septembre 2015

In cooperation with the CTI



Energy funding programme

Swiss Competence Centers for Energy Research



Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

Swiss Confederation

Commission for Technology and Innovation CTI

Small Hydro Powerplants (SHP)

New SHP on the river



SHP Tambobach, GR

< 10MW

SHP on existing infrastructure



SHP Profay, VS

Refurbishment of old SHP






SHP Hard, ZH

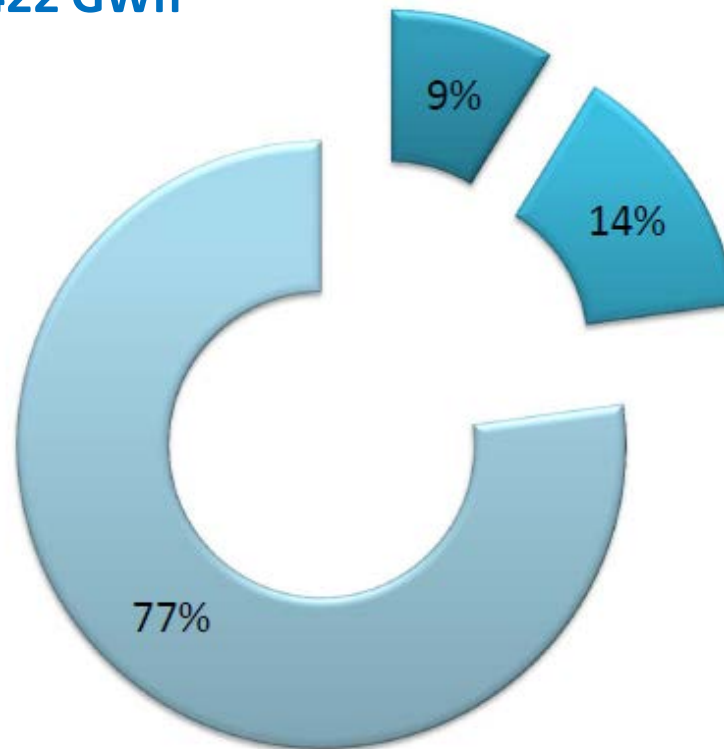
Small hydro production – 2004

P < 300 kW	≈ 300 GWh
300kW < P < 1 MW	481 GWh
1 MW < P < 10 MW	2'641 GWh
Total*	3'422 GWh

*Source PSI 2004

≈ **11 %**
of Hydroelectricity

-  P < 300 kW
-  300 kW < P < 1 MW
-  1 MW < P < 10 MW

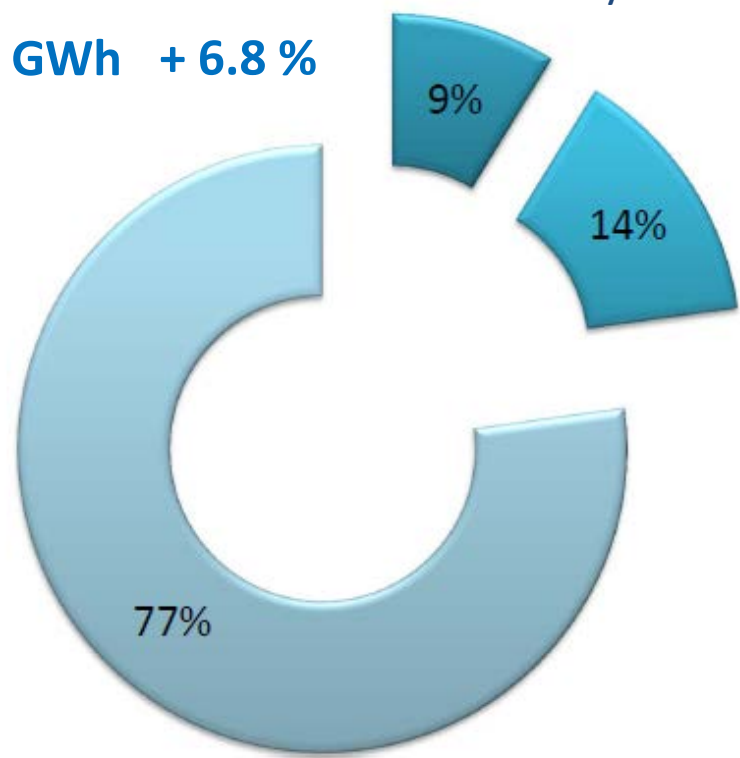





Small hydro production - 2013

P < 300 kW	≈ 310 GWh	+ 3% ?
300kW < P < 1 MW	526 GWh	+ 9.4%
1 MW < P < 10 MW	2'817 GWh	+ 6.6 %
Total*	≈ 3'653 GWh	+ 6.8 %

*Source OFEN 2013

≈ **10 %**
of Hydroelectricity



-  P < 300 kW
-  300 kW < P < 1 MW
-  1 MW < P < 10 MW

Promoting Renewable Energies

Feed-in remuneration at cost (KEV)



Feed-in remuneration at cost for ?

