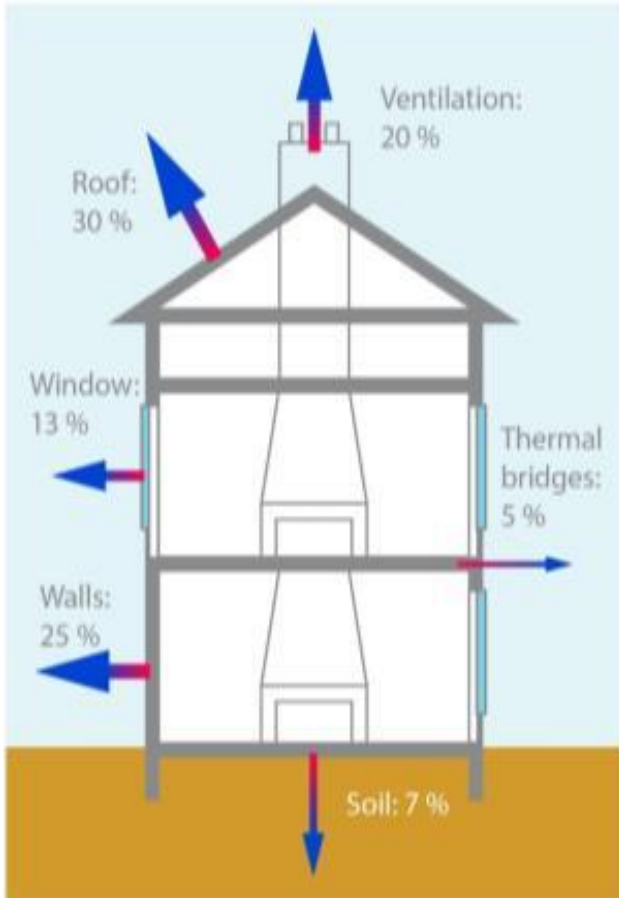


# greenTEG U-value measurement KIT introduction



August 2017

New York – Swiss-US Energy Innovation  
Days



# Buildings and Thermal Characterization has been complicated in the past!

## Application:

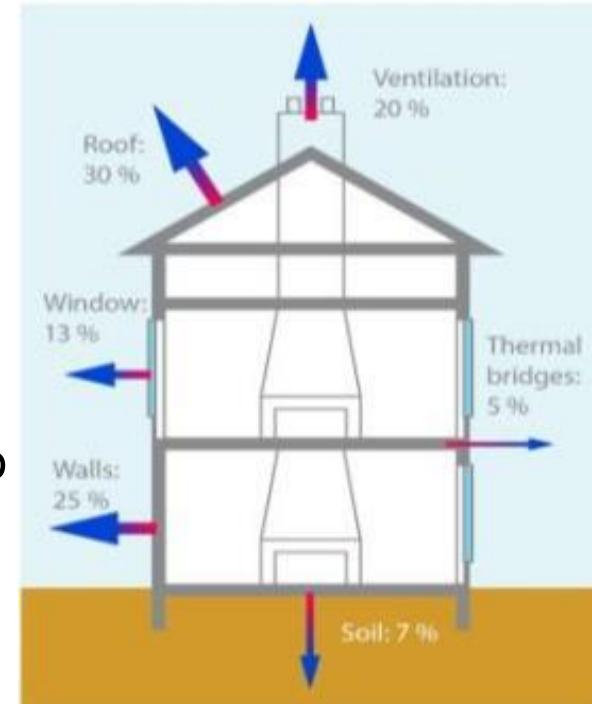
- Measuring thermal insulation quality of buildings (U-value)
- AIM: Improve energy efficiency of buildings

## Issue:

- Temperature measurement alone is not sufficient to determine U-value / estimate heating losses

