

BIPV performance analysis

results from 3 ongoing projects

14 juni 2018

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Building Physics and Services

Home BPS

Education

Research

Research profile

Chairs

Building Acoustics

Building Lighting

Building Materials

Building Performance

Building Physics

Building Services

PhD and postdoc projects

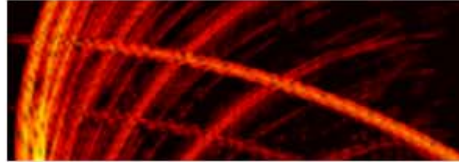
Staff

Group publications

Research meets practice

About BPS

Chairs



Building Acoustics

The chair Building Acoustics is the acoustics research group in the Laboratorium voor Akoestiek of the unit Building Physics and...

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Building Lighting

Light is essential for human life and functioning. It influences the well-being of people in a physiological, psychological and...

[Read more](#)



Building Materials

The chair Building Materials includes one full and two assistant professors (tenure) and 14 externally funded post-doc/PhD...

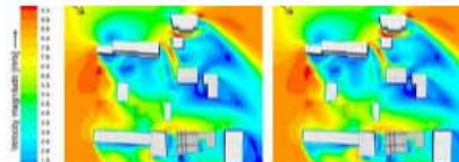
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Building Performance

Our aim is to contribute to achieving a sustainable, energy-positive built environment with indoor environmental quality optimized...

[Read more](#)



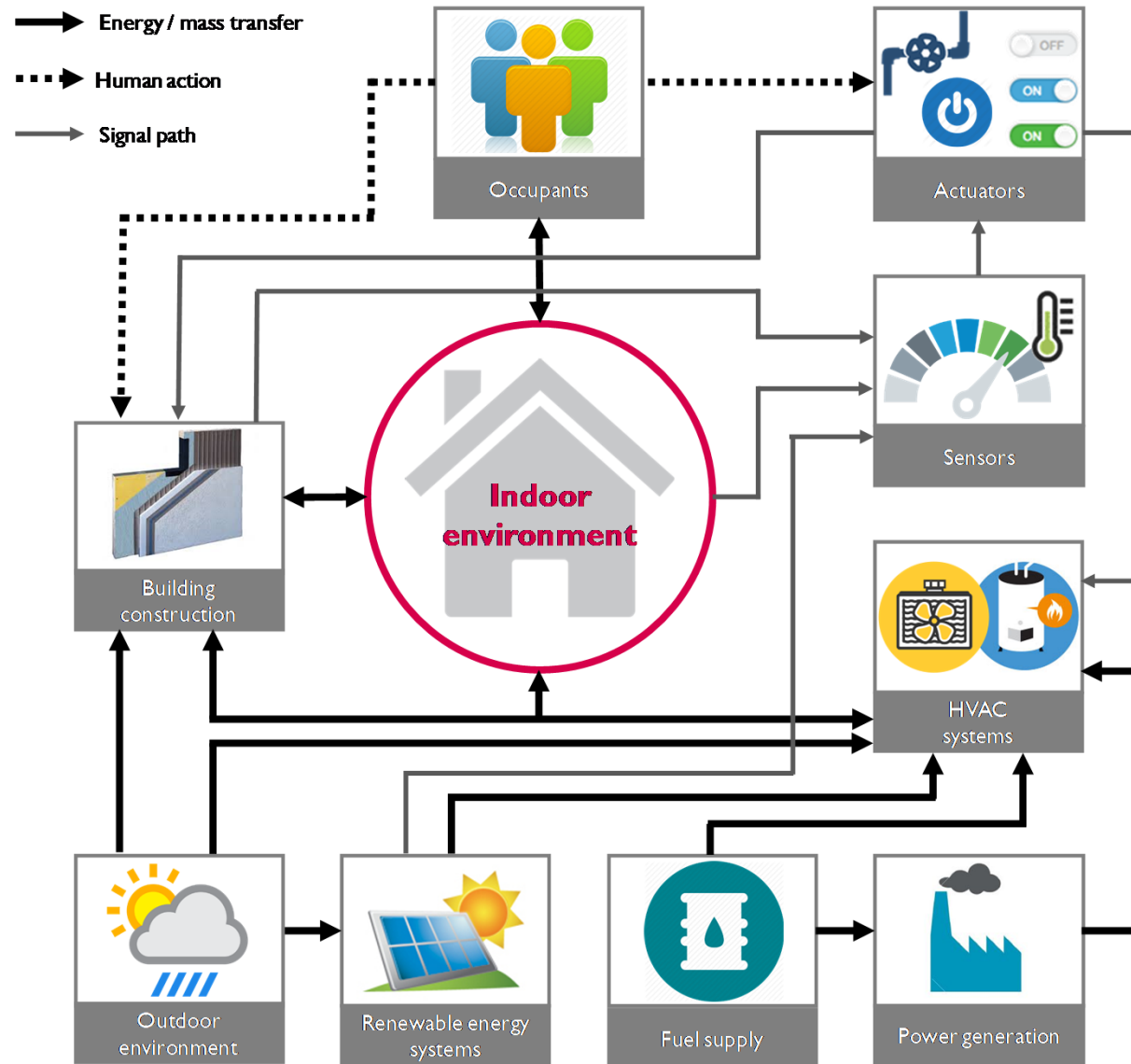
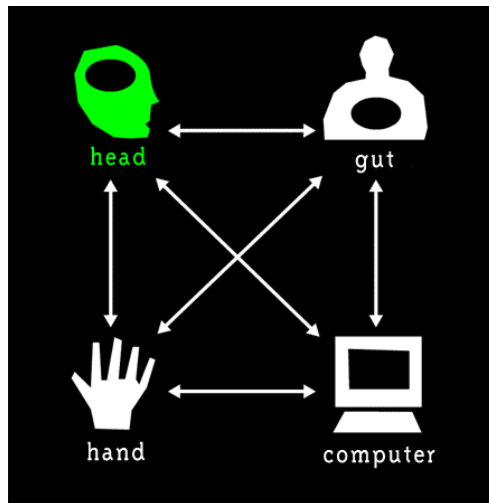
Building Physics

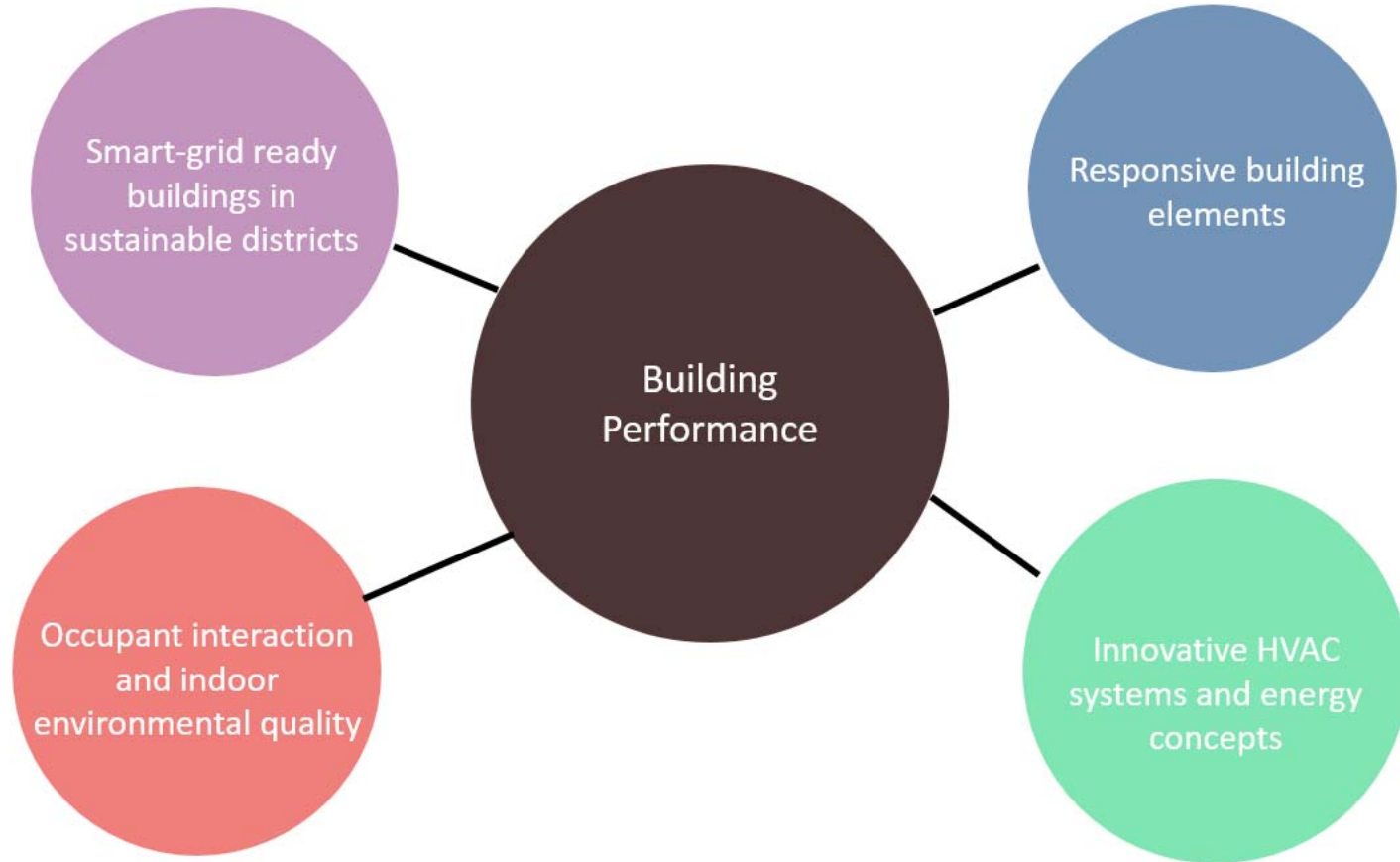
The research in the chairgroup Building Physics