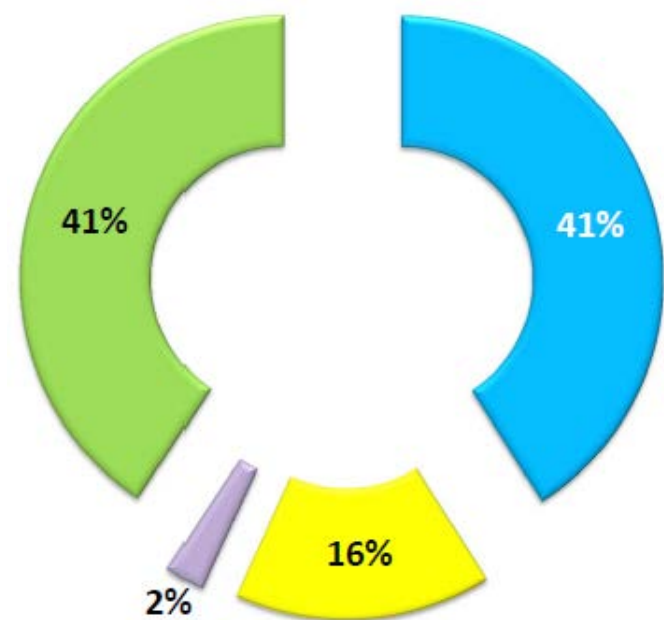
- ✓ Hydro power < 10 MW
- ✓ Photovoltaic energy
- ✓ Wind power
- ✓ Biomass energy
- ✓ Geothermal power

New SHP or refurbished SHP after January 2006

2009	2014
16.5 rp./kWh	15.2 rp./kWh
71 rp./kWh	42.6 rp./kWh
18.6 rp/kWh	18.7 rp./kWh
18.6 rp/kWh	19.9 rp./kWh

Small hydro –Feed-in tariff at cost

Operating power plants



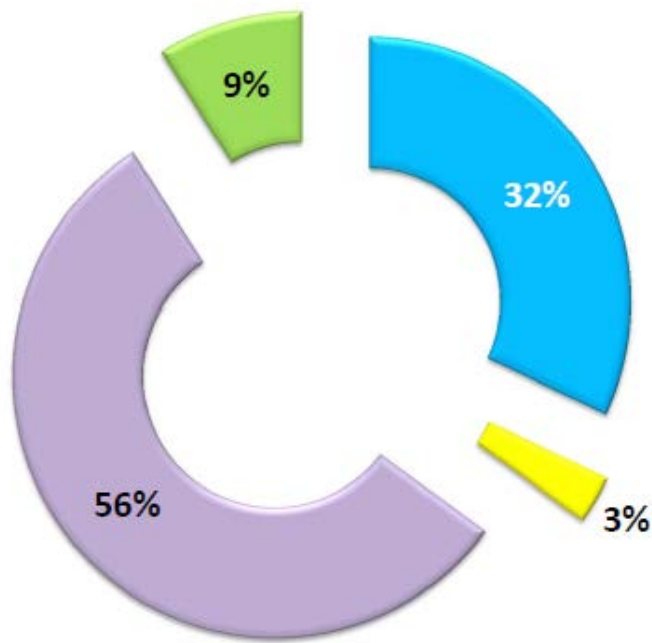
Technologies	Number	Power [MW]	Production [MWh/y]
Small Hydro	413	240	956'447
Photovoltaic	10'209	390	370'226
Wind power	18	30	56'528
Biomass	233	215	949'623

■ Hydro
 ■ Photovoltaic
 ■ Wind
 ■ Biomass

Source :Stiftung KEV
07.2015

Small hydro –Feed-in tariff at cost

Positive answers – not yet in operation



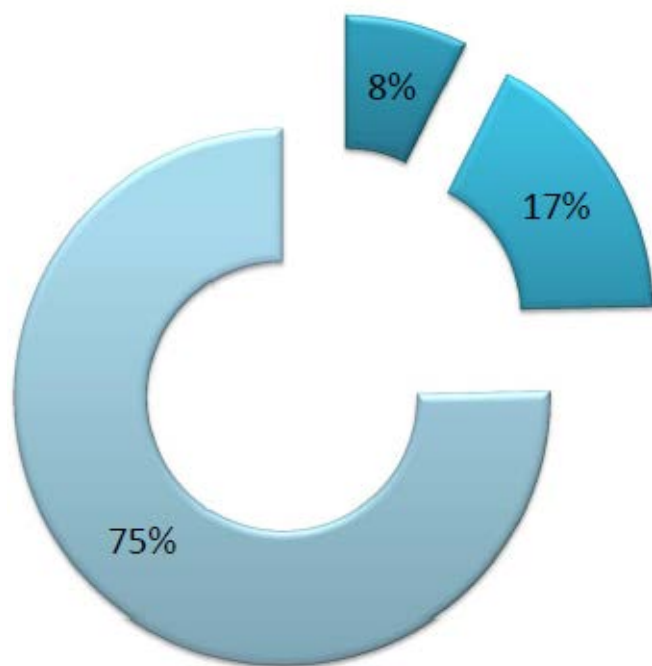
Technologies	Number	Power [MW]	Production [MWh/y]
Small Hydro	350	347	1'211'578
Photovoltaic	2'264	119	113'827
Wind power	572	1'243	2'112'283
Biomass	87	60	341'849