## Solution:

- Measure heat flux with T to determine U-value



# Typical U-value measurement set-up

Inside



Outside



- Easy set-up
- Data uploaded to cloud for analytics



# Infrared cameras, invasive drilling, or desktop calculations all lack the accuracy and ease which is delivered by the KIT

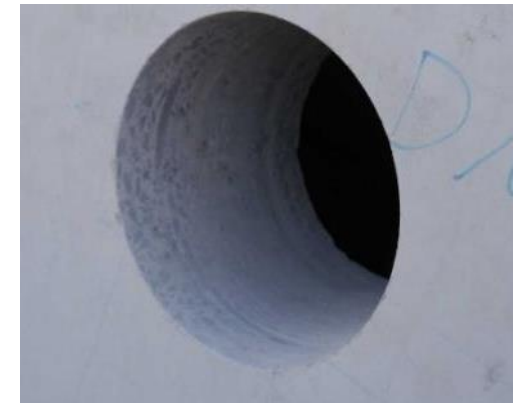


**Infrared Camera**  
No quantitative statement in regards to U-value is possible



**Calculation**  
Just an approximation, often not accurate due to unknown wall structure as well as moisture content

**Test drilling**  
Invasive, costly and only gives results in combination with calculation



# In the UK the regulator has evaluated the U-value KIT for building assessment and financial incentives are in place



Official review and recognition process finished in spring 2017 with [www.ofgem.gov.uk](http://www.ofgem.gov.uk)



**Regulatory Scheme:** ECO Carbon Optimisation & ECO funding for EWI, cavity wall insulation, loft insulation & boiler insulation

## **Incentive for Landlord and Utility:**

- Landlord receives **competitive financing for deep retrofitting** measures, can benefit from ECO support
- Utility: Is **required by law** (ECO) to fulfill obligations, based on their market share, for carbon reduction measures. One of the leader is e-on (worked already with U-KITs via consultant)

## **Concrete advantages/use cases U-KIT:**

- Energy consultants use U-KIT to **overwrite standard calculated U-values**
- Enables **“true picture” of the house** > leads often to higher reduction (or cleverer refurbishment)
- Not every house needs to get assessed, sample size of 10% of “sample housing stock”





# Our U-value KIT 4.0 > your feedback appreciated

- **Wireless** and therefore more complex measurement setups are possible
- **Simultaneously** measuring several U-values at **different measuring points** with ease
- Simple data management, **remote surveillance** and **data reading** thanks to the **cloud**



## gSKIN® U-value KIT 4.0

### The new and improved way of measuring U-values

The U value is the most important parameter for the user-independent determination of the energy requirement of a building. Today, it is possible to measure the U-value accurately and easily, greenTEG is the leading provider of U-value measurement solutions to quantify the insulation quality of buildings. We continue to push the limits of innovation and have developed a wireless U-value measurement solution, which is expandable with a multitude of measurement nodes.



### System concept

- Wireless sensor nodes
- Measurement of heat flux for an even more accurate U-values
- Measurement of surface, room and outside temperature
- Sensors developed especially for the building sector
- Central Gateway
- Cloud-based data upload
- Web application for data analysis

### Advantages of U-value KIT 4.0

- High user-friendliness for the measurement of R- and U-value
- Wireless and therefore more complex measurement setups are possible
- Simple and easy installation
- Simultaneously measuring several U-values at different measuring points with ease
- Simple data management, remote surveillance and data reading thanks to the cloud
- Standardized measuring method according to ISO 9869
- Also ideal as supplement to IR cameras

### How is the U-value measured?

For each U-value measurement one needs two sensor nodes. One node (A) is placed inside the building and measures the room temperature ( $T_{in}$ ) and the heat flux through the wall ( $q$ ). The other node (B) is placed outside the building and measures the outside temperature ( $T_{out}$ ). The surface temperature is also measured for both sensor nodes. The U-value is then calculated as arithmetic mean of all measured data points  $U = q / (T_{in} - T_{out})$  during the entire measuring time.



