The University Of Sheffield.

EPSRC
Engineering and Physical Sciences Research Council

SCOTSCAPE LTD
LANDSCAPE & BUILDING CONTRACTORS

Living Wall Research Project

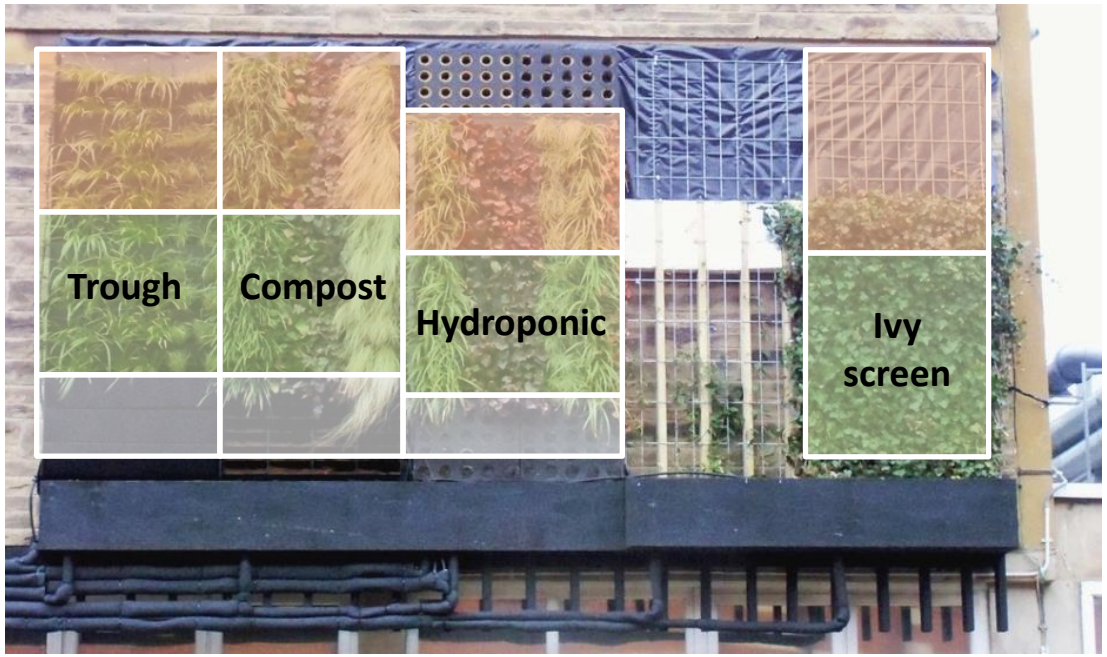
BEAU ▪ BUILDING ENVIRONMENTS ANALYSIS UNIT

Scotscape is pleased to share our interim results on the thermal benefits of Living walls.

Scotscape have invested in this research which has been carried out by Principle investigator Dr Hasim Altan and Research Assistant and PhD Student Juri Yoshimi as part of the Engineering and Physical Sciences Research Council funded Knowledge Transfer Collaborative R&D award, at the University of Sheffield.

These encouraging results have established the first bridge between the rapidly growing living wall industry and academic knowledge and will support the thermal benefits claims of living walls.
The results mark the beginning of Scotscape's planned research and development programme to continue to analyse and quantify the multi-faceted benefits that living walls can bring, both in terms of energy efficiency and bio-diversity to the sustainable urban environment.

Test Beds



System + extra insulation layer

Existing system

System without plants

- The monitoring started in **November 2012** for 12 months.
- **5 different systems** are tested
- Each system is divided into **3 sections** including a part with an extra insulation layer, existing system format and components without plants.
- Analysis is conducted on 4 systems