■ Hydro
 ■ Photovoltaic
 ■ Wind
 ■ Biomass

Source :Stiftung KEV
07.2015

Small hydro – Feed-in tariff at cost

Positive answers – not yet in operation



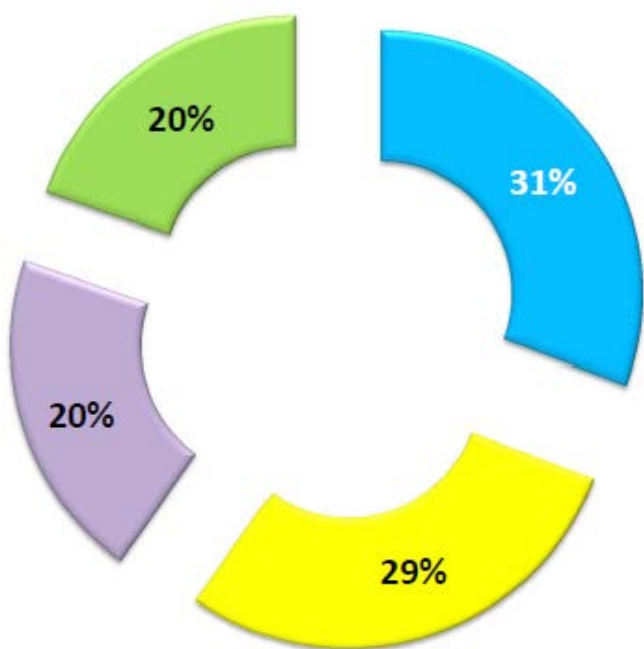
■ $P < 300$ kW ■ 300 kW $< P < 1$ MW ■ 1 MW $< P < 10$ MW

Technologies	Number	Power [MW]	Production [MWh/y]
Small Hydro	350	347	1'211'578
Photovoltaic	2'264	119	113'827
Wind power	572	1'243	2'112'283
Biomass	87	60	341'849

Source :Stiftung KEV
07.2015

Small hydro –Feed-in tariff at cost

Waiting list

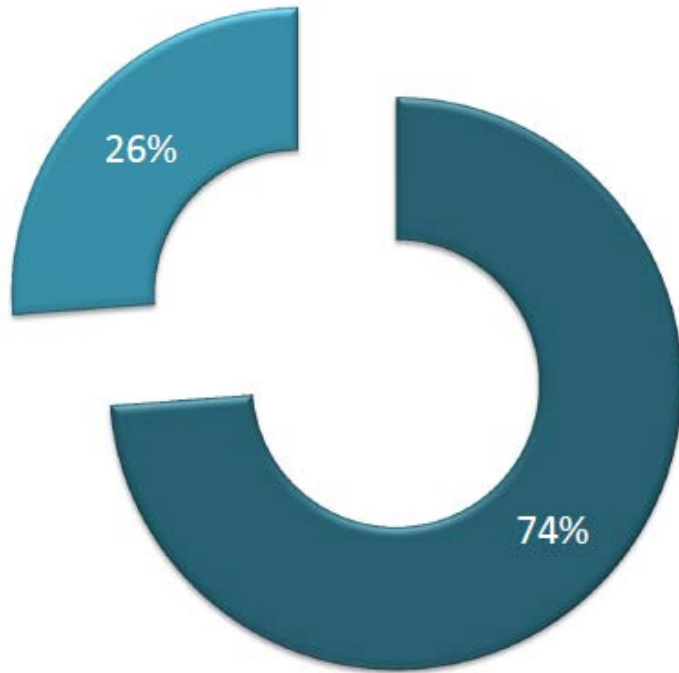


Technologies	Number	Power [MW]	Production [MWh/y]
Small Hydro	519	433	2'018'559
Photovoltaic	34'174	2'060	1'905'427
Wind power	329	735	1'344'672
Biomass	246	214	1'292'791

