



Energy Turnaround
National Research Programme

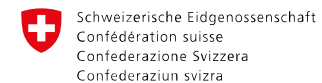


SWISS COMPETENCE CENTER for ENERGY RESEARCH
SUPPLY of ELECTRICITY

The Future of Swiss Hydropower



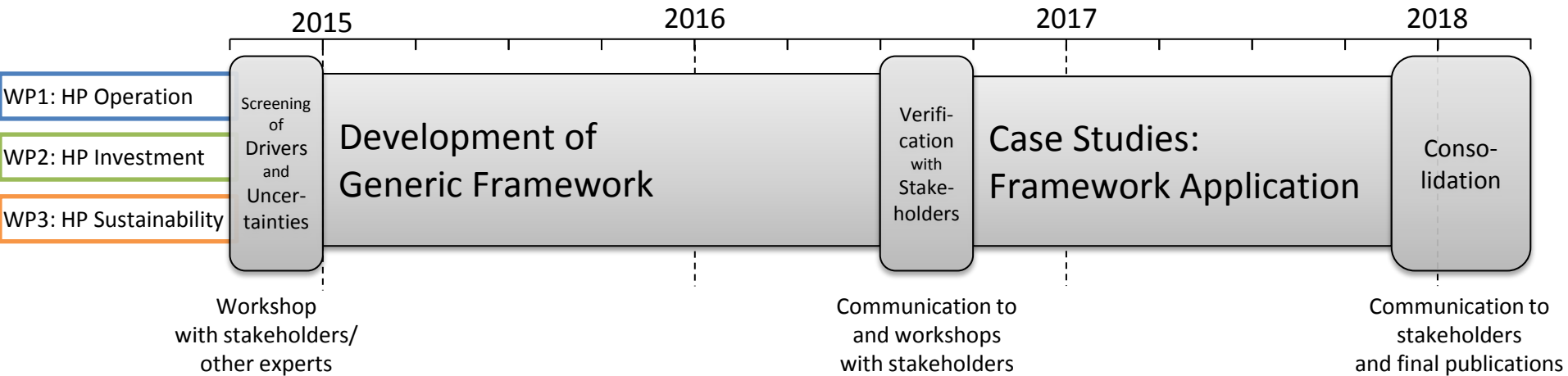
In cooperation with the CTI



Swiss Confederation

Commission for Technology and Innovation CTI

HP Future Project: Overview



Project Partners:

Alpiq, Repower, Azienda Elettrica Ticinese (AET), Forces Motrices Valaisannes (FMV), and Misurio

Case Studies:

1. Pilot Sus. Ass. in Valposchiavo, Grisons (Repower),
2. Single-site in Valais (Alpiq),
3. Multi-site in Leventina, Ticino (AET and Alpiq)

Project Team:

Weigt, *UniBas*: Lead, WP1

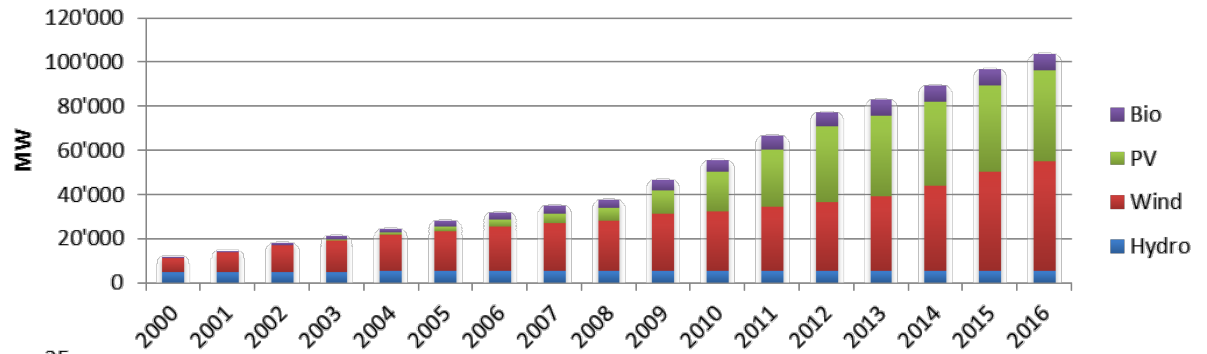
Schumann, *HES-SO*: WP1

Romerio, *UniGe*: WP2, WP3

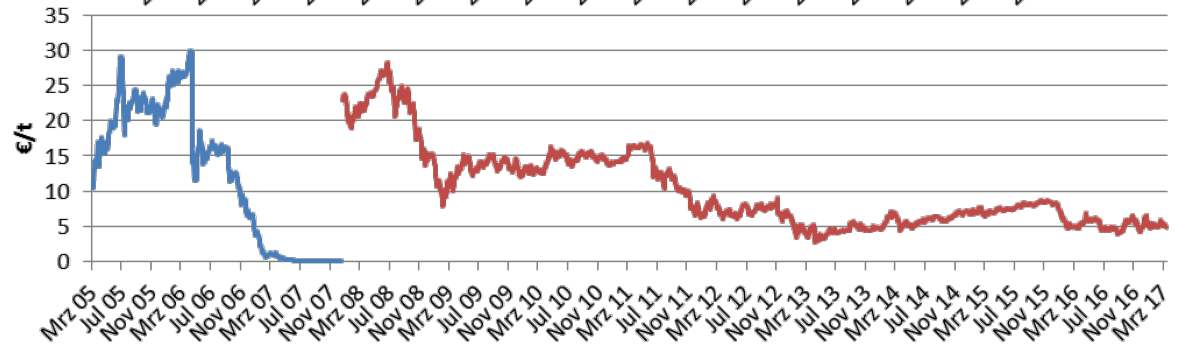
Hediger, *HTW Chur*: WP3, WP2

Back to the Future: 2001/2002

