Innovative BIPV rooftops: development, realization, and monitoring of 2 BIPV field tests in the Netherlands

Picture 1: Green and black PV modules on FlexHouse in The District of Tomorrow.

Innovative BIPV Rooftops

Development, realization, and monitoring of 2 BIPV field tests in the Netherlands

This research poster is part of a research in which the combined assessment of materials, embodied energy and operational energy in BIPV solutions is investigated, related to carrier capacity. The aim of this research is to formulate the interaction of the energy and material aspect of PV integration in the building envelope in a carrier capacity based assessment tool.

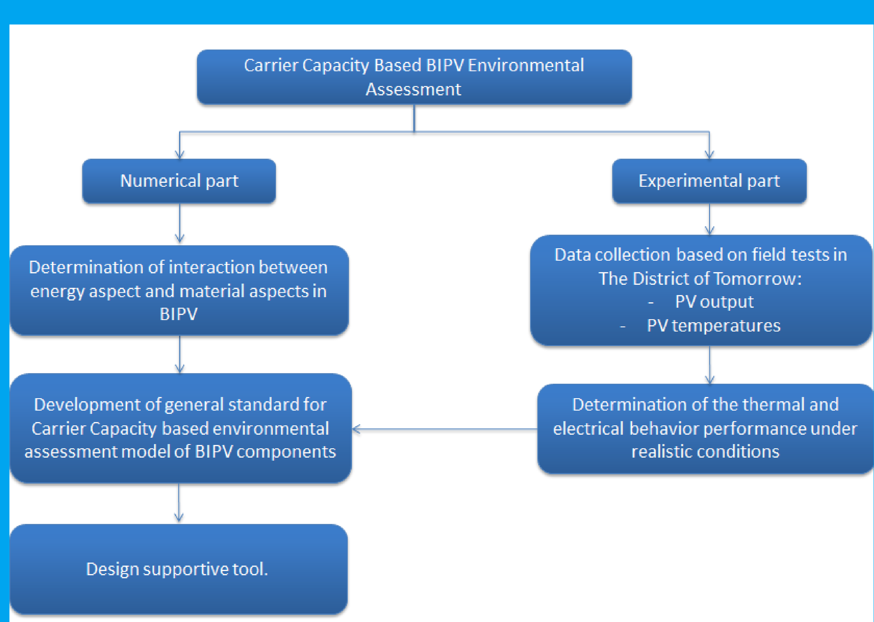


Figure 1. Overview of carrier capacity based environmental assessment of BIPV.

The research project is embedded in the following projects carried out by Zuyd University / Research institute Built environment of Tomorrow (RiBuilT):

IMDEP

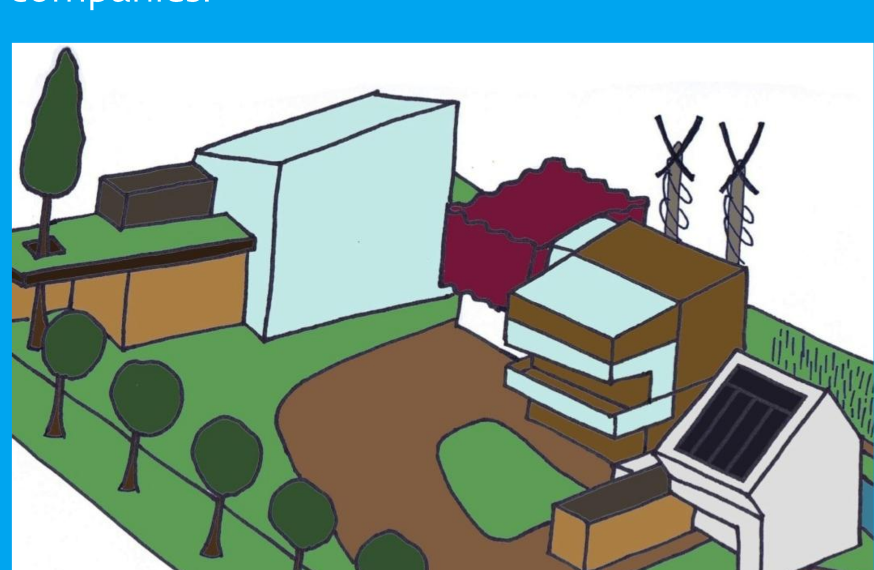
Research project aimed at defining innovative (material) concepts for an energy generating and sustainable building envelope of tomorrow.