**Available Fall 2017**

greenTEG AG

Technikerstrasse 1  
8005 Zürich, Switzerland

T: +41 44 632 04 20  
F: +41 44 632 12 68

info@greenTEG.com  
greenTEG.com



# Thank you for your interest & Contact information

**Dr. Holger Hendrichs**  
**Head of Sales and Marketing**

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**greenTEG AG**

Technoparkstr. 1. 8005 Zurich, Switzerland

tel. +41 (0)44 633 06 97

mob. + 41 76 200 66 34

[holger.hendrichs@greenteg.com](mailto:holger.hendrichs@greenteg.com)

<http://www.greenteg.com/>



Further product information  
(case studies, videos, etc.)  
online:

[www.u-value.greenteg.com](http://www.u-value.greenteg.com)



# Appendix

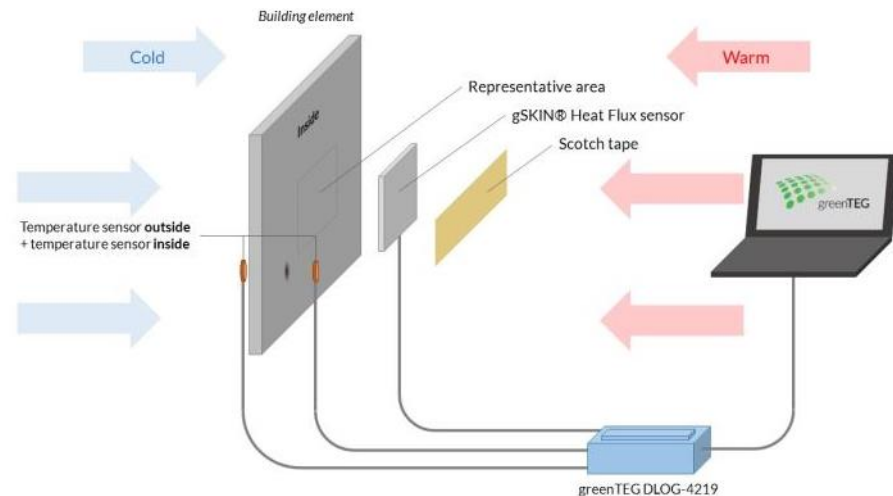


# greenTEG`s U-value measurement is based on heat flux monitoring, described in ISO 9869

## Method overview (ISO-9869)

- Provides reliable, quantitative and ISO 9869 conform data acquisition using the heat flux method
- Non-invasive measurements, starting with a temp. difference of as little as 5° C
- Easy data evaluation with help of integrated software
- Duration of the measurement has to be at least 72 hours (or a larger multiplier of 24h) to be ISO conform
- Moving average leads to stable results

## Measurement setup



## Underlying formula

$$U = \frac{\sum_{j=1}^n q_j}{\sum_{j=1}^n (T_{ij} - T_{ej})}$$

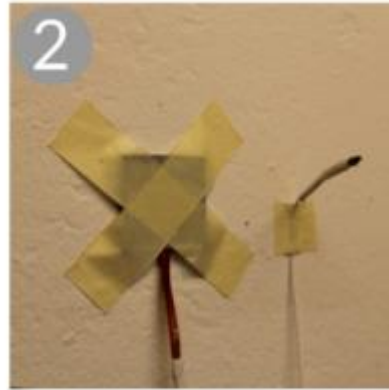
**U**= thermal transmittance  
**q**= density of heat flow rate  
**T<sub>i</sub>**= interior environmental temp.  
**T<sub>e</sub>**=exterior environmental temp.