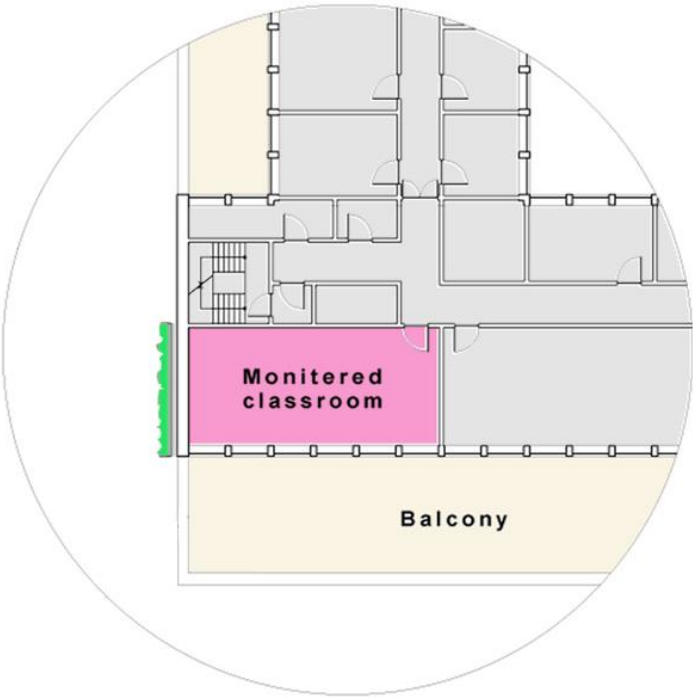
Building

- Living walls were installed on the south-west facing wall of the building. They cover a section of the walls of a 1st floor classroom.

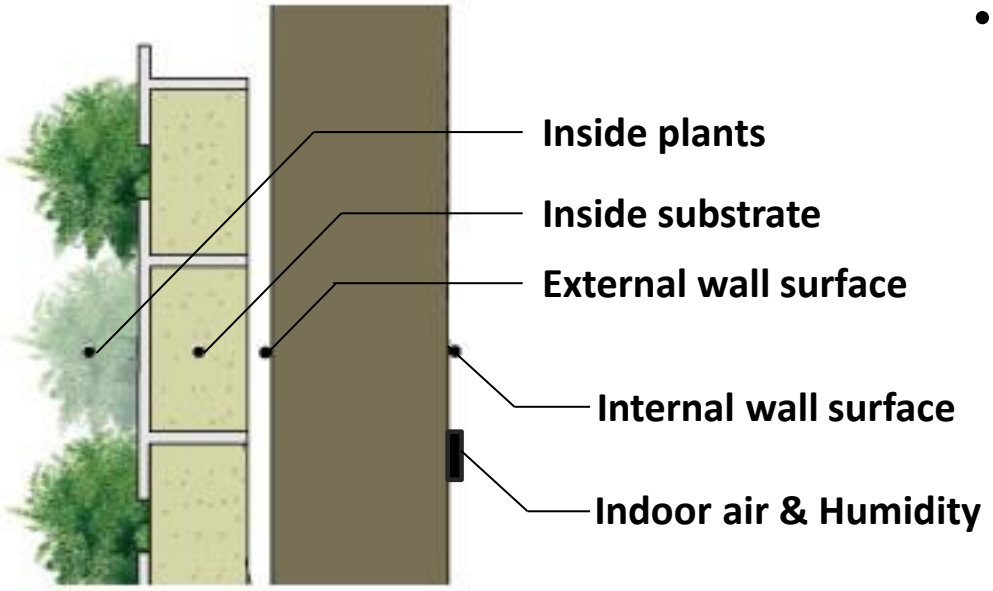
- Monitoring has also been carried out on the identical classroom directly above.

  1F: A room with living wall cover

  2F: Reference room (no vegetation cover)



