OUTDOOR CHARACTERIZATION OF INNOVATIVE BIPV MODULES FOR ROOF APPLICATION

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INTRODUCTION

In the framework of the European project Construct PV, two different outdoor test-facilities have been installed, one in SUPSI Campus (Lugano, Switzerland) and the other in TEGOLA Headquarters (Vittorio Veneto, Italy). The object of the investigation is a new BIPV solar shingle prototype, developed by Tegola Canadese S.p.a. The solution consists of a durable glazed panel (containing crystalline SWCT solar cells) integrated in a waterproofing back-sheet layer made of a bitumen-based membrane with the goal to ensure an easy-mounting and on-site customization. The test facilities are aimed both to demonstrate and disseminate the Construct PV technology (visits, professional development and student’s training, etc.) as well as to monitor the performance of the new BIPV shingle (stand 1) in comparison with existing systems on the market (stand 2). At SUPSI test-facility, new prototypes have been compared with the BIPV in-roof system developed by Meyer Burger AG, MegaSlate® that uses high efficiency monocrystalline cell technology (mc-Si), while at Tegola Headquarters the new solution has been compared with large size solar modules Tegosolar 136® using thin-film triple-junction amorphous silicon technology (a-Si).

Outdoor Test Facilities

SUPSI CAMPUS test-facility consists in two stands made with metallic structures supporting an orientable roof (1.8 x 3.0 m) where the complete roof structure has been installed to simulate the real building envelope behavior. The stands have been equipped with temperature sensors (PT100), predisposed along each roof layer as well as at the back of the PV modules, MPPT aimed to measure the electrical performances (Pm, Voc, Isc and IV curves), some humidity sensors and an air flow meter. Construct-PV prototypes, CS (in-roof installation) and D1 (full-ventilated), monitored by a couple of panels (Type 3.3) connected in series (equivalent to a large solar tile of 20 mc-Si SWCT solar cells, Type 3.1) have been compared to MegaSlate® (B3) BIPV in-roof module (30 mc-Si solar cells).

TEGOLA Headquarters test-facility consists in two separate test-stands installed on the concrete flat roof of an industrial building, where Construct-PV prototypes (in-roof installation), monitored (large solar tile of 20 mc-Si SWCT solar cells, Type 3.1), have been compared to Tegosolar 136® (a-Si technology).

PRELIMINARY RESULTS

Firsts months of monitoring are compared, showing strengths and weaknesses of the technology in a multicriteria perspective involving both energy and constructive requirements.

TEGOLA Headquarters (Vittorio Veneto, IT)

- Final Yield, Yf [kWh/kWp]: differences between Tegosolar 136 and Construct-PV (Type 3.1) are in a range of 93.2% to 99.4% (black line).
- Performance Ratio PR [%]: differences between Tegosolar 136 and Construct-PV have shown reaching values from 0.17% in February to 6.63% in May.
- Energy production $E_{P}$ [kWh/m²]: differences for total monthly values of Construct-PV roof system are higher than Tegosolar 136 reaching values from 55.1% to 59.2% of increase (Table II).

SUPSI Campus (Lugano, CH)

- Final Yield, Yf [kWh/kWp]: differences between MegaSlate B3 and Construct-PV CS in a range of 7.9% to 10.9% (red line) while between Construct-PV CS (in-roof) and D1 (free-standing) varies from 0.95% to 8.7% (blue line).
- Performance Ratio PR [%]: differences between MegaSlate B3 and Construct-PV CS have been up to 5.5% maximum while between CS (in-roof) and D1 (free-standing) have reached the 6.8% in May attributed to higher temperature of the unventilated module.
- Energy production $E_{P}$ [kWh/m²]: Total monthly values are higher in MegaSlate B3 than Construct-PV CS reaching values from 22.1% to 24.6% of increase (Table I).

FUTURE WORK

Monitoring campaign will continue until the end of the project, considering both the winter and the summer period. The test facility will serve also to test other BIPV complete system solutions (roof and façade) since the small demonstrator built at SUPSI Campus allows to flexibly change the installation systems and the tilt angle of the roof to perform different tests under real operation and weather conditions. In the nexts months these test facilities within the Construct-PV project will serve to:

- Demonstrate the new technology and for dissemination activities;
- Show innovation of the system and prevent manufacturing defects;
- Benchmark the technology with other BIPV solutions;
- Evaluate the construction and electrical performance of the system;
- Evaluate the scaling, shadowing and temperature effects as well as effects of back ventilation assessment.

ACKNOWLEDGEMENTS

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SUPSI

Construct PV

Hosted by SUPSI, this is a European project aiming at demonstrating and disseminating a new BIPV solar shingle prototype, developed by Tegola Canadese S.p.a. in Italy. The solution consists of a durable glazed panel (containing crystalline SWCT solar cells) integrated in a waterproofing back-sheet layer made of a bitumen-based membrane with the goal to ensure an easy-mounting and on-site customization.

The project is funded by the European Commission and the main objective is to demonstrate and disseminate the Construct PV technology (visits, professional development and student’s training, etc.) as well as to monitor the performance of the new BIPV shingle (stand 1) in comparison with existing systems on the market (stand 2).

The testing facilities are located in SUPSI Campus (Lugano, Switzerland) and TEGOLA Headquarters (Vittorio Veneto, Italy). The test facilities consist of two separate test-stands, one in SUPSI Campus and the other in TEGOLA Headquarters. The test-stands are equipped with temperature sensors (PT100), predisposed along each roof layer as well as at the back of the PV modules, MPPT aimed to measure the electrical performances (Pm, Voc, Isc and IV curves), some humidity sensors and an air flow meter. The test-stands are designed to simulate the real building envelope behavior.

In the framework of the European project Construct PV, two different outdoor test-facilities have been installed, one in SUPSI Campus (Lugano, Switzerland) and the other in TEGOLA Headquarters (Vittorio Veneto, Italy). The object of the investigation is a new BIPV solar shingle prototype, developed by Tegola Canadese S.p.a. The solution consists of a durable glazed panel (containing crystalline SWCT solar cells) integrated in a waterproofing back-sheet layer made of a bitumen-based membrane with the goal to ensure an easy-mounting and on-site customization. The test facilities are aimed both to demonstrate and disseminate the Construct PV technology (visits, professional development and student’s training, etc.) as well as to monitor the performance of the new BIPV shingle (stand 1) in comparison with existing systems on the market (stand 2).

At SUPSI test-facility, new prototypes have been compared with the BIPV in-roof system developed by Meyer Burger AG, MegaSlate® that uses high efficiency monocrystalline cell technology (mc-Si), while at Tegola Headquarters the new solution has been compared with large size solar modules Tegosolar 136® using thin-film triple-junction amorphous silicon technology (a-Si).