# 6 Steps to conduct a successful U-value measurement



1 Choose an optimal measurement spot on the building element of interest



2 On the inside of this spot, place the heat flux sensor, and one temperature sensor



3 On the outside of this spot, place the second temperature sensor



4 Connect all three sensors to the data logging unit

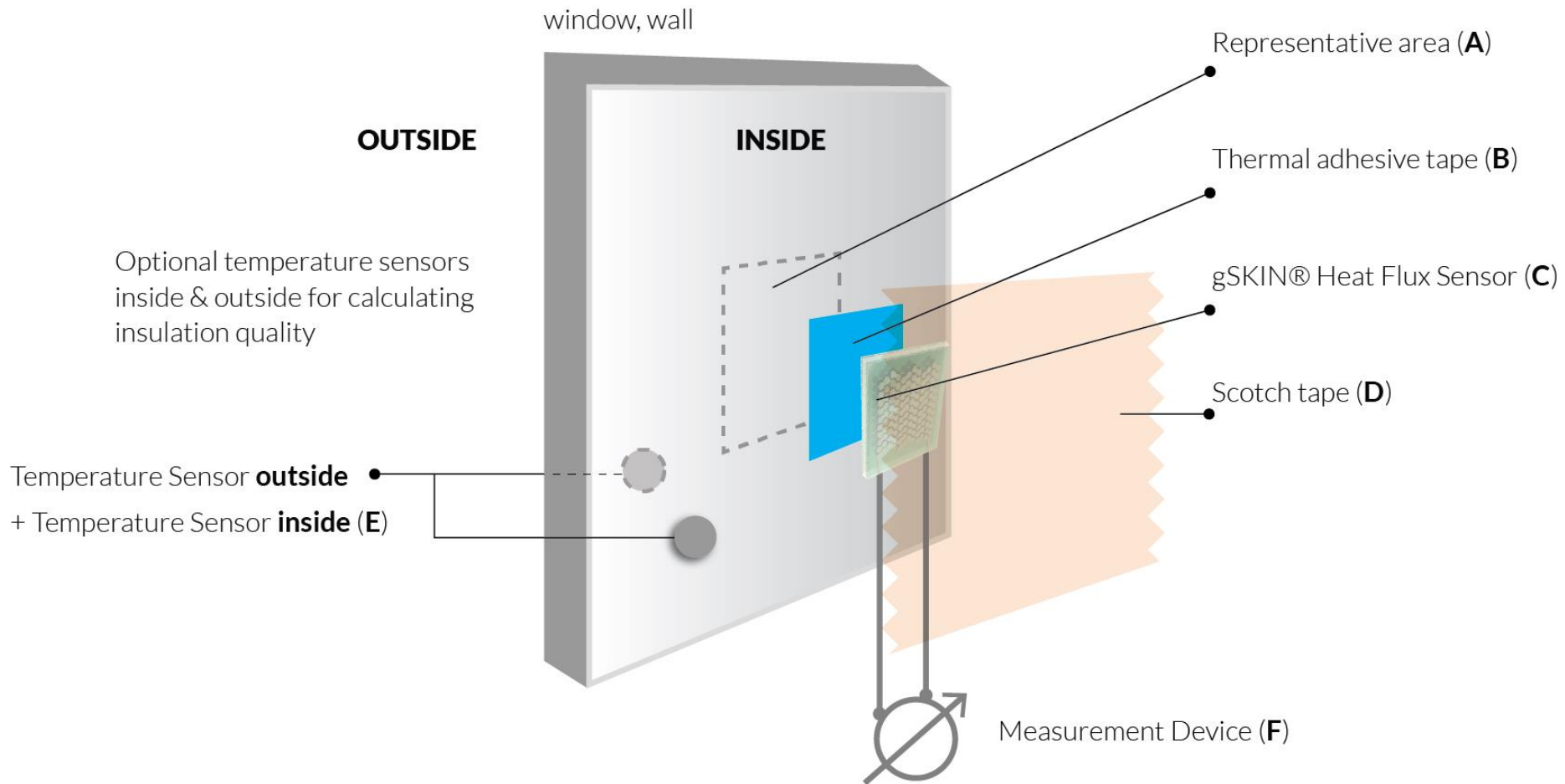


5 Start the measurement process (via your laptop)



6 Evaluate the U-value of the wall element with the software included

# Typical U-value measurement set-up



# The phenomenon of heat transfer can be observed in different situations

Underlying physics: Heat is transmitted from a hotter body to a colder body until a thermal equilibrium is reached

