Foldable PV
Challenge of Universally Applicable Performance Indicators

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Content

- Objectives of double use PV systems
- Folding PV principle
- Folding PV application on top of wastewater infrastructure
- Benefits of foldable PV on wastewater infrastructure
- Outlook

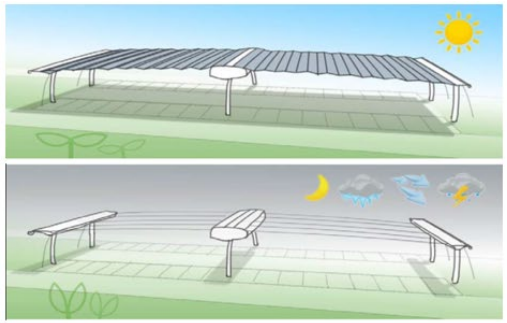
Objective: Double Use on top of infrastructure

- Saving land for PV greenfield plants
- Double use = infrastructure purpose
  + PV electricity

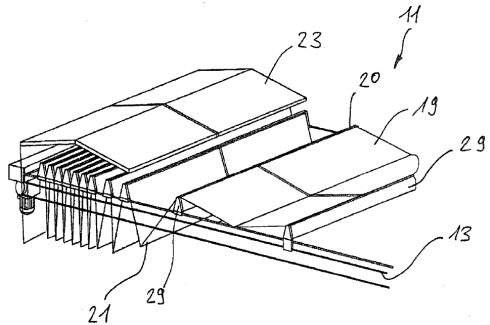
  (triple use) + other benefits
- other individual benefits like shading of cars
  - avoided energy for cars air condition
  - less stress to jump in a hot car
  -(but no single number fits to all of it)

Foldable PV System

Less mounting material needed less wind, snow and hail load



Patent:
2012; CH20120000750; A. Büchel, F. Baumgartner
2013; EP2669594 (A1); A. Büchel, F. Baumgartner
2014; WO2014179894A1; A. Büchel, F. Baumgartner
2016; EP2669594B1 Büchel, Baumgartner, Diem, Hügli



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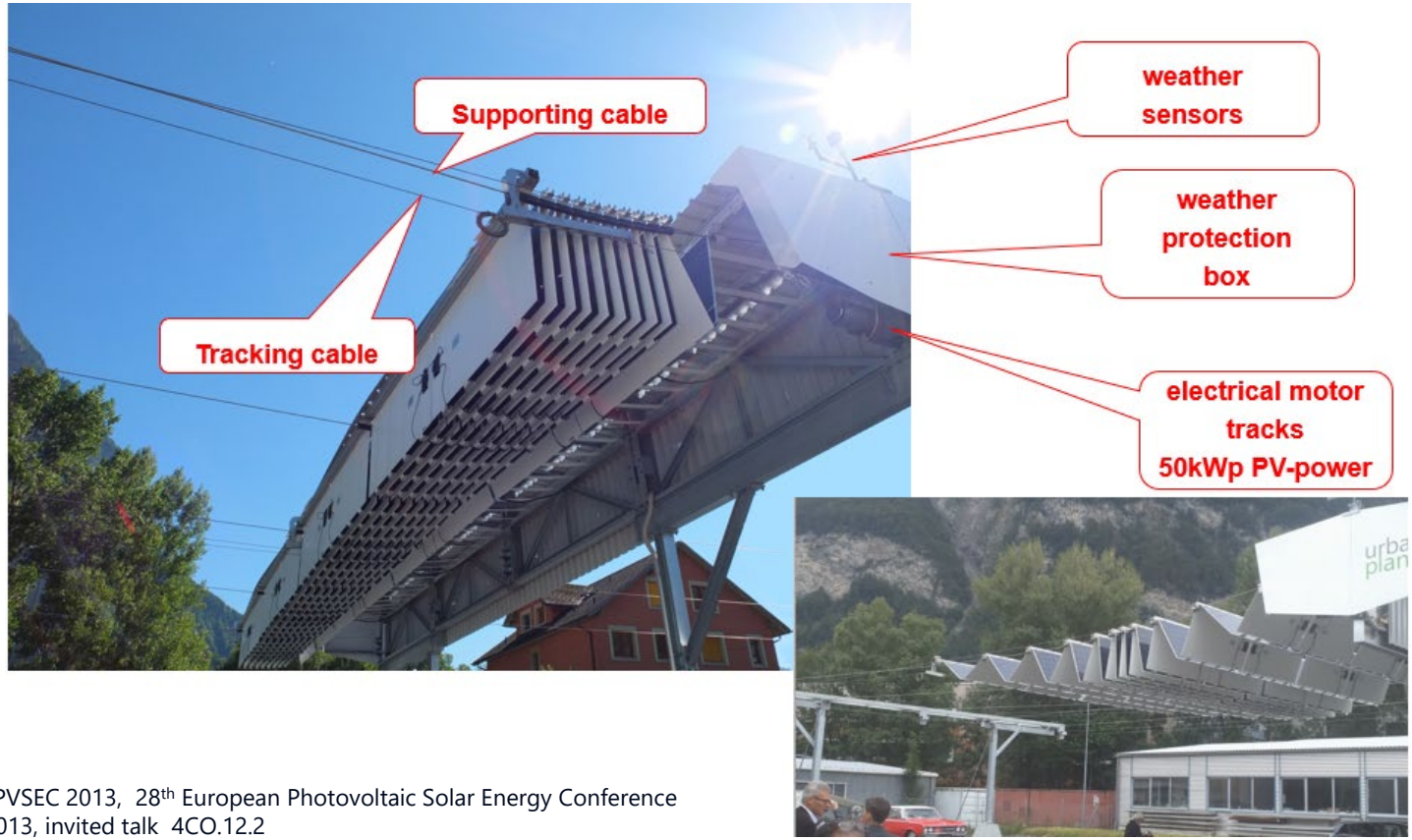
Foldable System Principls