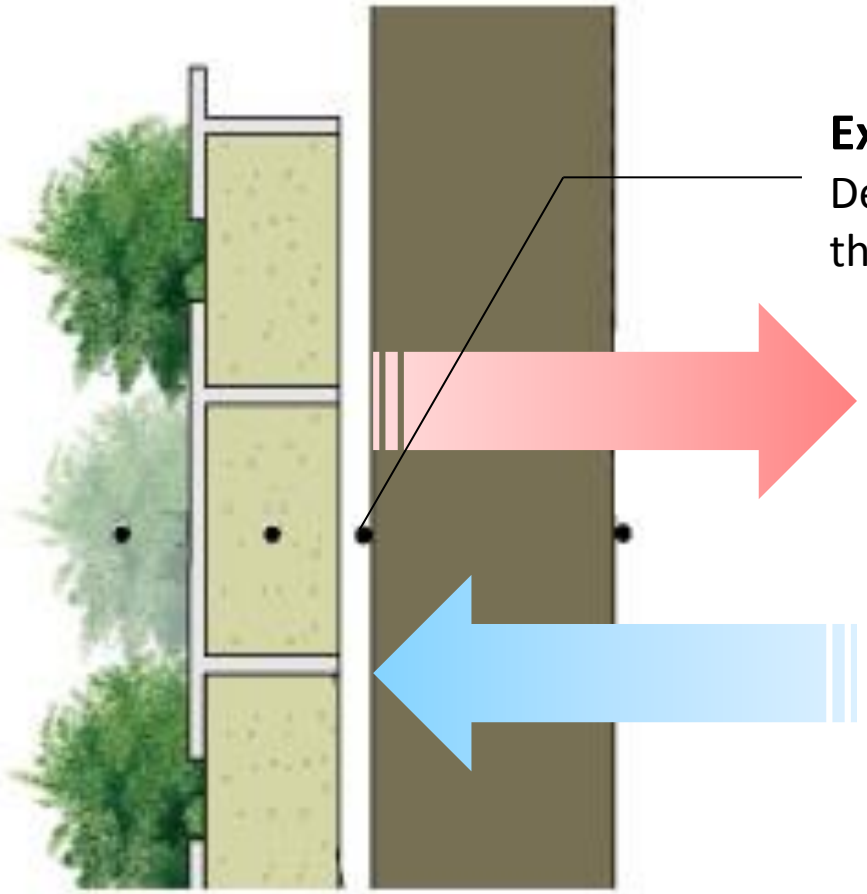
Measurements



- Sensors have been recording temperatures of **both surfaces** of the class room wall, inside the **substrate & foliage mass.**

- Water meters have been recording the consumption for irrigation and the tanks have been collecting the excess water released from each system.

