

# Earth, Wind & Fire Solution to the nZEB challenge

**Ben Bronsema**





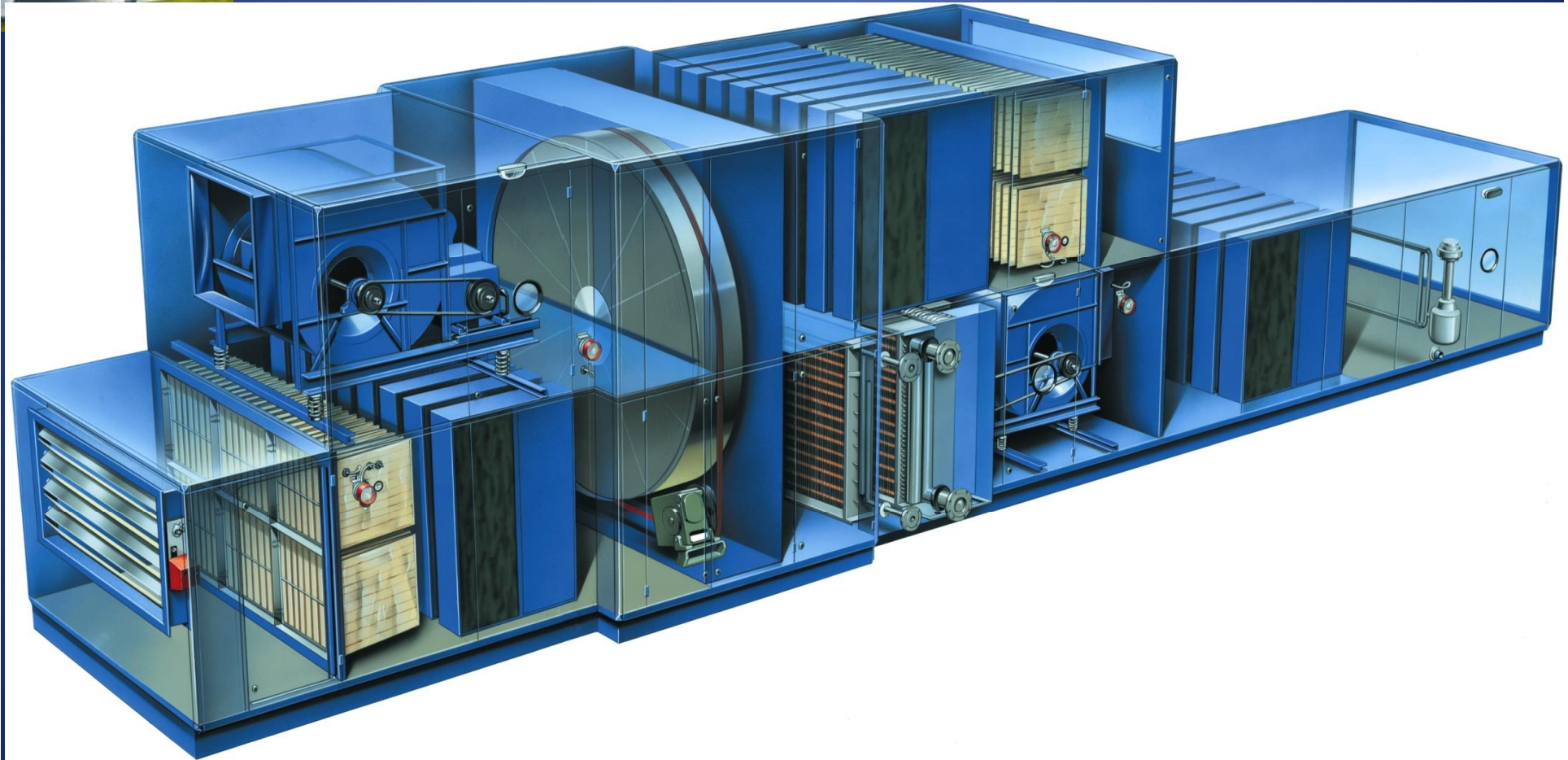






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# A modern Air Handling Unit





# Do people like air-conditioning?

Except during heat waves they generally do not

Noise

Draught

Air quality

Dry air

Energy Consumption



# Architect and Engineer

## Different minds

**Architect**  
**Artistic – Intuitive - Creative**

**Engineer**  
**Rational – Logical**





# Louis Kahn, famous American architect (1901-1974)

“I do not like ducts, I do not like pipes. I hate them thoroughly, but because I hate them so thoroughly, I feel that they have to be given their place. If I just hated them and took no care, I think that they would invade the building and completely destroy it. I want to correct any notion you may have that I am in love with that kind of things”



# Vitruvius (85 – 20 v.Chr)

- “ Firmitas > sterkte
- “ Utilitas > nuttigheid
- “ Venustas > schoonheid

## Contemporaine Vitruvius:

- “ Responsibilitas
  - > binnenmilieu
  - > energiezuinigheid
  - > ecologische prestaties
  - > sociale prestaties
  - > culturele prestaties

# Ontwikkelingen 1850 – 1900

- “ 1851 Koelmachine Gorrie
- “ 1857 Personenlift Otis
- “ 1876 Telefoon Bell
- “ 1880 Gloeilamp Edison
- “ 1887 Wisselstroommotor Tesla
- “ 1900 Roltrap Seeberger
- “ 1902 Airconditioning Carrier

# Gescheiden ontwikkeling Architectuur en Klimaattechniek

- “ < 1900 architect is integraal ontwerper
- “ > 1900 ontwikkeling klimaattechniek als zelfstandige discipline
- “ Moeizame communicatie architect en ingenieur
- “ Antibiose architectuur en klimaattechniek
- “ Slechte gegevensuitwisseling
- “ Gebouwkwaliteit niet optimaal
- “ Faalkosten: raming >10% van de omzet