■ Hydro
 ■ Photovoltaic
 ■ Wind
 ■ Biomass

Source :Stiftung KEV
07.2015

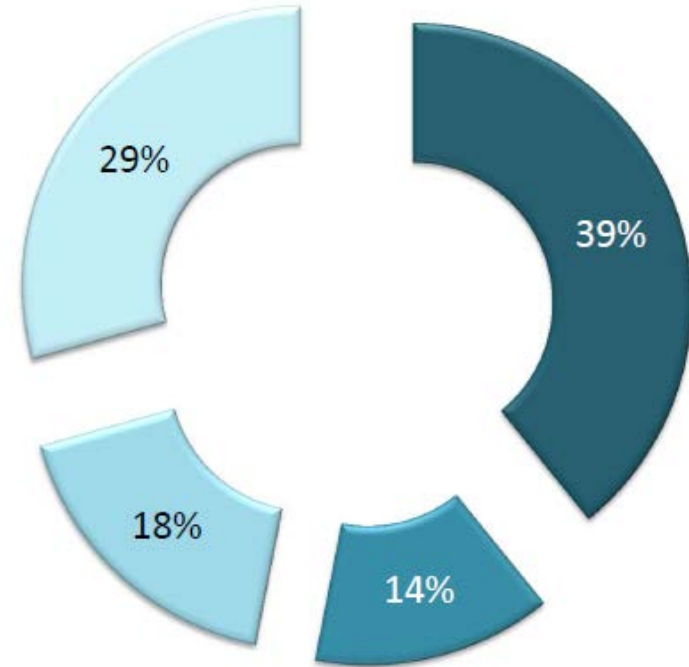
Small hydro – Potential



Current Production of SHP
 ≈ 3'650 GWh

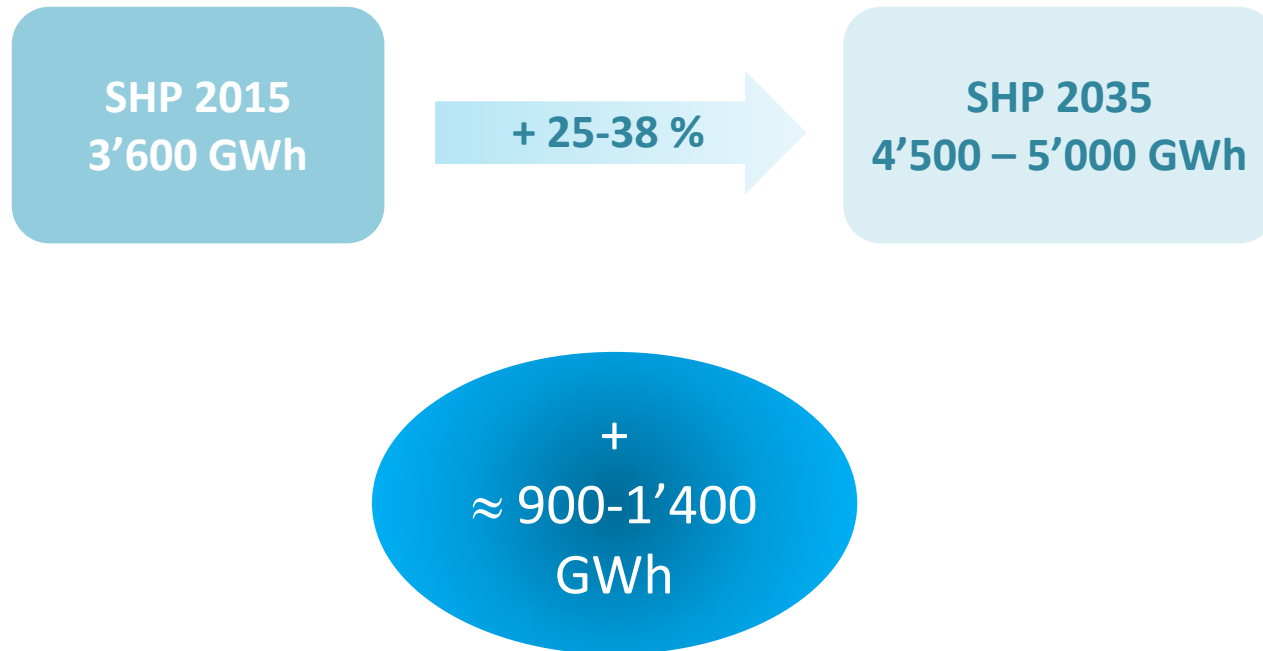
- Production SHP
- KEV-Production SHP
- KEV-Positive Answer SHP
- KEV-Waiting list SHP

+3'000
 GWh ?



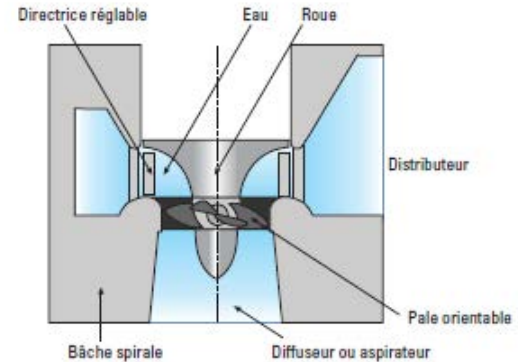
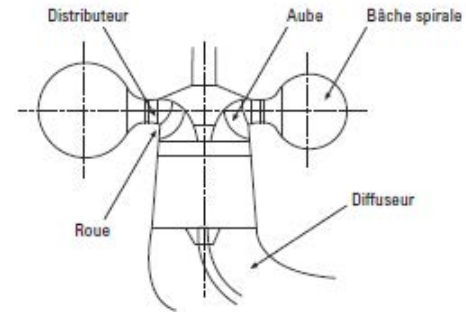
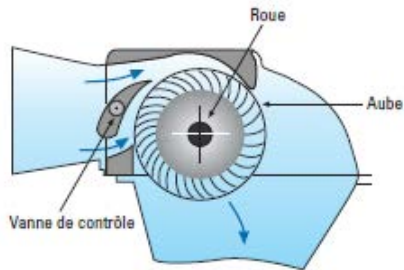
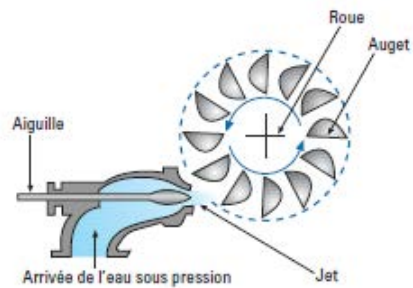
Total SHP Maximum potential
 ≈ 6'890 GWh

