SCCER SoE

SWISS COMPETENCE CENTER for ENERGY RESEARCH
SUPPLY of ELECTRICITY

# Future of Swiss small HydroPower plants

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**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

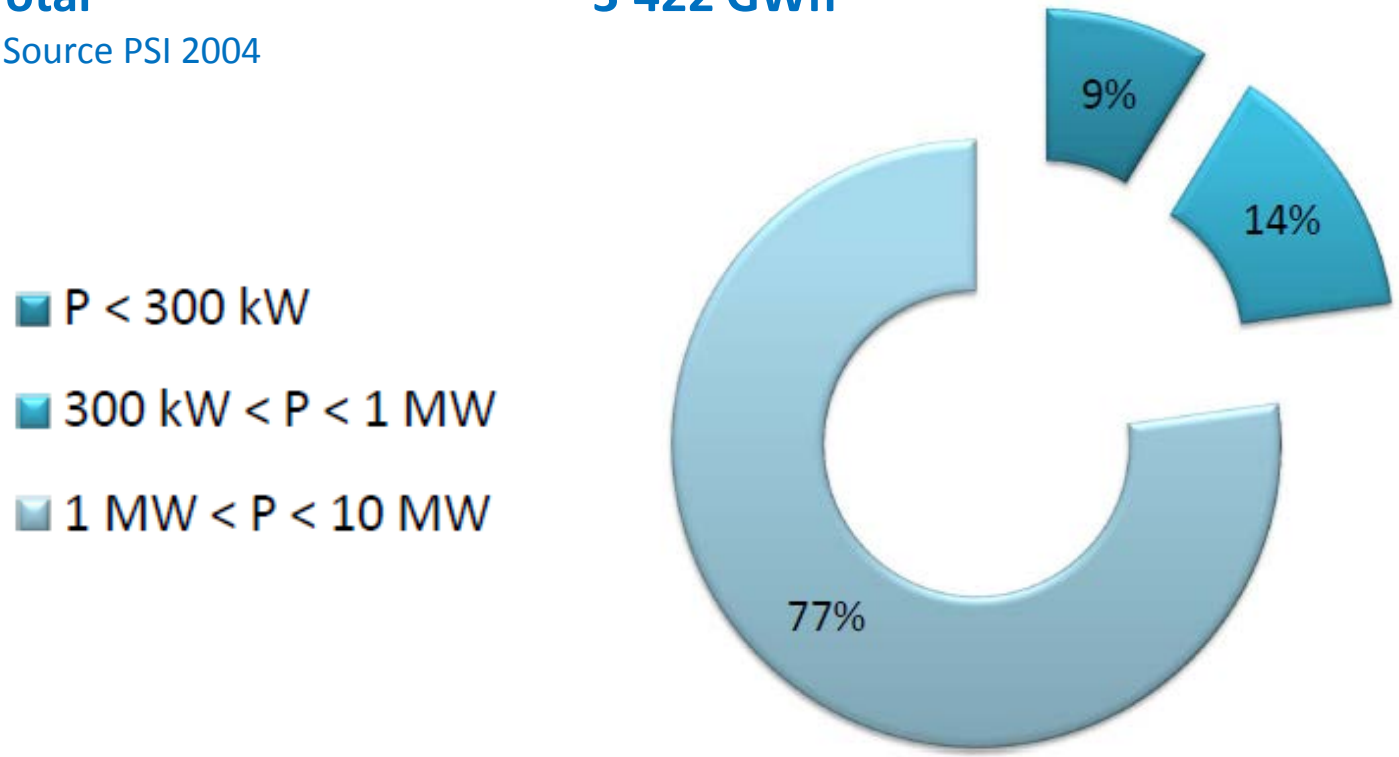
# Small hydro production – 2004

| | |
|---|---|
| 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



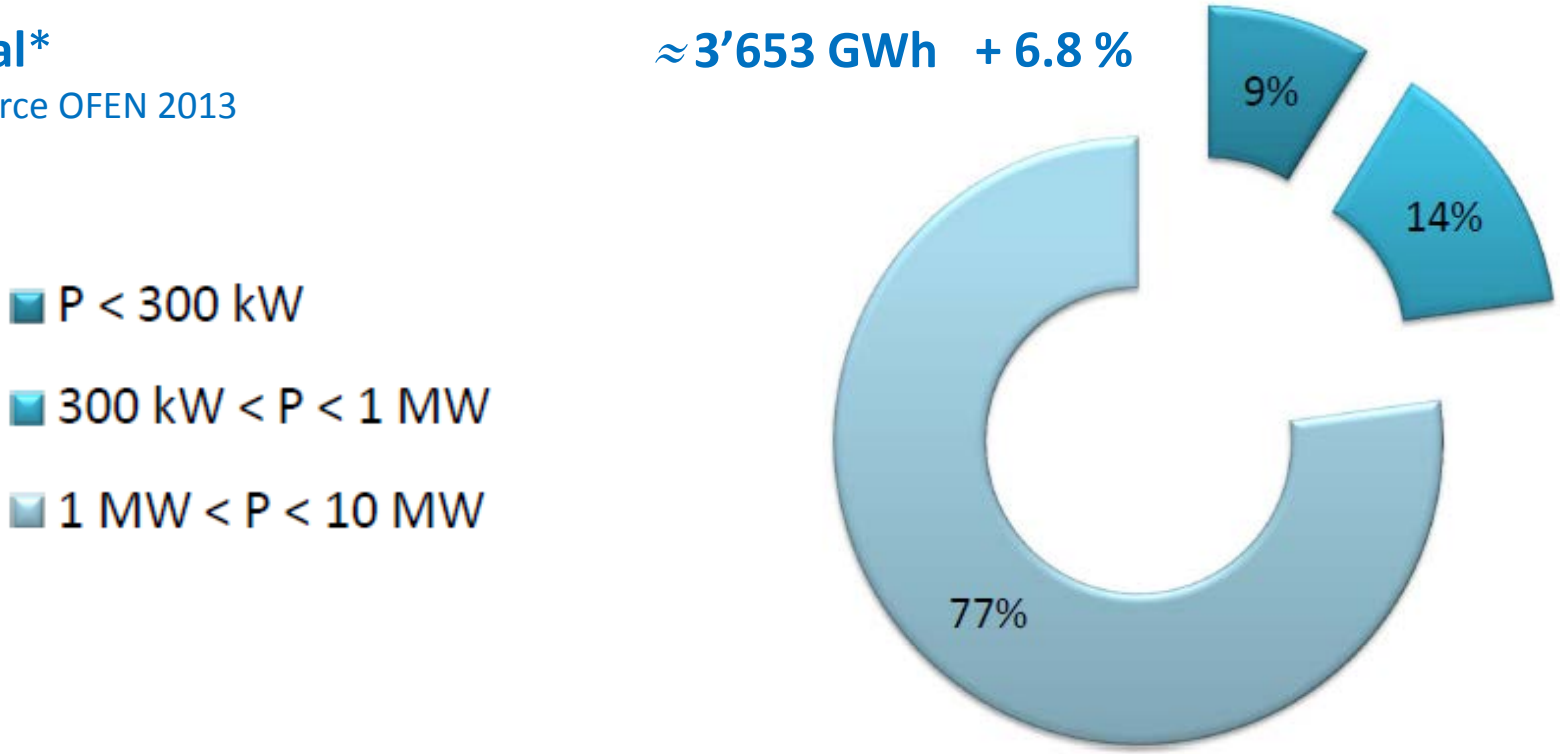
# Small hydro production - 2013

| | | |
|---|---|---|
| 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



# Promoting Renewable Energies

## Feed-in remuneration at cost (KEV)

START