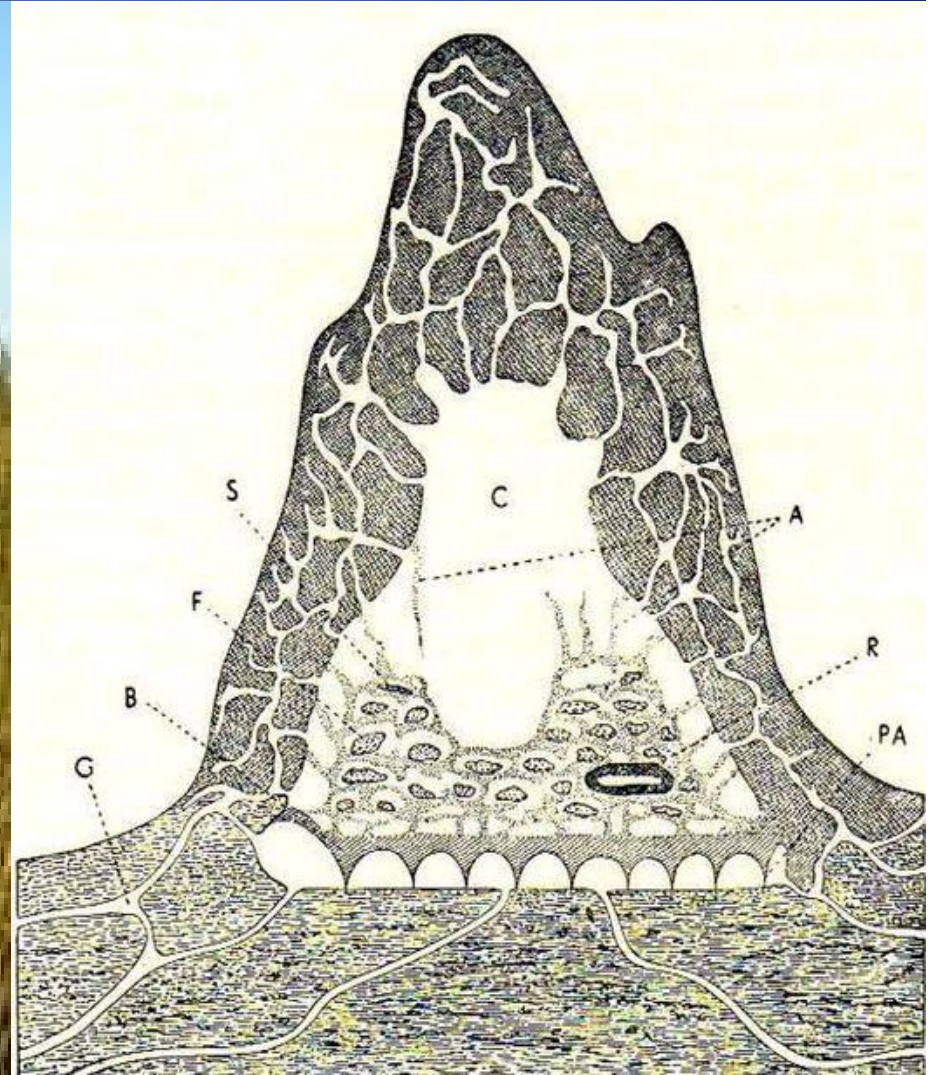


# Synthese tussen Architectuur en Klimaattechniek mogelijk?

- “ Maak van het gebouw een “klimaatmachine”
- “ Klimaattechniek met Architecturale middelen
- “ Synthese van
  - . architecturale expressie en klimaattechniek
  - . intuïtieve creativiteit en rationele logica
- “ Architect mede verantwoordelijk voor
  - . binnenmilieu
  - . energiehuishouding

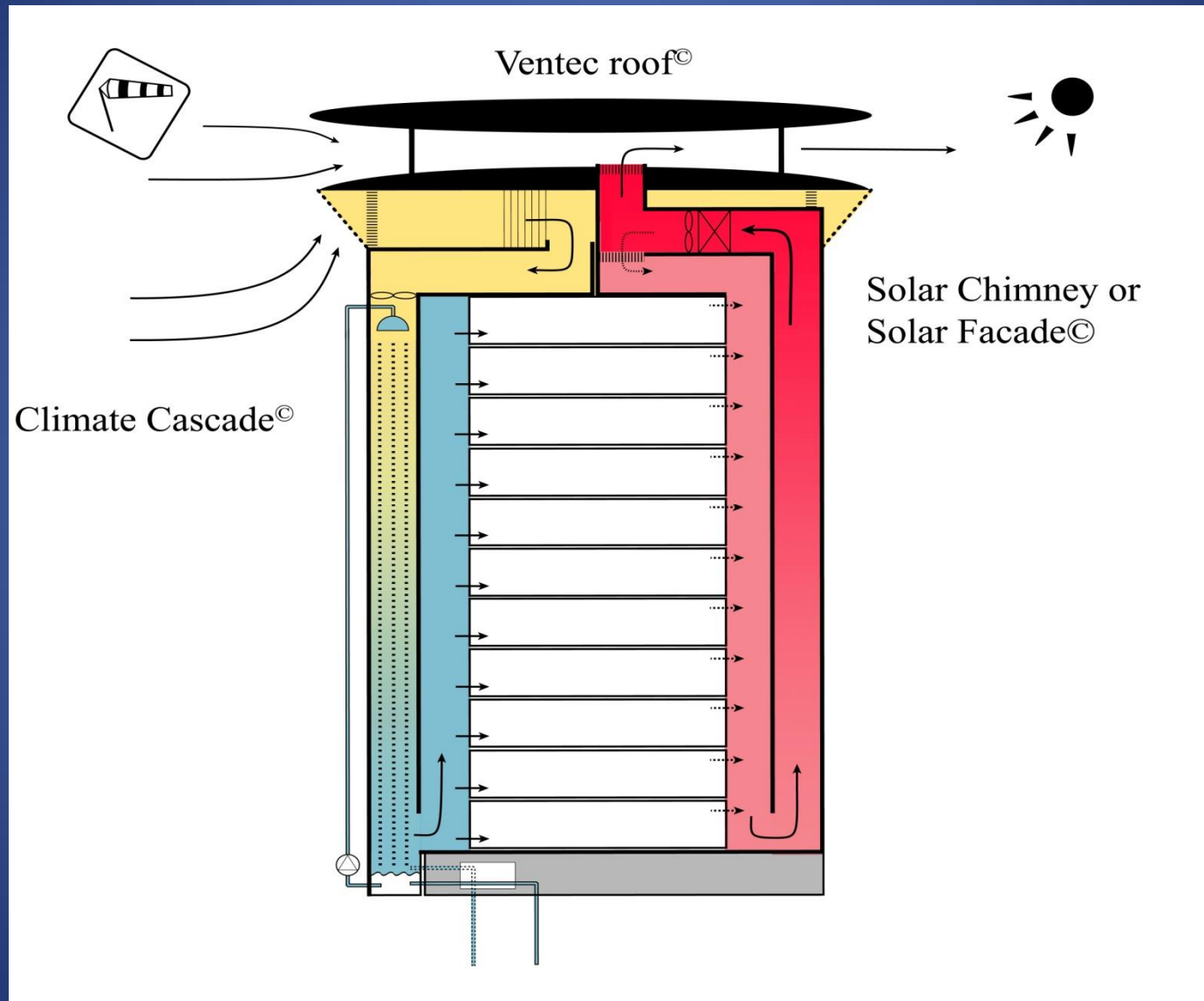
Klimaattechniek is te  
belangrijk om aan  
klimaatingenieurs  
over te laten