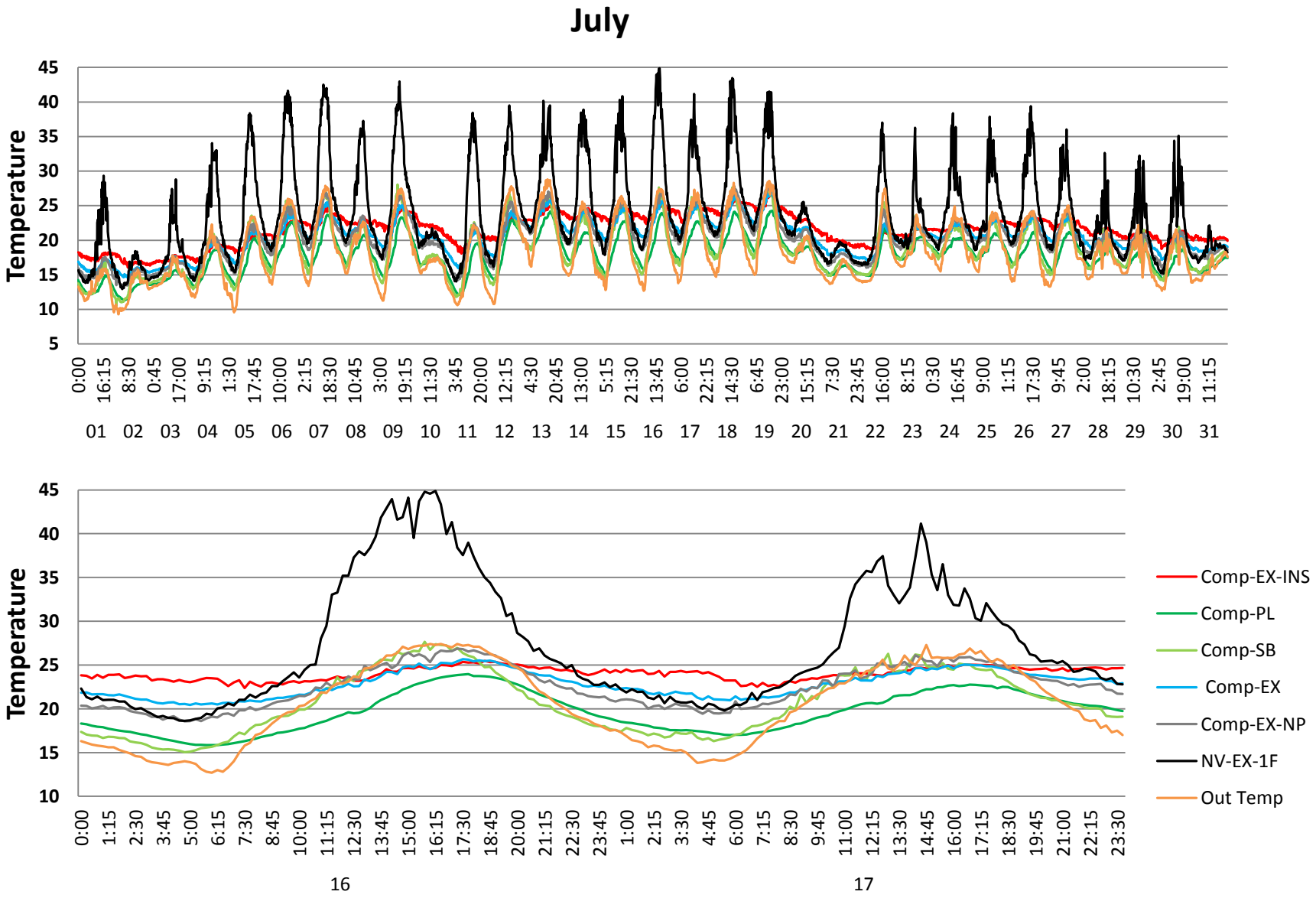
Thermal Analysis



External wall surface temperature
Determines how much heat coming in / out of the room through the wall