Mai 2008

SCCER SoE

**Feed-in remuneration at cost for ?**

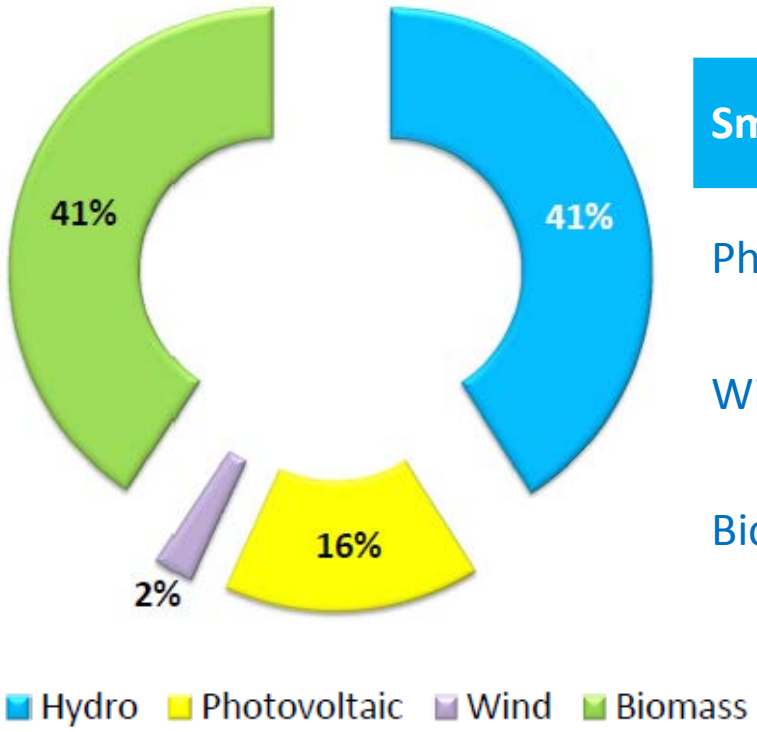
- ✓ Hydro power < 10 MW
- ✓ Photovoltaic energy
- ✓ Wind power
- ✓ Biomass energy
- ✓ Geothermal power

**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

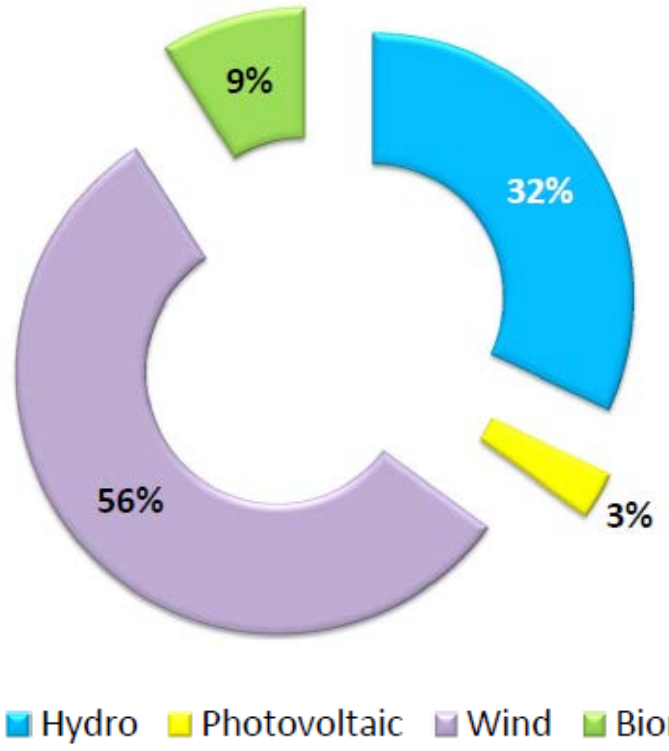



| Technologies | Number | Power [MW] | Production [MWh/y] |
|---|---|---|---|
| **Small Hydro** | **413** | **240** | **956'447** |
| Photovoltaic | 10’209 | 390 | 370'226 |
| Wind power | 18 | 30 | 56'528 |
| Biomass | 233 | 215 | 949'623 |