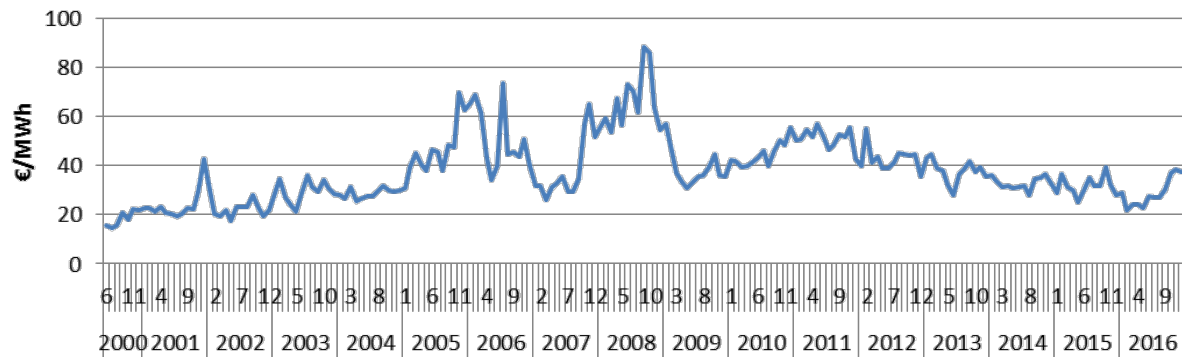
1. EEG in Germany



2. EU ETS in planning

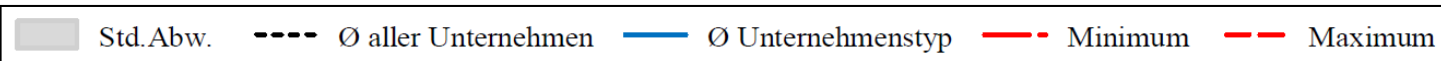
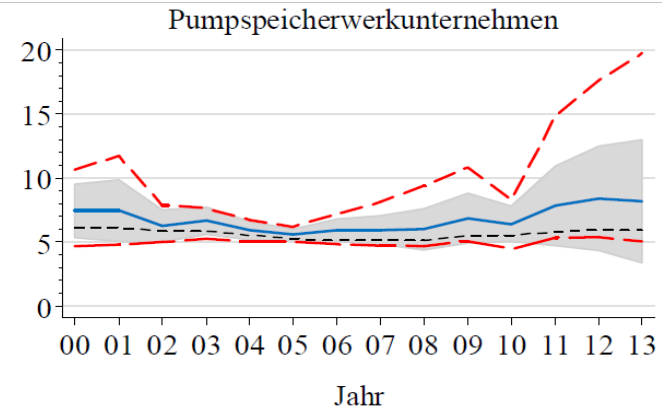
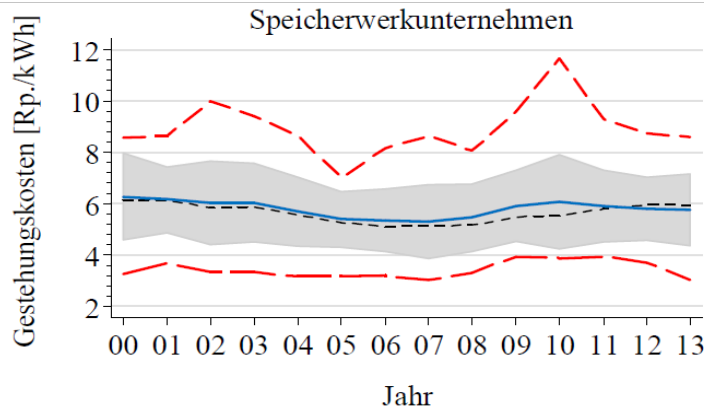
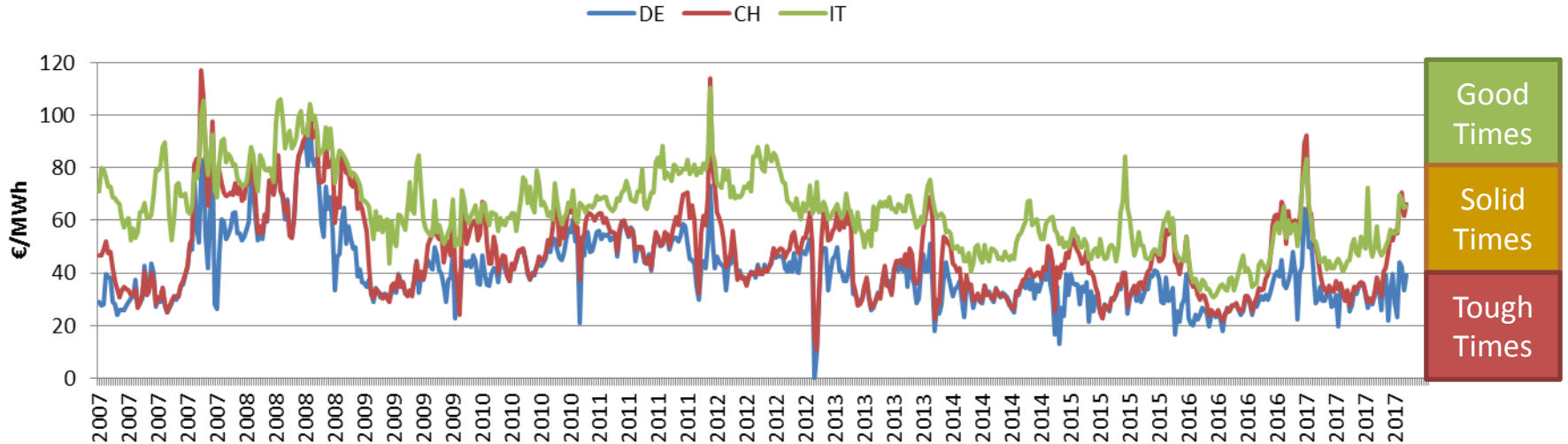


