INFINITE
BUILDINGRENOVATION
Industrialised envelope solutions

INFINITE project – Industrialized wooden based facade - mock-up results

Martino Gubert, Eurac Research

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MARTINO GUBERT

Industrialization in building expert; envelope technology developer; circularity and eco-design

Researcher
Institute for Renewable Energy

eurac research

T +39 0471 055 727
martino.gubert@eurac.edu

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Contents:

INFINITE Functional and outdoor Performance Mock-up:

Focusing the attention on the Green kit!

- Design, manufacturing and installation
- Monitoring system and data acquisition
- Results and first conclusions

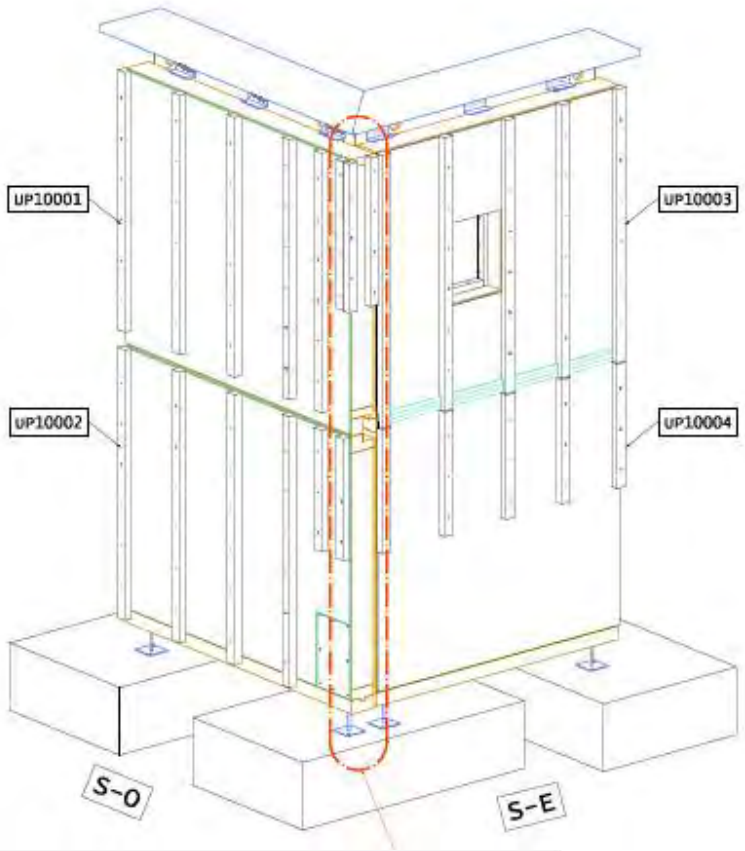
Functional and outdoor Performance Mock-up

Design, manufacturing and installation

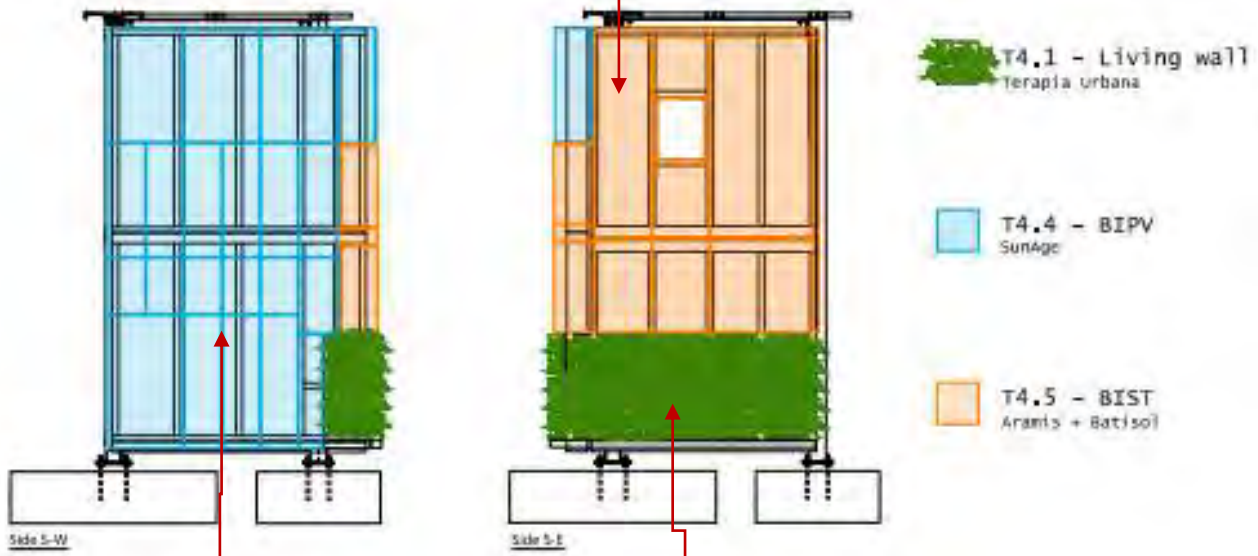
FLEXILAB mock-up design

The prefabricated module is composed by:

- 20cm of insulation
- A wooden based frame + membranes and ridig panels (OSB)
- The substructure of the cladding
- 3 different finishing (BIPV – BIST - GREEN



BIST kit - (Solar Thermal)



BIPV kit (Photovoltaics)

Green kit

Examples of details design: GREEN kit

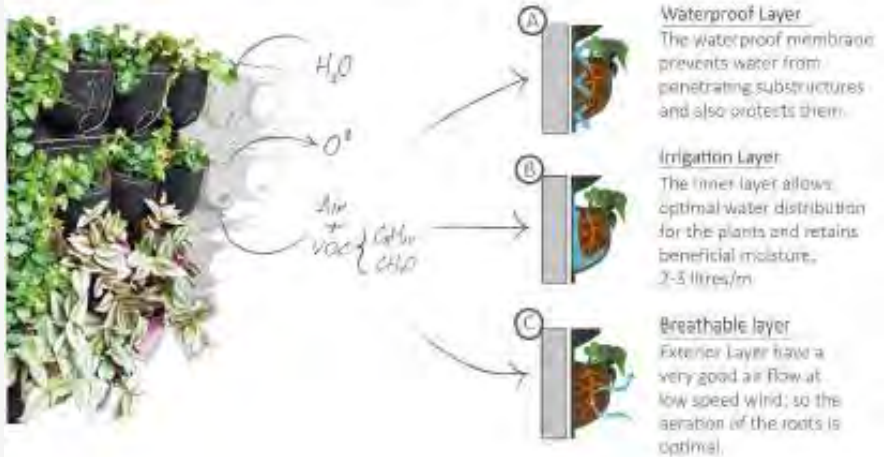
Selection criteria of the GREEN module:

- **Low weight**
- **Low thickness**
- **Easy to install**
- **Reasonable costs**
- **Possibility to pre-install offsite**

Fytotextile® Multilayer modules

It improves the health of the plant due to its high transpiration capacity in the buried layer and establishes an **optimal balance** between water, air and substrate in the buried part of the plant

Terapia Urbana

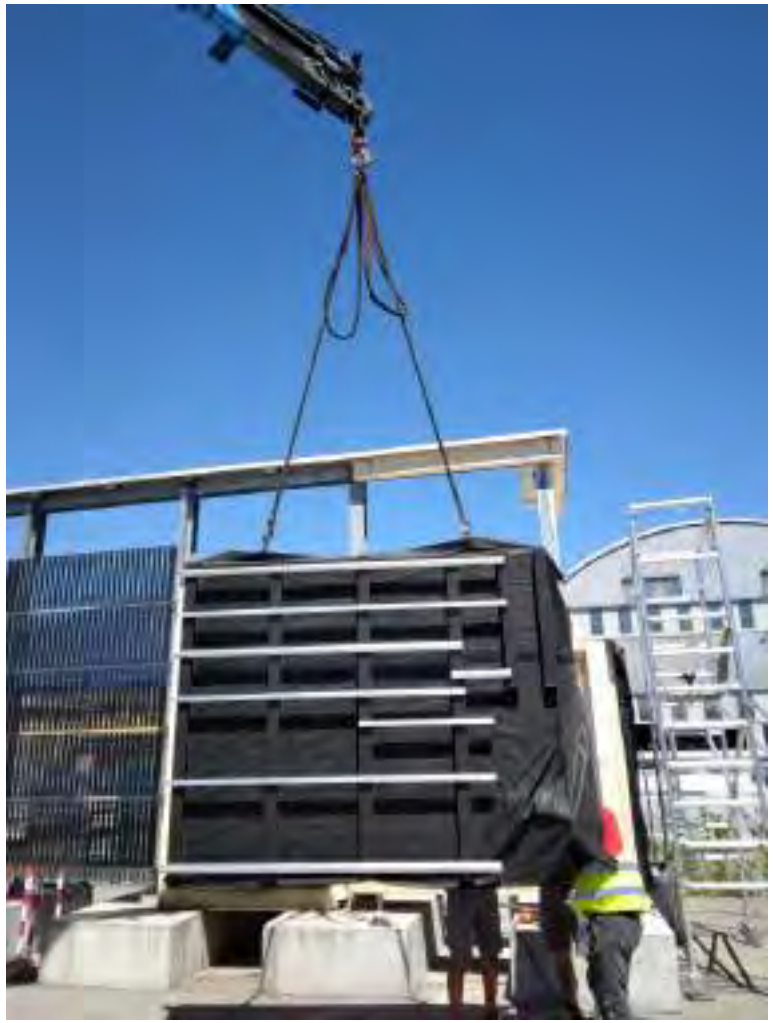


Mock-up installation

Mock-up installation

First „floor“ prefab module installation

Prefab module with BIPV substructure



Prefab module with BIST cladding

Mock-up installation

Base structure manufactured offsite

BIST corner installation on-site

BIPV installed on-site (due to fragility)

Mock-up installation

The GREEN part was planned on-site to **better evaluate the installation process**

All the GREEN substructure was defined **as „feasible“ for the installation off-site** -> future installation

Mock-up installation - GREEN

Mock-up installation

Flexilab Mock-up

Monitoring system and data acquisition

Monitoring system - Flexilab

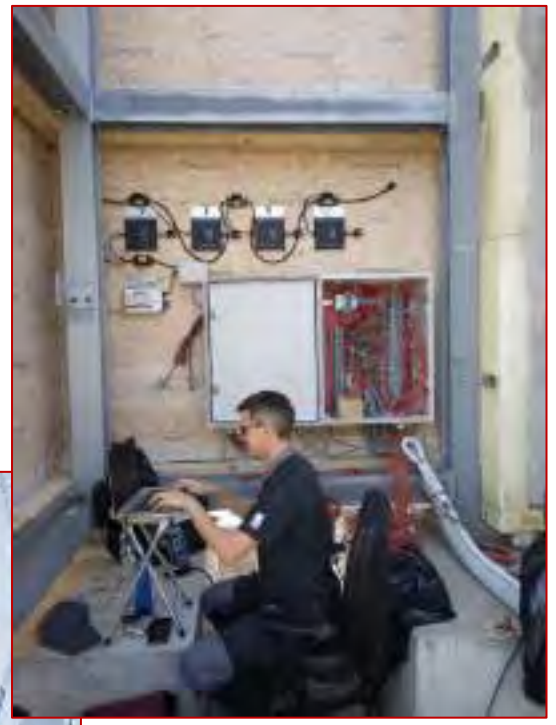
The Flexilab facility was build to **evaluate the installation and maintenance procedure, the operational phase and the preformances** in real conditions for long period.

monitoring campaign period -> **August 2022 - Present**

Aim:
- Monitor real environmental data on three different cladding
- Evaluate differences of behaviour on the **air cavity** with Three different cladding solutions
- Evaluate the efficiency of the BIPV panels with 5 different colours
- Evaluate the **Green behaviour** in two different orientation (south and east)
- **Compare the behaviour** of the different solutions

Measurements:
- Temperature surface in the cavity (CAV), in the wooden facade (WS) and on the back of the claddings (BC)
- Relative Humidity and Air Velocity in the cladding cavity (CAV)
- Water consumption and rain sensor for the GREEN part
- Pyranometer to have the irradiation on the facade
- Weather Station to monitor T, RH on the external conditions
- Elecricity measures (Ampere, Voltage, production)

