OPERATIONAL COSTS AND THEIR INFLUENCE ON LCOE OF PV PLANTS

Experience and outlook on operational costs for small to medium PV plants in Switzerland from a point of view of an independent power producer

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Agenda

- Point of view of an IPP from Switzerland
- Why are operational costs getting more important for further LCoE reductions?
- What are the main elements of operational costs?
- How can these elements be influenced?
- Why is quality assurance essential?
- Summary and Conclusions

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Independent Power Producer (IPP) Zürichsee Solarstrom AG (ZSSAG)

- Swiss based local company founded 2008.
- 100+ Shareholders: mostly private persons, but also communities and utilities.
- Aim of the ZSSAG is to efficiently develop new projects and finance, own and operate PV plants in the region lake of Zurich.
- TNC does project development, engineering and operation of PV plants for ZSSAG.
- Focus on medium sized PV plants (30-200 kWp)

ZÜRICHSEE SOLAR STROM

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Levelized Costs of Energy (LCoE)

LCoE = Capital Costs + Operational Costs

Capital costs base on economical framework/assumptions and PV system costs. System costs are mostly well known.

Calculation of operational costs up to now:
- by fix share of PV system costs
- by fix amount per kWh

How good is the match between calculations and reality?

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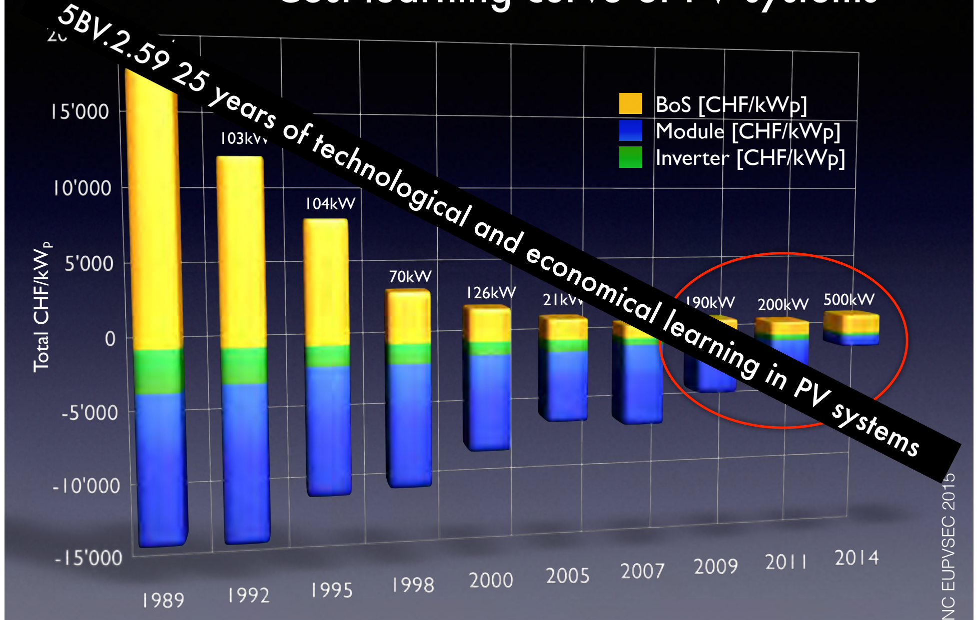
Cost learning curve of PV systems