*Source :Stiftung KEV 07.2015*

# Small hydro –Feed-in tariff at cost

## Positive answers – not yet in operation

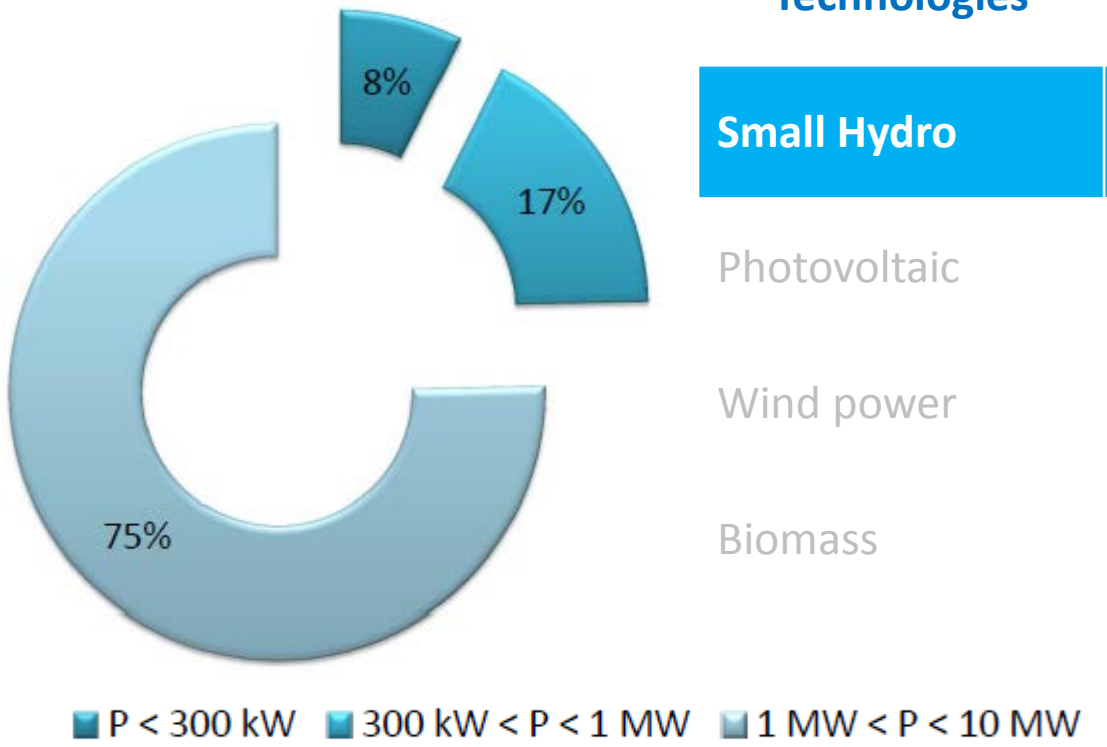



| Technologies | Number | Power [MW] | Production [MWh/y] |
|---|---|---|---|
| **Small Hydro** | **350** | **347** | **1'211'578** |
| Photovoltaic | 2'264 | 119 | 113'827 |
| Wind power | 572 | 1’243 | 2'112'283 |
| Biomass | 87 | 60 | 341'849 |

*Source :Stiftung KEV 07.2015*

# Small hydro –Feed-in tariff at cost

## Positive answers – not yet in operation

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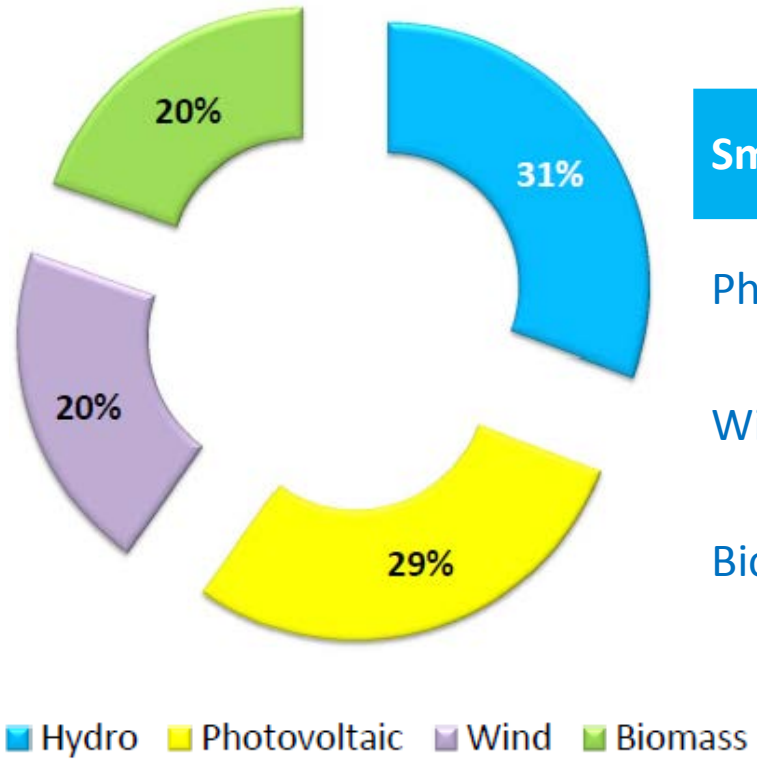
# Small hydro –Feed-in tariff at cost