Energy loads for heating & cooling
Heat transferred through the wall structure

External Surface Temperature - Summer

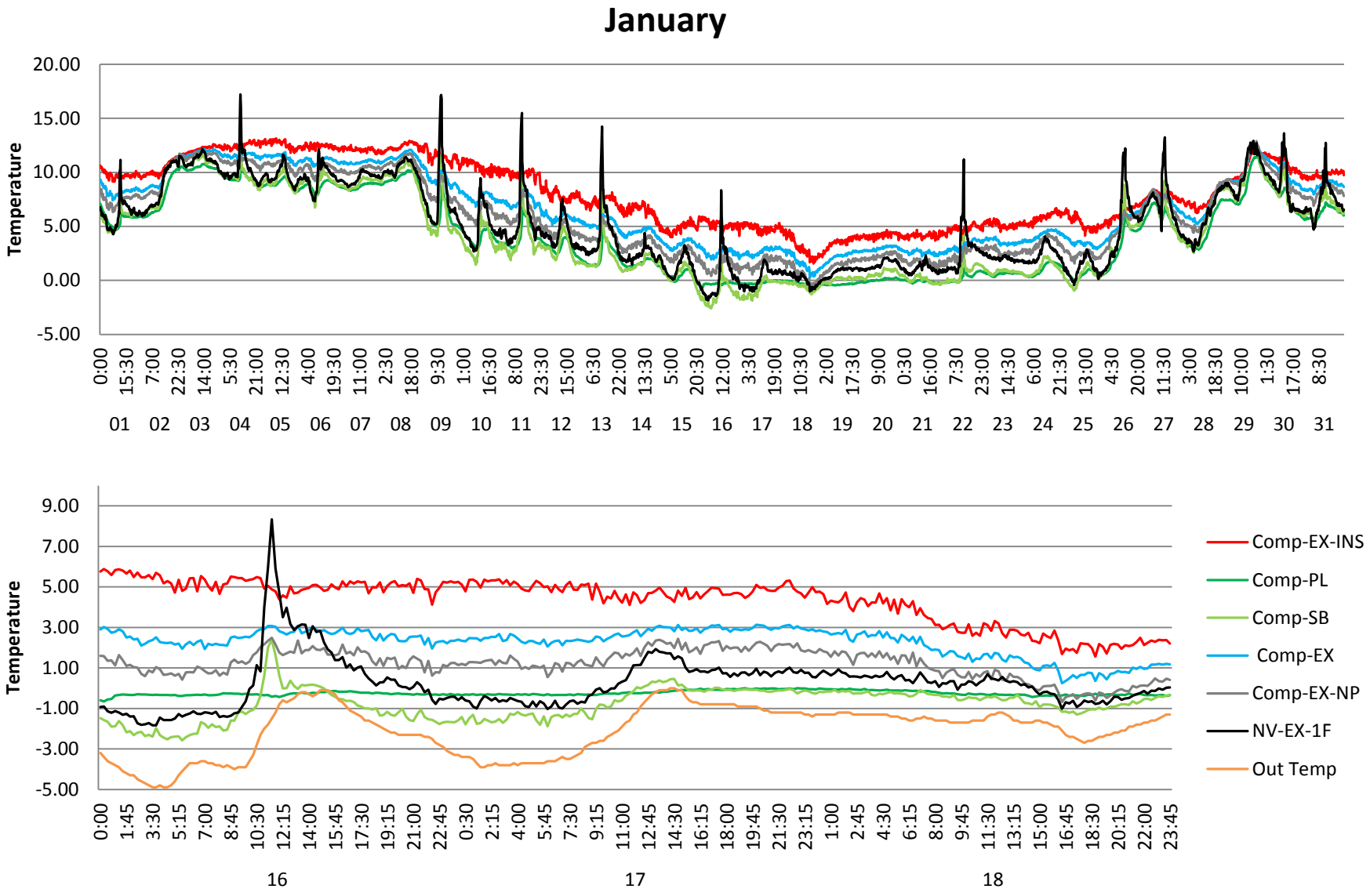


External Surface Temperature – Summer

Summary

- Summer in the UK in 2013 was the hottest summer on record since 1910 – on average it was 0.8°C hotter. July was the hottest month.
- The external wall temperature on a the non-vegetated wall surface reached a peak of 45°C.
- Temperatures behind all systems tested showed positive cooling effects, lowering the external wall temperature by 20°C.

External Surface Temperature - Winter



External Surface Temperature – Winter

Summary

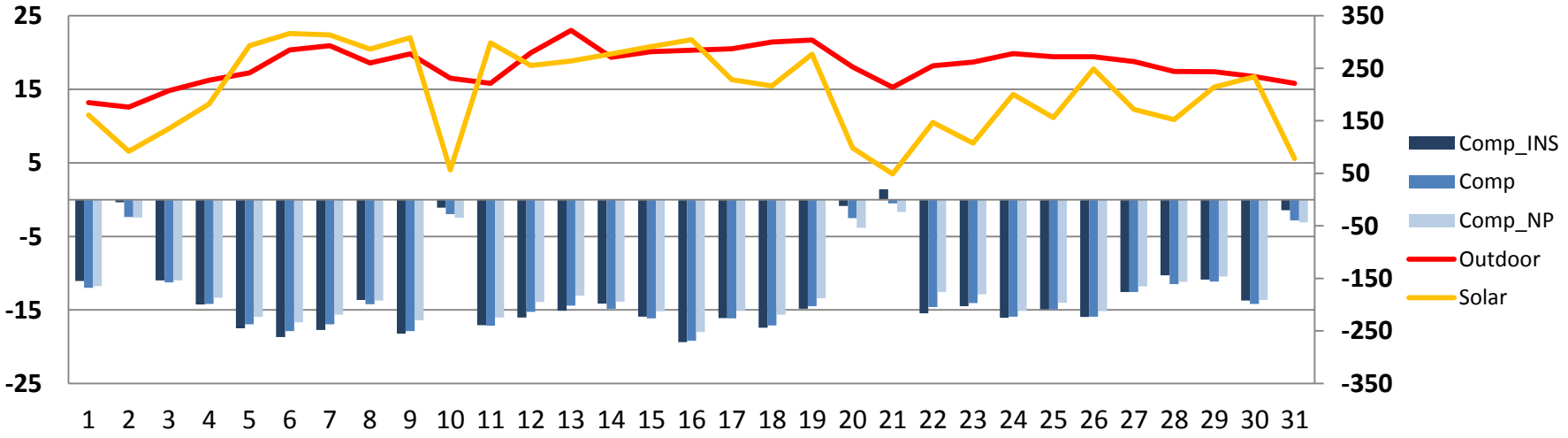
- Winter 2013 was slightly wetter than average and the temperature was an average of 0.4°C cooler. February was the coldest month of the year and a spell of severe weather brought very low temperatures during March and April.