Today: 1 CHF = 0.91 EUR

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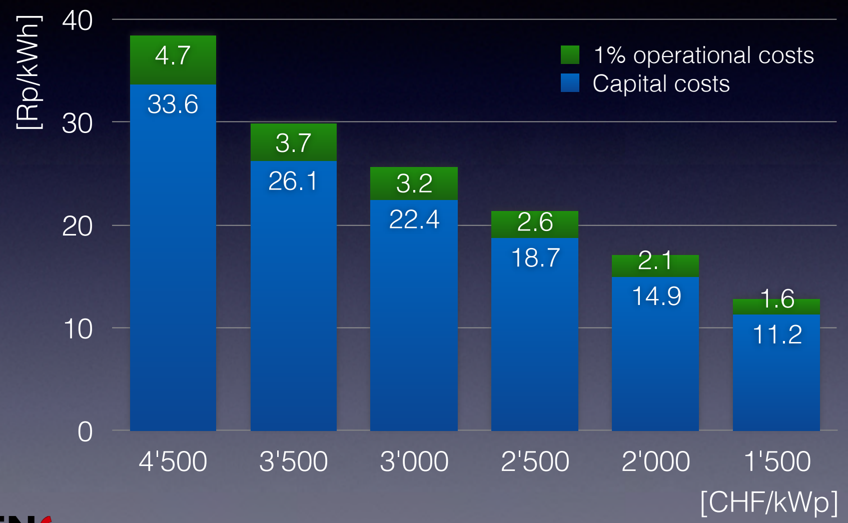
Calculation of operational costs with assumed fix amount per system costs (1%)



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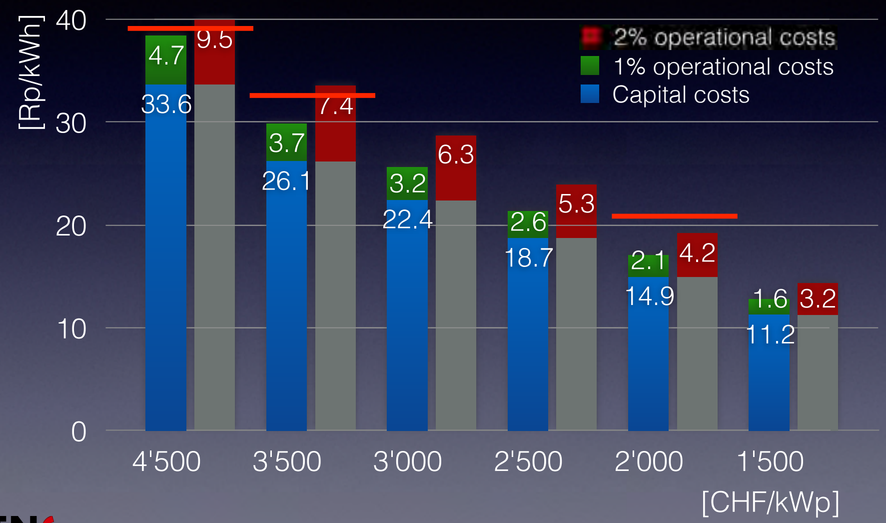
Comparison calculation of operational costs with assumed fix amount per system costs (1%, 2%)



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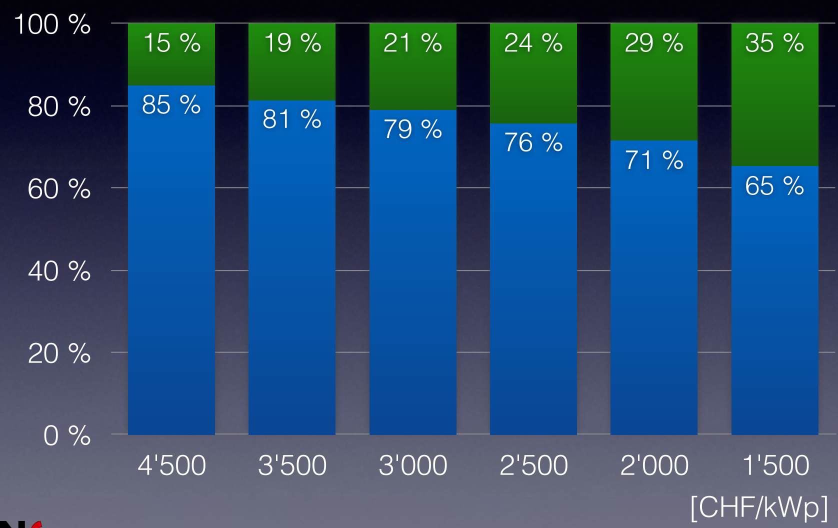
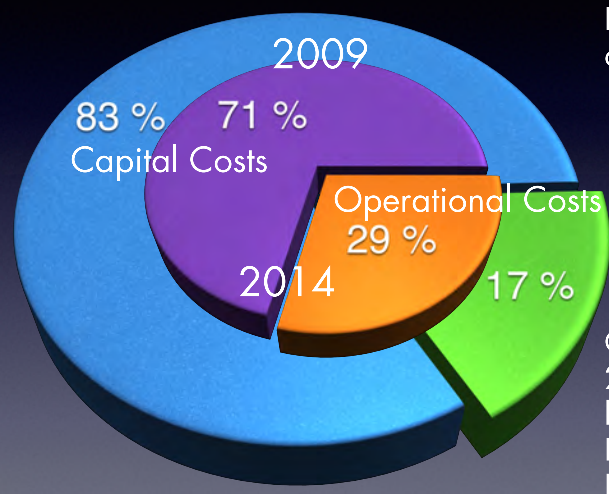
Calculation of operational costs with assumed fix amount per kWh (6 Rp/kWh)