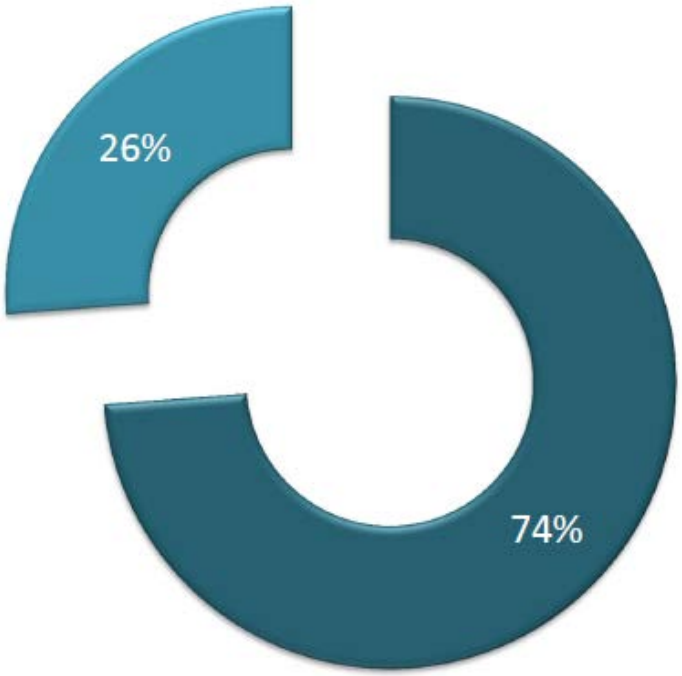
## Waiting list




| 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 |

*Source :Stiftung KEV 07.2015*

# Small hydro – Potential

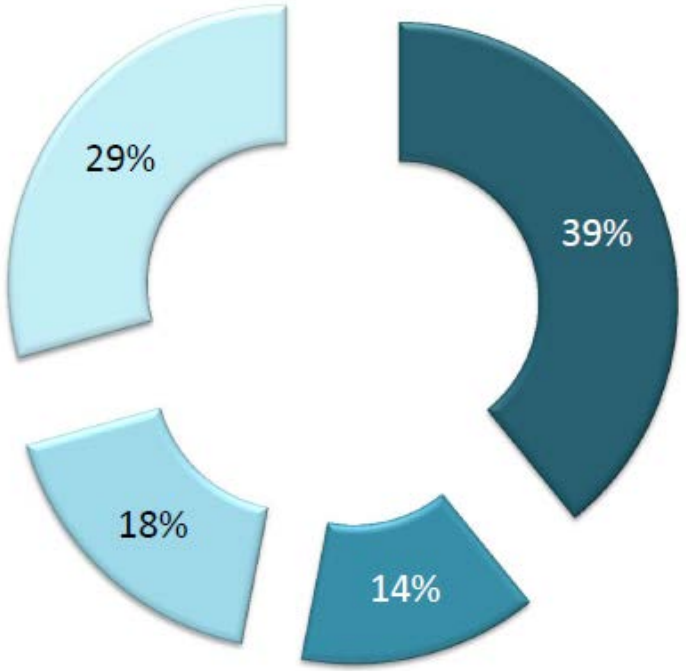



Production SHP

KEV-Production SHP

KEV-Positive Answer SHP

KEV-Waiting list SHP

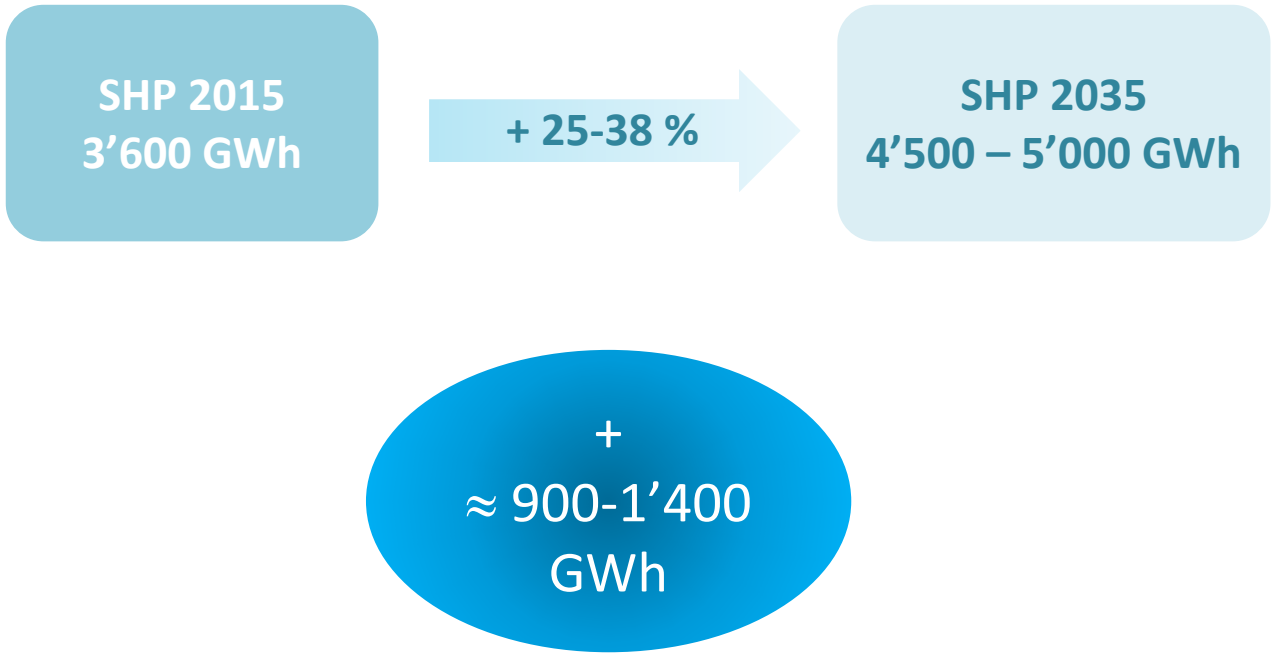



Current Production of SHP
≈ 3’650 GWh

+3’000 GWh ?