# Learning from nature – The Bio-mimicry principle Natural Airconditioning in a Termite Hill





# Natural Airconditioning in a building



# Projectvoorstel Earth, Wind & Fire

## Gericht op Energiezuinigheid

- “ 2005      Versie 1 > afgewezen
- “ 2006      Versie 2 > afgewezen
- “ 2007      Versie 3 > goedgekeurd
- “ Budget ca. 1 miljoen euro
- “ Samenwerking TU Delft en TU Eindhoven
  - . CFD en dynamische simulaties
- “ Partners
  - . Peutz: fysieke modelmetingen
  - . Spraying Systems GmbH: sproeitechnologie



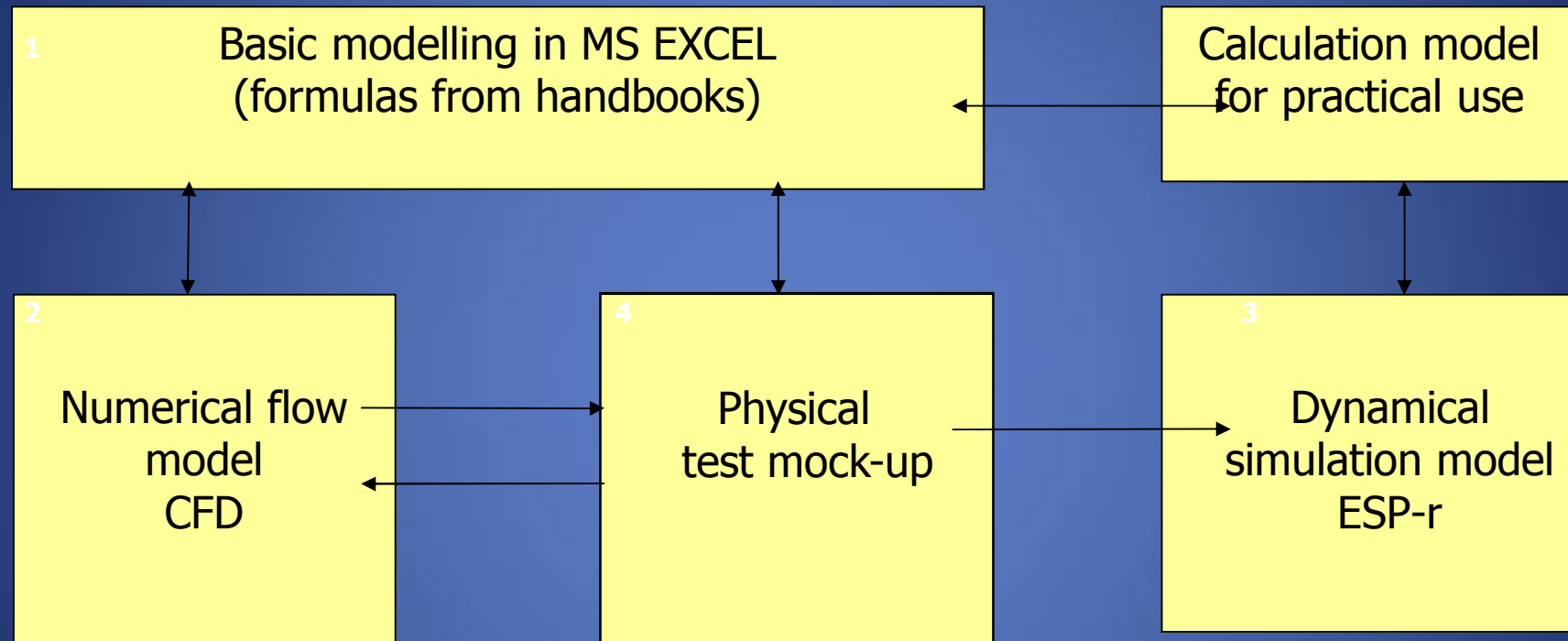


Dedicated to Ilona †  
my love

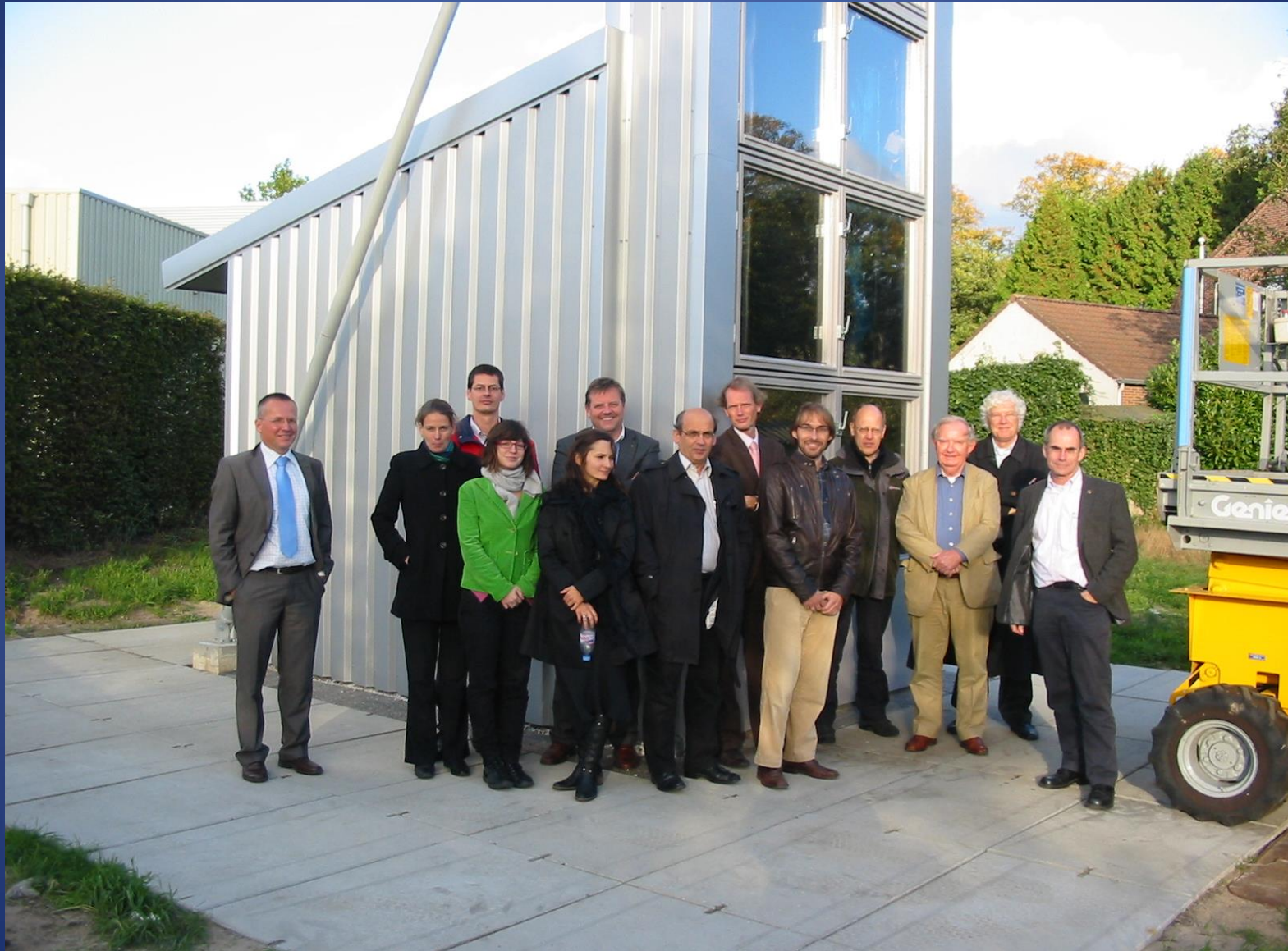
Sing, fight, cry, pray, laugh, work and  
admire