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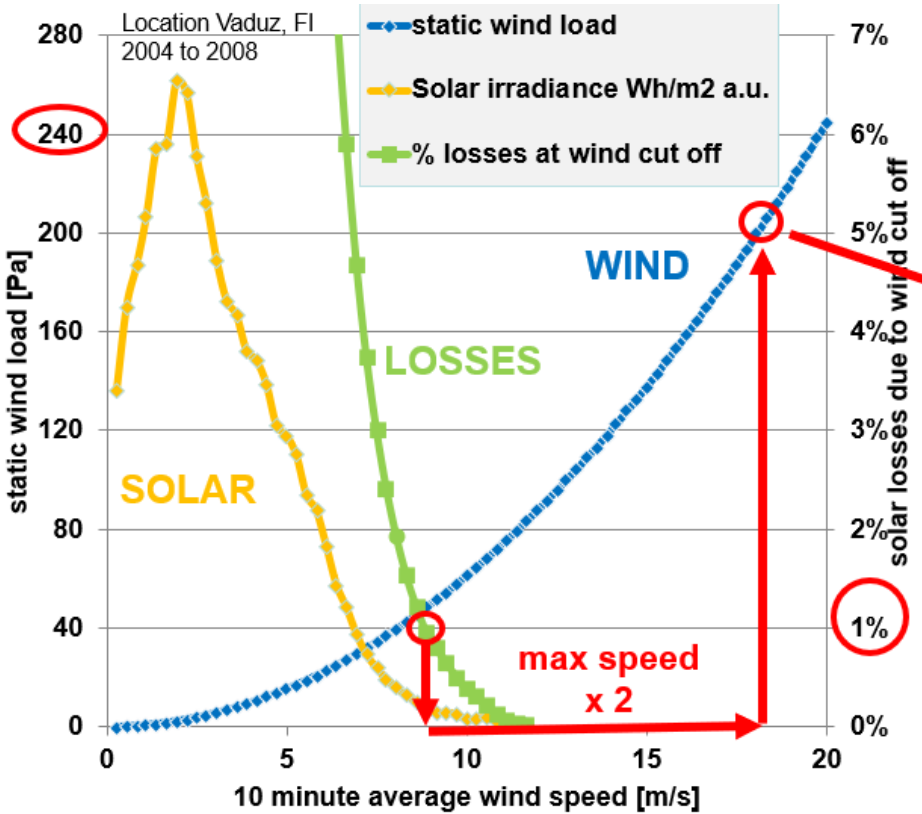
F. Baumgartner et.al., EUPVSEC 2013, 28th European Photovoltaic Solar Energy Conference & Exhibition, Paris, Oct 2013, invited talk 4CO.12.2