Small hydro – Objective 2035



From KEV- positive answer to operating SHP :
environmental protection and licencing procedure

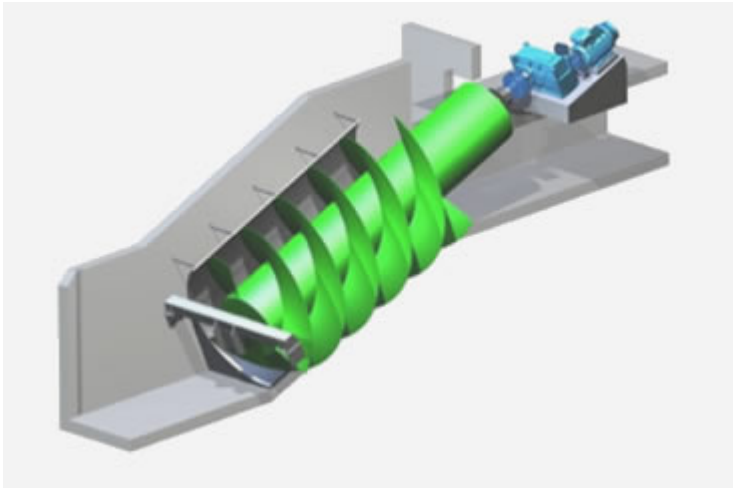
Small hydro turbines ... like the large ones



Small hydro turbines – specific technologies

SCCER  SoE

Examples of low head turbines



Archimedes screw

H : 1-10 m

Q : 100 l/s – 10'000 l/s

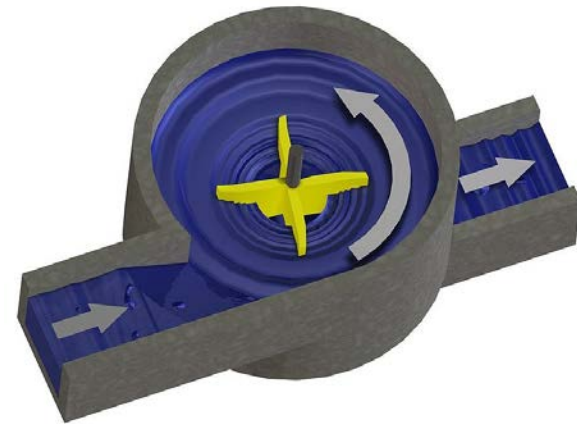
P : 1kW – 300 kW

Vortex turbine

H : 0.7-3 m

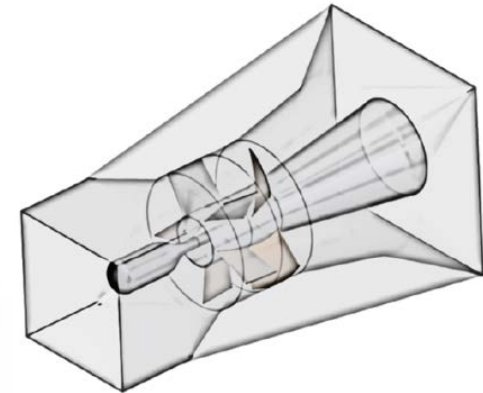
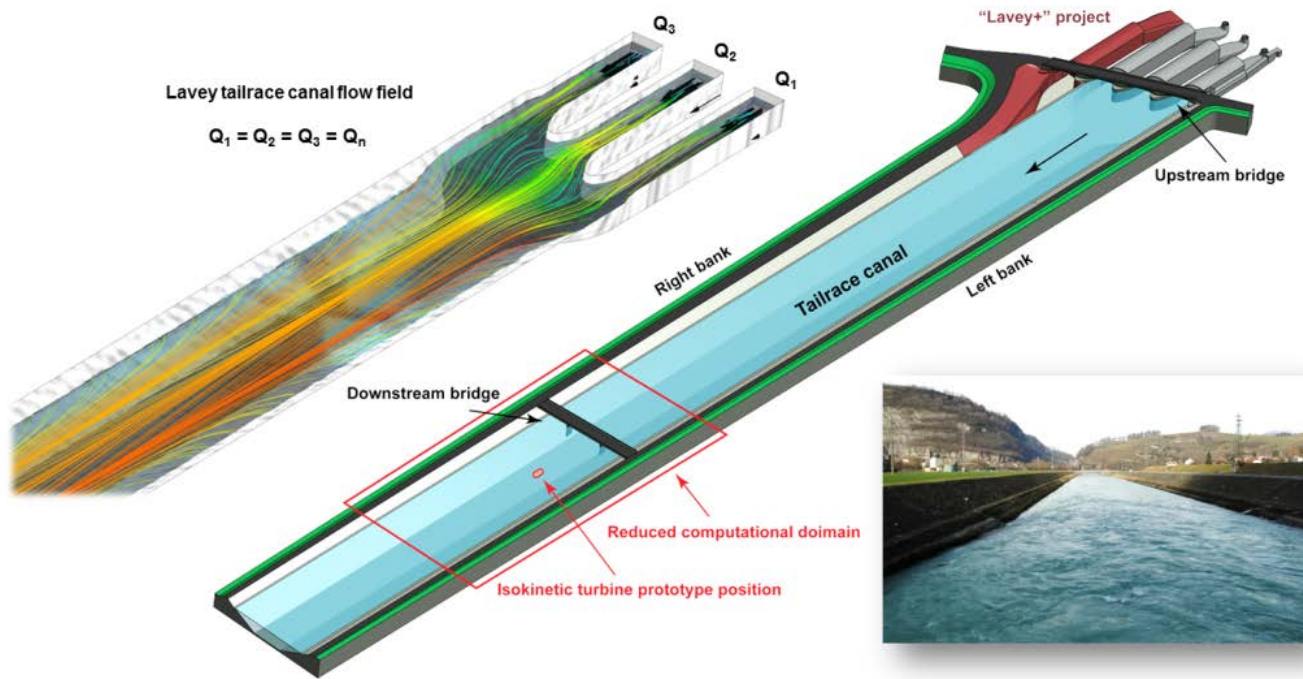
Q : 1'000 l/s

