We Make the World Flow Round.
Water Supply Technology and Energy Recovery using Pumps as Turbines

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- Examples
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Six Business Units focussing on product lines or Service function as interfaces between Sales and Operations.

The goal of our Research Work is to provide products with low energy consumption, high availability, a long service life and utmost reliability, as well as smart control systems.

One part of the research is …

Hydraulics & Structural Mechanics
Markets

Our range of products and services

Everything from a single source: pumps and valves, services and system solutions
Department

**Pumps as Turbines**

- New Department since 2008
- Also initiated by BMBF subproject PaT Indonesia
- Offering Standard Pumps as Turbines

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From 35 up to 750 kW can be achieved with Standard KSB PaT’s to generate Energy and Energy Recovery
Fundamentals
Using Pumps as Turbines

- hydraulically “unproblematic”
- flow rate adaptation not possible
- speed predetermined (50 Hz)

Example:
Pelton turbine + HP-Pump in RO-Installation

Pump impeller „outlet“ typically cut off
Using Pumps as Turbines

- offers lower Investment costs and lower LCCs compared with a traditional turbine
- installation costs <1.000 €/kW
- Systems with control valves allow fast amortization / additional benefit

The relation and diversification from Turbine types:
Pelton, Crossflow, Francis, Kaplan, compared with Pumps as Turbines

<table>
<thead>
<tr>
<th>Capacity (kW)</th>
<th>Turbine type</th>
<th>Pelton</th>
<th>Crossflow</th>
<th>Francis</th>
<th>Kaplan</th>
<th>Pump as Turbine</th>
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</thead>
<tbody>
<tr>
<td>20</td>
<td>8-20</td>
<td>3-14</td>
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<td>5-10</td>
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<tr>
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<td>50-80</td>
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<tr>
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<td></td>
<td></td>
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<td>100</td>
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</tbody>
</table>
Example

Gua Bribin
Java, Indonesia

- BMBF cooperative project
- Part project TP8: Development of Pump – Turbine - Modules
- Time Schedule: 01.07.2004 – 30.06.2009

Final Design:
- 5 Modules Water Transport
- 1 Module Power Generation
- Total efficiency 55 %
- Interflow Rate 1,9 m³/s
- Water Transport 65 l/s
Example:
Gua Seropan
Java, Indonesia

- BMBF cooperative project
  “IWRM Indonesia”
- Part project TP12
- Time Schedule:
  01.01.2009 – 31.12.2011

Current Turbine Design Data:
- $Q = 0.5 \text{ m}^3/\text{s}; H = 100 \text{ m}$
- One large module for simple adjustment control
- Split Casing Pump as Turbine – Gear Box – Multistage Pump

- Existing Reservoir (ca. 262 ASL)
- Projected pressure piping of wood
- Pump station
- Projected Pumping Station (ca. 140 ASL)
- Existing Weir (ca. 155 ASL)
- $H_T \approx 109-110 \text{ m}$
- $\Delta H_{\text{Brutto}} \approx 15-16\text{ m}$
- Interflow rate $Q = 0.5-0.8 \text{ m}^3/\text{s}$
Example

Energy Recovery

- Customer LWV Stuttgart
  Public Water Supply

Omega V 350-510 A
in turbine mode.

8 x Etanorm 150-315
in turbine mode.

Total Energy: 600 kW
Annual potential: 4,800,000 kWh
Amortization: < 2 Years

Total Energy potential: 300 kW
Annual potential: 2,400,000 kWh
Amortization: < 5 Years

In Emergency PaT must run in pump mode as well!

Sources: LWV Stuttgart, KSB VN Stuttgart, Prüffeld,
Example

Energy Recovery

- Water Tower Tubishof, City of Luxemburg

Total Energy: 36 kW
Annual Potential: 306,000 kWh
Amortization: < 5 years

Water is been supplied with 17 bars and must be throttled down to 2.5 bar

MTC A 100/5-7.1 in turbine mode.
Expected Growth of Hydropower Market up to 200 GW within 10 years.

Installed Capacity and annual growth potential 2004 - 2020, [GW]

World wide installed Power Plants capacity [1000 GW]

<table>
<thead>
<tr>
<th>Year</th>
<th>Total Installed Power Plants [GW]</th>
</tr>
</thead>
<tbody>
<tr>
<td>1980</td>
<td>2,1</td>
</tr>
<tr>
<td>2000</td>
<td>3,6</td>
</tr>
<tr>
<td>2004</td>
<td>4,3</td>
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<tr>
<td>2020</td>
<td>5,7</td>
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</tbody>
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- Gas turbine plants: 4% (2004) → 4% (2020)
- Diesel: 44% (2004) → 9% (2020)
- Nuclear: 3% (2004) → 6% (2020)
- Other renewables: 6% (2004) → 4% (2020)

Source: Siemens PG, Alstom, ESHA, IHA, OECD, Int. Journal on Hydropower and Dams, KSB/T12., ABS Energy Research, Global Data
**Summary**

- **technical view**
  - hydraulic behaviour identical to traditional turbines
  - lower efficiency compared with turbines
  - regulation not possible, except speed control
  - standard pumps are very robust

- **cost view**
  - low investment and life cycle costs

- **market view**
  - above average growing market of small hydro power

- **ecological view**
  - increased field of application due to low costs
  - “energy recovery” e.g. in public water supply, industry and in emerging markets