- Temperatures behind the systems with no vegetation remained between 2-5°C higher than the wall temperature with no systems in place

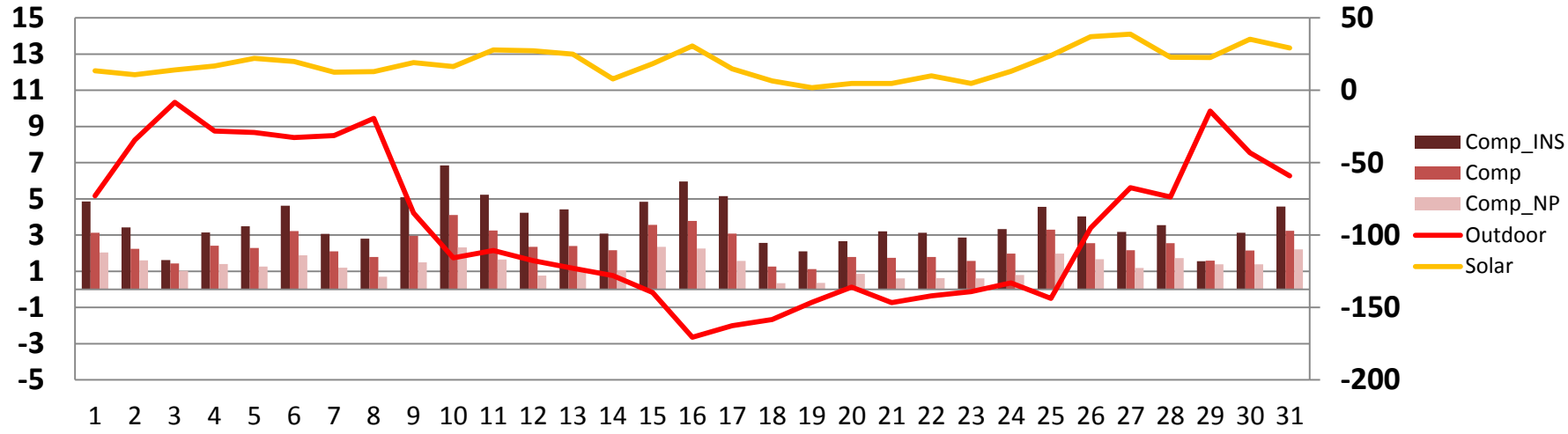
- Temperatures behind the systems with plants was 4-7°C higher than the wall temperature with no systems in place – meaning that plants provided additional insulation in winter.

External Surface Temperature – Effects

Reduction of daily peak temperatures (Cooling effect in a daytime in summer)

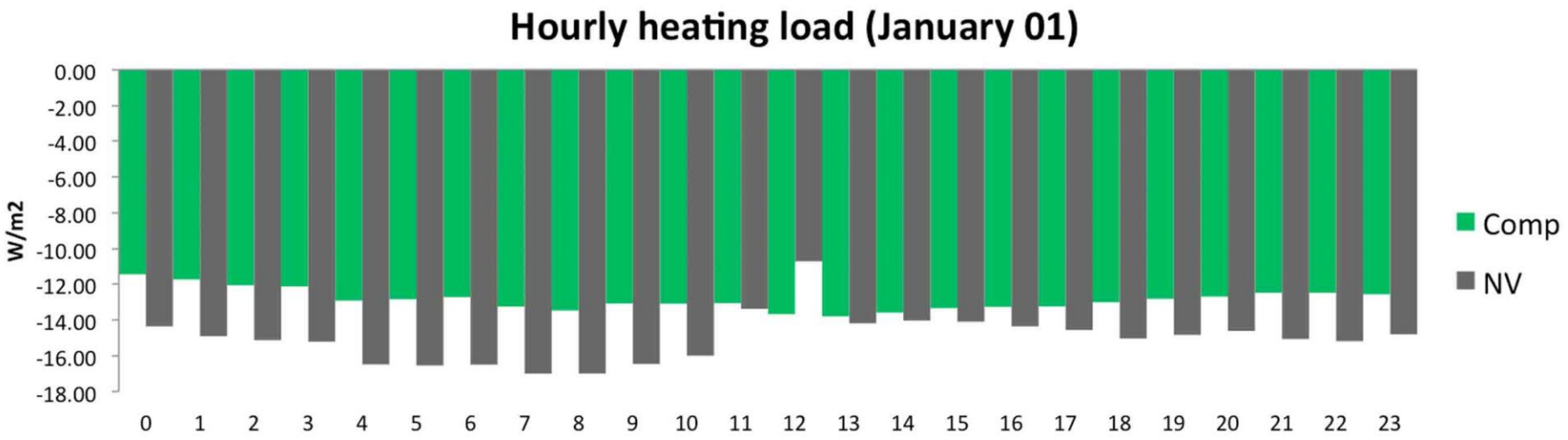


Increase of daily minimum temperatures (Insulating effects at night time in winter)