P : 5 kW – 20 kW



Small hydro turbines – development

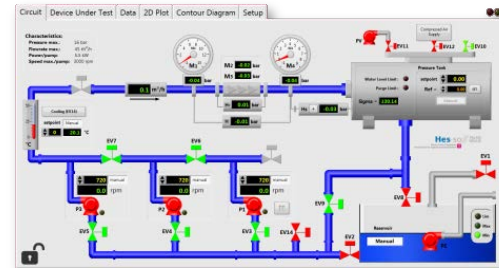
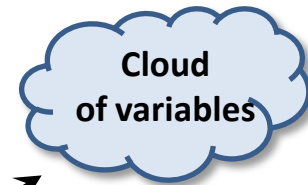
Isokinetic turbine for artificial waterways



A first prototype of 1kW will be installed in the tailrace channel of Lavey Power Plant
 Fundings research

Small hydro turbines

Specific infrastructure at the HES SO Valais



Main characteristics:

Maximum head: **160 mWC**

Maximum discharge: **100 m³/h**

Generating power: **20 kW**

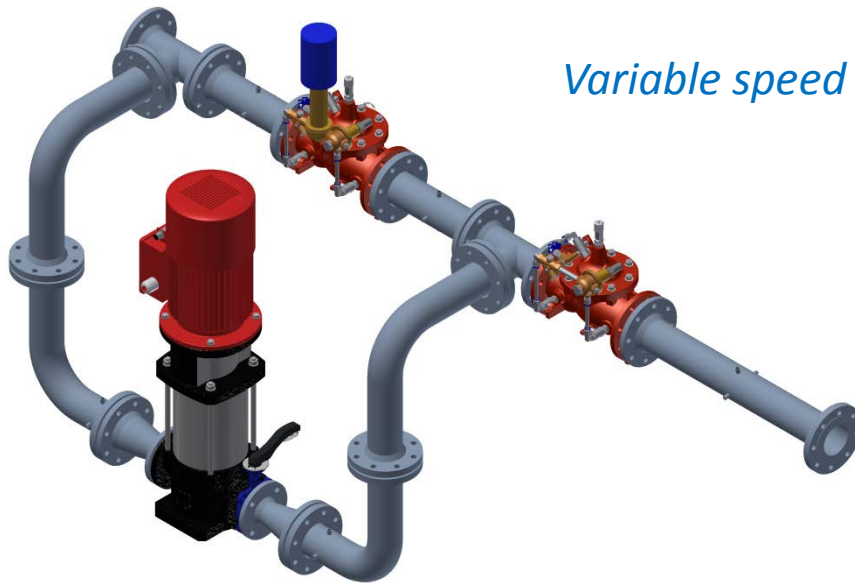
Pumping power: **2 x 18.5 kW & 1 x 5.5 kW**