Sensors Positions on the Mockup



SENSORS
Temperature
Relative Humidity
Air Velocity
Pyranometer
Weather Station
Water consumption
Rain sensors

Flexilab Mock-up

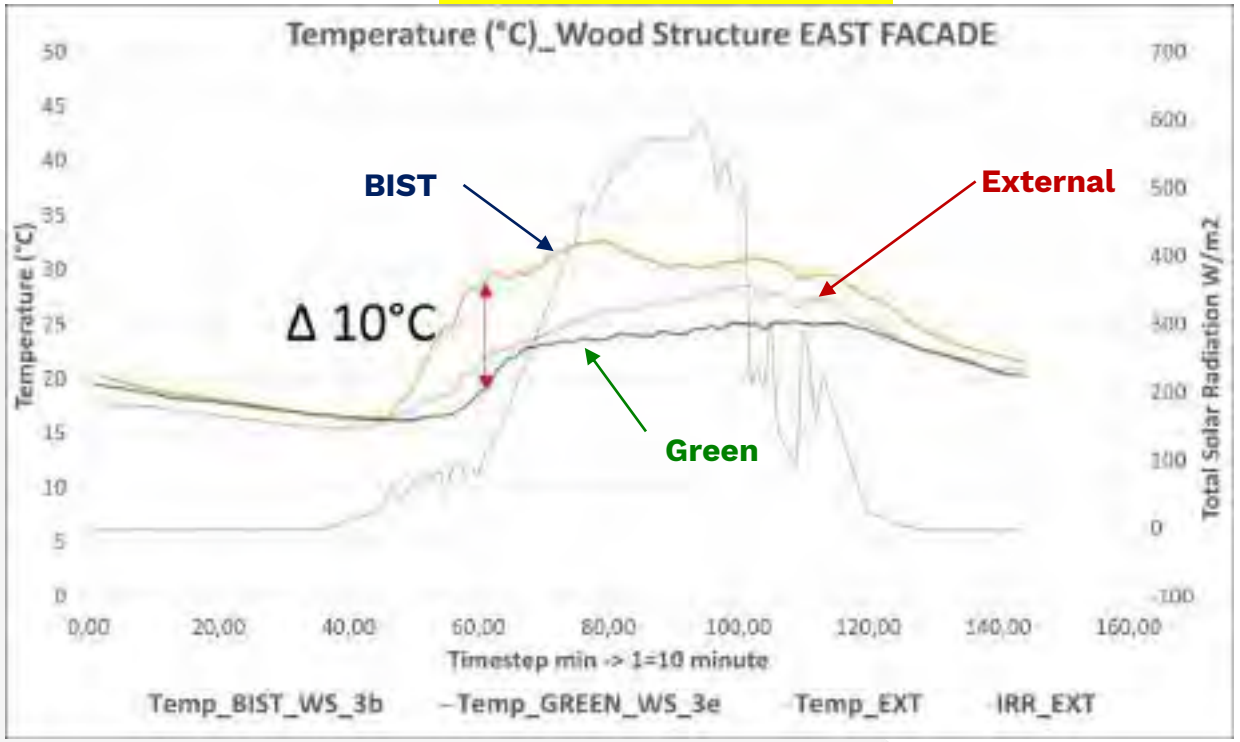
Results and first conclusions

Temperature gap – daily data

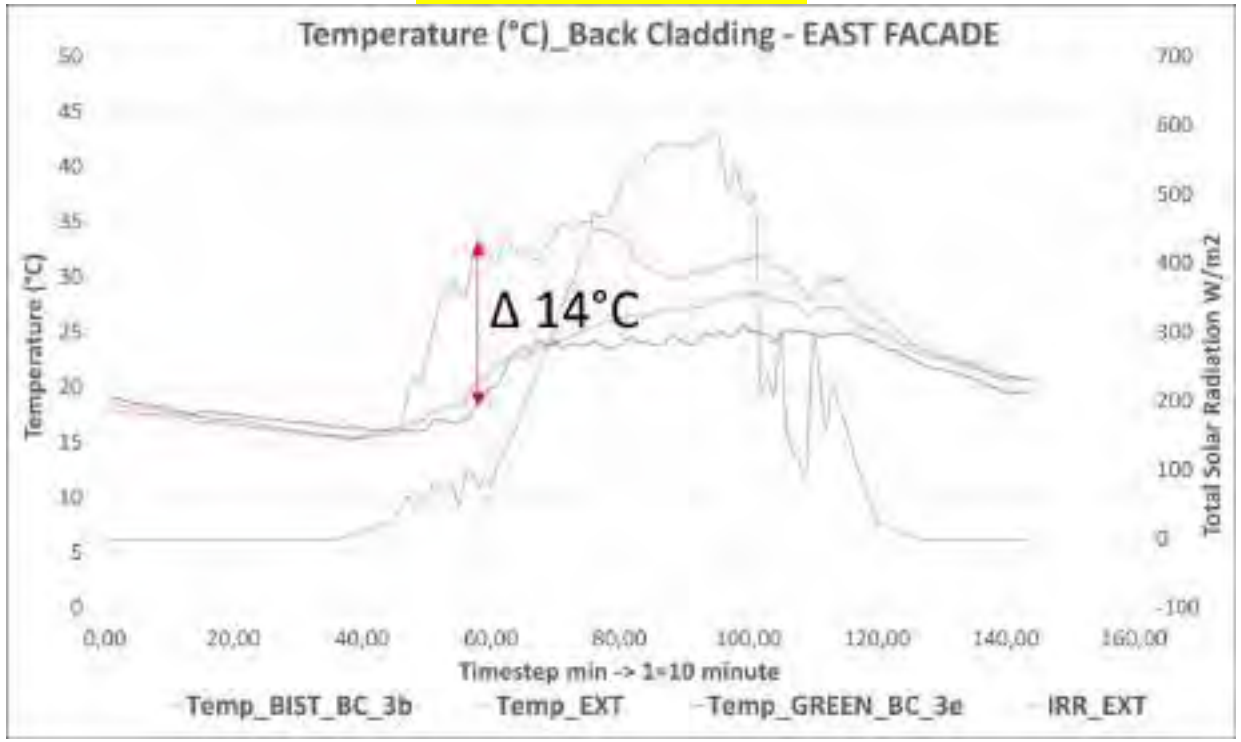
The surface temperatures differences on the BC (backside cladding) in the **hottest day of the year** is about **14°C** in the east orientations, while in the WS (wood structure) is about **10°C**.