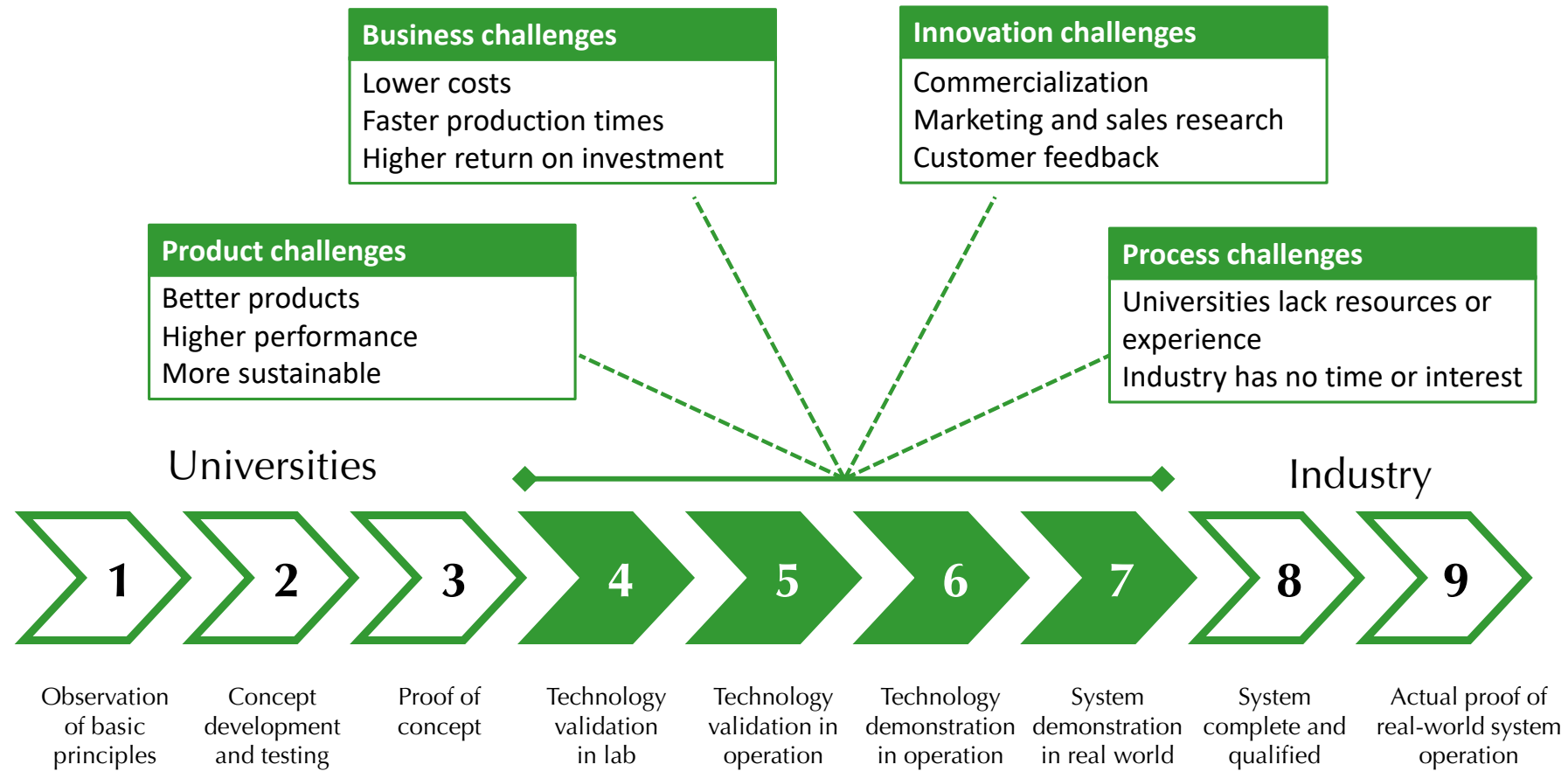
Building Services

The challenge for building services engineers is to

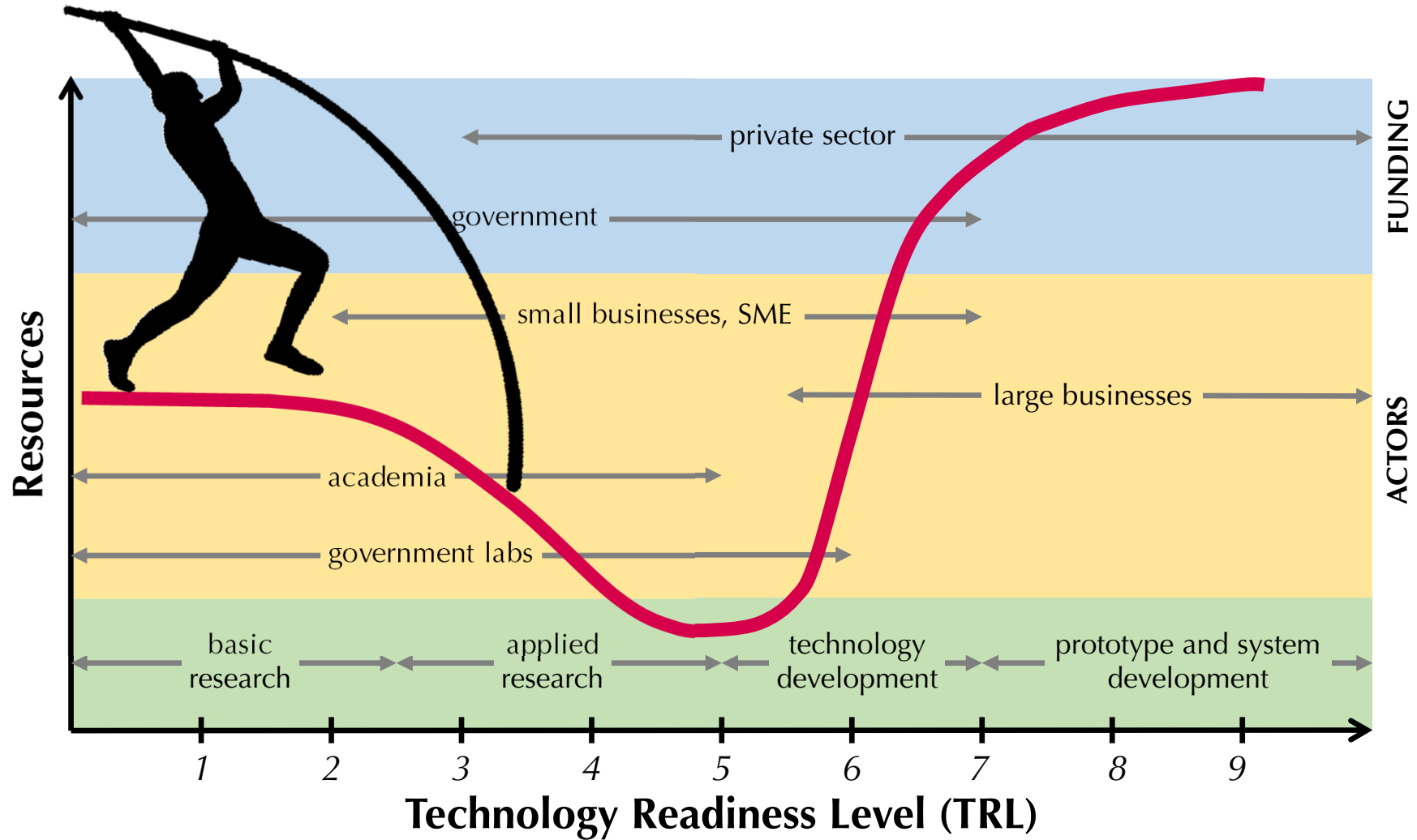




Technology readiness



The Valley of Death



SolarBEAT



This presentation

- » ZigZagSolar
- » Solar resource assessment
- » Lumiduct

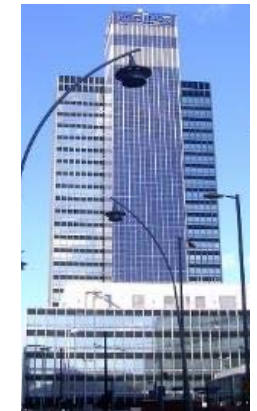
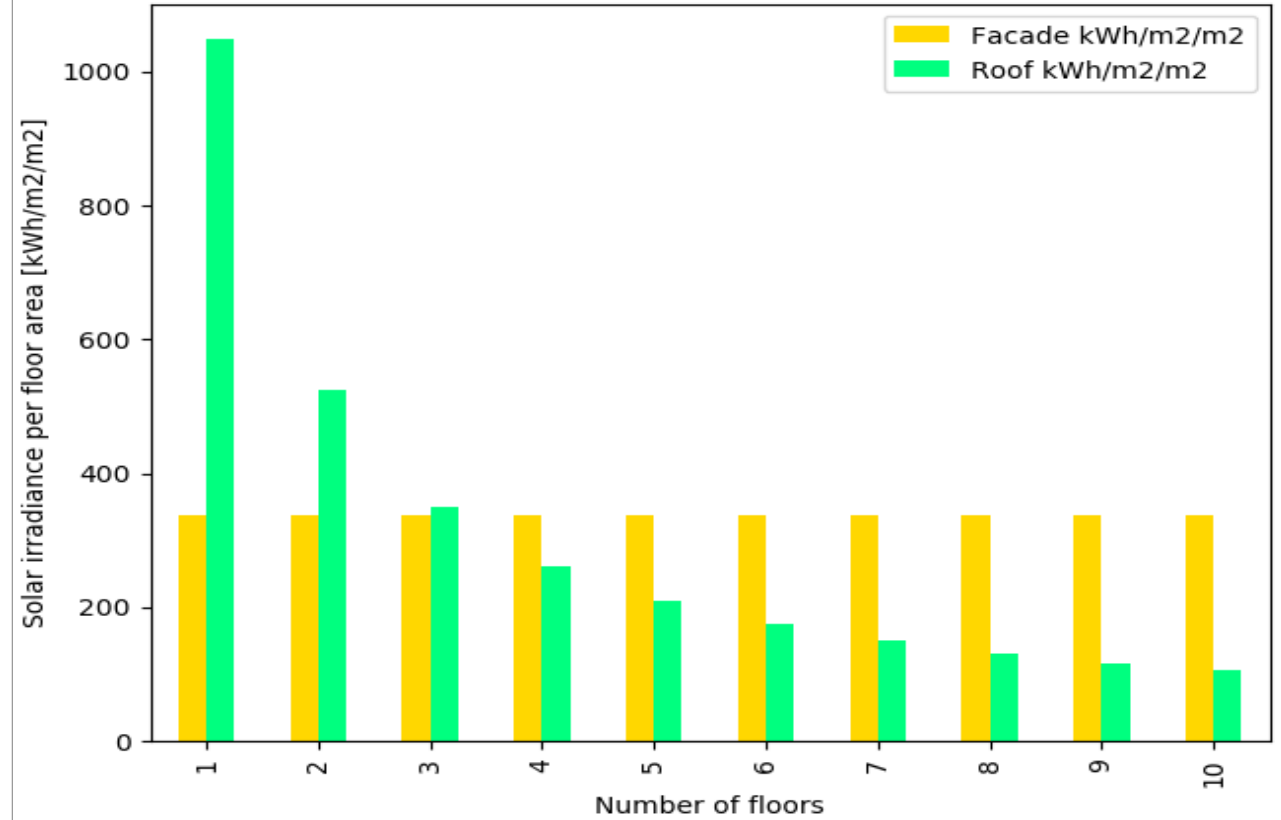
ZigZagSolar

Stefan Koenders
Adam Bognar
Roel Loonen
Jan Hensen

Why PV facades?

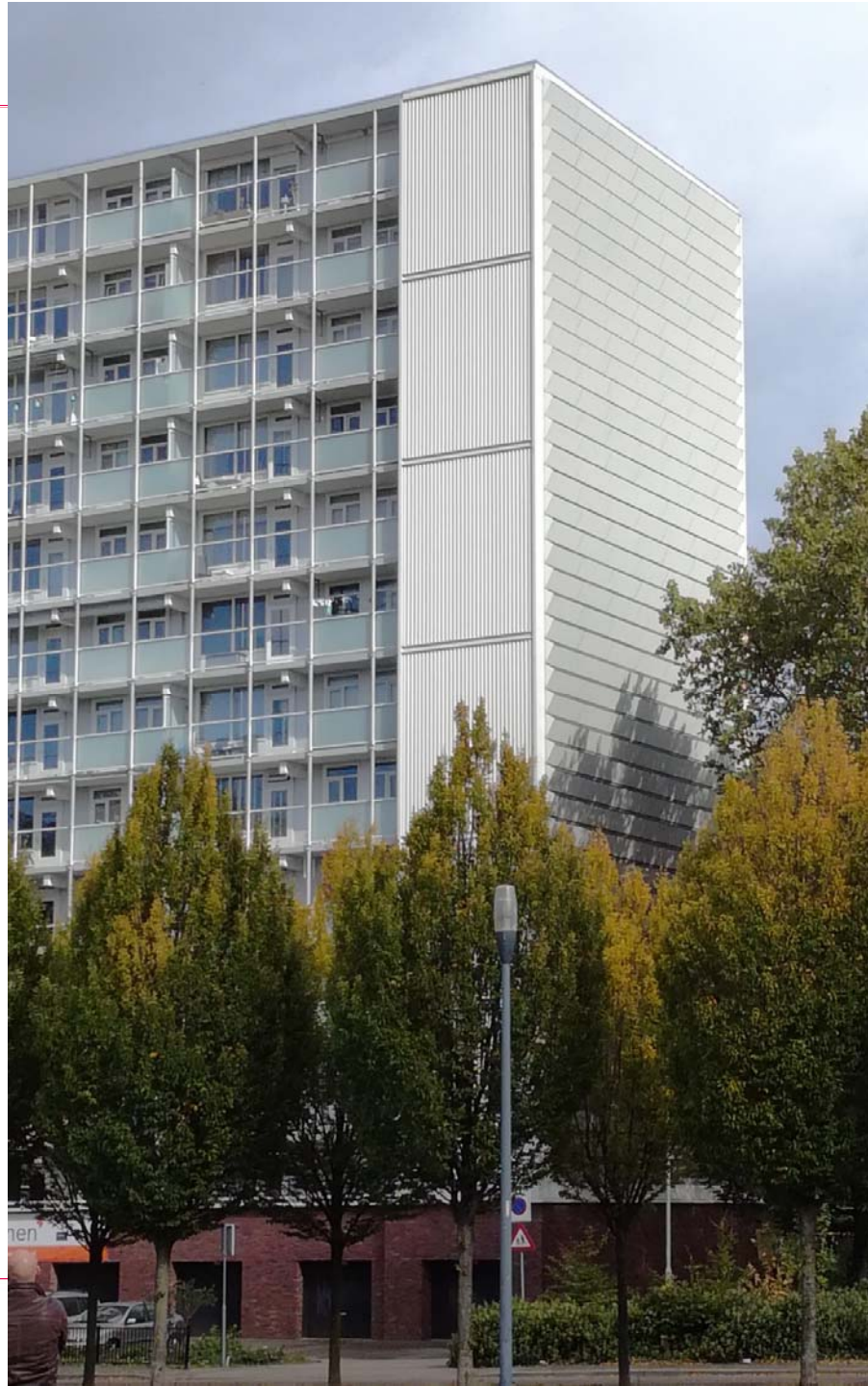


Solar Irradiance on Built Surfaces in Eindhoven, 2015
 Building (width x depth): 10m x 20m
 Storey height: 3m, wwr = 0.3