3. EU Market Liberalization



Better Make it through Today

Heterogeneous Costs

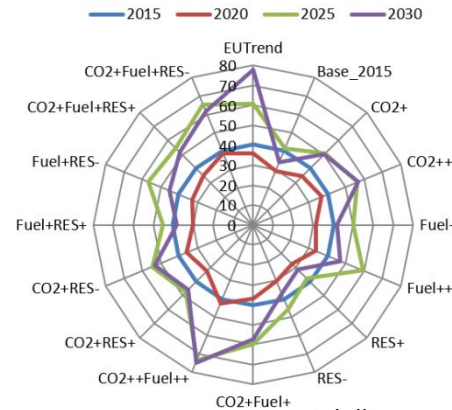
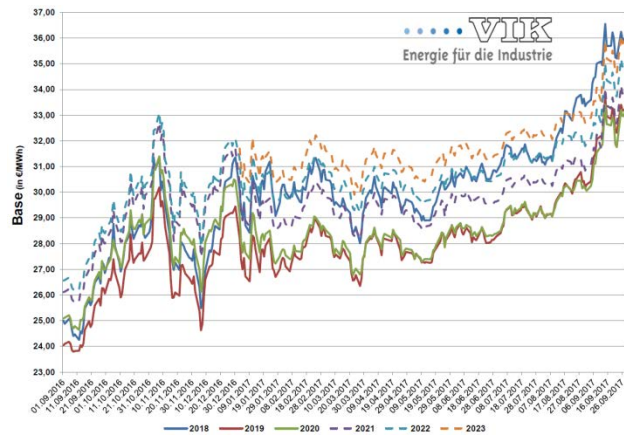


CEPE (2014)

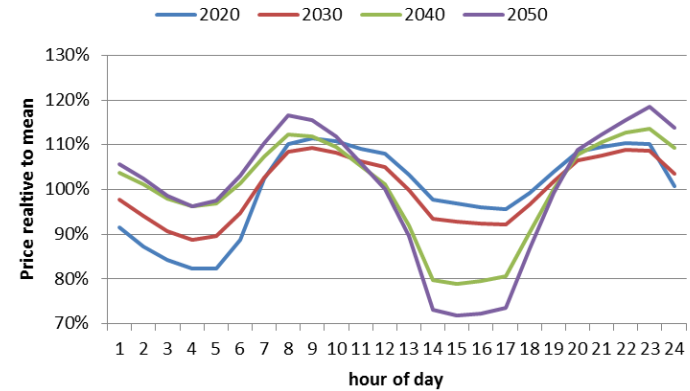


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Tomorrow Never Knows: High Uncertainty

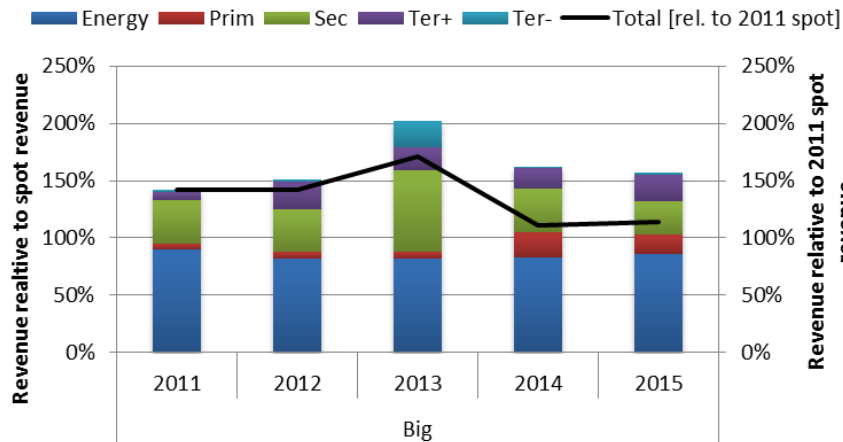


Schillinger et al. (2017)



Schlecht & Weigt (2015)

Revenue Option: Balancing Markets



Schillinger et al. (2017)