SMartChain

Research project aimed at bridging the gap between PV products and their integration in the building envelope. Partners in this project are Rimas, Soltech, Eurotech, XYZTEC, SCX Solar, Oskomera Solar Power Solutions, Chematronics, TNO and ECN. The SMartChain project is partly subsidized by the ministry of Economic Affairs, the provinces of Limburg and Noord-Brabant, and Samenwerkingsverband Regio Eindhoven.

The District of Tomorrow

Innovative research and education center for the built environment and new energy on the cross-border business park Avantis. In 'The District of Tomorrow', four building objects will be developed, produced, exhibited, exploited and monitored by students, researchers and companies.



Picture 2. Overview of The District of Tomorrow with four innovative sustainable building objects.

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BIPV development

Building Integrated PV (BIPV) is seen as strategy to realize the EU target of Nearly Zero Energy Buildings (NZEB's), while at the same time creating an aesthetically acceptable built environment. This in contrast with Building Added PV (BAPV) of which the result is often seen as aesthetically unwelcome additions to new and existing building.

Picture 3: Building Applied PV (BAPV) versus Building Integrated PV (BIPV).

On the other hand, BIPV might have some negative aspects considering lifespan and PV output besides the aesthetical positive effect.

Field Tests

In this research project two field tests are realized in The District of Tomorrow to investigate the negative aspects of different BIPV solutions, focusing on the effect of back-string cooling of PV modules on PV electricity output, relative humidity and lifespan. These aspects are seen as possible bottlenecks for large-scale acceptance of BIPV in society. The design, realization and monitoring of these field tests can contribute to an increased implementation of BIPV through improved BIPV solutions.

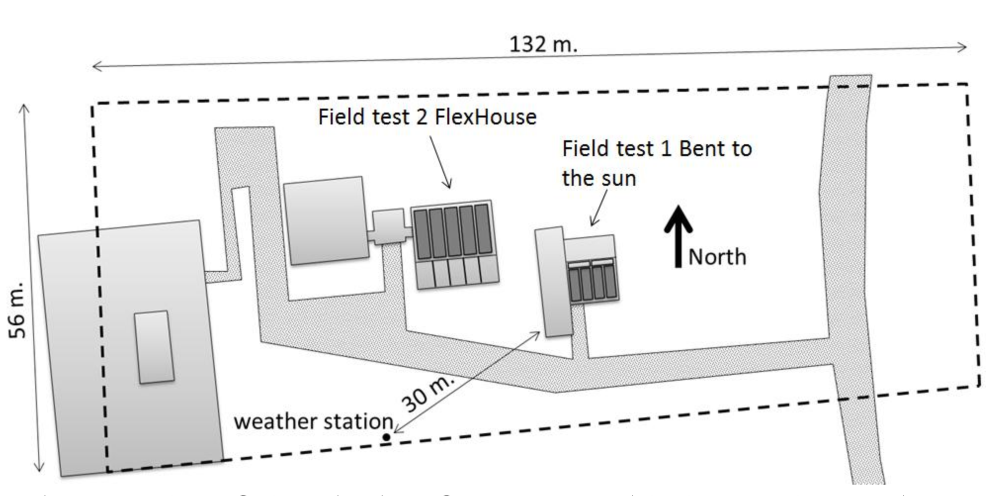


Figure 2: Plan of The District of Tomorrow with the weather station installed approx. 30 m. west to southwest of the field test.

The BIPV field tests consist of a 6,000 Wp installation on 'Bent to the sun' and a 10,000 Wp installation on 'FlexHouse'. The backstring cooling is varied between the segments on the different roofs by fluctuating the amount of backstring ventilation and fluid cooling, as indicated in Fig. 3 and 4.