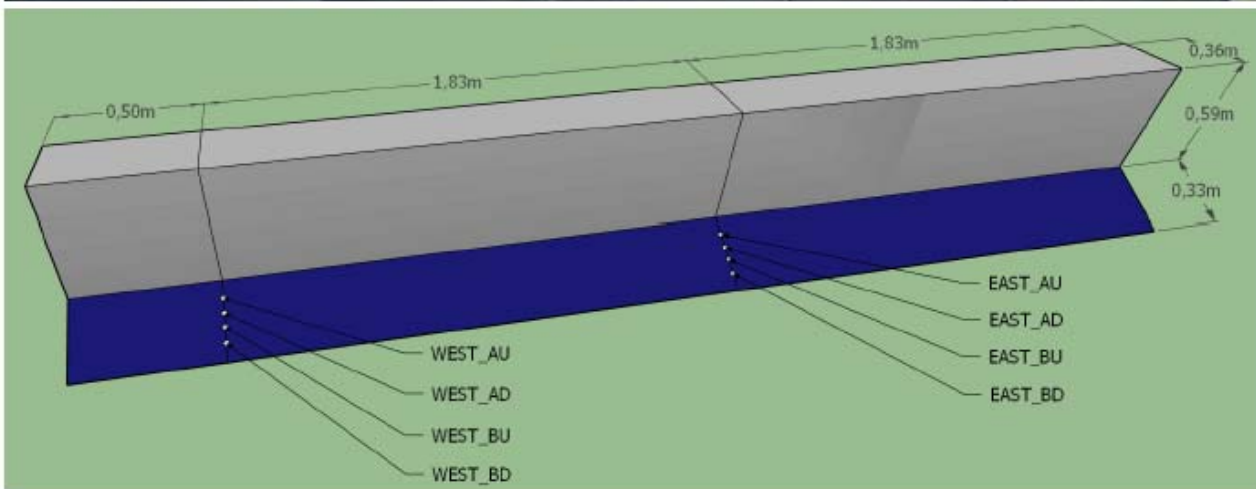
ZigZagSolar







ZigZagSolar



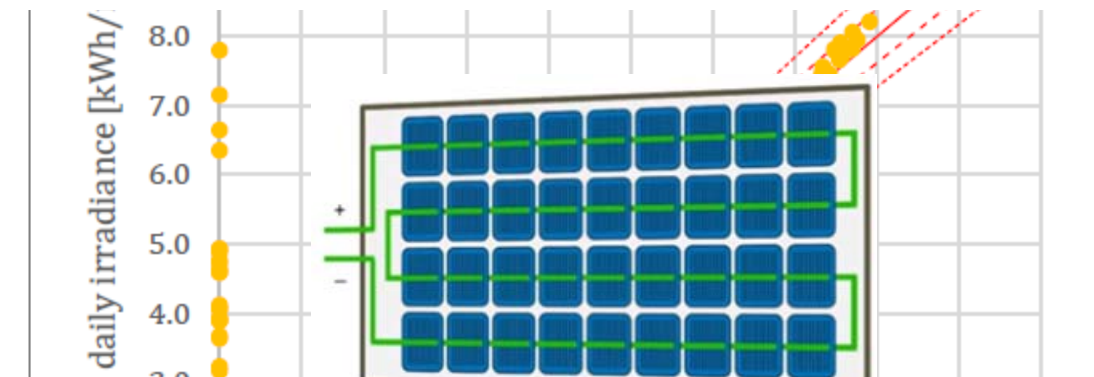
Single panel system

22-6-2016 12:30

FOLD



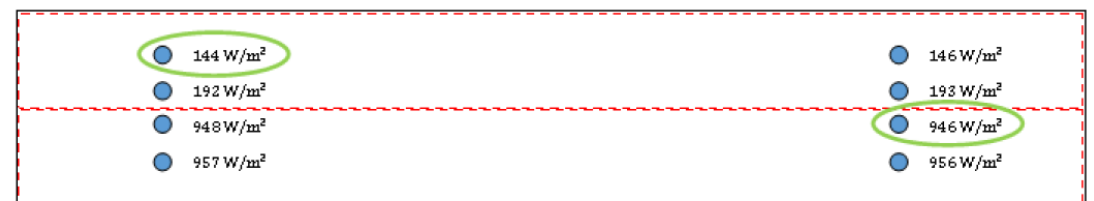
EDGE



Split panel system

22-6-2016 12:30

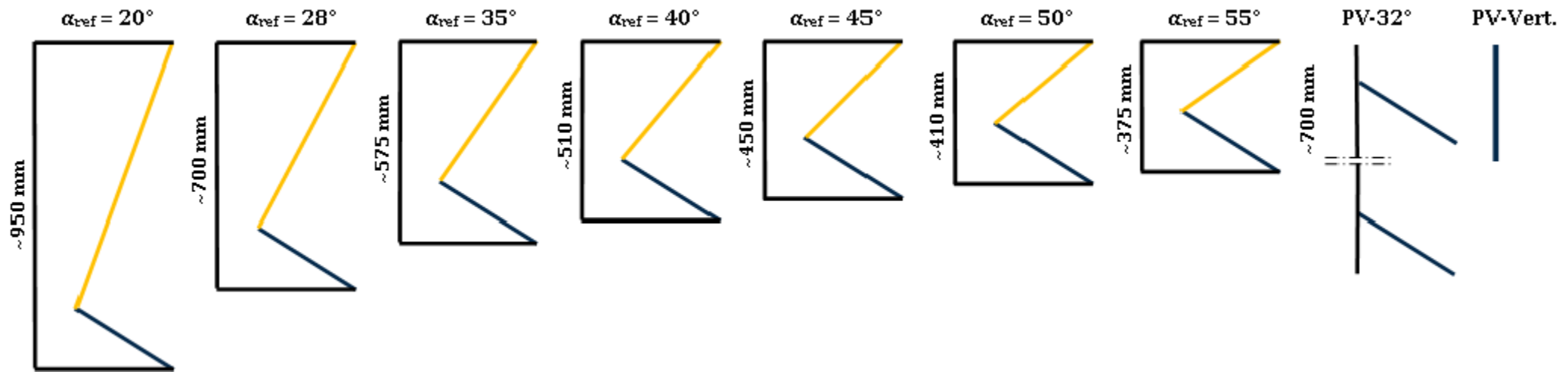
FOLD



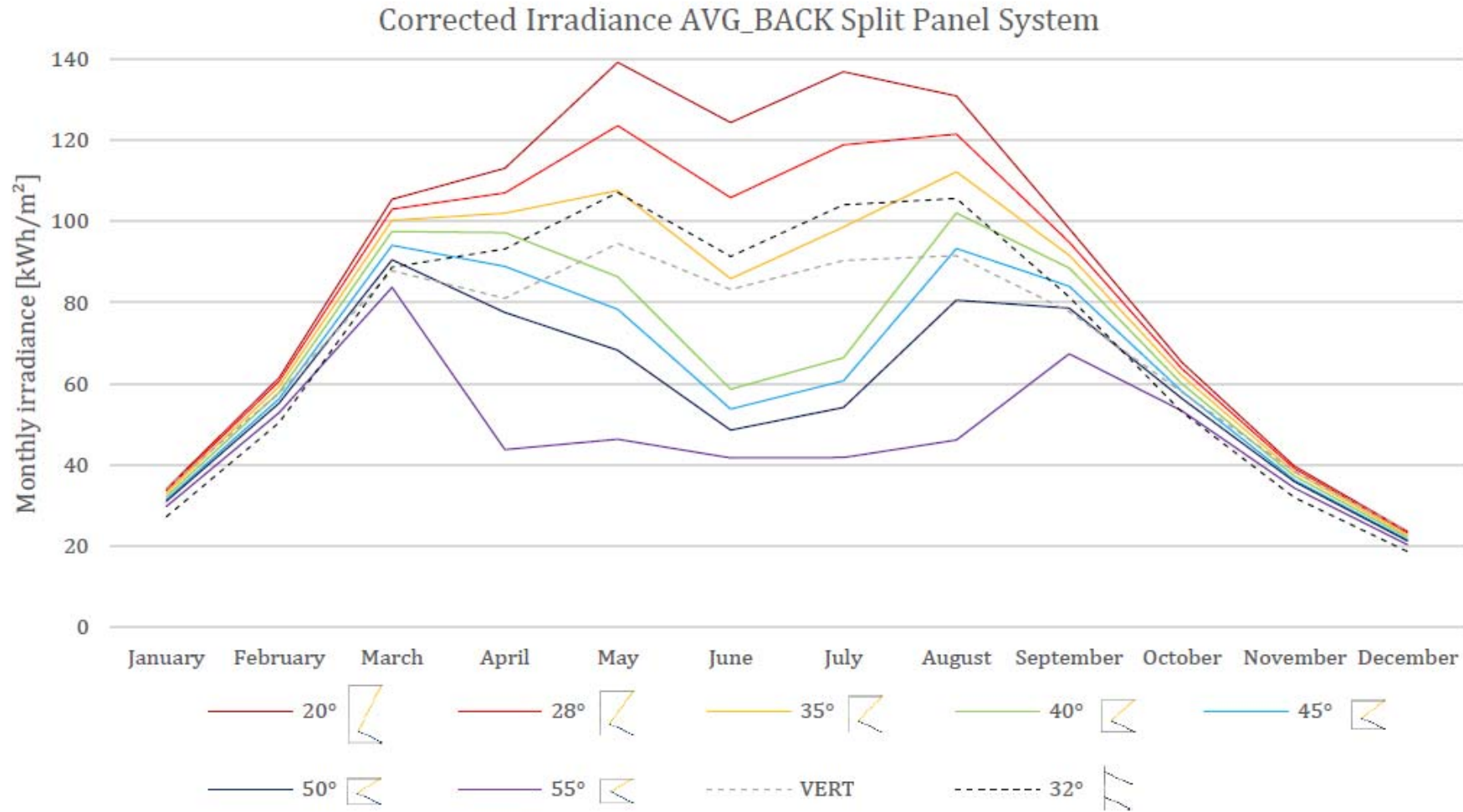
EDGE

Source: DelftX: PV3x Solar Energy: Photovoltaic (PV) Systems

Different reflector angles



Results

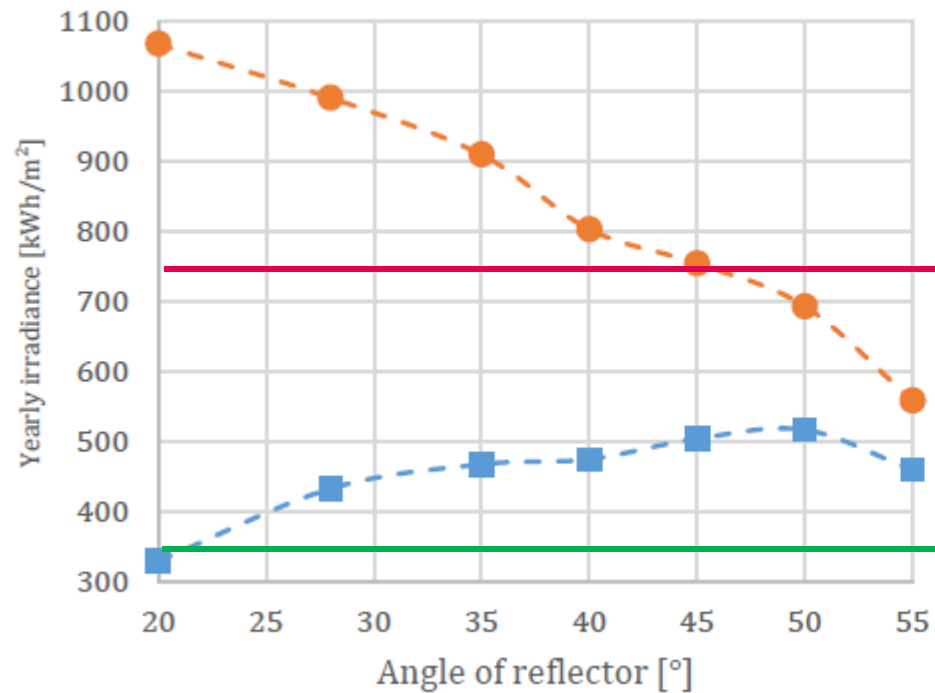


Case study

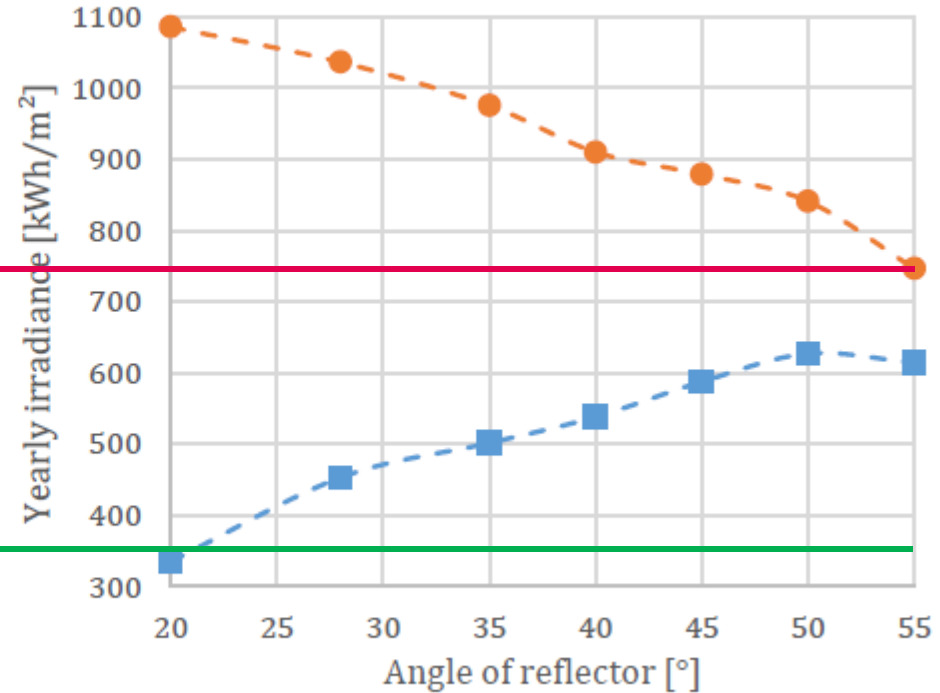


Case study results

AMS - Reflector Angle vs Irradiance:
Single Panel System



AMS - Reflector Angle vs Irradiance:
Split Panel System

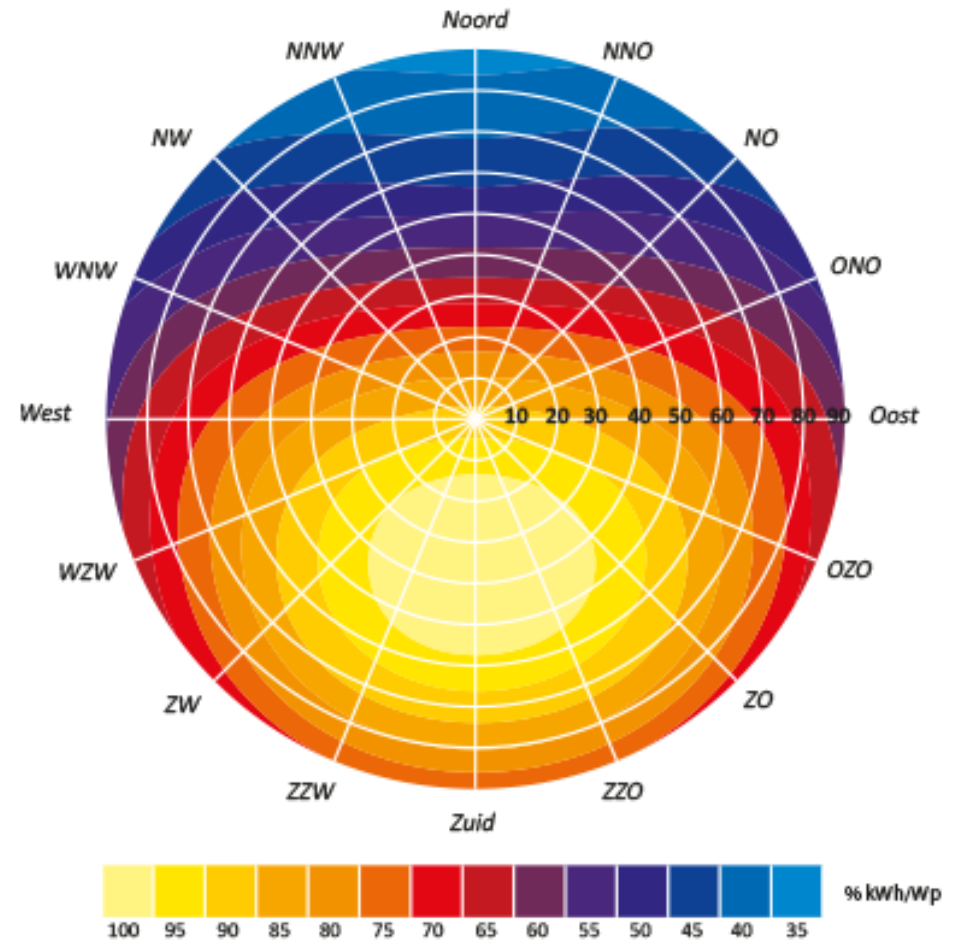
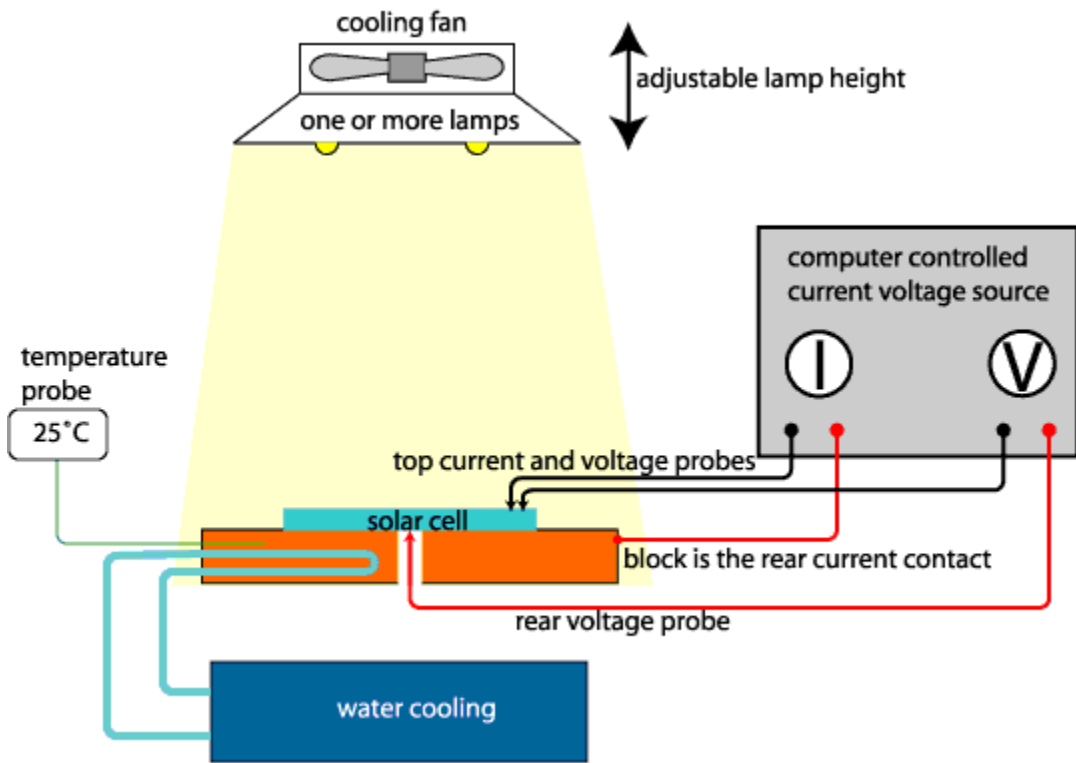


—■— Irradiance per m² façade —●— Irradiance per m² panel

—■— Irradiance per m² façade —●— Irradiance per m² panel

