



Foldable PV

Challenge of Universally Applicable Performance Indicators

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- 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)















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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





Foldable System Principls









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

PVPS



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

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- 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

VPS

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



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Higher PV output in regions with heavy snow

- Foldable PV System in Davos, Switzerland
- Elevation 1500m
- 252kWp

PVPS

- 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

PVPS



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Foldable PV Parking

- Appenzell, Switzerland
- SAK St.Gallisch-Appenzellische Kraftwerke AG
- •2019-2020
- 429kWp

PVPS

 Realisation: dhp-technology.ch



dhp-technology.ch



Folded PV parking

PVPS





- 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

PVPS



- 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 CO₂ rucksack realised due to minimum material – wood structure₁₅

3) automatically PV module cleaning will reduce O&M costs at higher yields





- 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 CO₂ 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

www.iea-pvps.org

Thank you for your attention

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