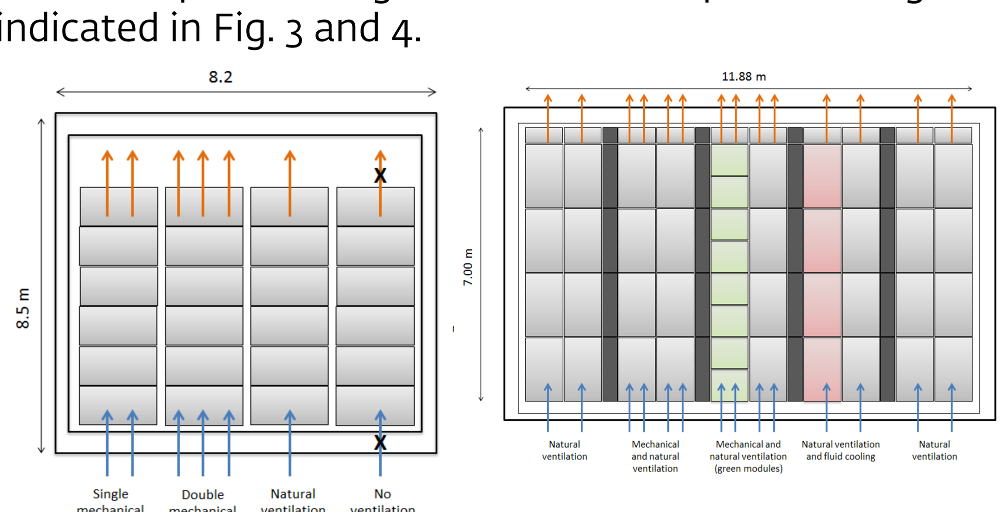


Figure 3 and 4: Top view of field test 1 and field test 3 with an indication of the different backstring cooling methods.

Monitoring

In both field tests, an extensive monitoring installation has been installed. On string level in the first field test and on module level in the second field test. The monitoring consists of surface temperatures, air temperatures, air speeds, relative humidity, electricity output and visual inspection, as shown in Fig. 5 and 6.

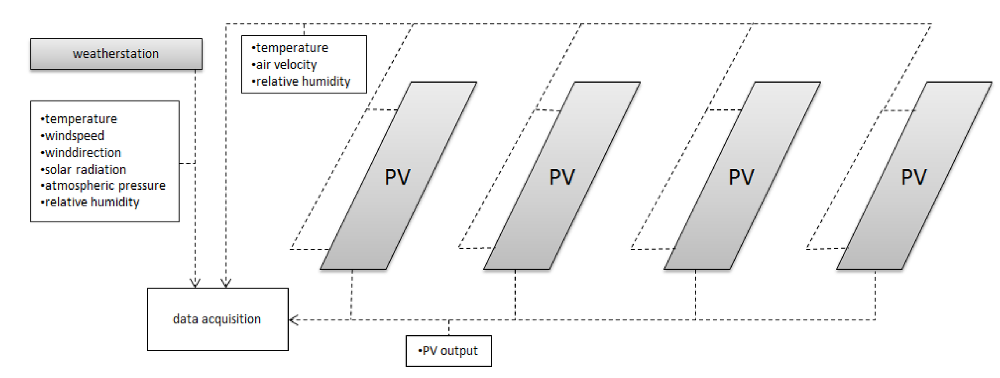


Figure 5: Overview of the monitoring installation in field test 1 on string level.