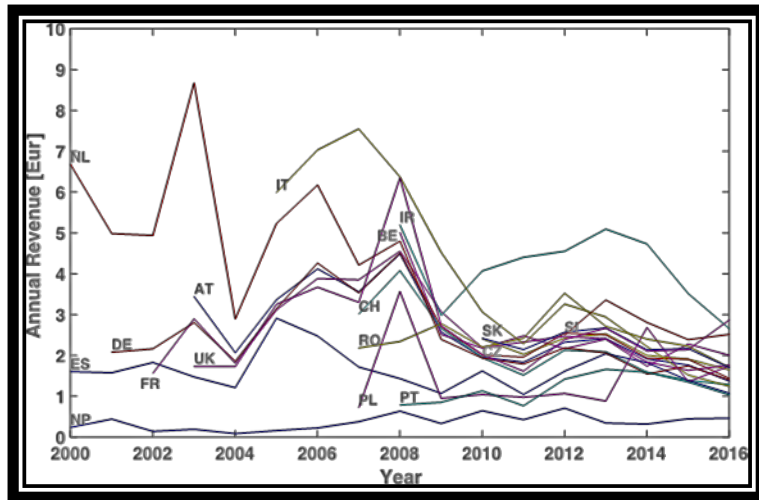
| | Spot | Asset Based Trading | Total |
|------------------------|------------|---------------------|------------|
| 11/12 | 7.83 | 2.16 | 9.98 |
| 12/13 | 6.92 | 2.19 | 9.11 |
| 13/14 | 5.91 | 1.83 | 7.73 |
| 14/15 | 5.19 | 1.38 | 6.57 |
| 15/16 | 4.69 | 1.05 | 5.73 |
| 16/17 | 5.18 | 2.12 | 7.3 |
| 17/18 | 5.24 | 1.38 | 6.62 |
| 18/19 | 5.06 | 1.13 | 6.18 |
| 19/20 | 5.02 | 1.1 | 6.11 |
| 20/21 | 5.07 | 1.18 | 6.25 |
| Average Outlook | 5.1 | 1.2 | 6.3 |

**Revenue Option:
Continuous Intraday Optimization**

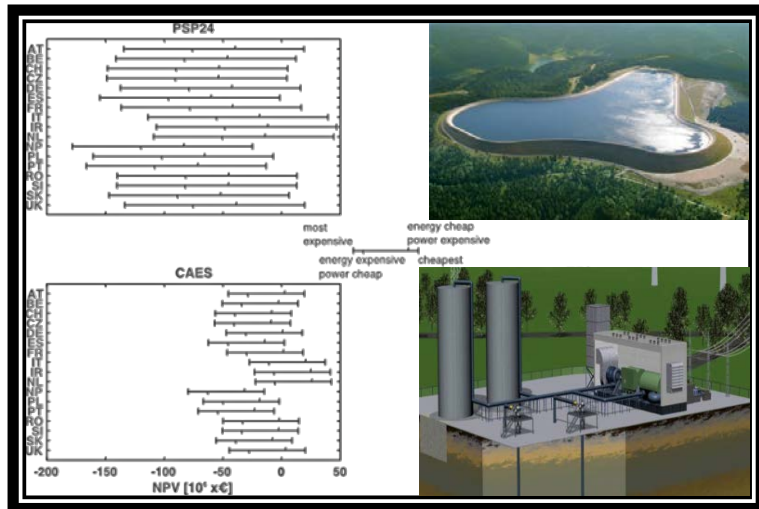
Rp/kWh
ior/cf-HSG (2017)