In general, it can be observed that the temperature of the green façade, during the day, is often lower than the external ambient temperature (Temp_EXT).

WOOD STRUCTURE



BACK CLADDING

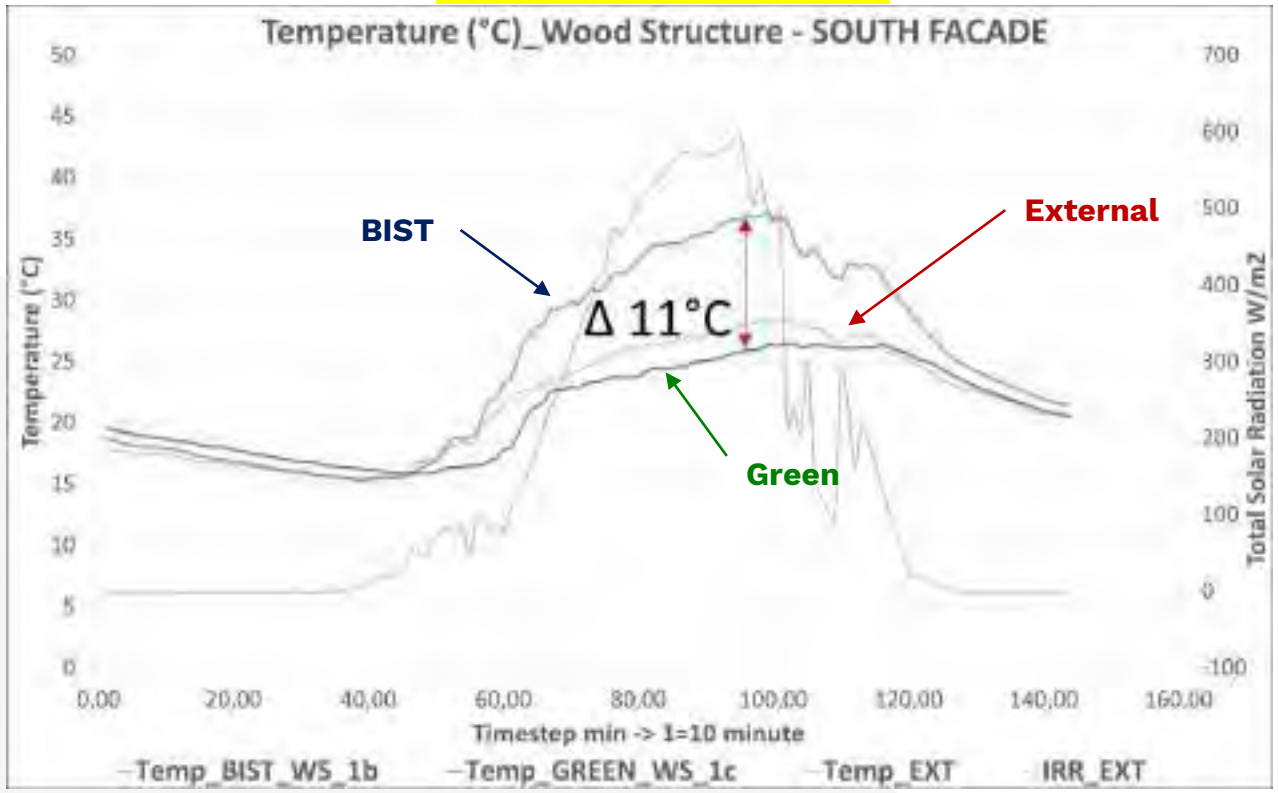


Temperature gap – daily data

The surface temperatures differences on the BC (backside cladding) in the **hottest day of the year** is about **18°C** in the south orientations, while is about **11°C** in the east orientation.

In general, it can be observed that the temperature of the green façade, during the day, is often lower than the external ambient temperature (Temp_EXT).

WOOD STRUCTURE



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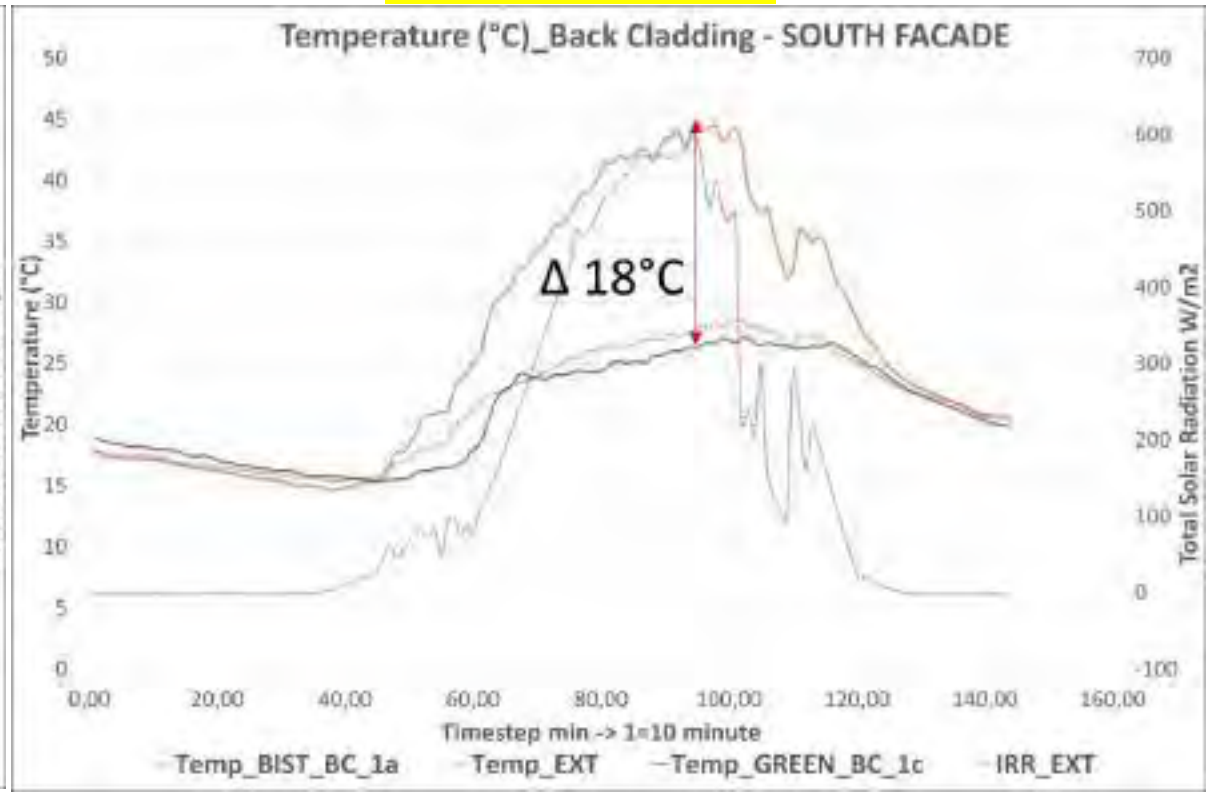
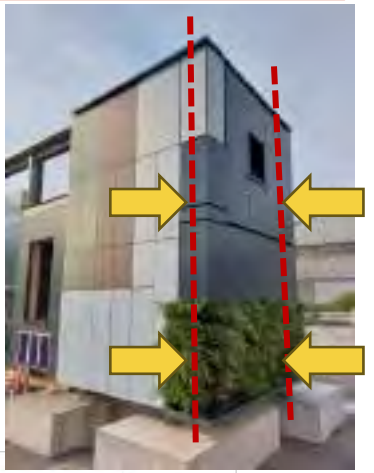