Solar resource assessment

Dmitry Surugin
Roel Loonen
Jan Hensen



Why kWh/W_p is not always enough?

- » Advanced systems (ZigZagSolar, colored PV, bi-facial, ...)
- » Shaded environments
- » Comparison with alternative technologies (wind, heat pumps, more insulation, ...)
- » kWh performance guarantees
- » Zero energy bill houses
- » Battery storage

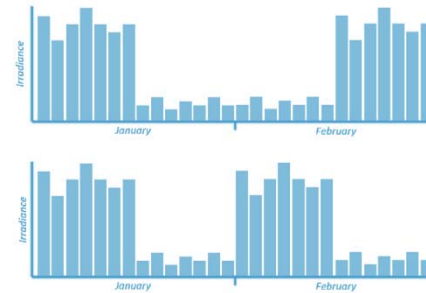
Typical meteorological years

The typical or reference year has to be characterized by: [1]



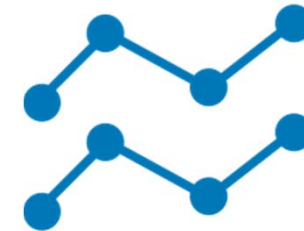
true frequencies

(i.e., the reference year should be a good approximation of the mean values derived from a long period of measurements);



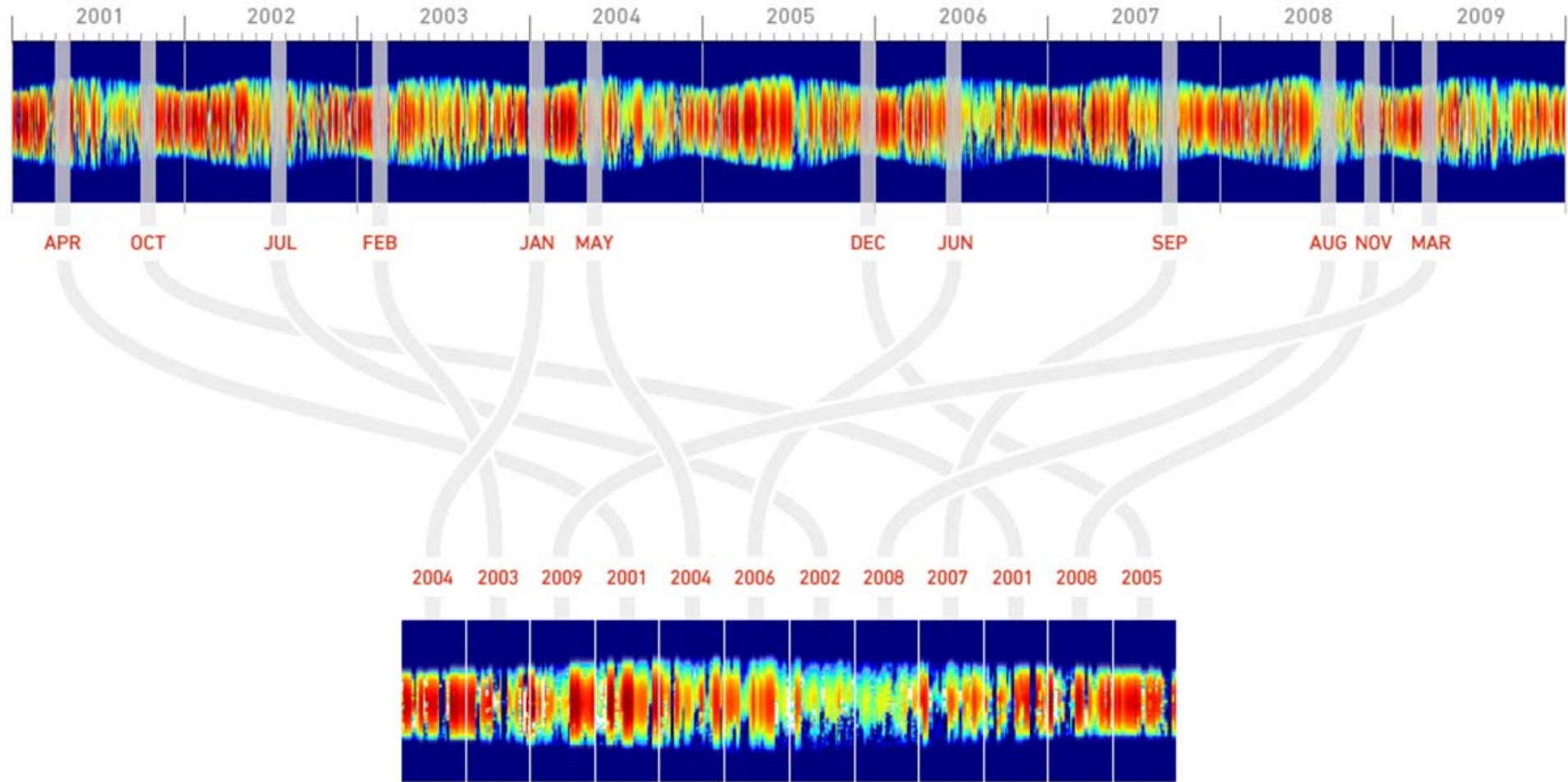
true sequences

(i.e., the weather situations must follow each other in a similar manner to the recorded data);