> Typical heat flux values and signal voltages of gSKIN<sup>®</sup> (to air):



THUMB

Heat Flux: 130 W/m<sup>2</sup>

Voltage output: = 0.247 mV



FRESH BEER

Heat Flux: - 150 W/m<sup>2</sup>

Voltage output: = -0.285 mV



HOT COFFEE

Heat Flux: 600 W/m<sup>2</sup>

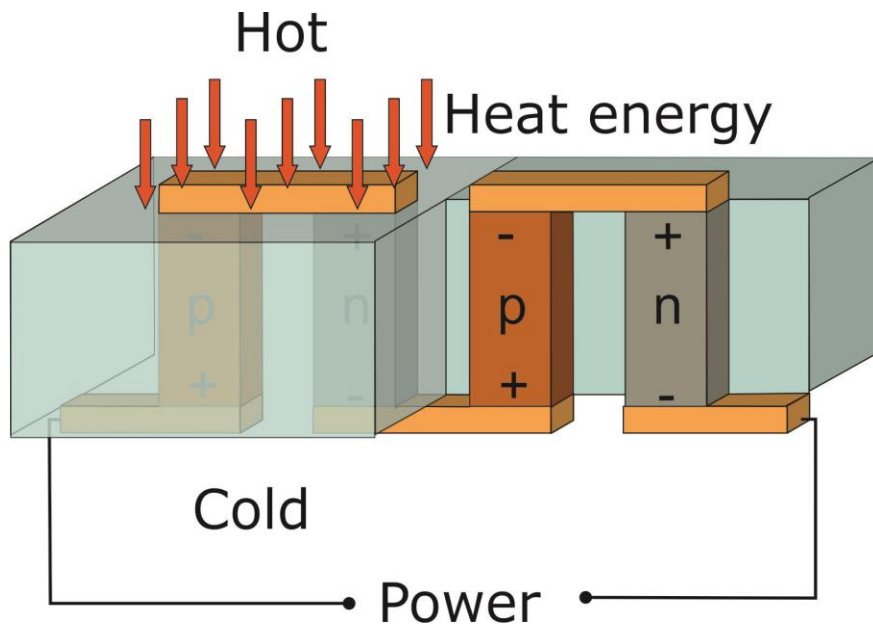
Voltage output: = 1.14 mV

More information on wikipedia:

[https://en.wikipedia.org/wiki/Heat\\_flux\\_sensor](https://en.wikipedia.org/wiki/Heat_flux_sensor)

