Energy performance of a 1.2 MWp photovoltaic system distributed over eight buildings at Utrecht University campus

Wilfried van Sark¹, Arjen de Waal¹, Jasper Uitlooi², Niekol Dols², Frédérique Houben², Richard Kuepers², Michiel Scherrenburg³, Benno van Lith⁴, Ferry Benjamin⁵

¹Utrecht University, Copernicus Institute of Sustainable Development, Utrecht, The Netherlands
²Utrecht University, Real Estate and Campus, Utrecht, the Netherlands
³Utrecht University, Programme Team Sustainability, Utrecht, the Netherlands
⁴BAM Bouw en Techniek - Regio Midden, Bunnik, the Netherlands
⁵ProfiNRG, Harmelen, the Netherlands

Introduction

Utrecht University aims to be CO₂-neutral by 2030. Intermediate aim to generate half of its energy consumption in 2020 in a sustainable way, including thermal storage, the purchase of wind power and the use of solar energy. This has motivated the design and realization of 4,600 PV modules on several buildings in the Utrecht Science Park De Uithof in the period May-September 2016. The grid-connected system is designed such that it is predicted to generate one million kWh of electricity annually, which constitutes ~2% of the annual electricity demand. The installation of the PV systems contributes to a reduction of the CO₂ footprint. Moreover, it offers the potential to enhance research and education component of faculties involved.

System location

1: Caroline Bleeker building, 2: Victor J. Koningsberger building, 3: Library, 4: David de Wied building, 5: Jeannette Donker-Voet building, 6: Willem C. Schimmel building, 7: Martinus G. de Bruin building, 8: Waterberging Diergeneeskunde/Jongveestal. The Utrecht Photovoltaic Outdoor Test facility (UPOT, red dot) is used for measured irradiation.

System description

The layout of the system is optimized using separate inverters per orientation.

- 4,600 modules of 270 Wp are installed at 10 degree tilt (some at 30 degree tilt).
- 37 inverters of AC capacity 12, 20, 23, and 30 kW.
- Average ratio of PV DC size to AC inverter capacity is 0.825

Monitoring

- Calibrated production meters (for SDE+ subsidy)
- Inverter readings of power (5 min time resolution)
- Irradiation from UPOT
- In future: 15 pyranometers per system per orientation, and temperature sensors on back of ~50 modules
- Period: September 2016 – August 2017

System installation video

Impressions

Irradiation

Summary of results

Building | Size (kWp) | Orientation | Ratio PV size to inverter capacity | Total energy (MWh) | Yield (kWh/kWp) | Performance ratio
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1 (CB) | 132.3 | W-E | 0.81 | 81 | 613 | 0.592*
2 (VJK) | 33.4 | S | 0.90 | 29 | 865 | 0.835
3 (Lib) | 232.2 | S-N | 0.85 | 202 | 871 | 0.841
4 (DdW) | 121.1 | W-E-S | 0.80 | 111 | 899 | 0.868
5 (JDV) | 46.4 | W-E | 0.73 | 25 | 529 | 0.511*
6 (WCS) | 233.3 | W-E | 0.85 | 186 | 798 | 0.771
7 (MdB) | 285.7 | W-E | 0.81 | 245 | 856 | 0.827
8 (JV) | 131.2 | S | 0.81 | 129 | 986 | 0.857

Conclusion

PV system delivers energy as designed.

Building JDV* and CB* suffer from data transmission issues. Data of production meters shows that systems actually are running well.

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