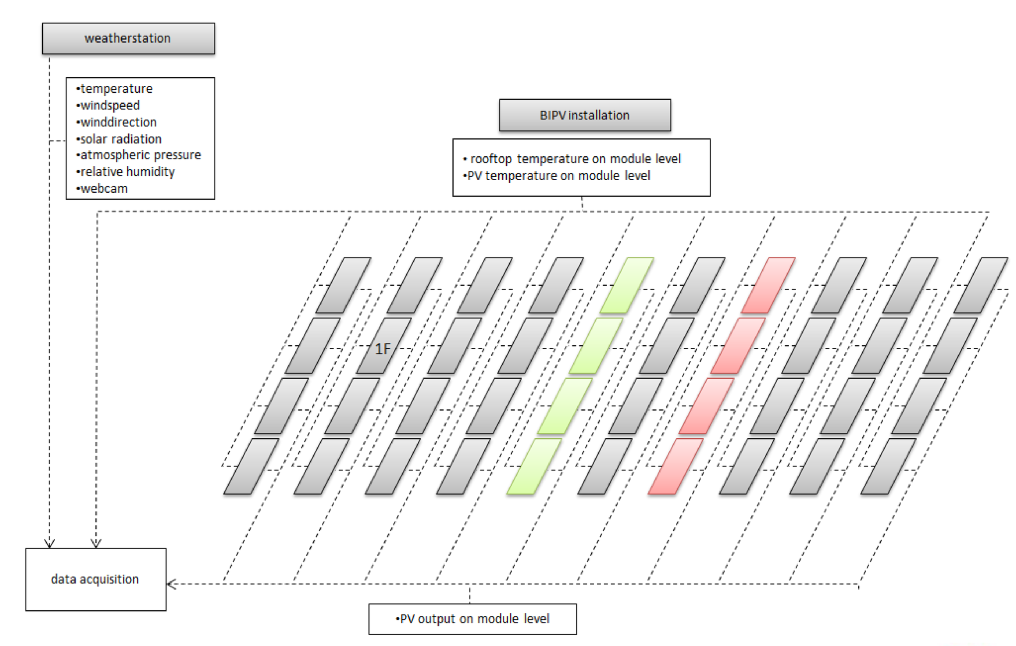
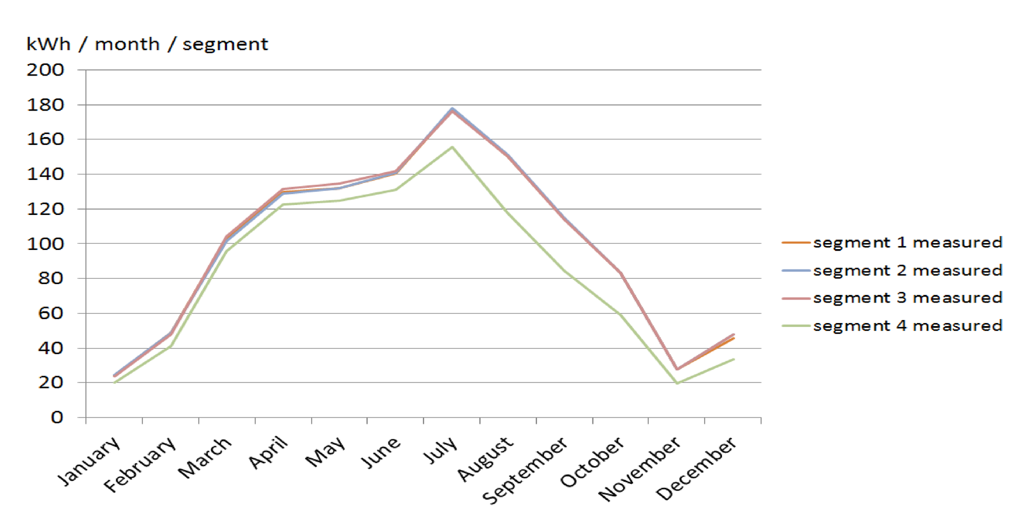


Figure 6: Overview of the monitoring installation in field test 2 on module level.

The first results of field test 1 indicate that the string with no backstring ventilation shows a significant lower electricity output, as indicated in Graphs 1, in combination with higher temperatures and condensation In the air gap.



Graph 1: Monthly electricity output per string over 2013. All strings show a comparable output except for string 4, the non-ventilated string.

The visual inspection of the field tests is considered to be a valuable addition to the data collection of PV output and temperatures (Fig 7 and 8).

Figure 7 and 8: Visual inspection at 5-minute intervals of the BIPV roofs in The District of Tomorrow indicating weather characteristics.

Outlook

The presented two BIPV solutions will be monitored and analyzed extensively for the next year. The results will contribute to generate insight in the chances of future development of BIPV in the Netherlands and comparable climates.

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