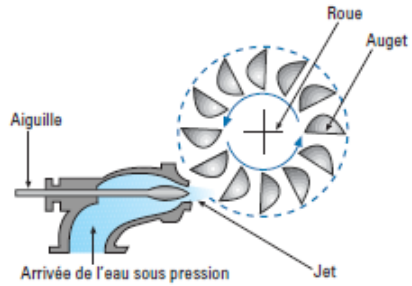
Total SHP Maximum potential
≈ 6’890 GWh

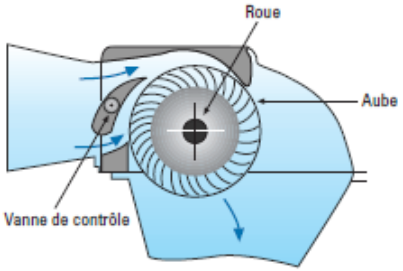
# Small hydro – Objective 2035

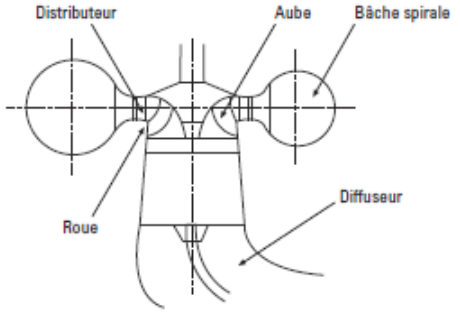


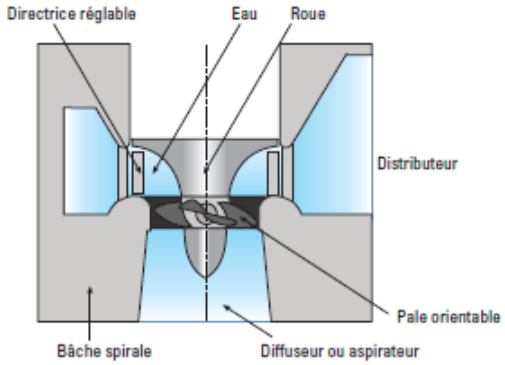

From KEV- positive answer to operating SHP :
environmental protection and licencing procedure

# Small hydro turbines … like the large ones



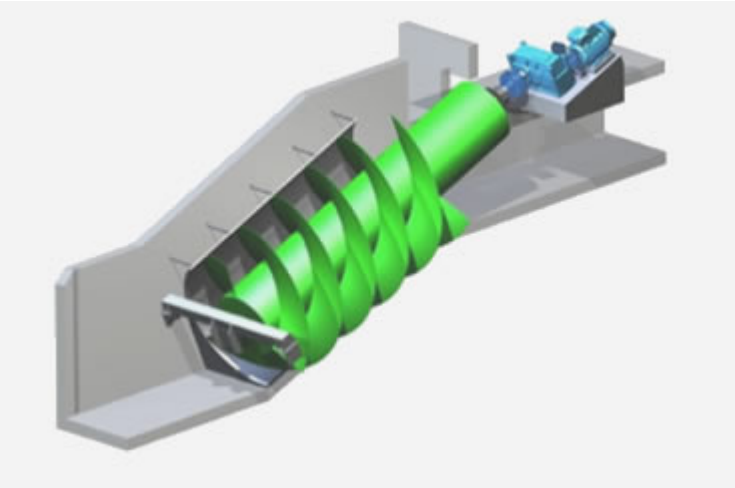



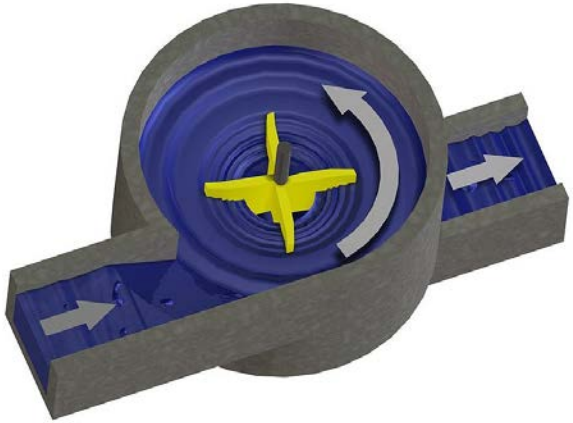

# Small hydro turbines – specific technologies

## Exemples of low head turbines



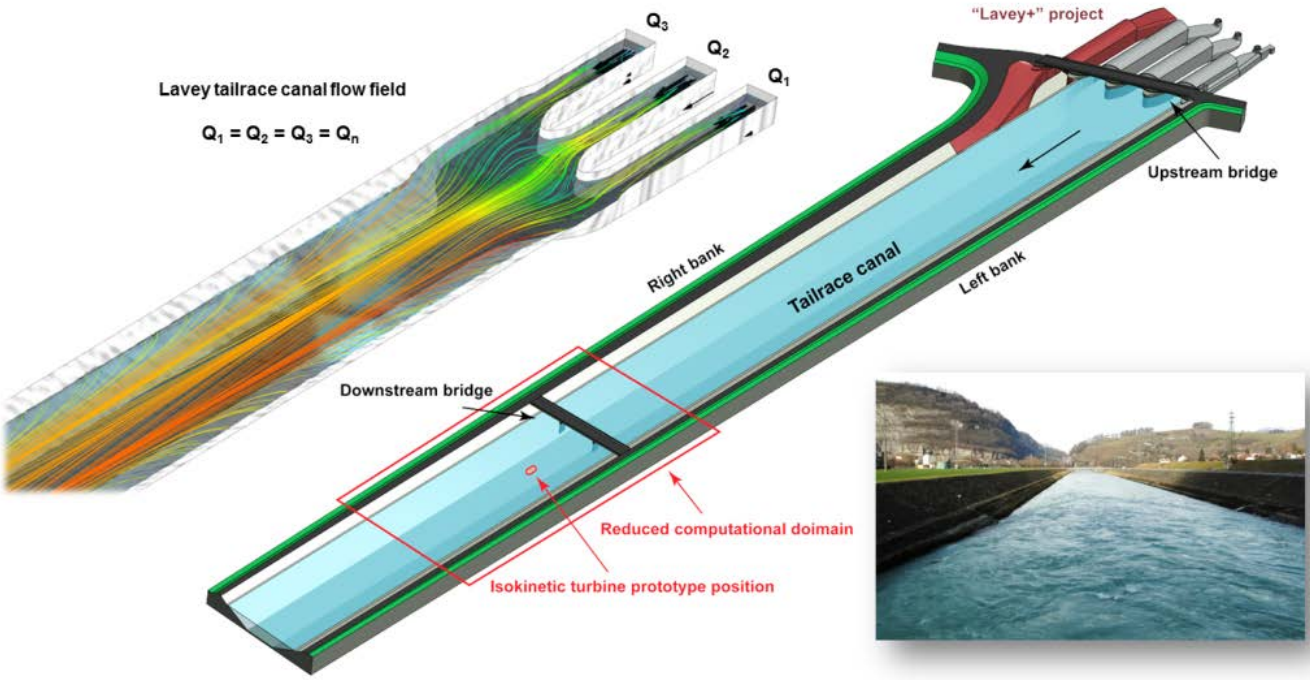
Archimedes screw
H : 1-10 m
Q : 100 l/s – 10’000 l/s
P : 1kW – 300 kW