Maximum pumps speed: **3'000 rpm**

Total circuit volume: **4.5 m³**

Small hydro turbines

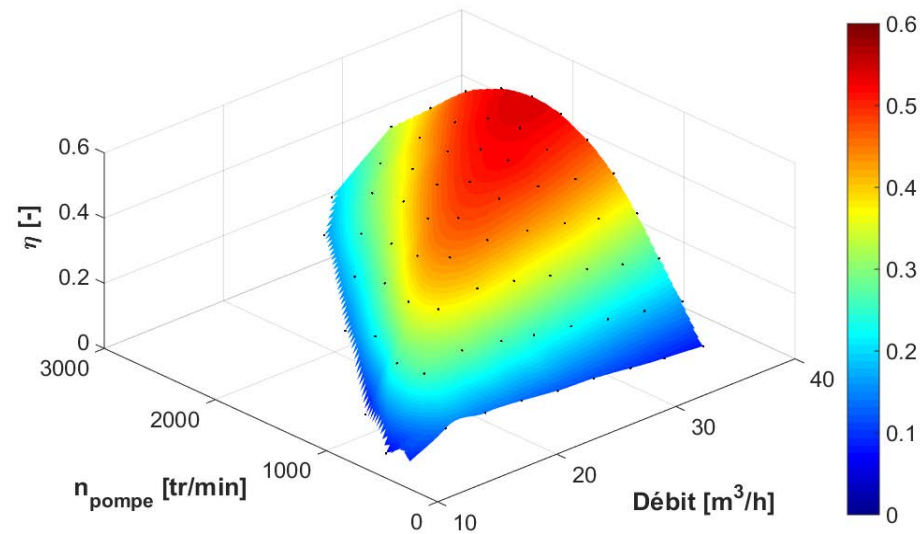
Specific technologies : Pump as turbine



H : 30 -120 m

Q : 3-12 l/s

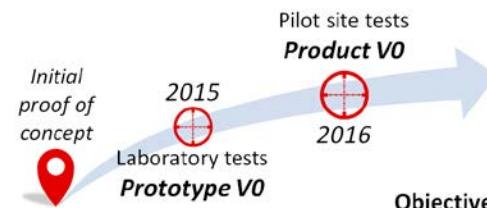
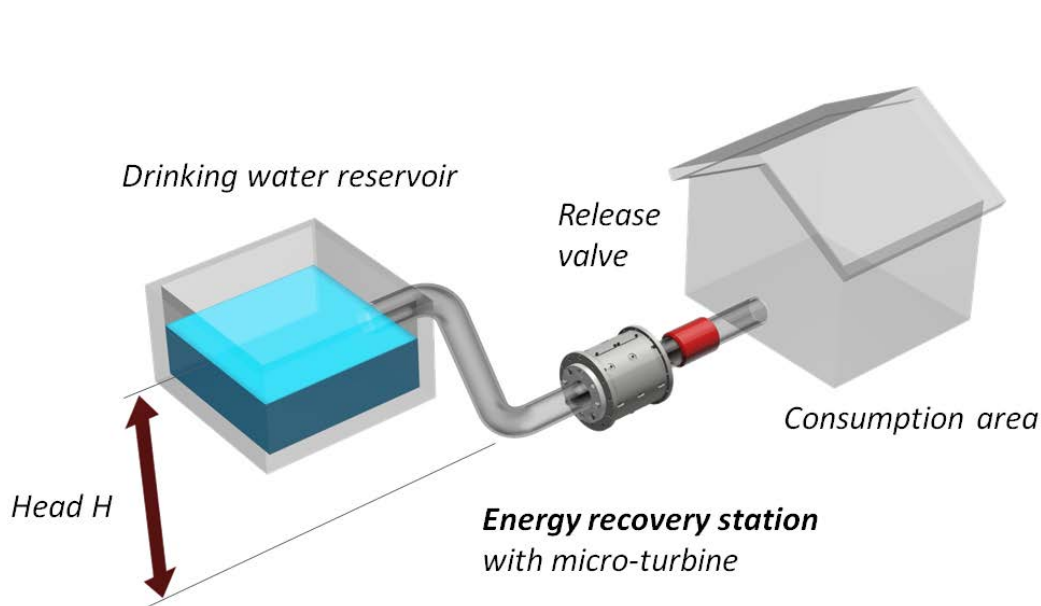
P : 3kW – 10 kW



Small hydro turbines – development

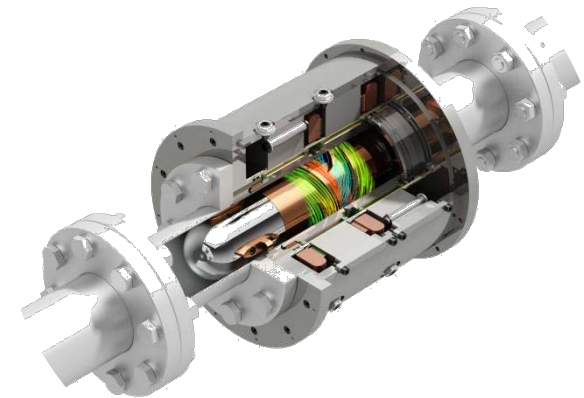
Microturbine with counter rotating runners