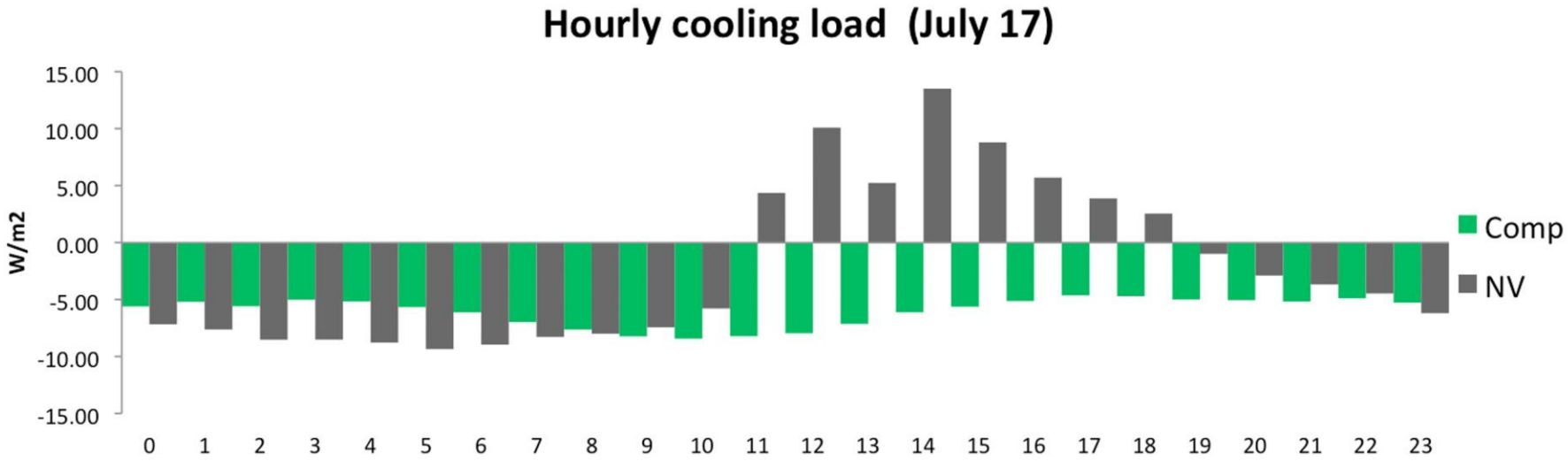


Reduction of Monthly Cooling & Heating Loads

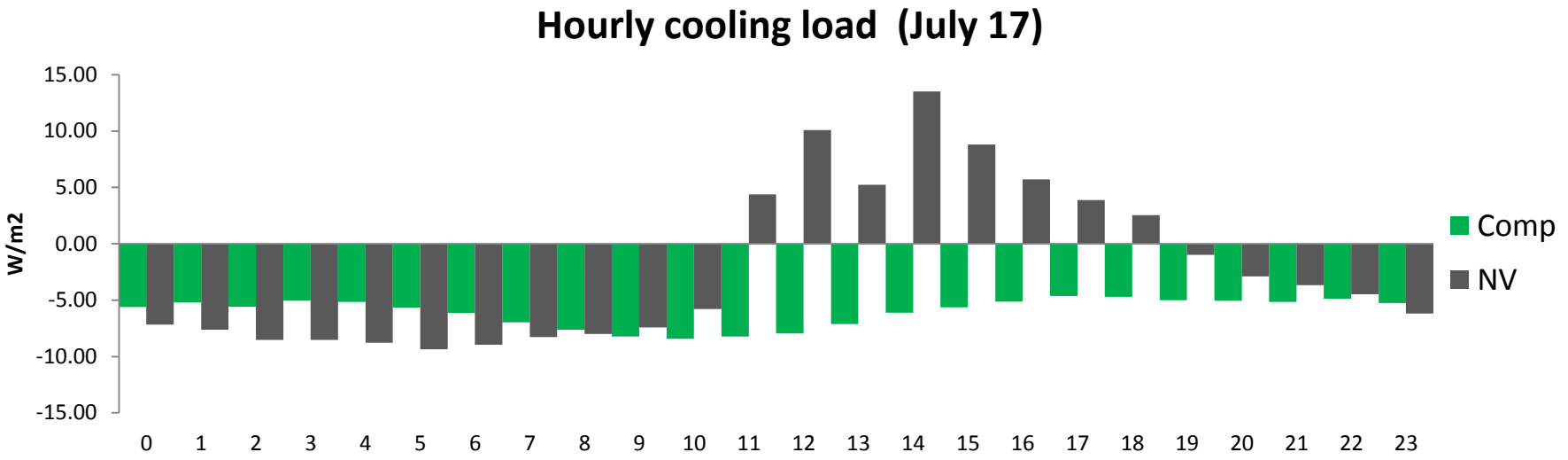
JULY		**Cooling load** (Wh/m2)	**Reduction**
When air-conditioning is on for 24hrs	No Living Wall	1685	
	Living Wall	0	100%
	Living Wall + Insulation	0	100%
Between 8:00 – 19:00	No Living Wall	1667	
	Living Wall	0	100%
	Living Wall + Insulation	0	100%
JANUARY		**Heating load** (Wh/m2)	**Reduction**
When heating is on for 24hrs	No Living Wall	11712	
	Living Wall	10844	7%
	Living Wall + Insulation	8379	28%
Between 8:00 – 19:00	No Living Wall	5671	
	Living Wall	5544	2%
	Living Wall + Insulation	4360	24%