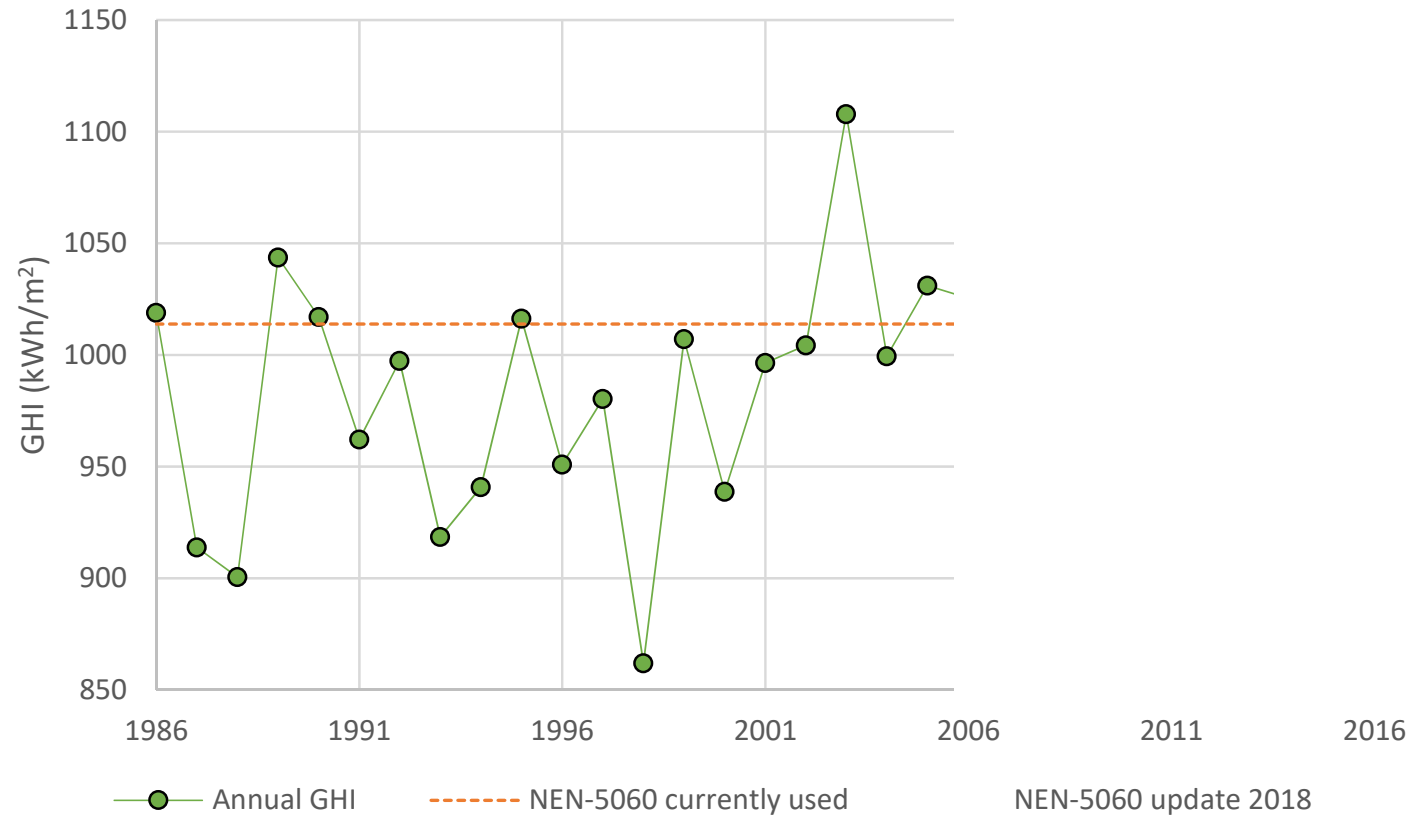


true correlations

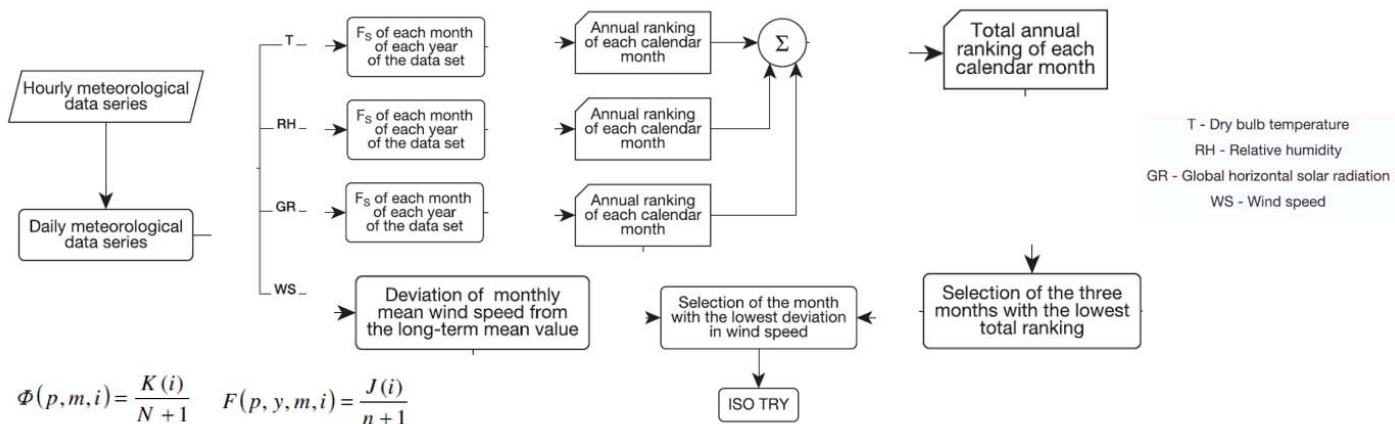
(i.e., the weather data are cross-correlated variables).



De Bilt

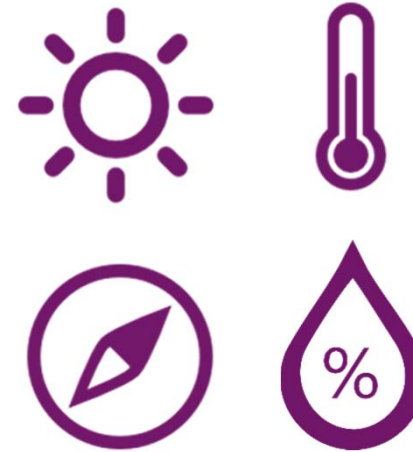


Procedure for obtaining GHI-based year



$$\Phi(p, m, i) = \frac{K(i)}{N+1} \quad F(p, y, m, i) = \frac{J(i)}{n+1}$$

$$F_S(p, y, m) = \sum_{i=1}^n |F(p, y, m, i) - \Phi(p, m, i)|$$



EN ISO 15792-4



Solar Year

NEN 5060 update

Normontwerp referentieklimaat voor energieprestatie gepubliceerd

25-05-2018 De gegevens van het referentieklimaat worden aangepast. Dit is nodig door de opwarming van de aarde, maar ook om aan te sluiten bij de nieuwe energieprestatie bepalingsmethode, NTA 8800. Het ontwerp van de norm is nu beschikbaar op de website van NEN. Belanghebbenden kunnen tot 15 augustus commentaar indienen.



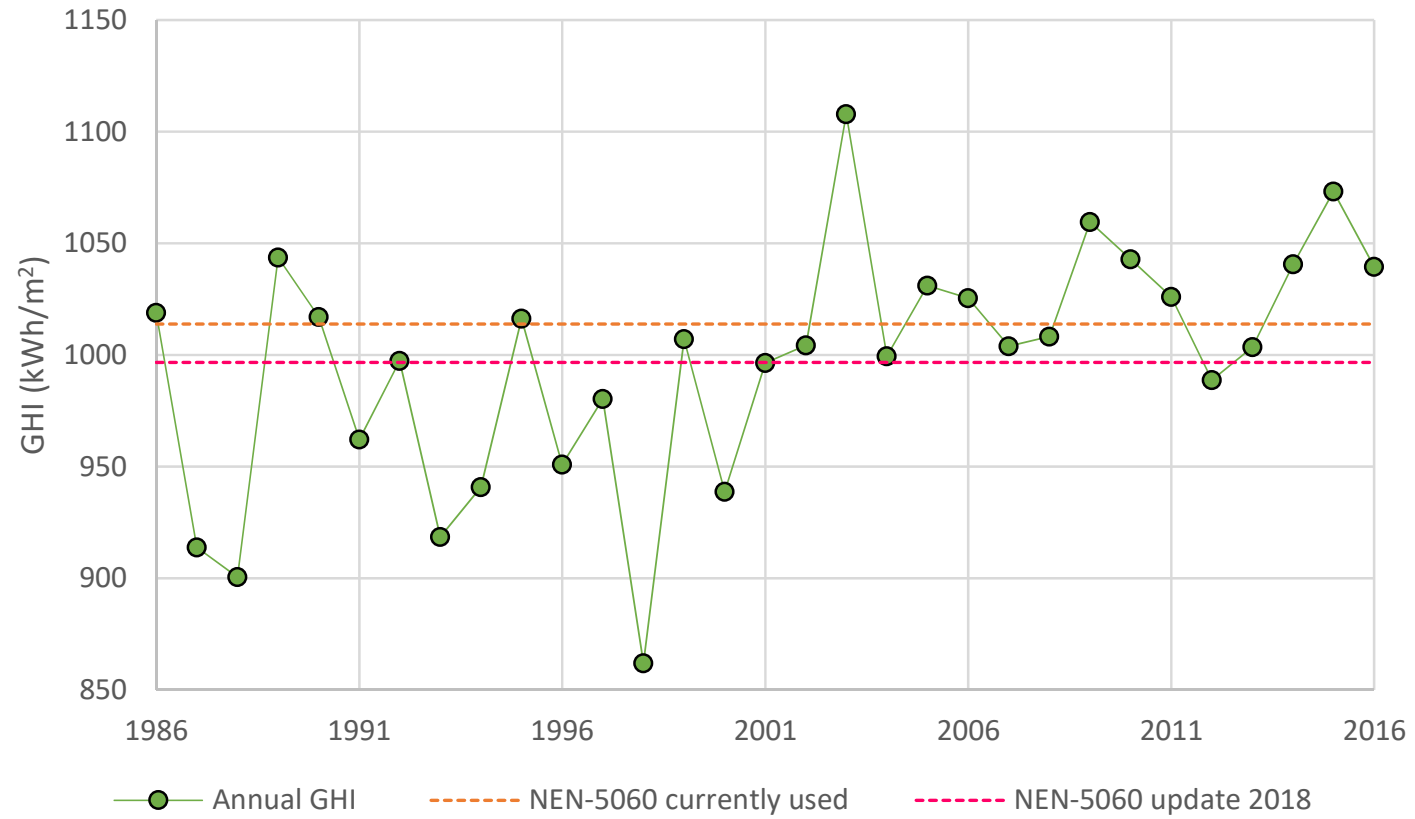
NEN 5060 'Hygrothermische eigenschappen van gebouwen – Referentieklimaatgegevens' bevat een drietal referentiejaar: Eén jaar voor energieberekeningen en een tweetal jaren voor ontwerpdoeleinden. Het referentiejaar voor energieberekeningen is representatief voor Nederland en is bedoeld voor het buitenklimaat bij energie(prestatie) berekeningen. De referentiejaar geven

