Zukunft der Schweizer Wasserkraft

Hannes Weigt, 23.01.2019
Swiss Hydro Under Pressure

Wohl und Weh der Wasserkraft
Basler Zeitung

Ist die Wasserkraft wirklich so schlecht wie ihr Ruf?
Tages-Anzeiger

Schwache Wasserkraft
Neue Zürcher Zeitung

Sorgenkind Wasserkraft

WWZ

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Last Years Market Prices: Down, Down, Down and a bit Up again

- Generation costs [CHF/MWh] (weighted, financial costs)
- Run-of-river
- Storage
- Pump-storage
- Average

- Other costs
- Other taxes
- Energy & grid usage
- Personell costs
- Material & ext. services
- Profit before taxes
- Financial expenses
- Amortisation
- Water fees
Main Drivers for Swiss Hydro?
Market Outlook: Uncertain with Strong EU Impact

Average Prices (Schillinger et al., 2017)

Average Prices (Betz et al., 2018)

Hourly Prices, Base Case, AFEM project

Hourly Prices, Reference Days (Panos and Densing, 2018)
Policy Outlook: Under Negotiation

• Water Fees
• Concession Renewal
• Market Premium for Large Hydro
• EU-CH market agreement
• Full Market Liberalization (+requirement for local, green supply)
• Storage Reserve
• Environmental Regulations
Today: Storage Reserve

Tomorrow: Water Fee Reform

The Day After Tomorrow: Climate Change
'Diese aktive Reserve ist als *Ergänzung zum Energy-Only-Markt* ... zu sehen: Primär wird die Versorgung durch reine Marktmechanismen gewährleistet; erst wenn diese Mechanismen versagen, kommt die Reserve zum Einsatz ... dient .. dazu, Energie ausserhalb des Marktes *für ausserordentliche und für Marktakteure nicht absehbare kritische Knappheitssituationen zurückzuhalten.*'

'Reserve soll .. in Form einer .. Speicherreserve ausgestaltet werden, die sicherstellt, dass in den kritischen Zeiten *genügend Energie vorrätig* ist (*und mit der vorhandenen Kapazität tatsächlich produziert werden kann*). Die Kraftwerksleistung wird nicht aus dem Markt genommen, ... kein Anreiz geschaffen, neue Kraftwerksleistung zuzubauen.*'
Worst Case?

1. No Imports possible:
   - Grid likely not the main bottleneck
   - Supply from neighbors?

2. Hydro not available:
   - ‘Overcapacity’
   - ‘Natural’ incentive to provide shortage times

ca. 4.7 GW RoR
ca. 8.7 GW Storage
ca. 0.5 GW Pump
ca. 2.7 GW Umwälzwerke
Total: ca. 15-16GW
PeakLoad: ca. 10GW
## Preliminary Results: Worst Case vs. ‘some nice energy number’

<table>
<thead>
<tr>
<th>Our Worst Case</th>
<th>SFOE/Consentec/ Frontiers Example</th>
<th>A bit more ‘Full Load’</th>
</tr>
</thead>
<tbody>
<tr>
<td>Full Autarky (12GW) needed for 10 hours</td>
<td>775 GWh ('2 weeks full load’ ca. 2.3GW)</td>
<td>2TWh (6 GW for 2 weeks)</td>
</tr>
<tr>
<td>21.4 €/MWh</td>
<td>13.6 €/MWh</td>
<td>30.9 €/MWh</td>
</tr>
<tr>
<td>214 €/MW</td>
<td>4’580 €/MW</td>
<td>10’400 €/MW</td>
</tr>
<tr>
<td>2.6 mn € total</td>
<td>10.5 mn € total</td>
<td>62.2 mn € total</td>
</tr>
<tr>
<td>System costs: 1.2 mn €</td>
<td>System costs: 3.0 mn €</td>
<td>System costs: 32.6 mn €</td>
</tr>
</tbody>
</table>
Agenda

*Today*: Storage Reserve

*Tomorrow*: Water Fee Reform

*The Day After Tomorrow*: Climate Change
It’s just a small levy for Switzerland, but a huge cost for Swiss hydro... really?

Water fees represent ca. 1-1.2 Rp/kWh of company costs (ca. 25%)

Total income from water fees: ca. **550mn per year**

High relevance for mountain cantons

**Overview of financial flows (2016)**

<table>
<thead>
<tr>
<th>Water fees (incl. Municipalities)</th>
<th>Payments in million CHF, 2016 (gross)</th>
</tr>
</thead>
<tbody>
<tr>
<td>AG, AI, AR, BE, BS, FR, GE, GL, GR, JR, LU, NE, NW, OW, SG, SH, SO, SZ, TG, TI, UR, VD, VS, ZG, ZH</td>
<td></td>
</tr>
<tr>
<td>AG</td>
<td>AI</td>
</tr>
<tr>
<td>234</td>
<td>9</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>National resource equalization</th>
</tr>
</thead>
<tbody>
<tr>
<td>Financial flows in million CHF, 2016 (net)</td>
</tr>
</tbody>
</table>