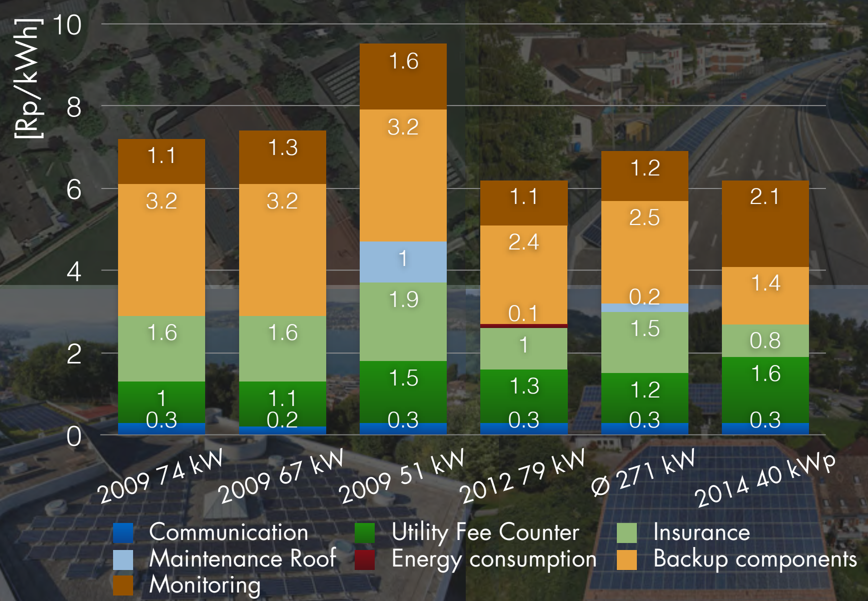
Comparison of achieved operational costs



LCoE reduced by about 50%

Operational costs: 2009 @ 7.3 Rp/kWh 2014 @ 6.1 Rp/kWh Reduction of 6.5%

PV plants realized 2009-2014 (756 kWp)



Development of main elements

	2009-2014	Outlook
Communication	-58 % per unit +/- 0% overall	Further small improvements possible
Utility Fee Counter	-0…50 % per unit + 0…60% overall	Support of utilities/political framework necessary
Insurance	-53 %	Further small to medium improvements expected
Maintenance Roof	only needed for green flat roofs	development depends on mounting construction
Energy Consumption	-	Irrelevant
Backup Components	-56 %	further but slower improvements expected
Monitoring	+0…72%	critical mass and/or size of plants needed

Development of main elements

	2009-2014	Outlook
Communication	-58 % per unit +/- 0% overall	Further small improvements possible

Observation

- Relative improvements on low absolute level
- Profit from mobile data price development outside PV
- Number of communication units relevant

