Bifacial modules used in cable based PV carport applications

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Goals

Long-term goals:

- Huge potential for PV power is available to be installed on top of parking spaces, typ. 2kW on top of each parking space
- Two different mounting conditions have to be analysed
  - horizontal
  - vertical

Intermediate goals:

- Improving the energy yield modelled by new measurement methods to convince the market
- Economic evaluation of different cable based setups or fixed bifacial mounting solutions on top of carports or other applications

Expected benefit of bifacial and PV carports

- Due to high amount of diffuse light at the back side of the mounted PV modules on top of PV carports, higher energy yield per nominal power is expected.
- Higher elevation of the mounted PV modules leads to better cooling characteristics hence a better yield [1].
- Mounting bifacial modules in vertical position will benefit in reducing the total PV production peak in the utility grid at noon by observing one peak in the morning and a second in the afternoon [2].
- Cable based mounting are performed at low consumption of mounting material like, metal and concrete thus offering beneficial low rates of total CO_2 emission rates of producing the system.

Cable based mounting of bifacial PV modules

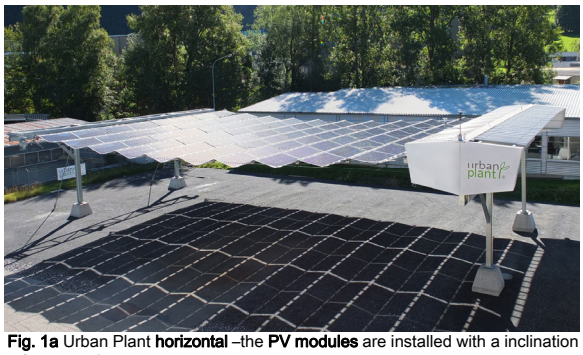

Fig. 1a Urban Plant **horizontal** –the **PV modules** are installed with a inclination of about 10° like in the 50kW prototype installed in Balzers FL [1]

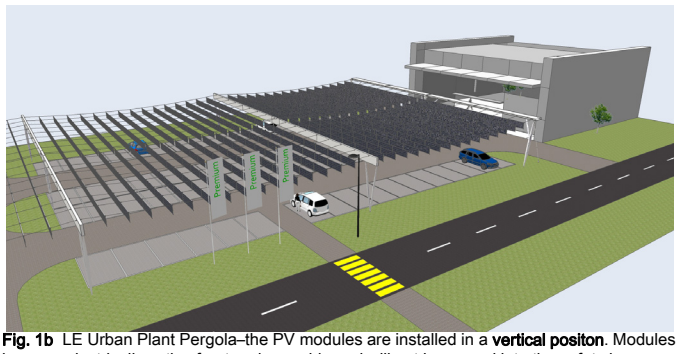

Fig. 1b LE Urban Plant Pergola–the PV modules are installed in a **vertical positon**. Modules have an electrically active front and rear side and will not be moved into the safety box.

Measurement results

Clear sky day: 2014-05-18, Winterthur, Switzerland

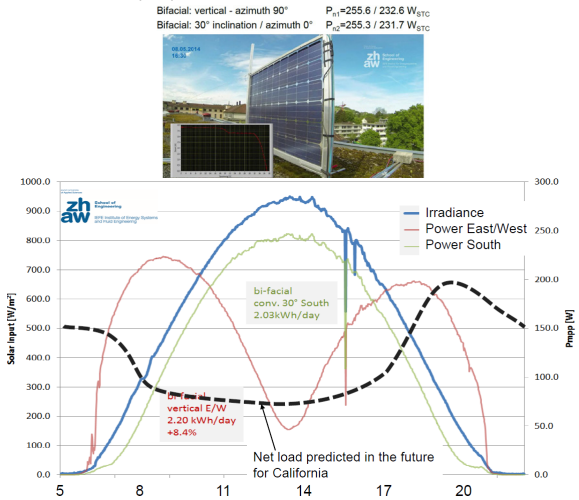

Fig. 2 Daily characteristics of a vertically mounted bifacial module facing south compared to second bifacial module mounted in a standard 30° south orientation directly on the flat roof.

Result: Daily yield gain of 8.4% by vertically installed bifacial module compared to module installed facing 30° south .

New measurement method: ZHAW IEFE Fast PV Tracker , Winterthur

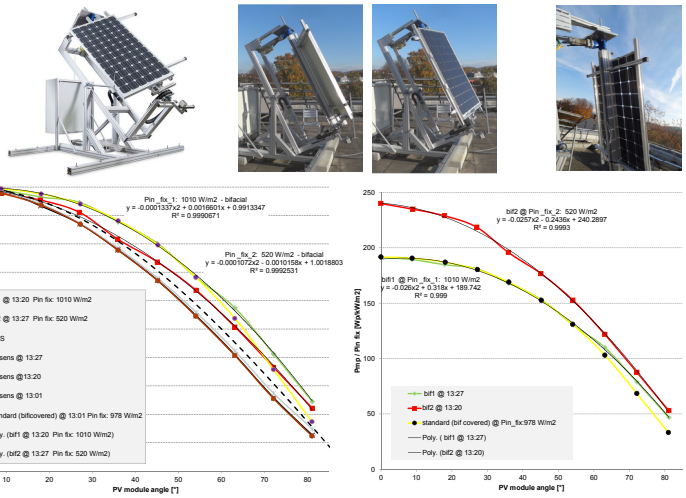

Fig. 3 Measured power at maximum point of a bifacial module (see Fig. 2) at noon in Winterthur on Nov 7th, 2014 by turning the module with 10 degree increment around the axis and performing an IV scan in such fixed position – total scan time for all positions were 18 seconds.

Result: Yield gain of bifacial PV module compared to single-facial at lower irradiance

Summary

Cable based **mounting of bifacial modules** in a **vertical** or in a **horizontal** orientation is **demonstrated**, also on top of carports . **Yield gains of 8%** on a clear sky day (Fig. 2) were **measured** together with **higher yield at lower irradiance** levels by the use of the new **measurement system** of the **fast module tracker**. First results of applying the commercial PV energy yield tool PVSYST lead to annual additional electricity production in Switzerland of about 15% if the bifacial modules are tracked at two fixed positions relative to fixed mounted 30° tilted south oriented PV modules. These **simulation show relevant deviations to the measured daily power production characteristics** and will be **improved in a future research project** based on the presented new measurement methods of standard outdoor monitoring, but also using the data given by the ZHAW fast module tracker measurement system.

References

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[2] J. Libal, V. D. Mihailetchi, R. Kopecek, Photovoltaics International, p 35 – 45, www.pv-tech.org, 23rd, March 2014
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