Ramses Shaffy

# Modelling, Simulating and Validating



# Research team and Supervisory group

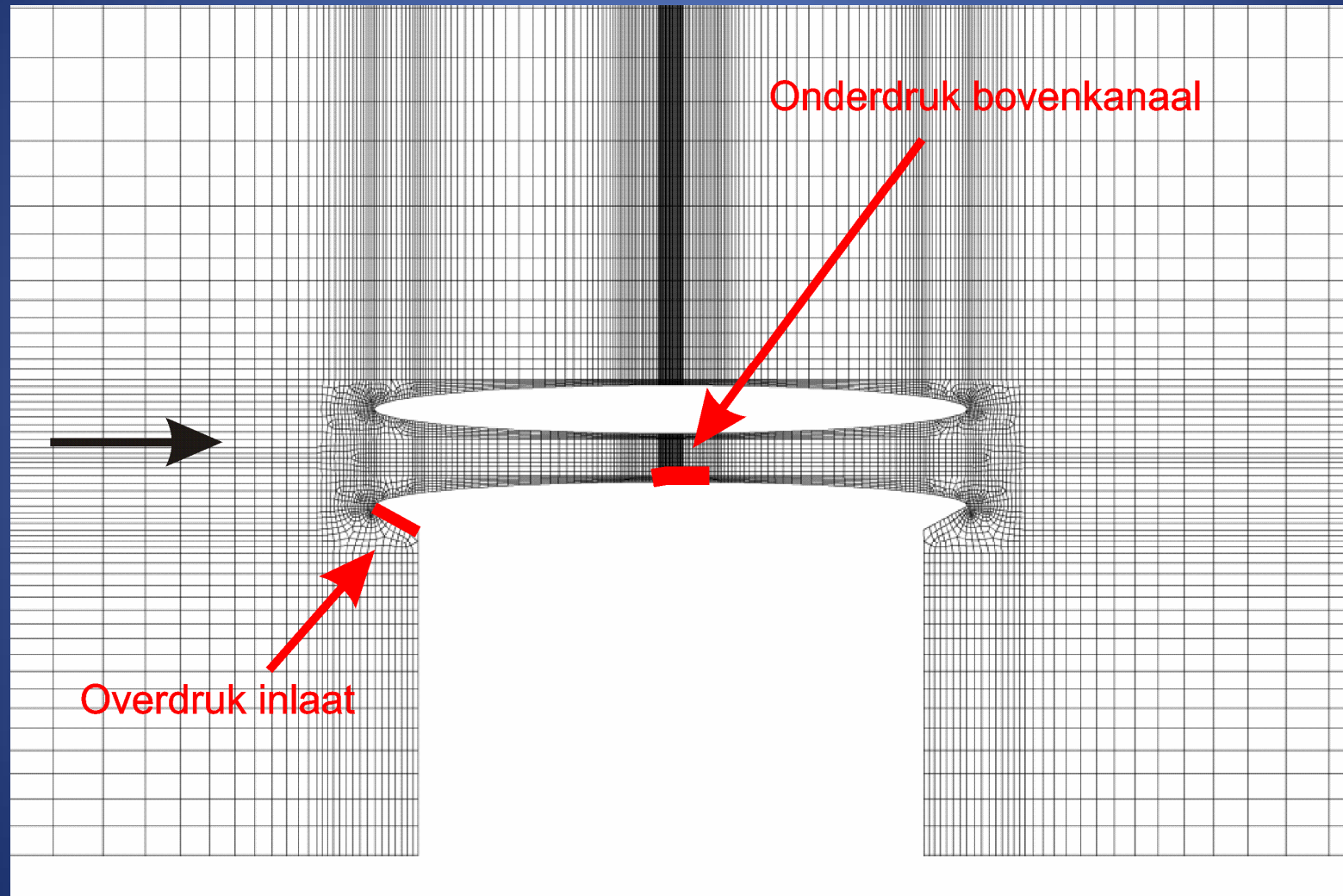


07-04-2015

KIVI Homelab 2050

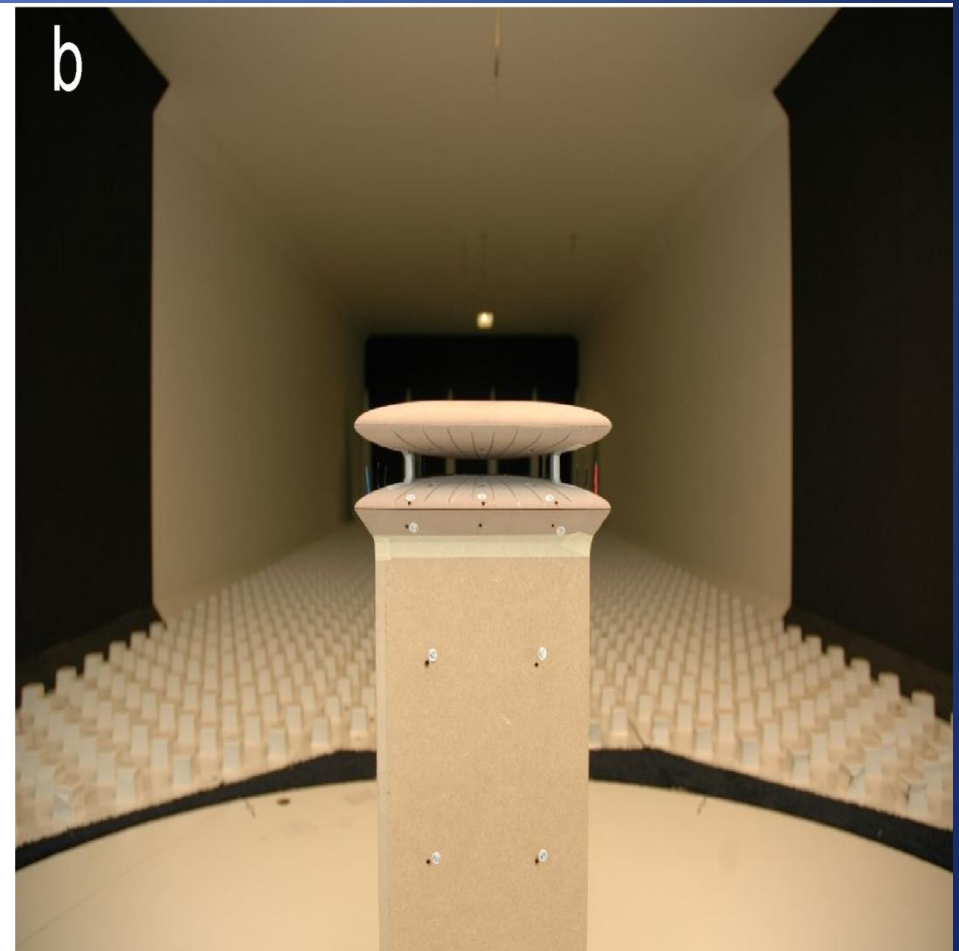
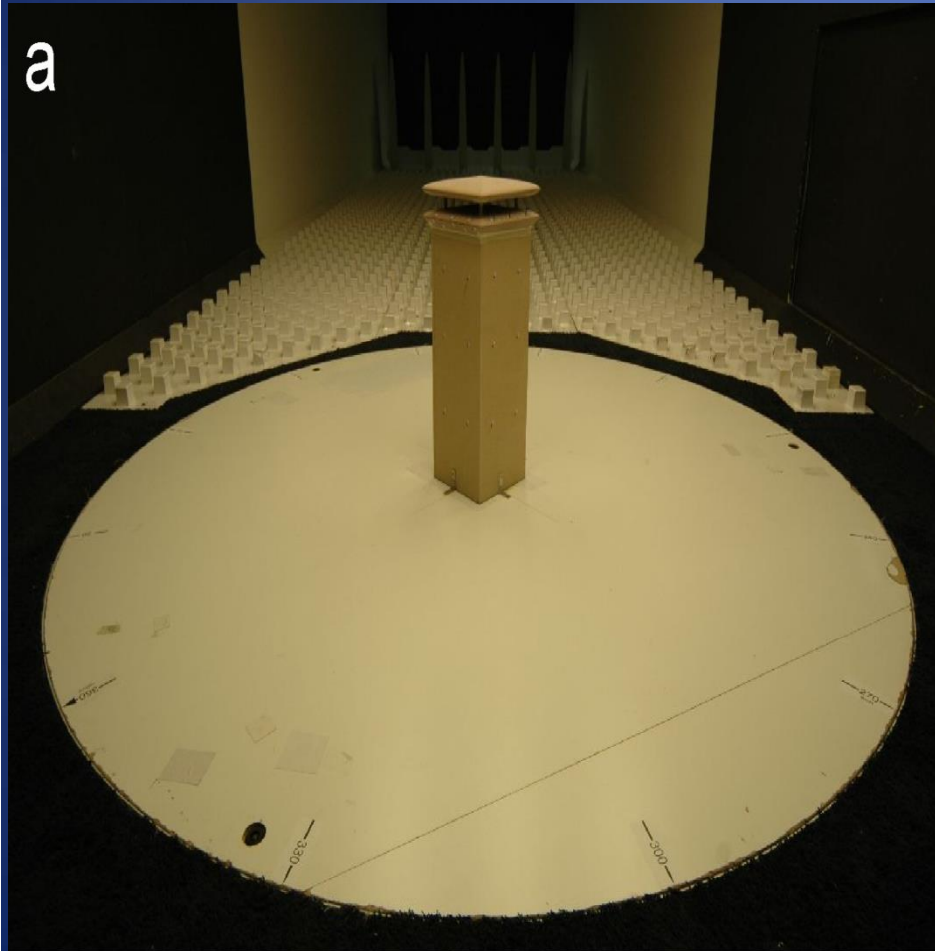
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# CFD simulation Ventec roof