Duo Turbo CTI Nr. 17197.1 PFEN-IW



Objective

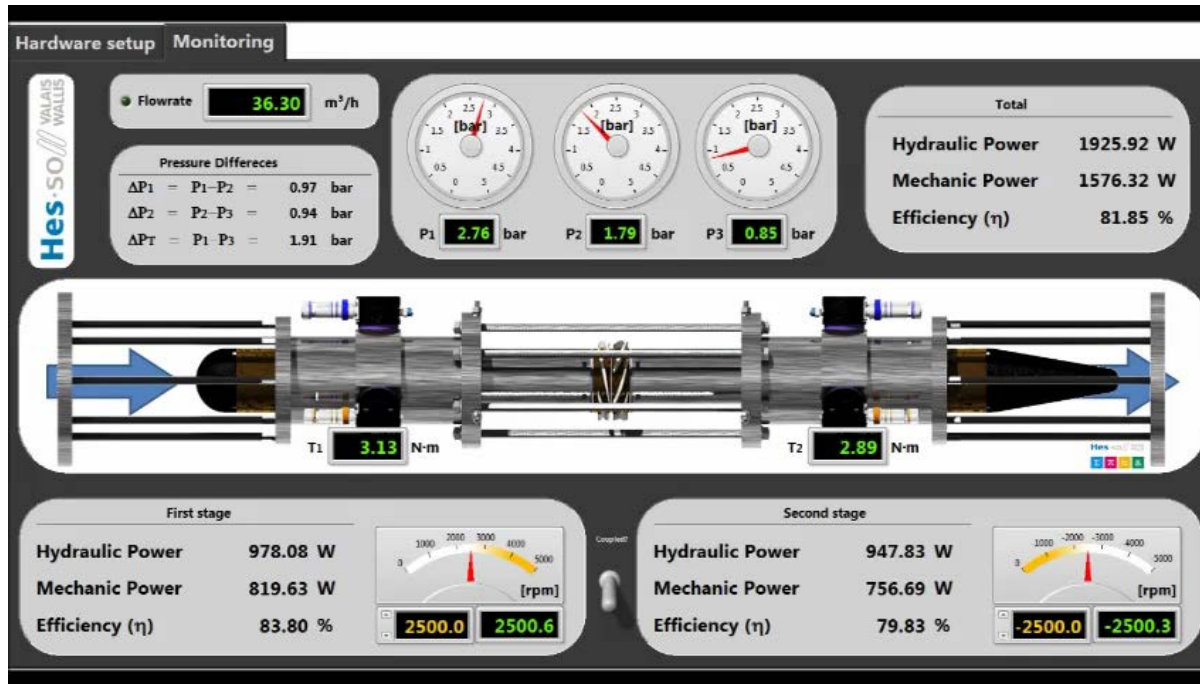
- Family of modular ERS
- Harness Swiss potential around 35 GWh per year



Small hydro turbines – development

Microturbine with counter rotating runners

Duo Turbo CTI Nr. 17197.1 PFEN-IW

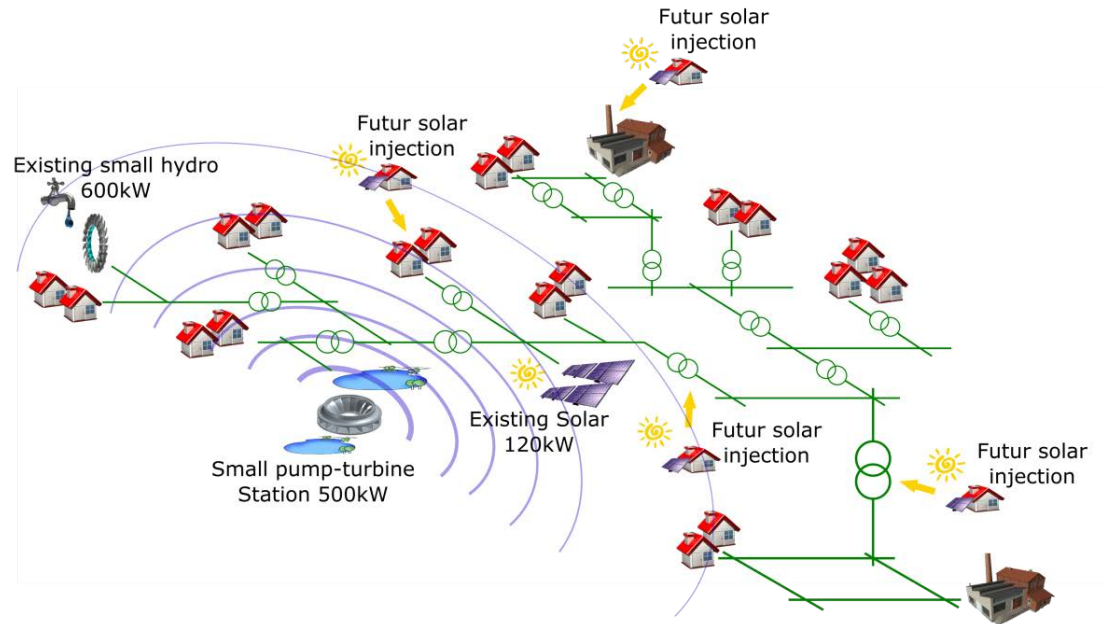


Small hydro turbines – development

Small pumped storage power plant



Diagonal turbine –Mhylab



Bulletin ElectroSuisse Février 2015

Conclusions

- Small Hydro in Switzerland : 10 % of Hydroelectricity
- Feed-in remuneration :70 % of the costs in 2014
- 900-1'400 GWh more until 2035
- Environmental protection & licencing procedure
- SCCER SoE :
 - New technologies to harvest this potential
 - Environmental aspects