Vortex turbine
H : 0.7-3 m
Q : 1’000 l/s
P : 5 kW – 20 kW

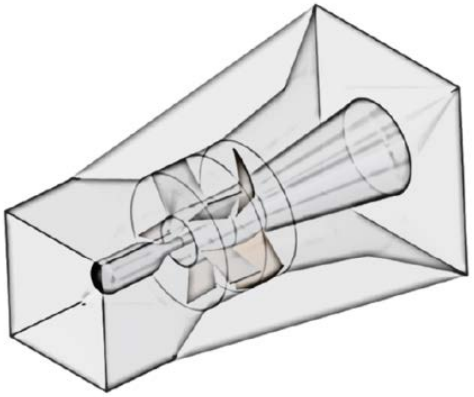


# Small hydro turbines – development

## Isokinetic turbine for artificial waterways





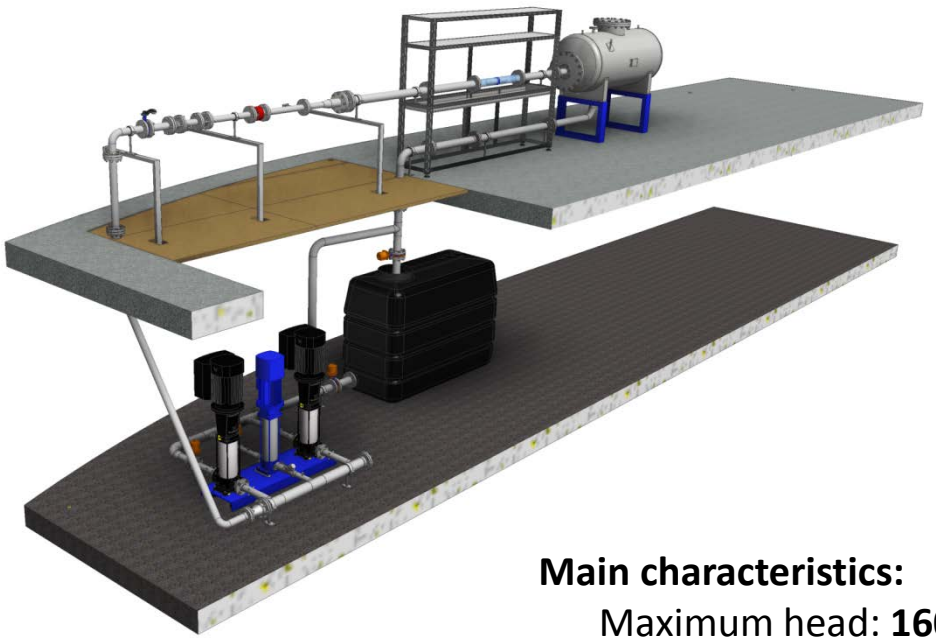



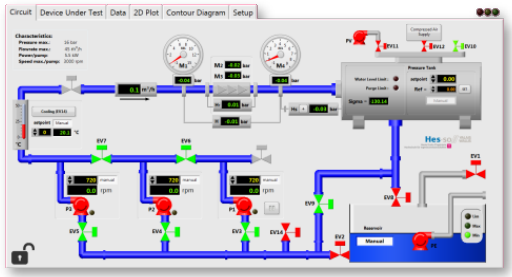
A first prototype of 1kW will be installed in the tailrace channel of Lavey Power Plant