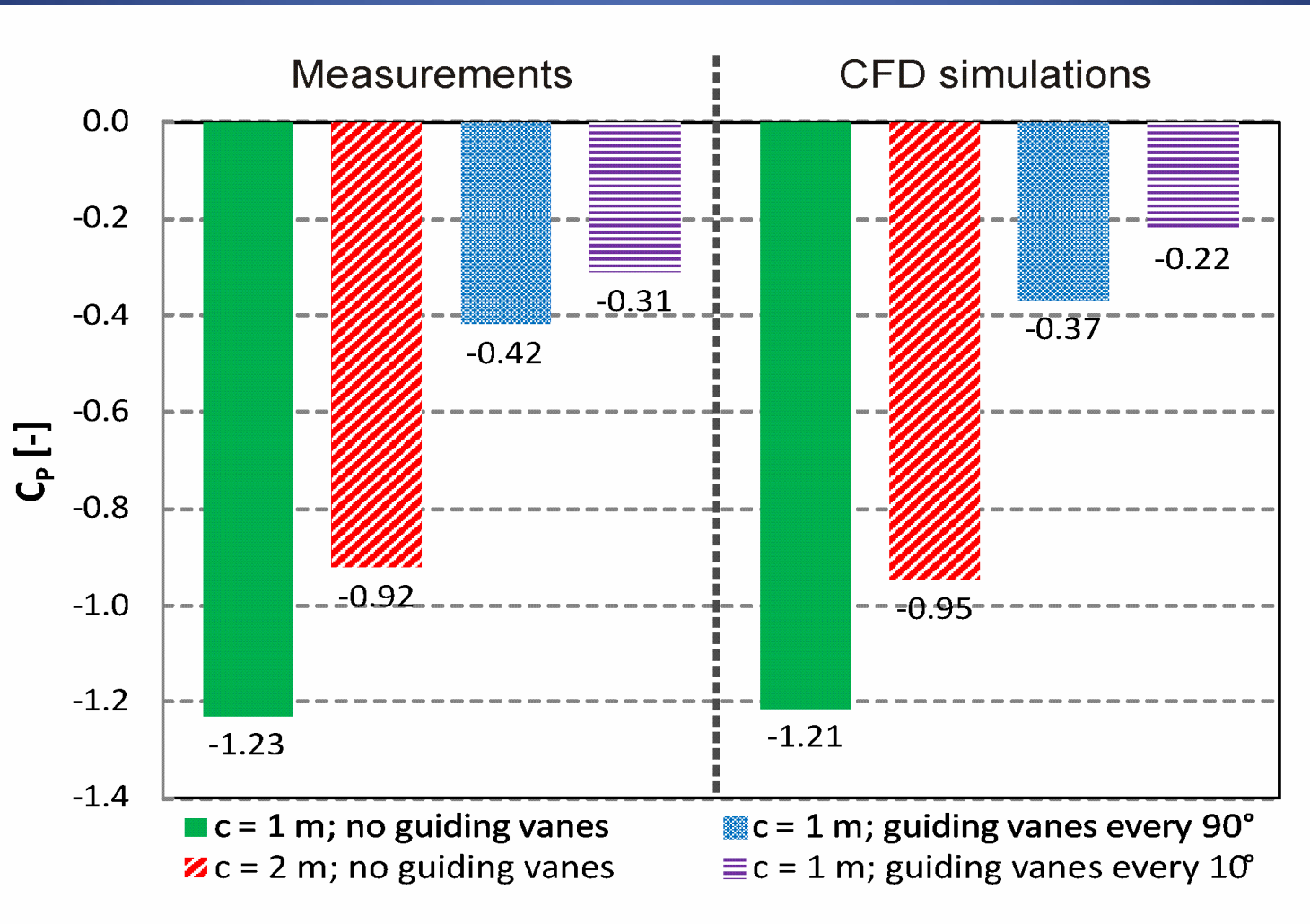




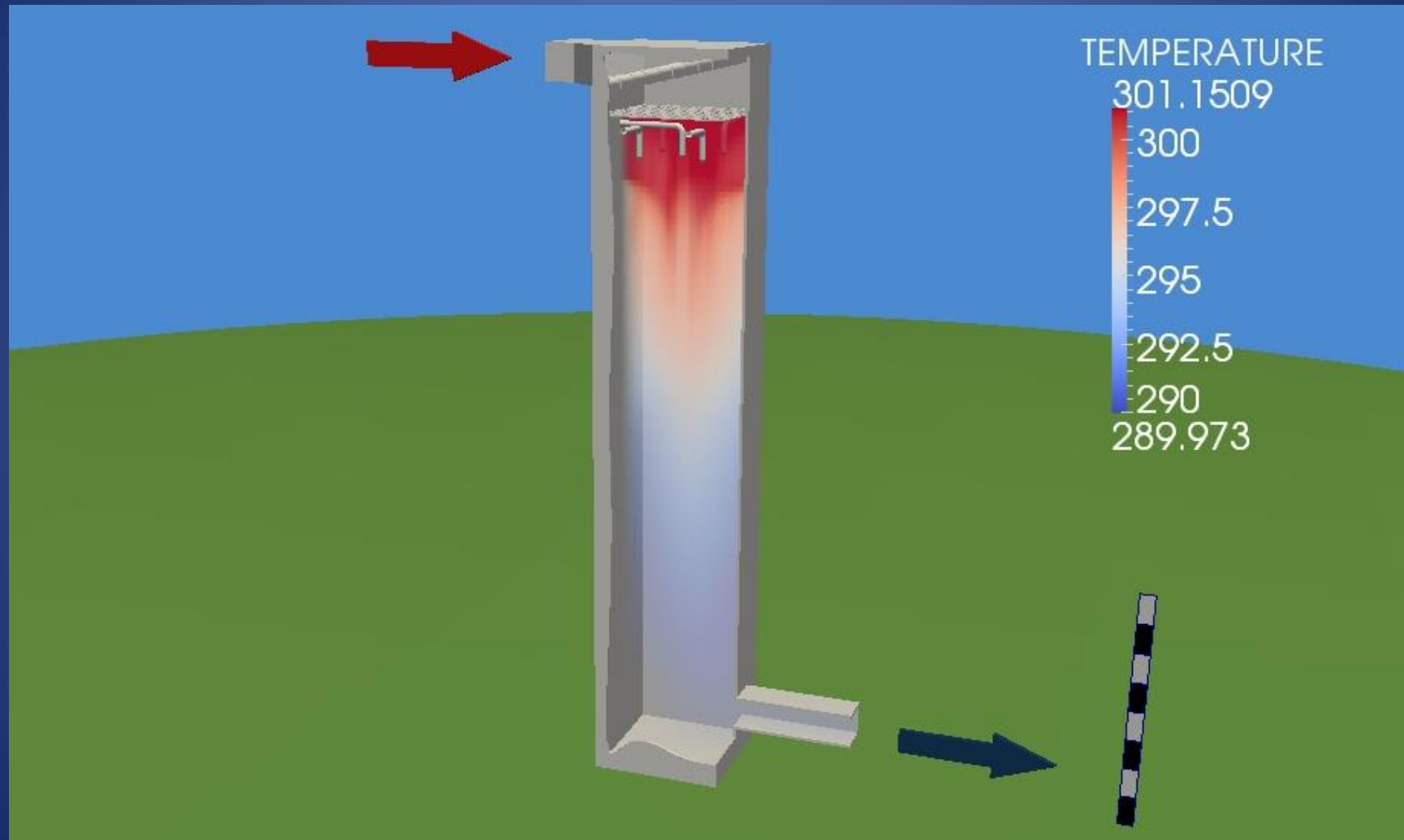
# Testmodel Ventec roof in