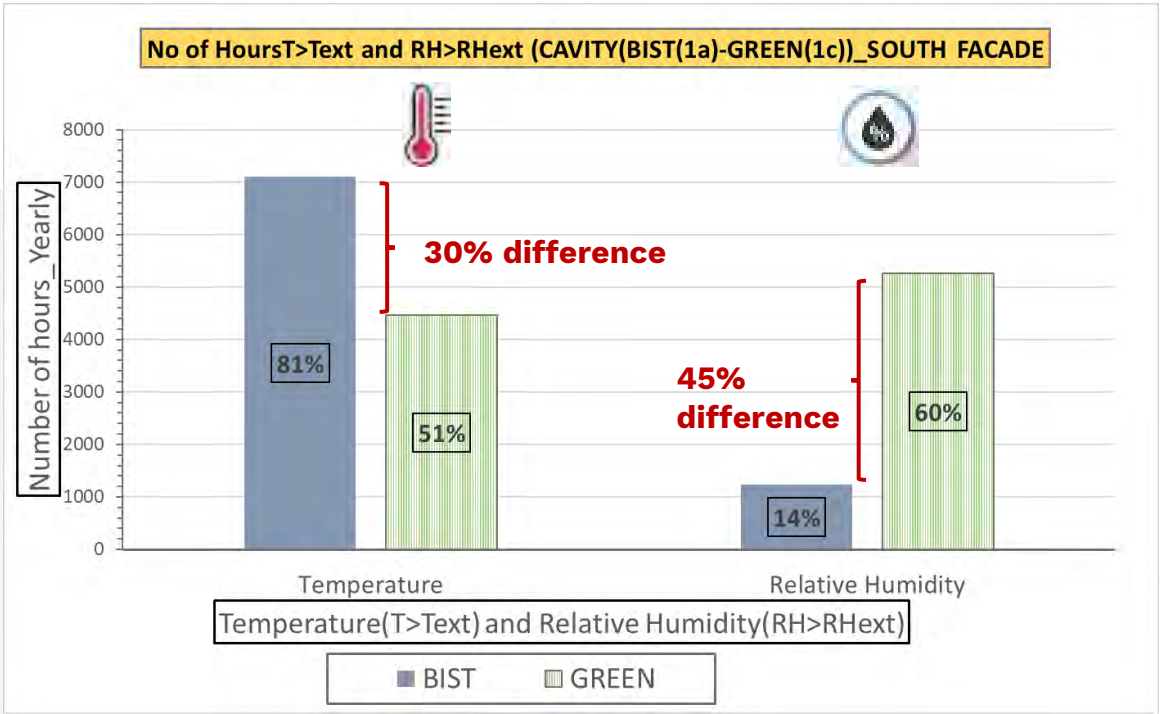
Cumulative data – Yearly based

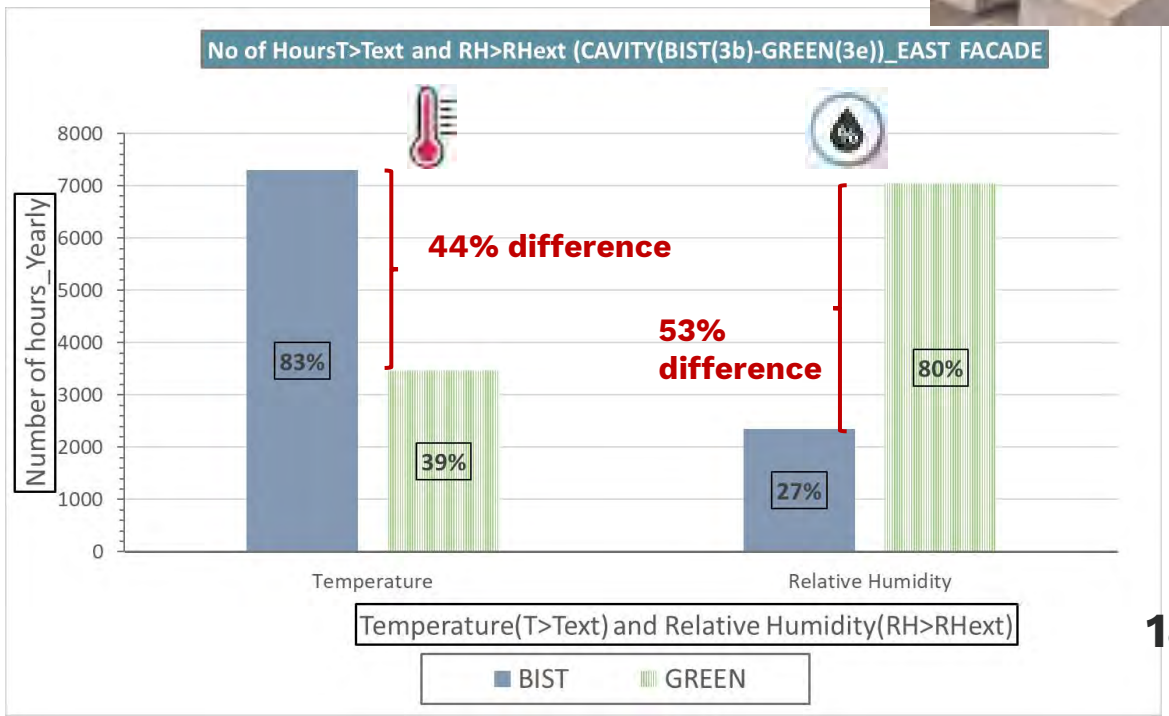
Number of Hours T>Text and RH>RHext (CAVITIES_SOUTH and EAST FAÇADE)