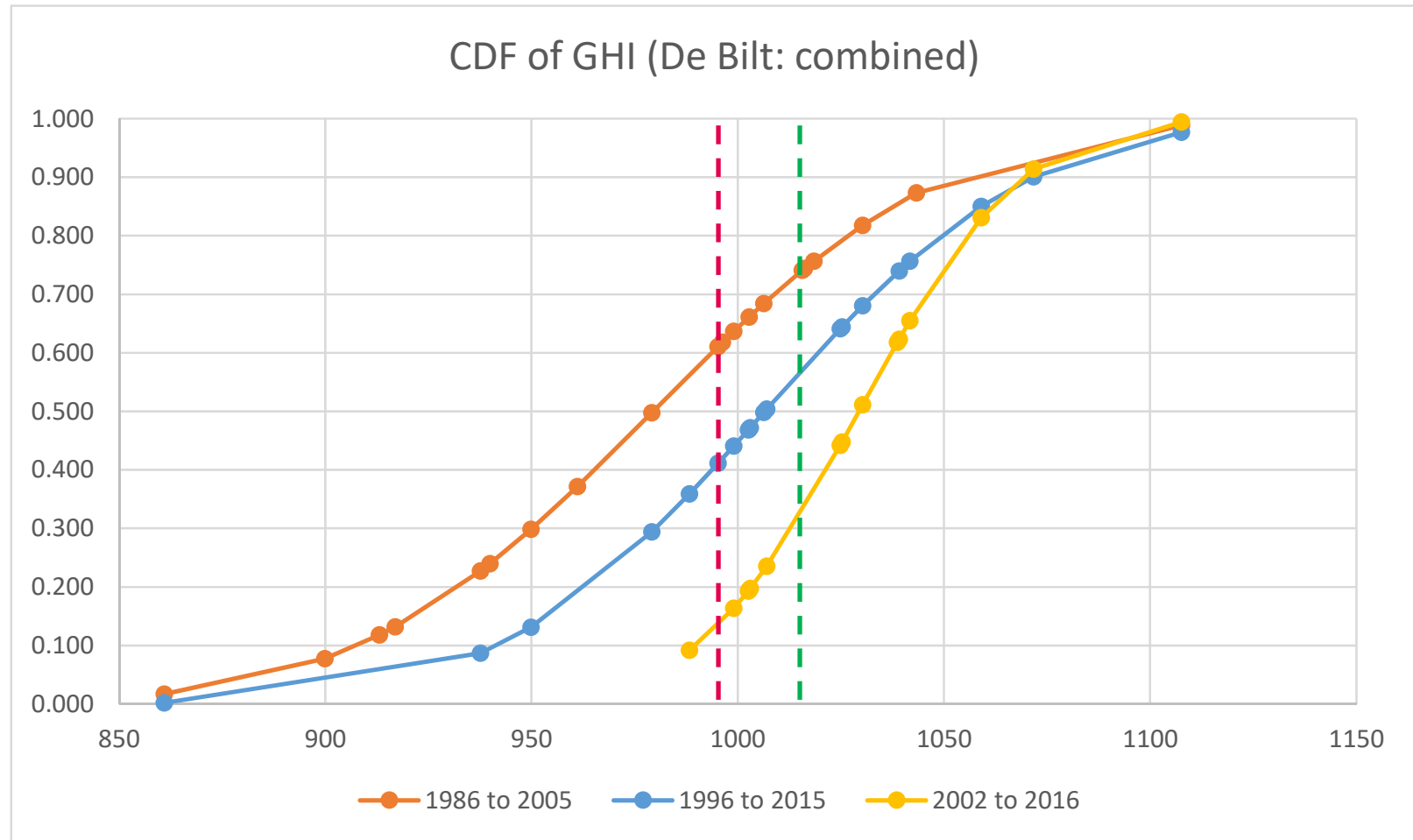
waarden voor buitentemperatuur, globale zonnestraling, windsnelheid, windrichting, luchtvochtigheid en neerslag.

iets warmer

In het concept zijn nieuwere klimaatgegevens gebruikt, namelijk de klimatologische gegevens over de periode 1996 tot en met 2015 van het KNMI-weerstation in De Bilt. Dit laat een hele lichte stijging van de temperatuur zien, met iets grotere uitschieters naar boven en naar beneden.

De Bilt



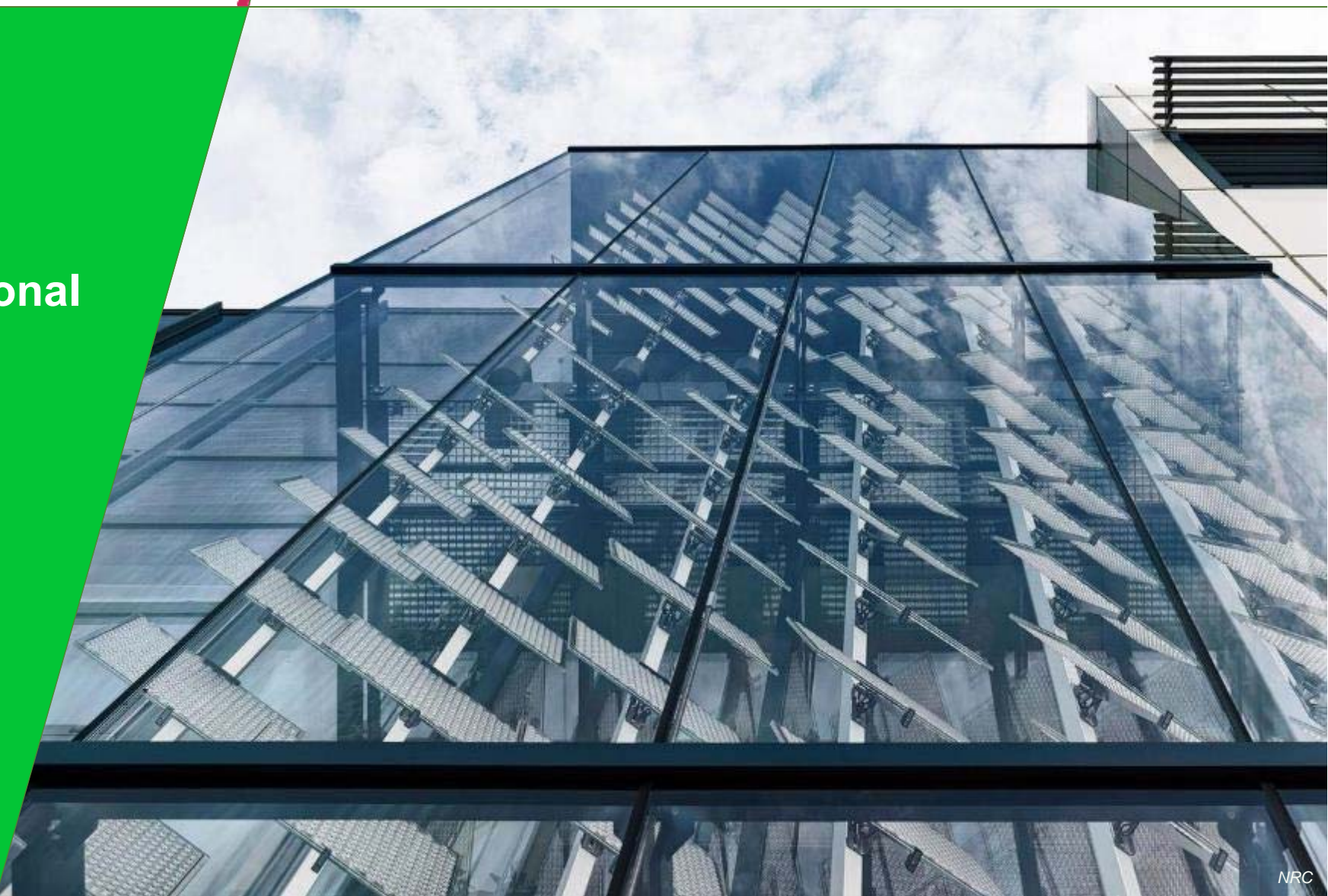


Lumiduct

Teun van Oirschot
Hemshikha Saini
Antía Varela-Souto
Roel Loonen
Jan Hensen

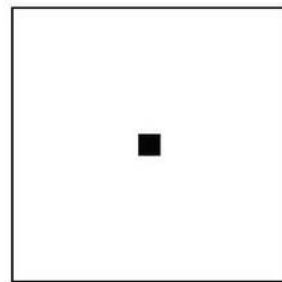
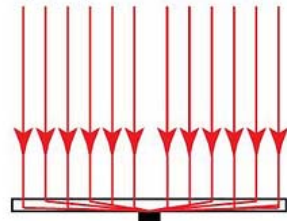
Lumiduct

Experimental & computational
study on visual & thermal
performance



Concentrating PV

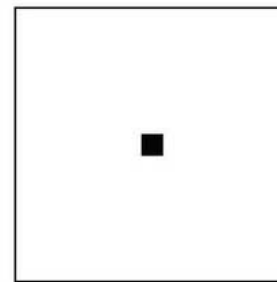
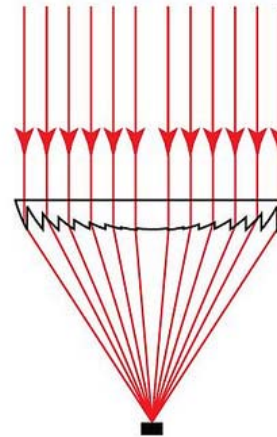
Light-guide Solar Optic



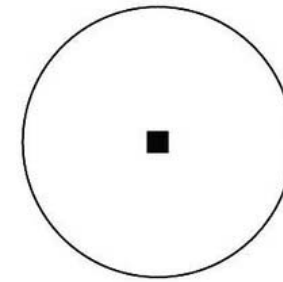
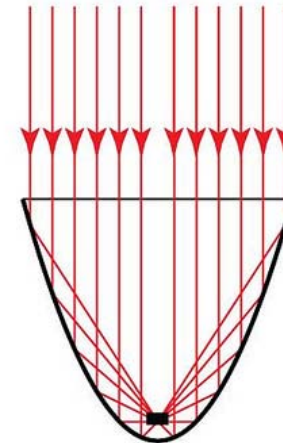
■ PV cell

The Competition

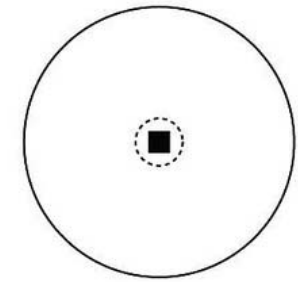
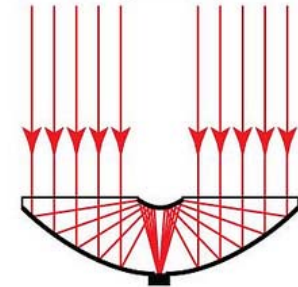
Fresnel Lens



Parabolic Mirror



Cassegrain Optic



Introduction



Concentrating PV



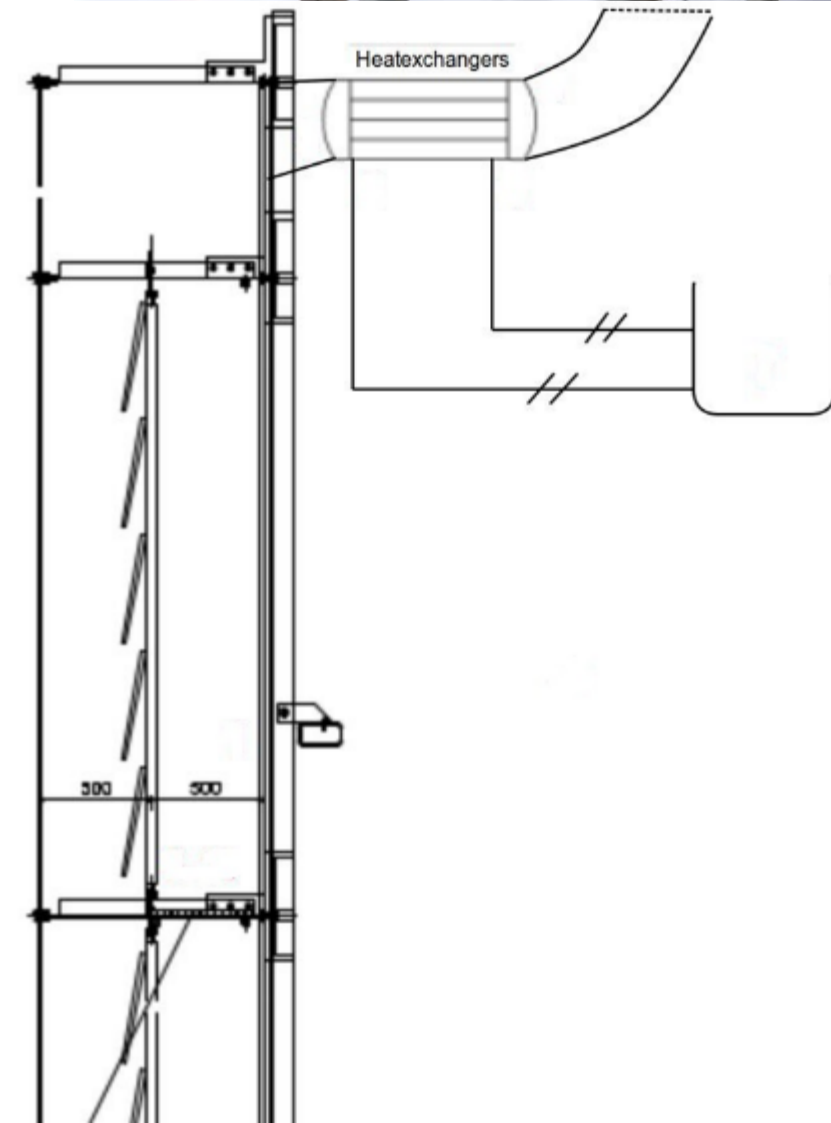
video:www.wellsun.nl

Introduction

- Are glazed PV facades possible?