Windtunnel



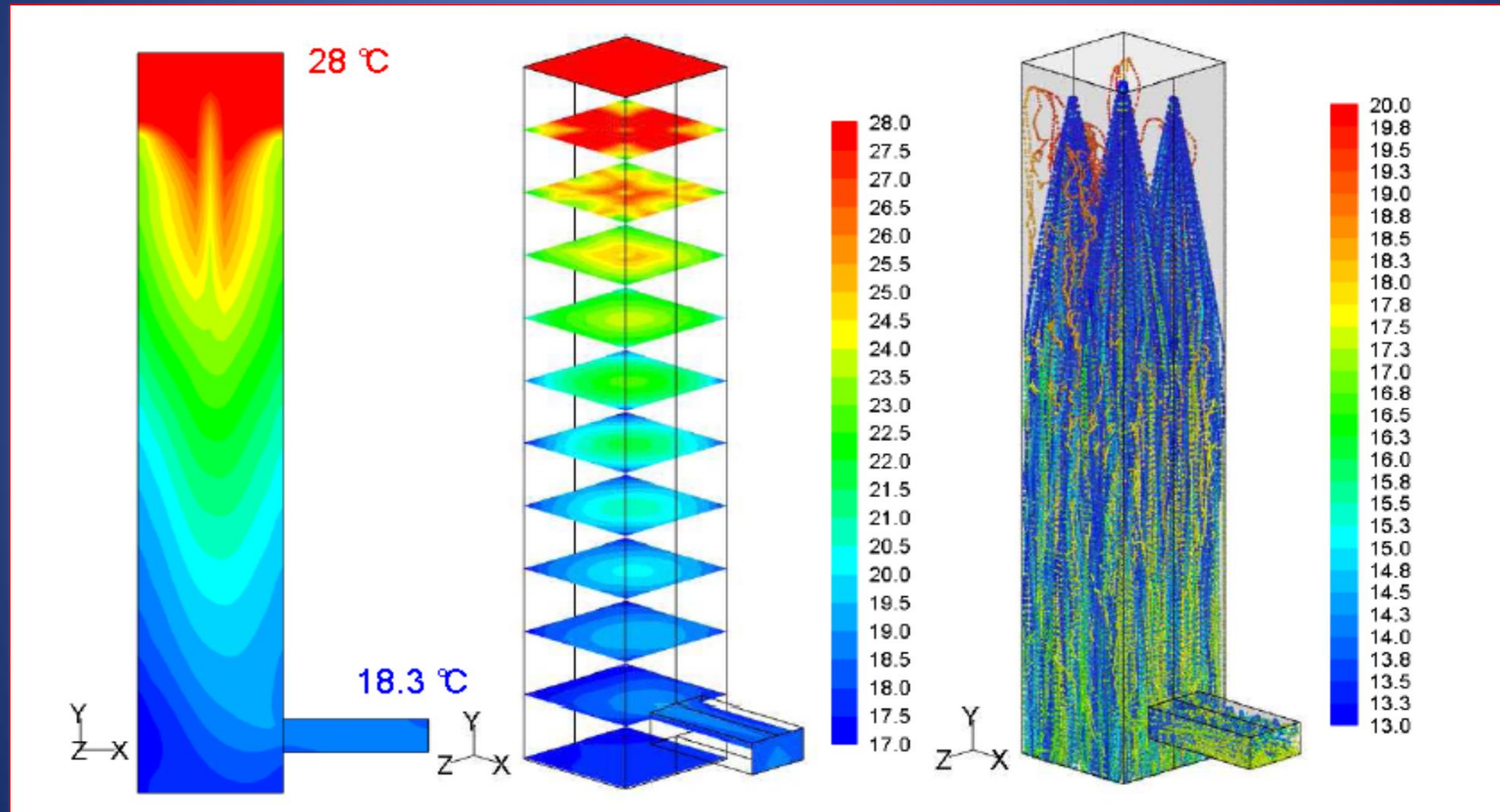
# Cp values in centre Ventec roof ejector not active