**Average generation cost [CHF/MWh]**

- Run-of-river
- Storage / Pump-storage
- Average

**Amortisation**

**Material & ext. services**

**Personell costs**

**Energy & grid usage**

**Other taxes**

**Other cost**

**Financial expenses**

**Profit before taxes**

**Water fees**

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Variable Prices, Fixed Fees
The Bundesrat 2018 proposed six options:

- Flexible water fees (with a fixed and a variable part)
- Fee on the resource rent
- No federal maximum of the water fee, instead qualitative guidance
- Cantonal regulation only, no maximum given by federal level
- Levy on consumers e.g. via network surcharge (instead of holders of the concession)
- Integration in the national fiscal equalization

→ Let's examine variable fee design
Variable Fees

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Water fee (WF)</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>WF0</td>
<td>WF = 0</td>
<td>No water fee</td>
</tr>
<tr>
<td>WFC</td>
<td>WF = 110CHF/kW Br</td>
<td>Current water fee level</td>
</tr>
<tr>
<td>WF1</td>
<td>WF = 50 + max(2P-45,0)</td>
<td>Partly flexible water fee</td>
</tr>
<tr>
<td>WF2</td>
<td>WF = 80 + max(2P-60,0)</td>
<td>Partly flexible water fee</td>
</tr>
<tr>
<td>WF3</td>
<td>WF = 2P</td>
<td>Completely flexible water fee</td>
</tr>
</tbody>
</table>

Now what is that exactly?
Profit Impact (2025 case)
Payment Impact
Today: Storage Reserve

Tomorrow: Water Fee Reform

The Day After Tomorrow: Climate Change
Climate & Swiss Hydropower

How will climate change impact Swiss hydropower’s market performance?

Data and methods:
• Swissmod electricity market model
• Runoff data with high geographical and temporal resolution (by WSL)
• Data for three climate periods
  • Historic (1980-2009)
  • 2021-2050
  • 2070-2099
Climate data: Runoff (historic)
Climate data: Runoff (2021-2050)
Climate data: Runoff (2070-2099)
Inflow Change by Climate

Historic, 2021 – 2050, 2070 – 2099

Average year

Dry year

Wet year

Monthly inflow (TWh)

Yearly energy changes

base  2%  0%

-10%  -15%  -26%

20%  22%  22%

0  2  4  6  8  10  12

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System Impact

Absolute difference in Total System Cost relative to historic base year

Change in total inflow (energy)

Change in total system costs

Historic, 2021 – 2050, 2070 – 2099
Revenue increases in average years for both dam and RoR

**RoR benefits from better seasonality**

For other weather conditions:

- Dry years get worse
- Wet years get better
Large **Heterogeneity** of Swiss Hydro Plants
And Who Knows What the Market Brings...
Conclusions

• The only certainty is the uncertainty

• Its the economy, stupid!

• Swiss choices do matter, for Switzerland

• BUT: in the long run, hydro is likely not dead!
# 3rd Workshop: The Future of Swiss Hydropower

**29.03.2019, 9:15-12:30**  
Welle 7, Schanzenstrasse 5, Bern

## Program

<table>
<thead>
<tr>
<th>Time</th>
<th>Session</th>
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<tbody>
<tr>
<td>8:45</td>
<td><strong>Registration and Coffee and Gipfeli</strong></td>
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<tr>
<td>9:15</td>
<td><strong>Welcome, Introduction and Project Overview</strong></td>
</tr>
<tr>
<td>9:30</td>
<td><strong>Market Realities</strong></td>
</tr>
<tr>
<td></td>
<td>• Ups and downs in coming years</td>
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<tr>
<td></td>
<td>• Little money for flexibility</td>
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<td>• Uncertainty will become the norm</td>
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<tr>
<td>10:15</td>
<td><strong>Break</strong></td>
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<tr>
<td>10:30</td>
<td><strong>Regulatory and Policy Challenges</strong></td>
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<tr>
<td></td>
<td>• Drivers and institutional issues</td>
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<td></td>
<td>• More than just energy</td>
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<tr>
<td></td>
<td>• Water fees: company and canton perspectives</td>
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<tr>
<td>11:30</td>
<td><strong>Discussion:</strong></td>
</tr>
<tr>
<td></td>
<td>• Where can and where can’t Swiss Hydro act?</td>
</tr>
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<td></td>
<td>• Flexible water fees: compromise possible?</td>
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<td></td>
<td>• Electricity market design and hydropower</td>
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<td></td>
<td>• What needs to be done until 2024?</td>
</tr>
<tr>
<td>12:15</td>
<td><strong>Summary, Open Points and Needed Next Steps</strong></td>
</tr>
<tr>
<td>12:30</td>
<td><strong>Lunch buffet</strong></td>
</tr>
</tbody>
</table>
Backup