Conclusions

- Re-evaluate communication on a regular base
- Try clustering communication units

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Development of main elements

	2009-2014	Outlook
Monitoring	+0…72%	critical mass and/or size of plants needed

Observation

- If not willing/able to realize all plants with the same components (inverters), secondary monitoring system becomes necessity
- Compare set-up to operation in terms of time needed

Conclusions

- Evaluate possible reduction of work needed for operation
- Clustering/outsourcing of monitoring

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Development of main elements

	2009-2014	Outlook
Insurance	-53 %	Further small to medium improvements expected

Observation

- Sinking PV system costs lead to lower insurance fees
- Lower FiT lead to lower insurance fees for lost energy production
- Insurance companies improve/adapt their products to PV

Conclusions

- Re-evaluate on a regular base
- Compare insurance fee vs. replacement without insurance

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PV plant design and operational costs

Example: mounting construction

PV plant design and operational costs

Example: mounting construction

Observations:

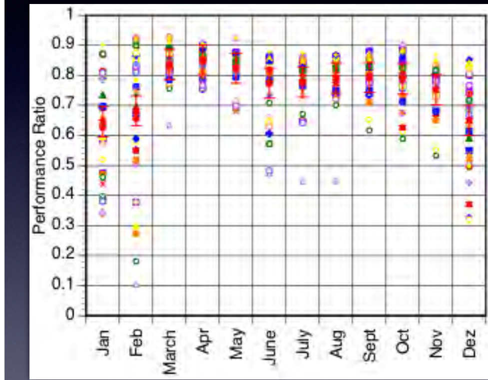
- Lower inclination modules, less distance to roof surface
- Mounting structure: 16% of system costs
- Capital costs 64% LCoE - mounting structure about 10% overall
- 1 Rp/kWh maintenance corresponds to 4.5% LCoE

Conclusions:

- Careful with savings in system costs and their influence on operational costs (and LCoE)

PV plant design and operational costs

Example: mounting construction



- Reduction PR to 0.5 from 0.82 (-39%)
- Yield Dec/Jan/Feb = 11% of overall yield
- Snow cover leads to 4% less overall yield
- 4.1% rise in LCoE

Development of main elements

	2009-2014	Outlook
Backup Components	-56 %	further but slower improvements expected

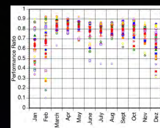
Observation

- Cost for components to be replaced (inverters, modules) profit form overall PV learning curve
- Installing costs become the dominant part

Conclusions

- Re-assess value of backup components on a regular base

Quality assurance and operational costs



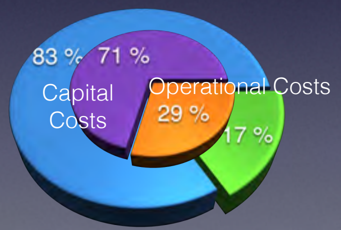
- Quality assurance in components: longer lifetime, less downtime, higher yield
- Costs of event-based intervention: 0.5…1 workday for replacement, from recognition to insurance to organizing work force for replacement ≈ 1.3…2.6 Rp/kWh for a 40 kWp plant per event
- Installations performed by unqualified personal due to price pressure FiT: leads to more efforts for quality assurance, even if replacements in first years are within warranty of installer
- Prove of high quality allows lower insurance fees

Conclusion:

- Quality assurance over the complete system and operation is essential for mid- to longterm development of LCoE

Summary

- Influence of operational costs on LCoE is rising
- Decrease of operational costs can not keep up with decrease of costs for PV components
- Spread in operational costs are very high
- Reductions in PV system costs can lead to increase in operational costs



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Conclusions

- Further analysis on a broad database and in detail is required to better understand operational costs
- Project specific calculations on operational costs are necessary for reliable LCoE calculations
- Re-evaluation of components on a regular base is necessary, tenders can be useful
- Clustering or outsourcing can help reduce operational costs
- Quality assurance is essential for further reduction of LCoE mid- to long-term