# greenTEG's technology is based on thermoelectricity: Converting heat to electricity

## Schematic



## Principle

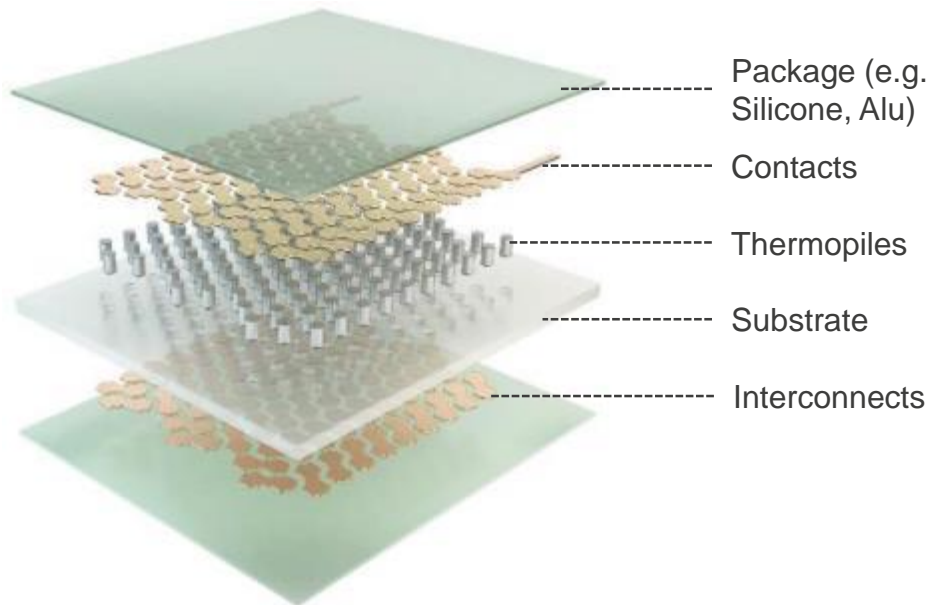
- 2 materials within the sensor for opposite polarity
- Power / Voltage due to temperature differential (“Seebeck effect” used)
- No emissions & no moving parts, no maintenance

Heat flux is the rate of heat energy transfer through a given surface per unit time