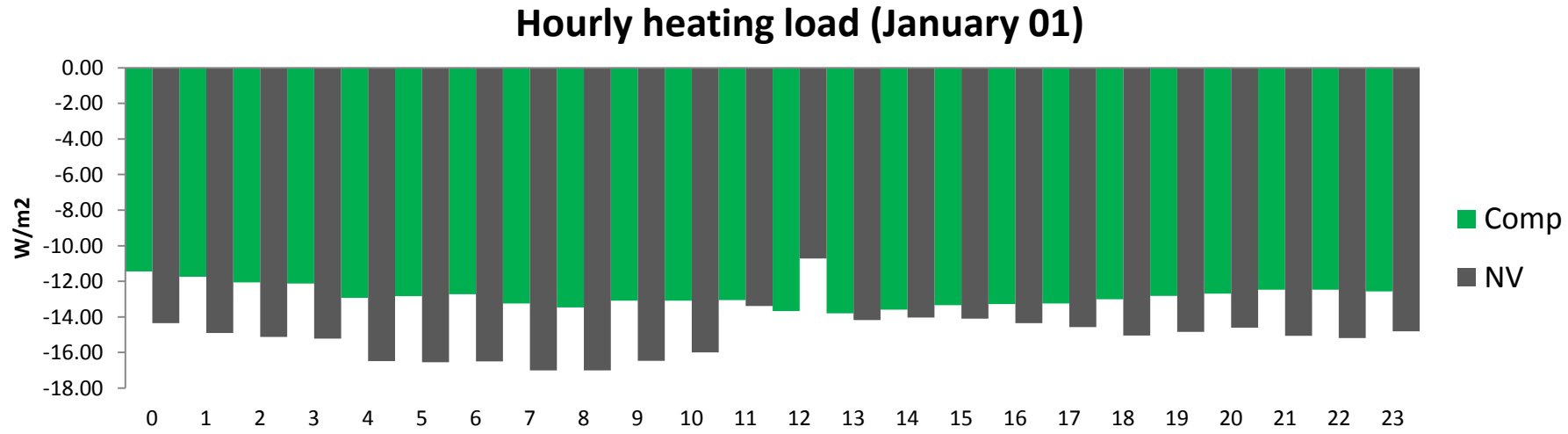

Hourly heating load (January 01)
W/m2
0.00
-2.00
-4.00
-6.00
-8.00
-10.00
-12.00
-14.00
-16.00
-18.00
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23
Comp
NV

Heating and Cooling Loads (Compost system)



Heating and Cooling Loads





Research Summary

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- Living walls are very effective tools to reduce the heat absorbed by buildings during the Summer.

- Living walls are effective insulators of buildings during the Winter.

- Significant energy efficiencies are delivered by living walls – especially in the summer – cooling buildings by up to 20°C – reducing the need to cool buildings by using excessive air conditioning.

- Good energy efficiencies are delivered by living walls in the winter – insulating buildings by up to 7°C.

- Scotscape are able to offer site specific building services calculations to show how living walls assist with reduction of ‘u’ values.