Wellsun develops the Lumiduct system

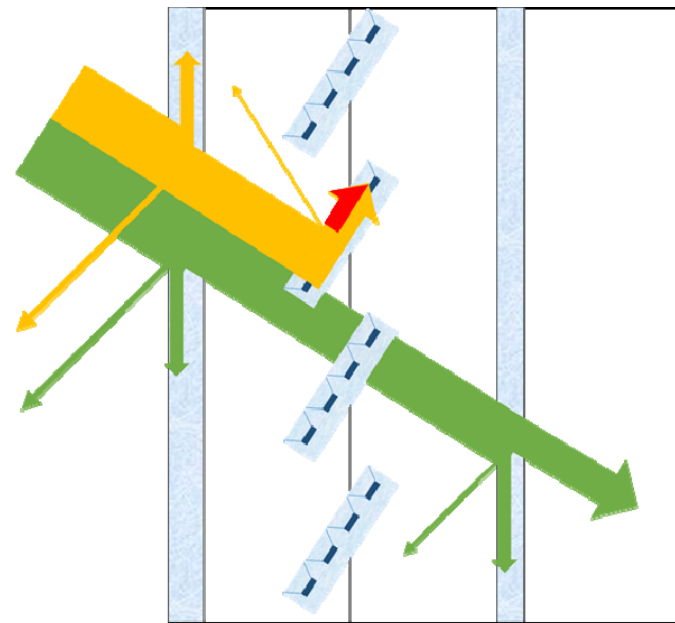
- Building Integrated Concentrator Photovoltaic (BICPV) system
- Double skin-façade with concentrator PV modules
- Track the position of the sun
- Solar shading device
- Heat generation



Introduction

Full-scale pilot-project at Mondial Movers (Alblasserdam)

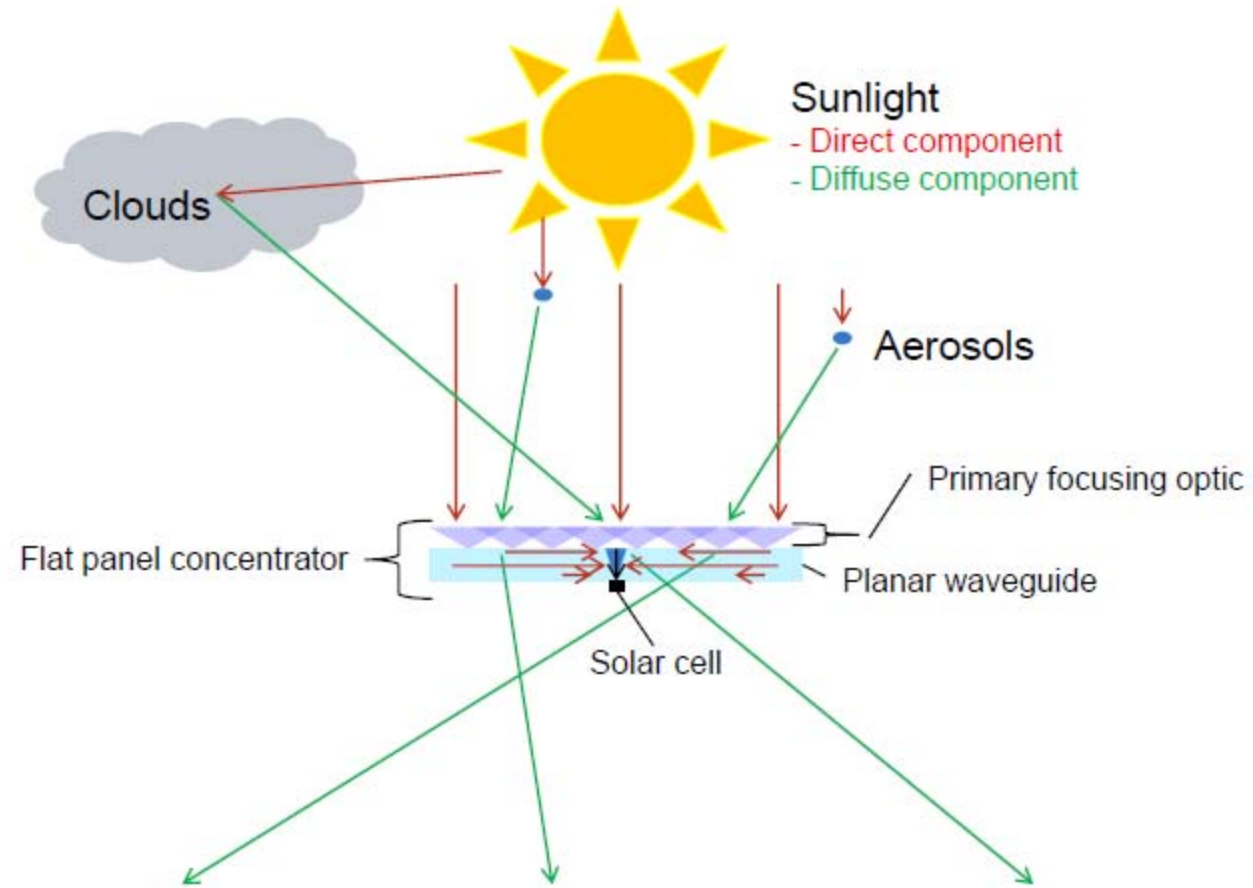
- Allows measurements of visual/thermal performance
- Neighbours as reference case



LUMIDUCT

— Direct radiation — Diffuse radiation — Electricity





- Location: Amsterdam, the Netherlands
- Façade orientation: Vertical, southward facing ($0^\circ, 180^\circ$)
- Transmission outer façade, $T_o = 0.90$
- Coupon efficiency, $\eta = 0.30$

Method: Measurements visual performance

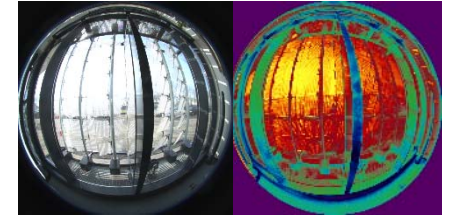
Horizontal illuminance:

- Hagner detector illuminance photo-sensor
- Amplifiers



Analysis of glare:

- HDR camera
- Evalglare tool



Modeling of the reference product

Method: Measurements thermal performance

Air and surface temperature:

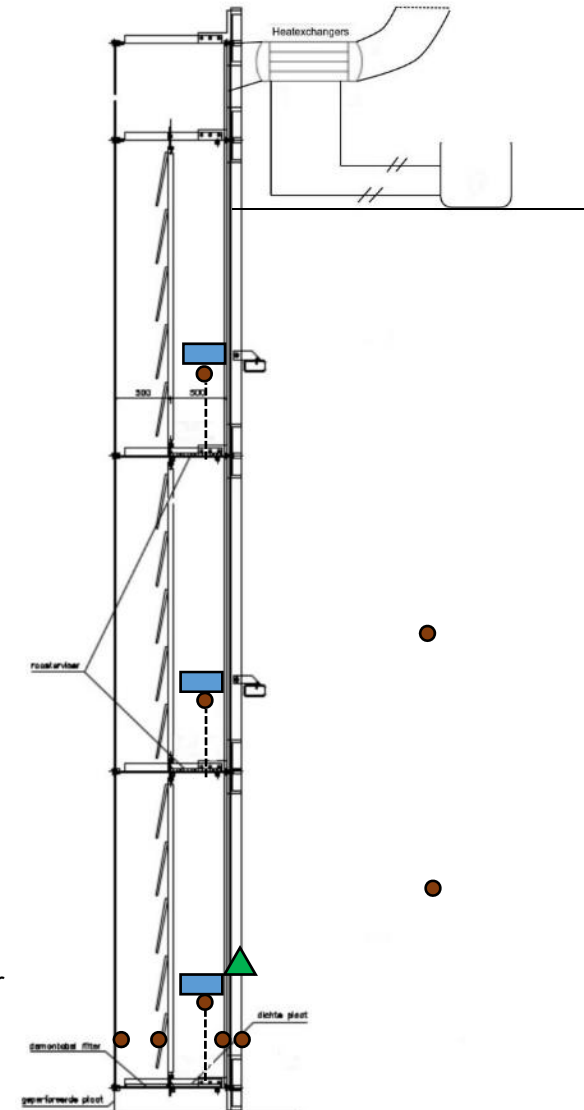
- NTC thermistors

Heat transfer:

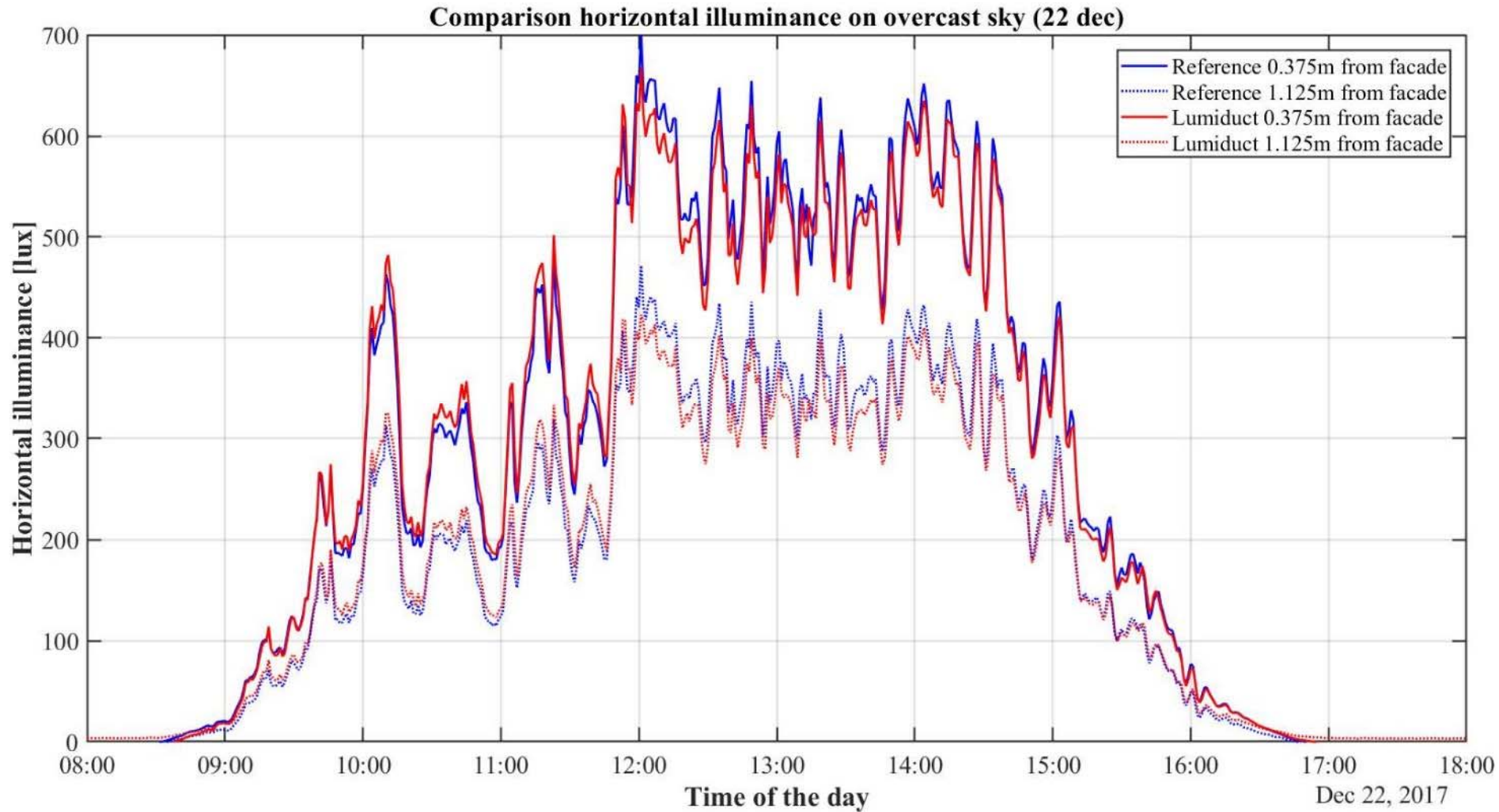
- Hukseflux heat flux plate

Airflow behaviour in cavity:

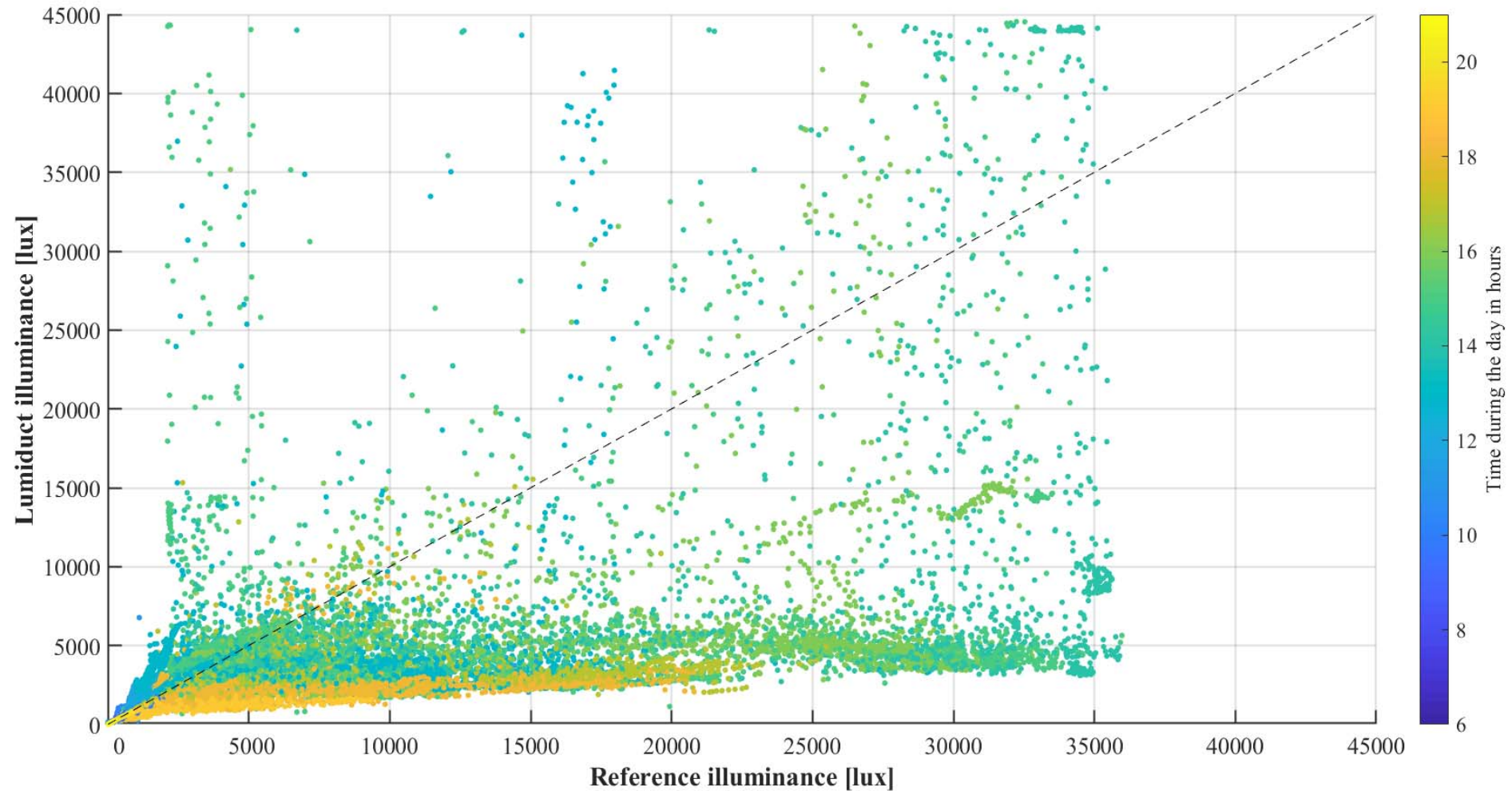
- Air velocity measurements with Windsonic
- Smoke tubes



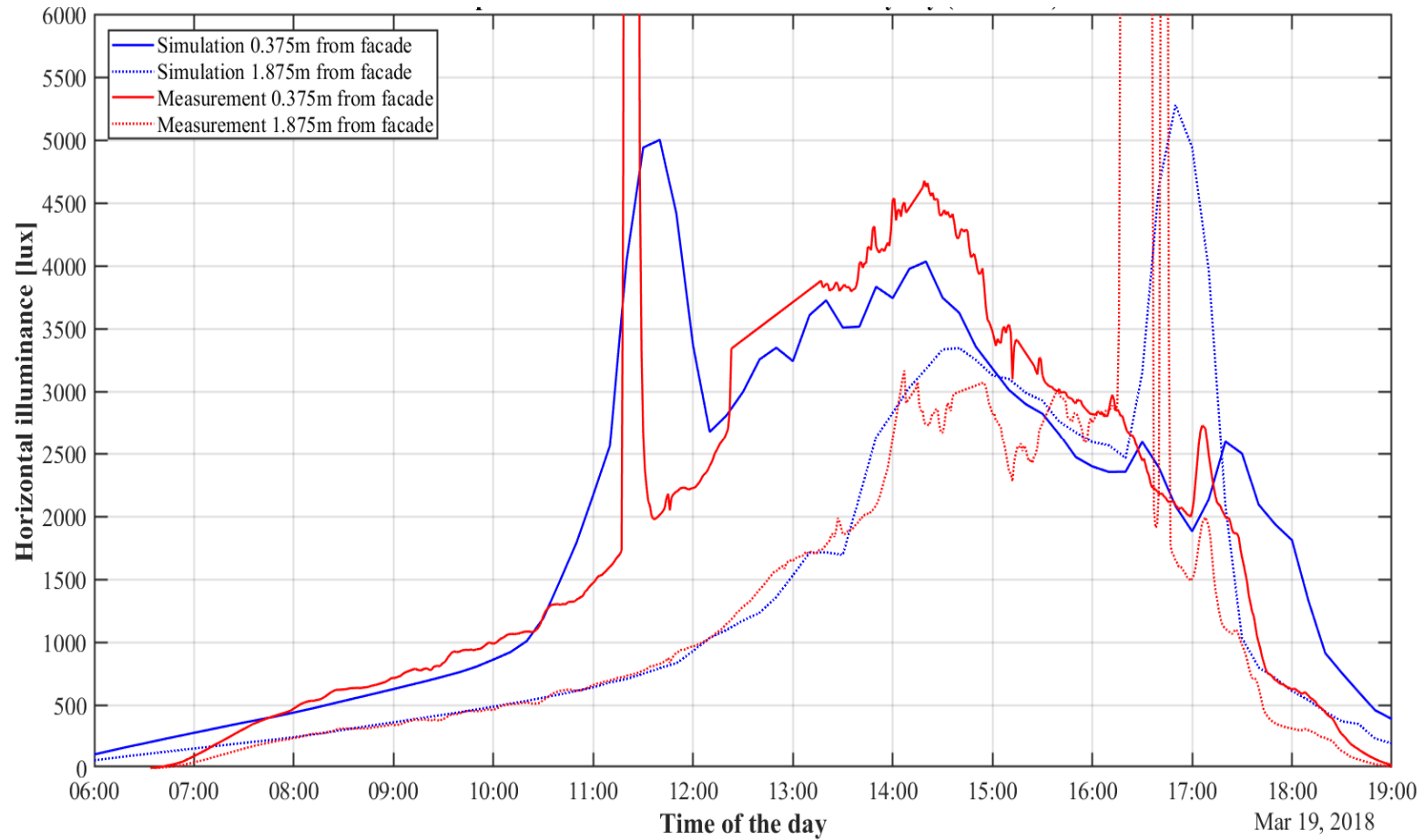
Measurement results: visual comfort



Daylight level: Comparison all datapoints

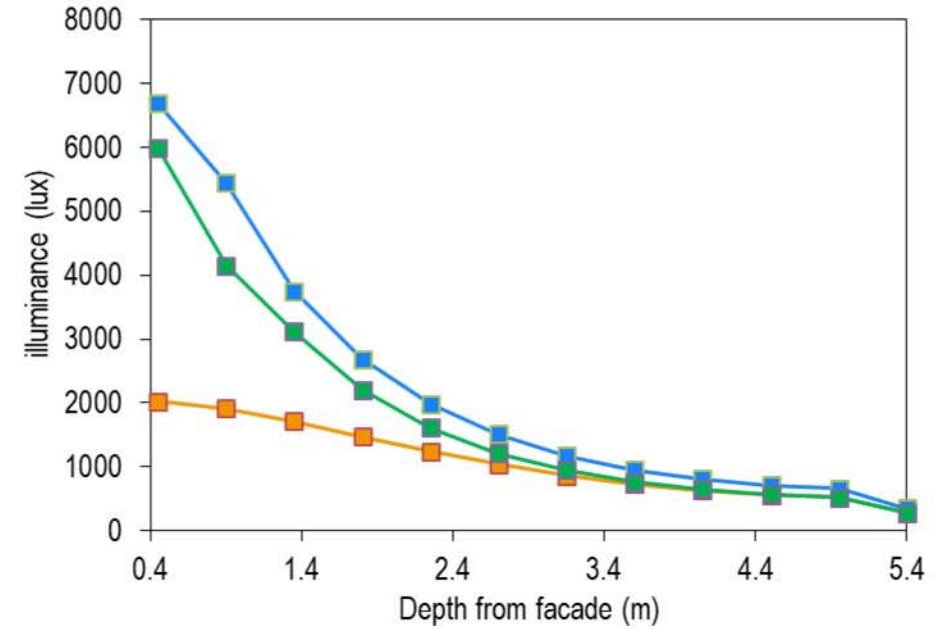
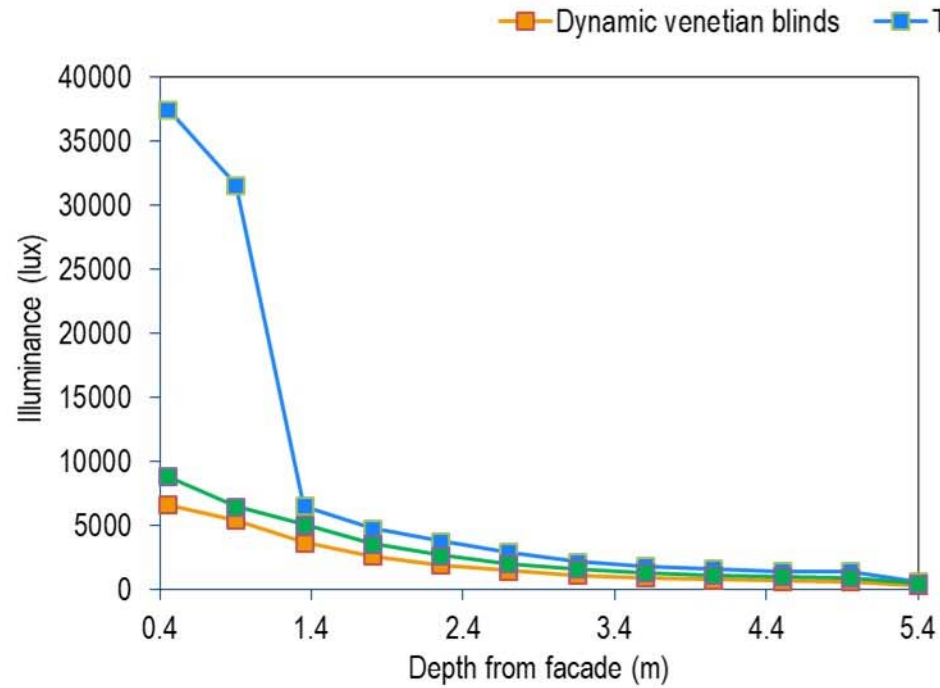


Model calibration



Results

- 4th June-10th June





thank you