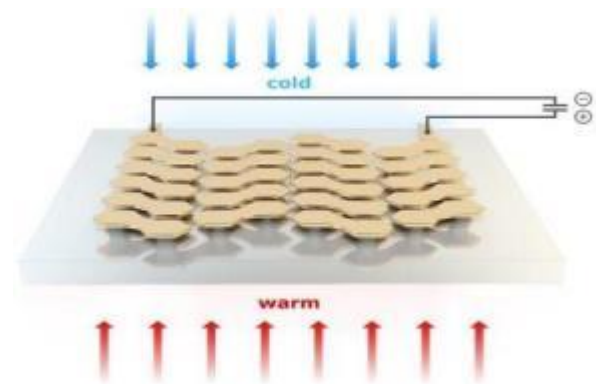


# Introduction to Thermoelectricity: Design and Working principle

## Design

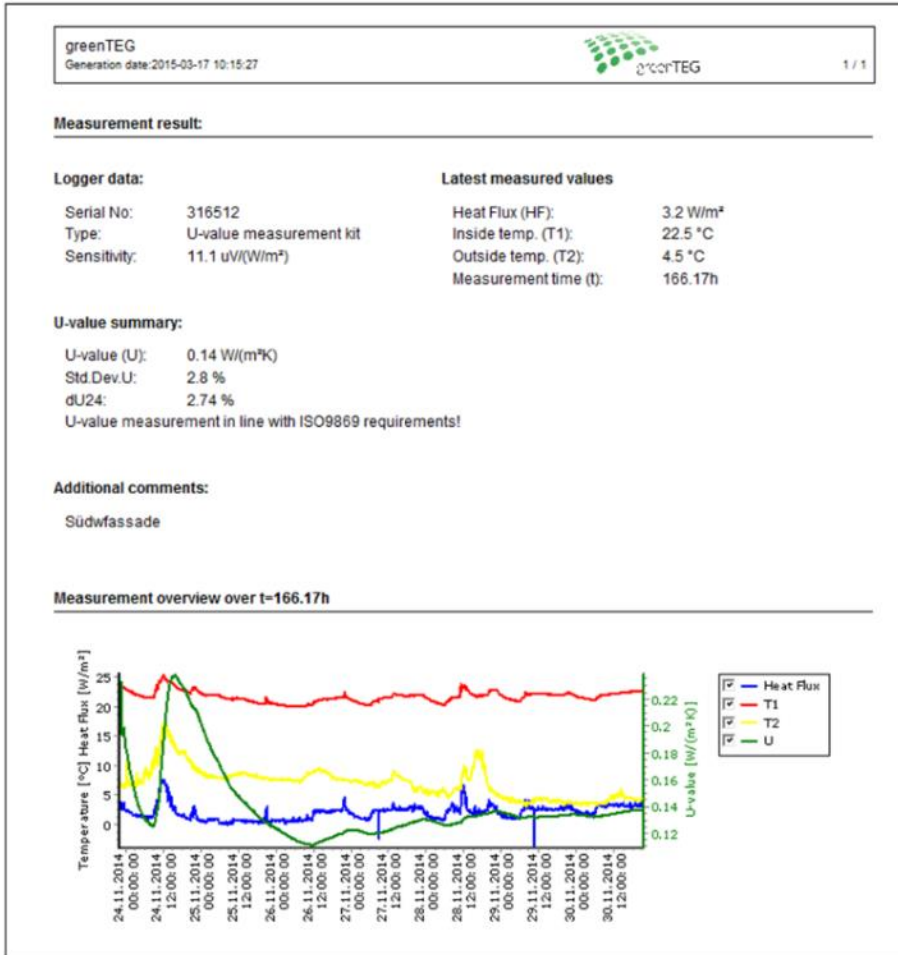


## Working principle

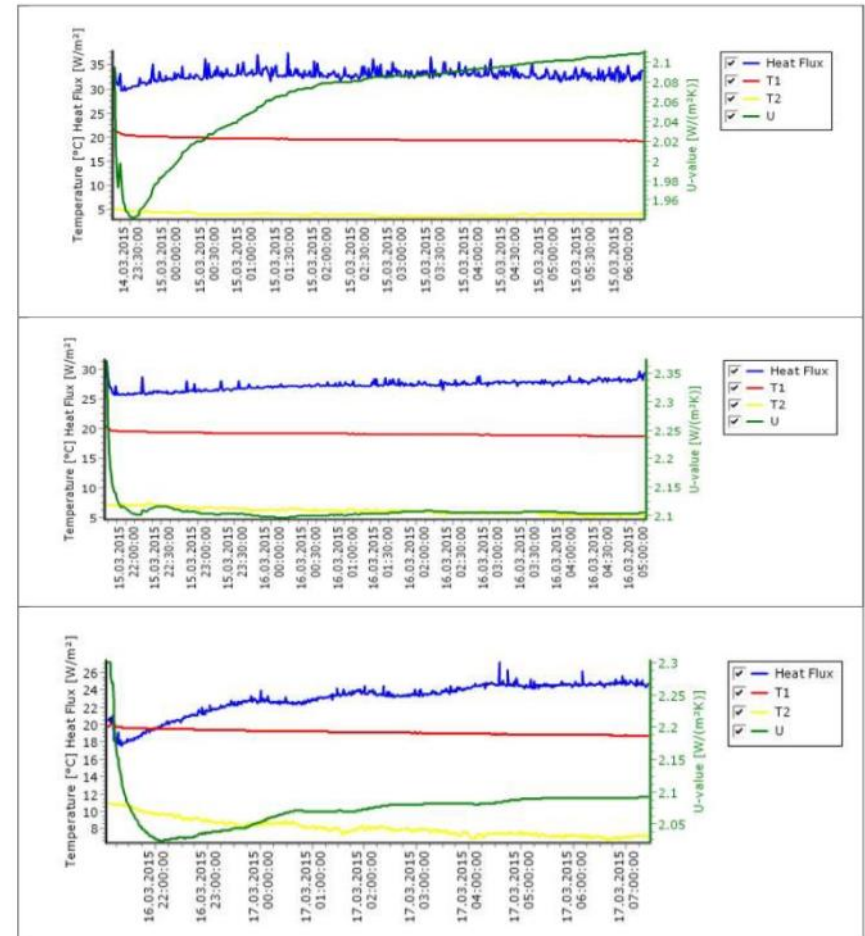




# Overview of measurement results (software)



Report of a U-value wall measurement



Results of a U-value window measurement