What's in Store for Me: Competition Arrising

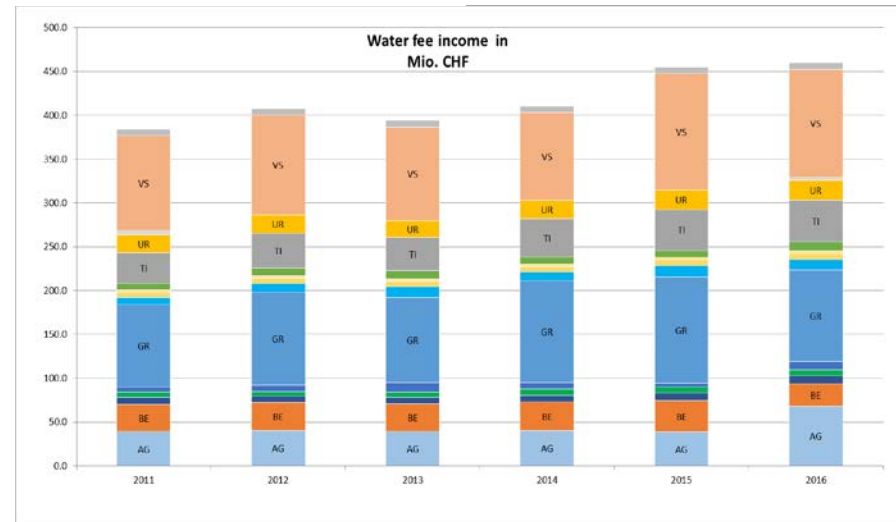
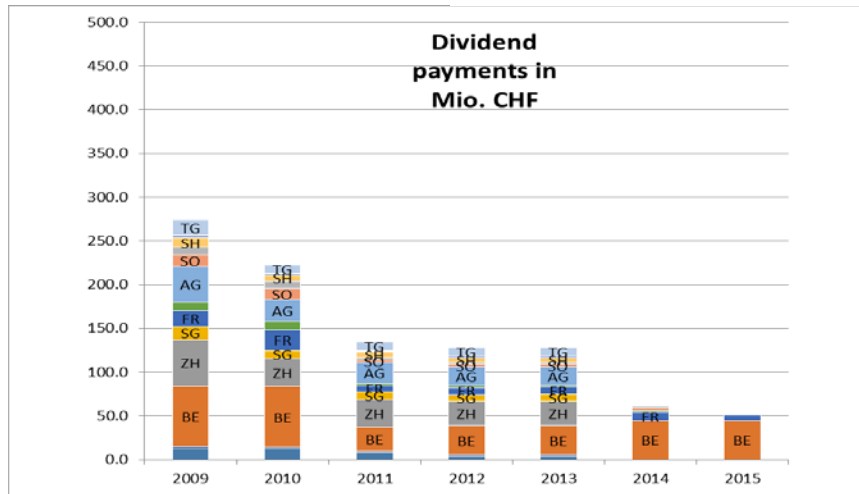
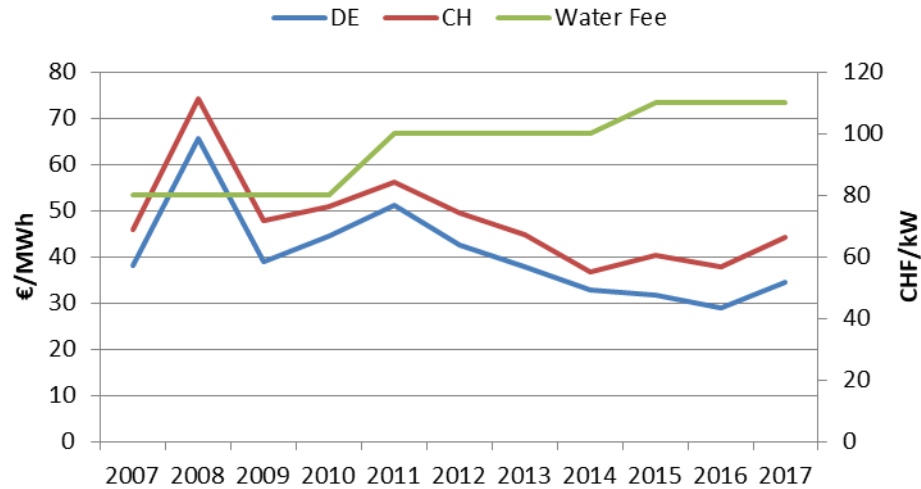


PSES revenue converges (at a relatively low level) on the European markets



New energy storage technologies are getting competitive

River Deep – Mountain High: Money Flows



Betz et al. (ongoing)

Inside Out: What is the Value of HP

| Total value of hydropower | | |
|-------------------------------------|---------------------------------|-------------------------|
| Private value | | External value |
| Total net revenues (resource rents) | | |
| Profits | | Water fees and taxes |
| Dividends | Reinvestment | |
| “Externalities” | | |
| Changes of reputation capital | Salaries paid | |
| | Socially valued contribution to | Macroeconomic stability |
| | | Social capital |
| Environmental capital | | |

Hediger (2017)

Shaping the Future

What Companies can do:

- Optimize the value of flexibility in the short run (trading)
- Account for flexibility in the long run (investments)

What Switzerland can do:

- Provide a flexible regulatory environment for all stakeholders
- Ensure a close exchange and cooperation with EU

What Swiss HP will have to live with:

- Uncertainty
- Competition