# CFD simulation Climate Cascade (temperatures)

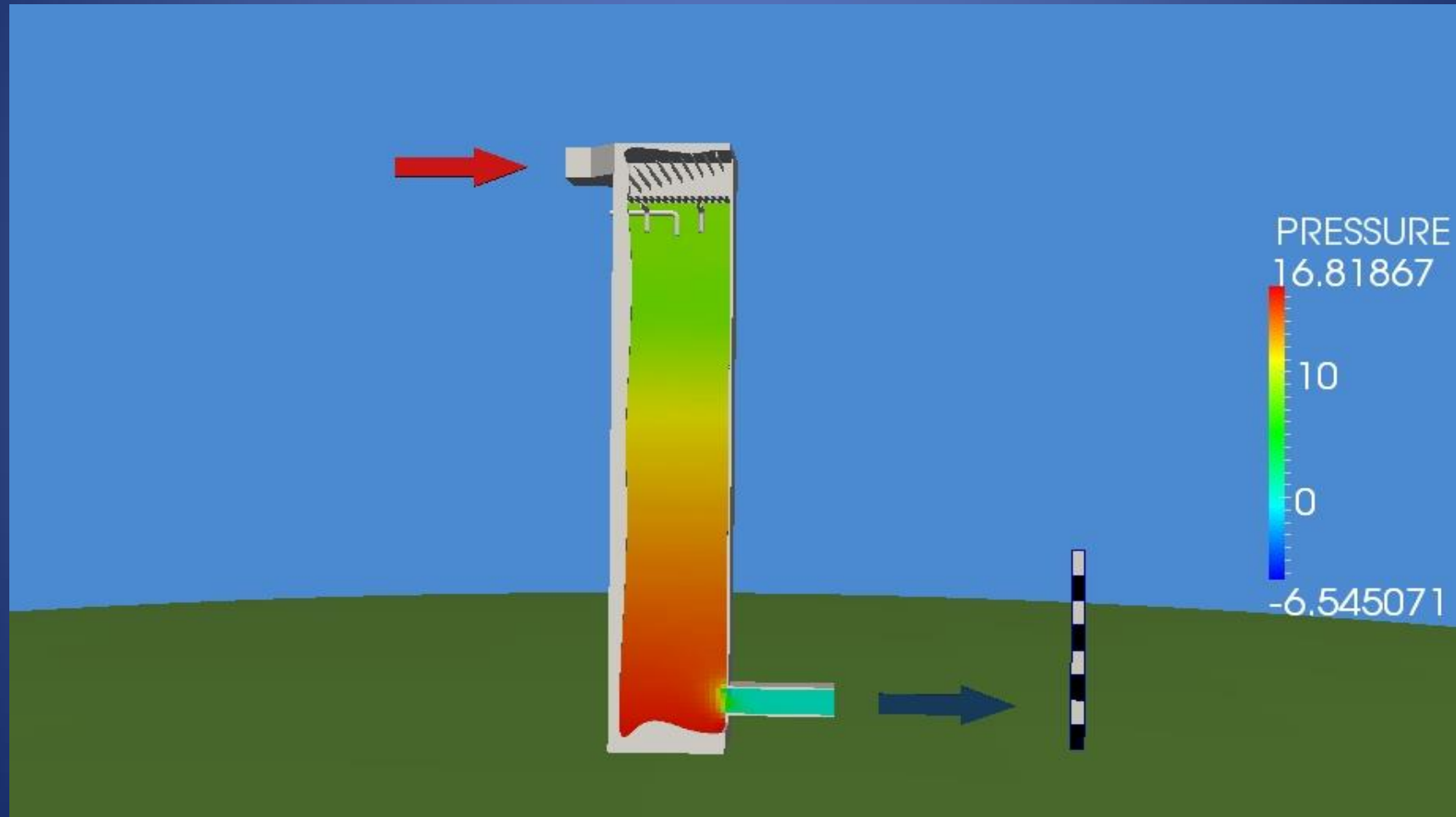


# CFD simulation summer





# CFD simulation Climate Cascade (pressures)



# Test mock-up Climate Cascade in lab.

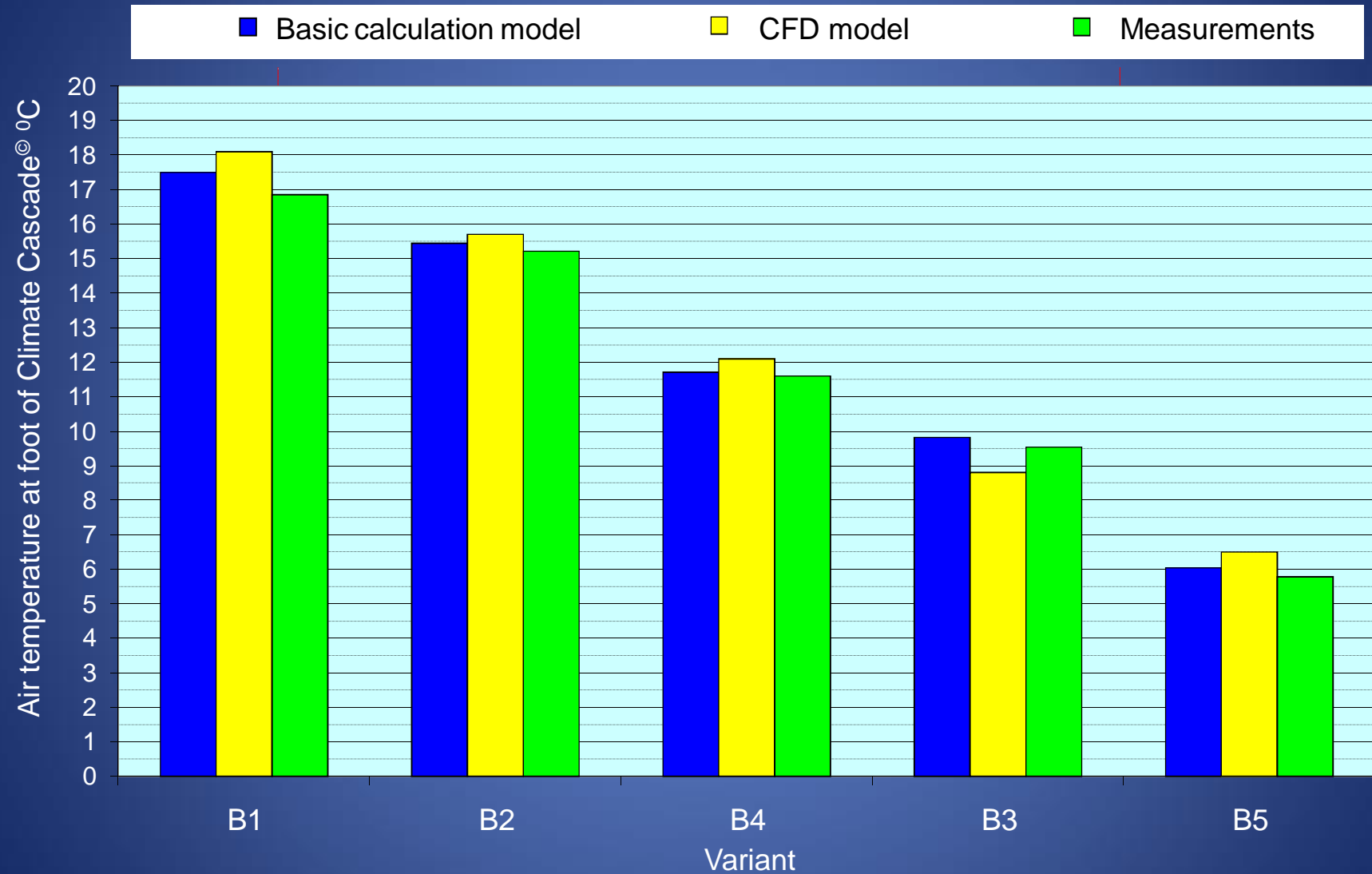