Fundings research

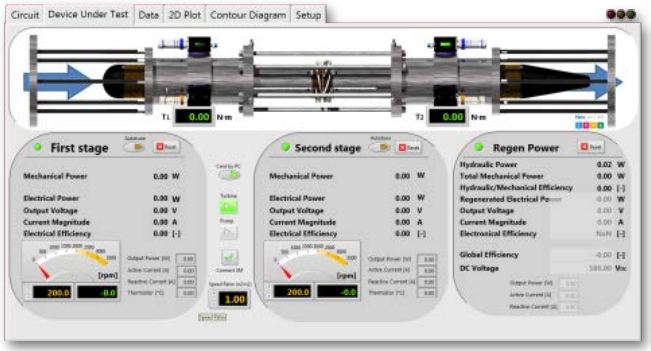
# Small hydro turbines

## Specific infrastructure at the HES SO Valais





Cloud of variables

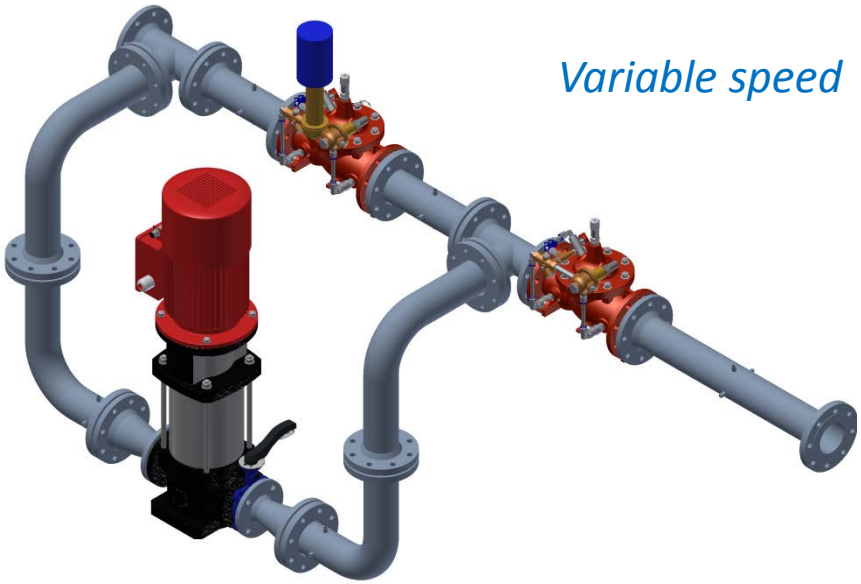



**Main characteristics:**

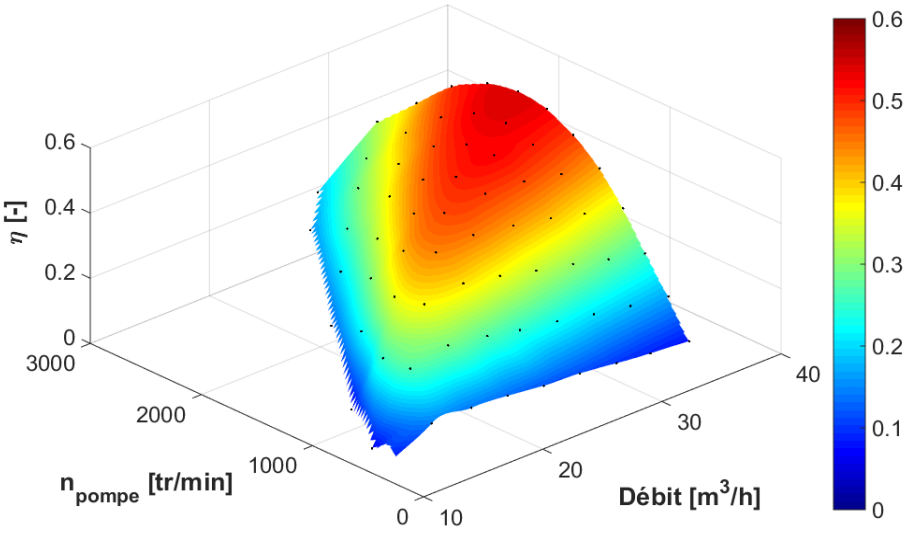
- Maximum head: **160 mWC**
- Maximum discharge: **100 m³/h**
- Generating power: **20 kW**
- Pumping power: **2 x 18.5 kW & 1 x 5.5 kW**
- Maximum pumps speed: **3'000 rpm**
- Total circuit volume: **4.5 m³**