Can be interested also observe the RH and T (in the cavity) behaviour of the green and BIST kit compared to the external temperature:

- In the **south façade:**
  - the **green** has respectively **50% and 60%** of the year a **T and RH** higher that the external conditions, while the **BIST** has respectively **81% and 14%** of the year.
- In the **east façade:**
  - the **green** has respectively **40% and 80%** of the year a **T and RH** higher that the external conditions, while the **BIST** has respectively **83% and 27%** of the year.





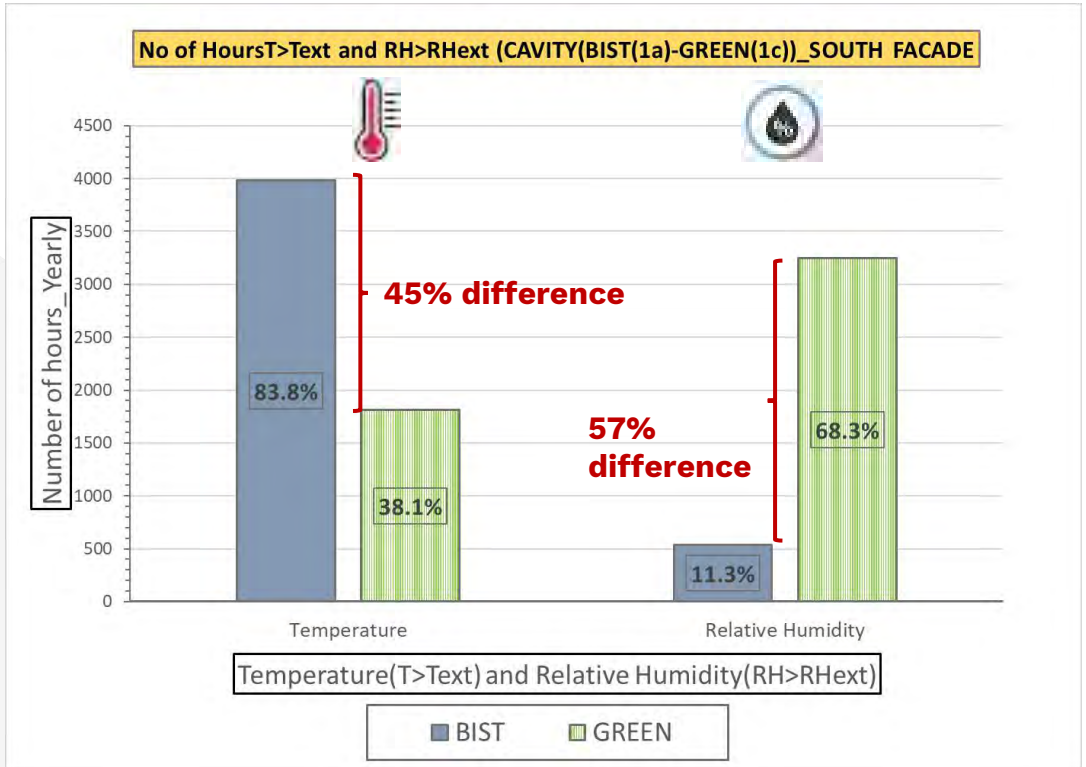


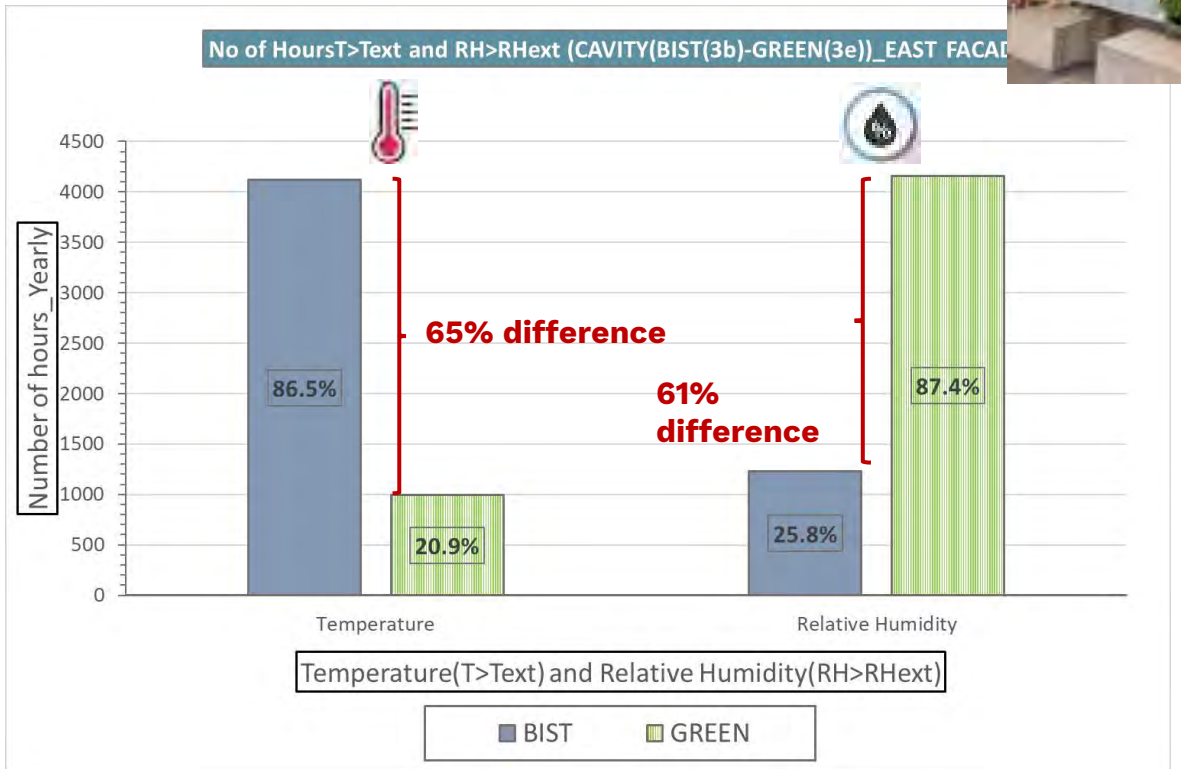
Cumulative data – Yearly based

Number of Hours T>Text and RH>RHext (CAVITIES_SOUTH and EAST FAÇADE) based on Yearly (daily) data (7:00-19:00)

Focusing the attention to the "daily" period (from 7 a.m. to 7 p.m.) the results are quite different:

- In the **south façade,** the **green** changes respectively from **50% to 38%** and from **60% to 68%**, while the **BIST** changes slightly respectively from **81% to 84%** and from **14% to 11%** of the year.
- In the **east façade,** the **green** changes respectively from **40% to 21%** and from **80% to 87%,** while the **BIST** changes respectively from **83% to 86%** and from **27% to 26%** of the year.

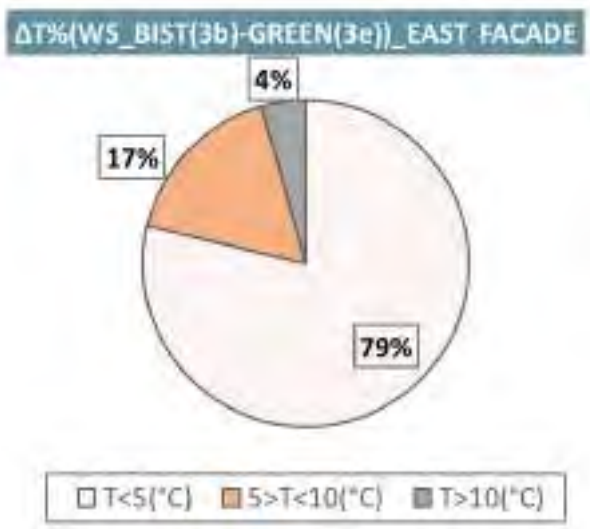


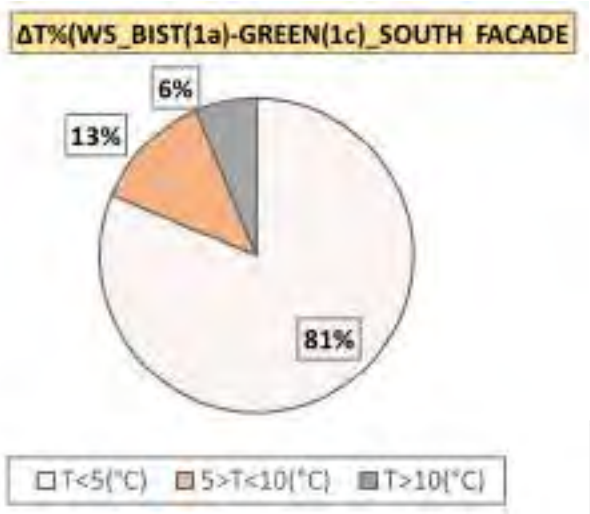


Cumulative data – Yearly based

Number of hours_ΔT%(WoodenStructure_BIST-GREEN)_SOUTH and EAST FAÇADE based on Yearly data

WOOD STRUCTURE





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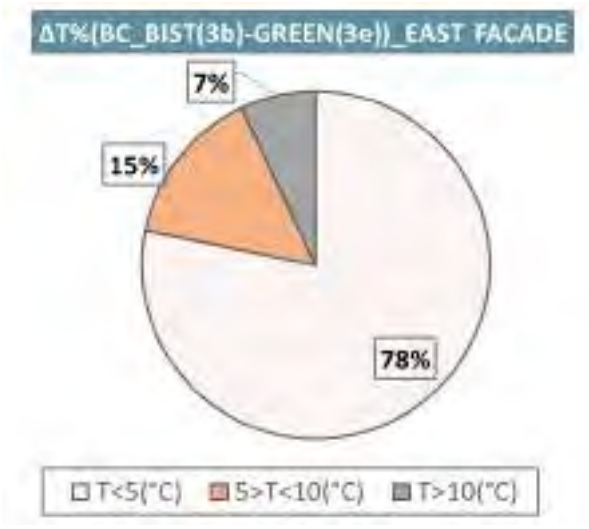
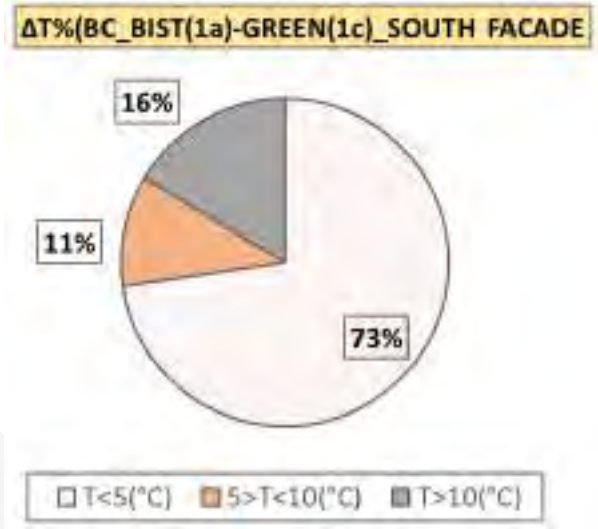




EAST

Most of the time (**78-79%**) the differences in T between green and BIST is lower that 5°C;
15-17% of the time with Delta T between 5 and 10°C;
Only 4-7% of the time with Delta T higher than 10°C;