No PV production at heavy wind conditions



Weather related mechanical loads

- Wind load – module test 2400Pa, IEC 61215
- Snow 5400 Pa, ASTM E1830

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Foldable PV system of waterwaste systems Chur

Wind speed below 15m/s, no snow, no hale
1.5% PV losses

Heavy wind >15m/s and during night

IBC Energie Wasser Chur, 2016–2018, PV Power 643 kWp

PV production fits to the local needs

- 95% of PV electricity used on site
- 20% of electricity consumption powered by PV
- About 1.5 % PV losses due to heavy wind (CH <3%)
- 2.3% gain winter (snow)
- 60 seconds – move in
- 40 000 cycles in/out
- 130kg steel for each kWp

PV shading reduce Alge growth rate

Foldable PV system facilitates service tasks

- Fixed PV mounting systems are limiting the flexibility of service tasks

Higher PV output in regions with heavy snow

- Foldable PV System in Davos, Switzerland
- Elevation 1500m
- 252kWp
- installed in 2020
- 93% PV self consumption by the waste water treatment facility
- PV electricity production while other roofs are covered by snow

Foldable PV parking

dhp-technology.ch

Foldable PV Parking

- Appenzell, Switzerland
- SAK St.Gallisch-Appenzellische Kraftwerke AG
- 2019-2020
- 429kWp
- Realisation: dhp-technology.ch

dhp-technology.ch

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Folded PV parking

- Wood replaces steel construction
- Future project higher wood content

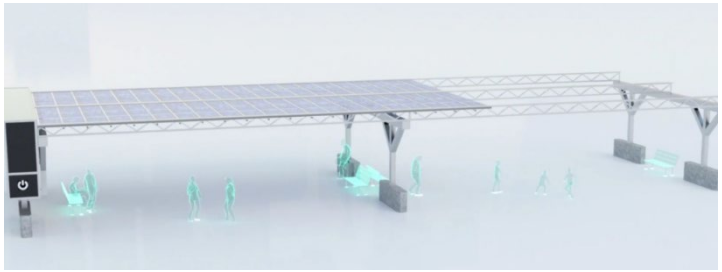
- **DHP project status** total 3.500 kW
- 7 projects in Switzerland in operation
- 3 projects planning phase in Germany

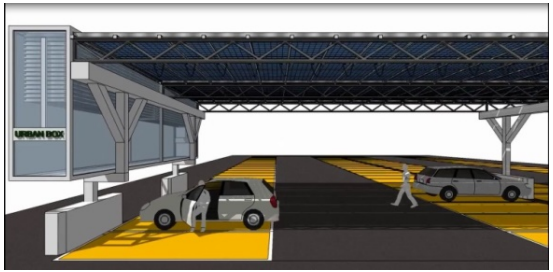
Summary

- Foldable PV systems shows highest benefit if the infrastructure area below the PV panels have to be accessible temporarily
- Like Application on top of wastewater systems
  1) Shading by PV panels reduces the growth rate of algae (O&M cost benefit)
  2) Shading is also beneficial for service workers during cleaning the basins
  3) High level of local PV self consumption
- Higher PV self consumption by charging station at PV carports
- Higher PV performance during wintertime at higher snow fall rates (snow free)
- Less mechanical stress applied to PV modules during heavy wind load
- Per kWp lowest kg steel, lowest kg concrete fundaments possible
  1) on the long run min. limiting material costs for economy of scale approach
  2) lowest CO_2 rucksack realised due to minimum material – wood structure
  3) automatically PV module cleaning will reduce O&M costs at higher yields

Outlook

- Why not using foldable PV as flexible AGRO PV System for special crops?
- Development of other PV mounting systems with retractable PV panels are under way like URBANBOX using standard PV modules in operation 2022





www.iworks.li

- Comparison of total CO_2 emission analyses of foldable PV systems relative to conventional PV systems have to be carried out including the cradle to grave of all mounting systems materials and fundaments

Thank you for your attention

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