# Small hydro turbines

## Specific technologies : Pump as turbine



*Variable speed*




H : 30 -120 m

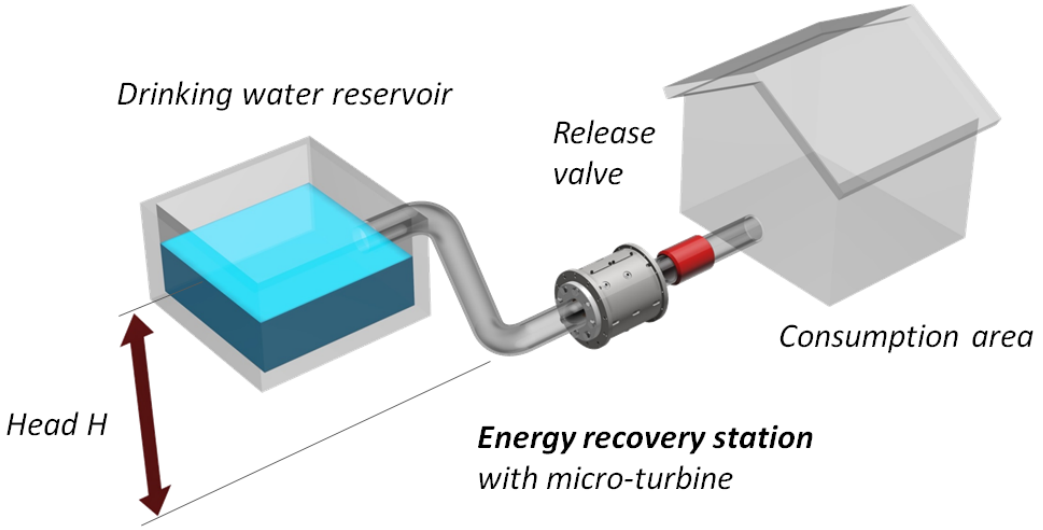
Q : 3-12 l/s

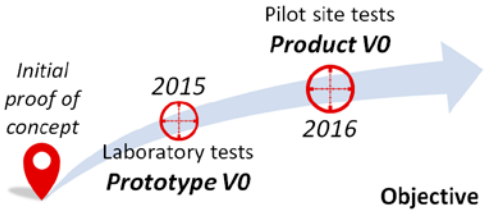
P : 3kW – 10 kW

# Small hydro turbines – development

## Microturbine with counter rotating runners

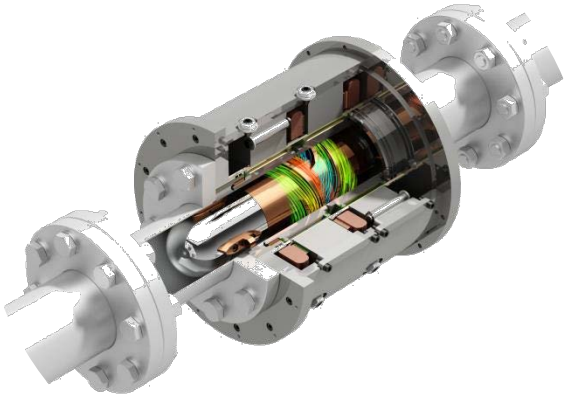
### Duo Turbo CTI Nr. 17197.1 PFEN-IW




**Objective**

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



# Small hydro turbines – development

## Microturbine with counter rotating runners

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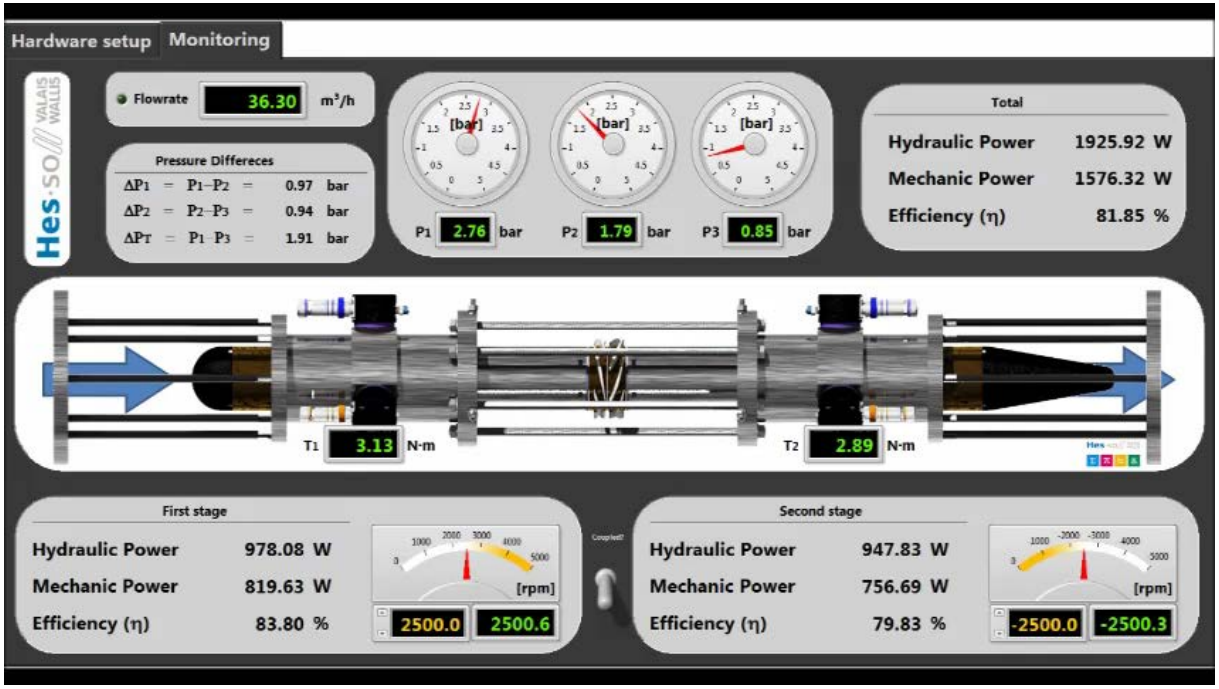
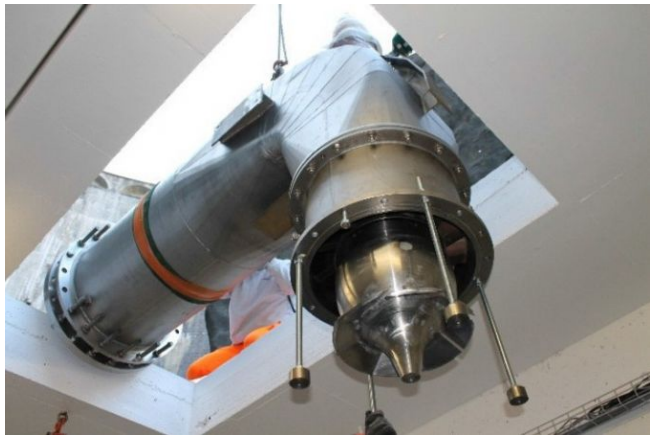
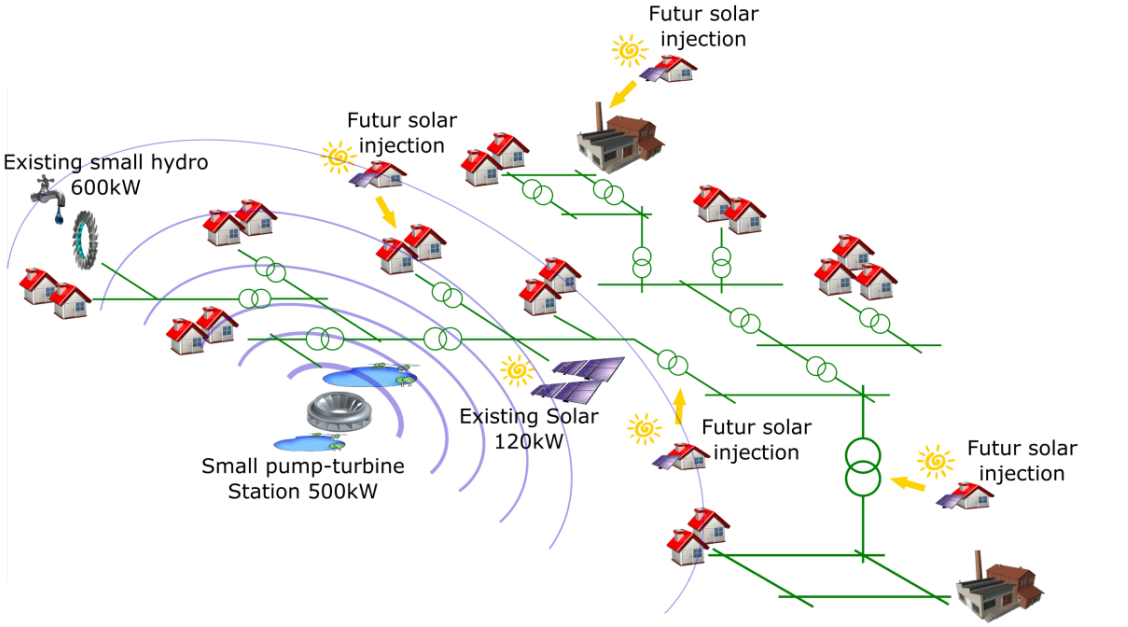


# Small hydro turbines – development

## 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