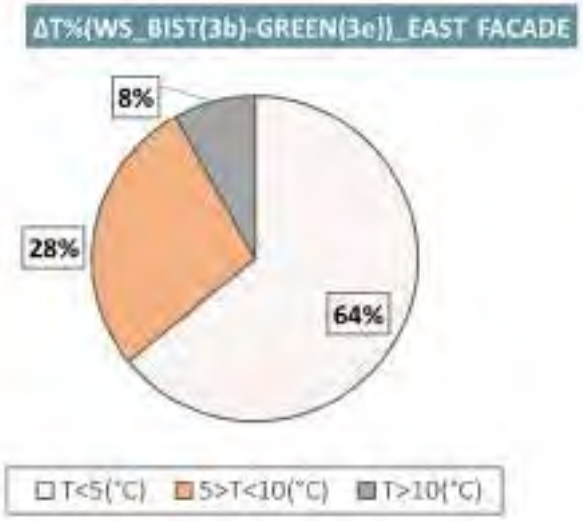
SOUTH

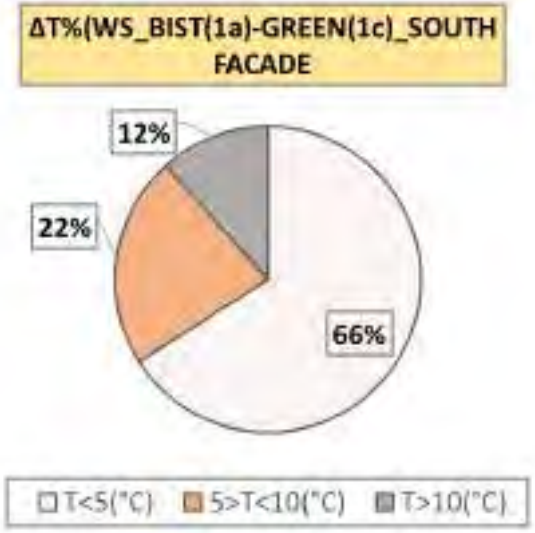
Similar behaviour can be observed in the south façade with a slightly **difference mainly in the Back Cladding for higher temperature** (from 7 to 16%) due to the higher exposition

Cumulative data – Yearly based

Number of hours_ΔT%(WoodenStructure_BIST-GREEN)_SOUTH and EAST FAÇADE based on Yearly – daily (7:00-19:00)

WOOD STRUCTURE





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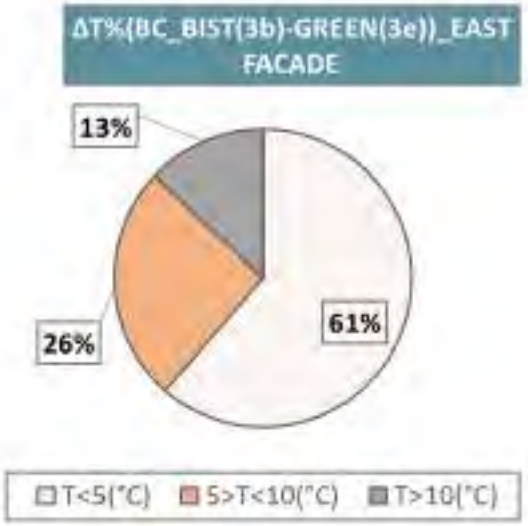

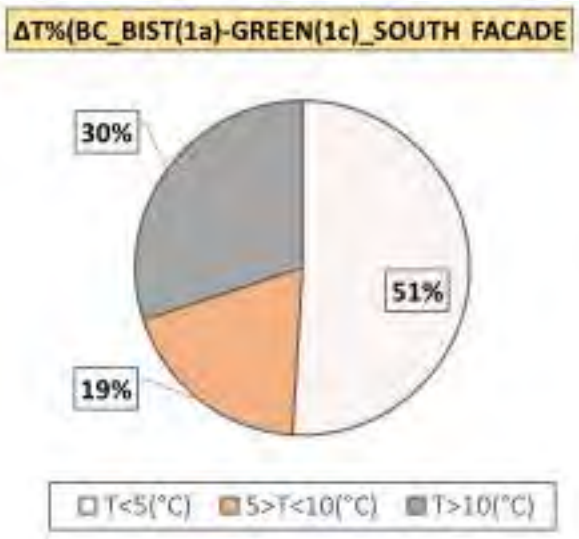

EAST

SOUTH

Focusing the attention to the "daily" period (from 7 a.m. to 7 p.m.) the results are quite different:
- the differences in T between green and BIST lower that 5°C decreases to **61-64%;**

The delta T between 5 and 10°C increase to **26-28%**

The delta T higher than 10°C increase to **8-13%;**

The behaviour is confirmed also in the south façade with **higher difference for the delta T higher than 10°C that increase to 30%**

Conclusion and discussion

LOOKING at the comparison of the Green and the BIST with the external conditions (T and RH)

- As expected, the GREEN cladding compared to a Black cladding has **lower Temperatures** both in the BC and WS; the differences between the GREEN and BIST is quite sensitive
- The GREEN T and RH is respectively **most of the time lower-higher than external conditions**
- The BIST (black cladding) has respectively higher T and lower RH of the GREEN part in any case and also compared to the external conditions
- The results on the **"daily" hours represent better the comparisons** of the Temperature and Relative Humidity between GREEN – BIST with the external temperature

LOOKING at the temperature comparison between the Green and the BIST based on "delta temperature"

- The **yearly data** shows that during the year the delta temperature between the GREEN and the BIST is **mostly lower that 5°C**
- The results on the **"daily" hours represent better the comparisons** of the delta temperature Temperature that occurs during the daily hours between GREEN – BIST cladding
- The "daily" behaviour shows how the **delta temperature between the GREEN and the BIST become relevant to the range 5-10°C and above 10°C**

These experiments will help us to further evaluation and simulate the effect of the GREEN on buildings in the future!!!!

Consortium

Coordinator

eurac research

Project Partners

HUYGEN INGENIEURS & ADVISEURS

GreenDelta

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GRÜN STATT GRAU

one team

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INFINITE
BUILDINGRENOVATION

Thank you

Eng. Martino Gubert

Martino.gubert@eurac.edu

EURAC RESEARCH

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