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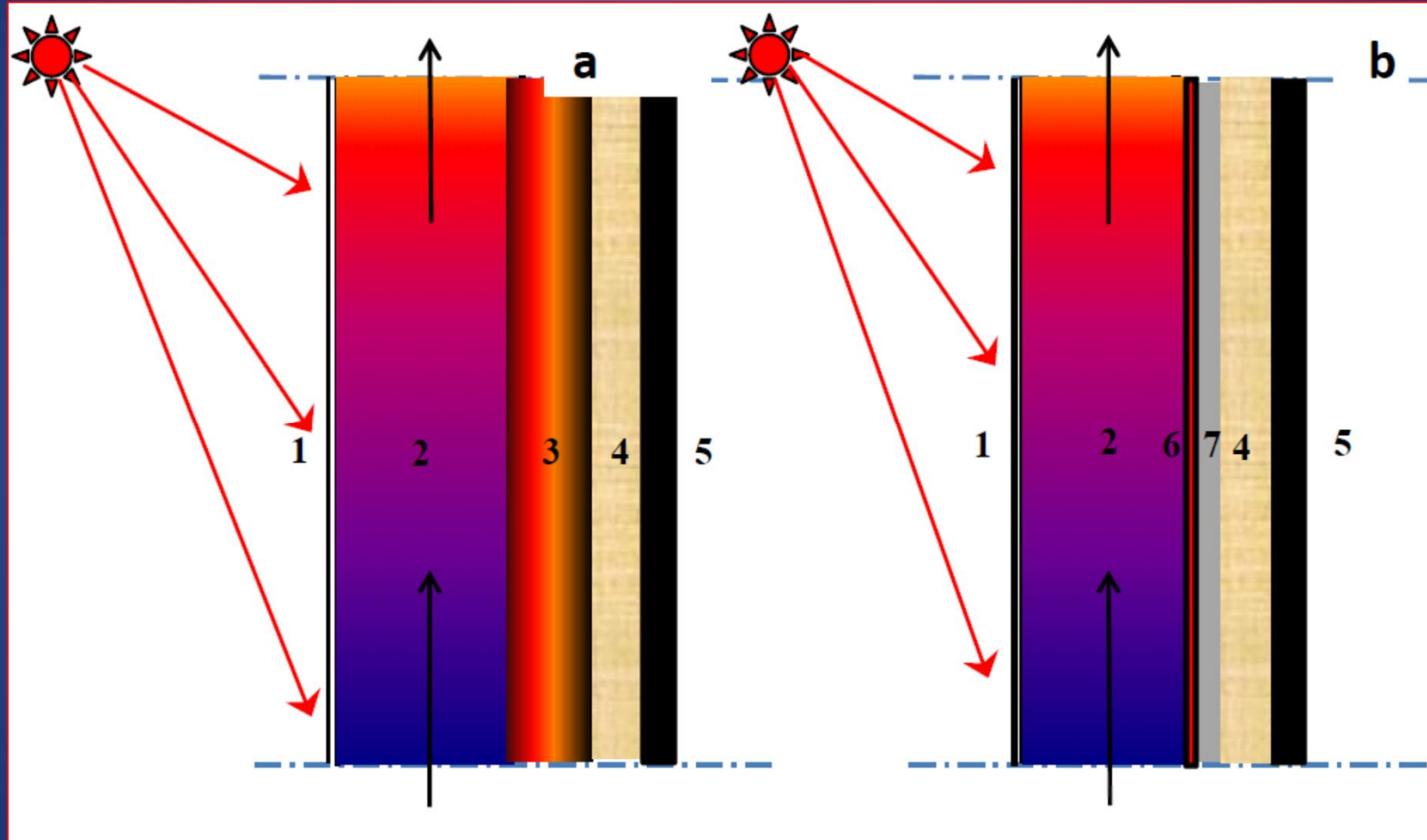
KIVI Homelab 2050

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# Calculations vs Measurements

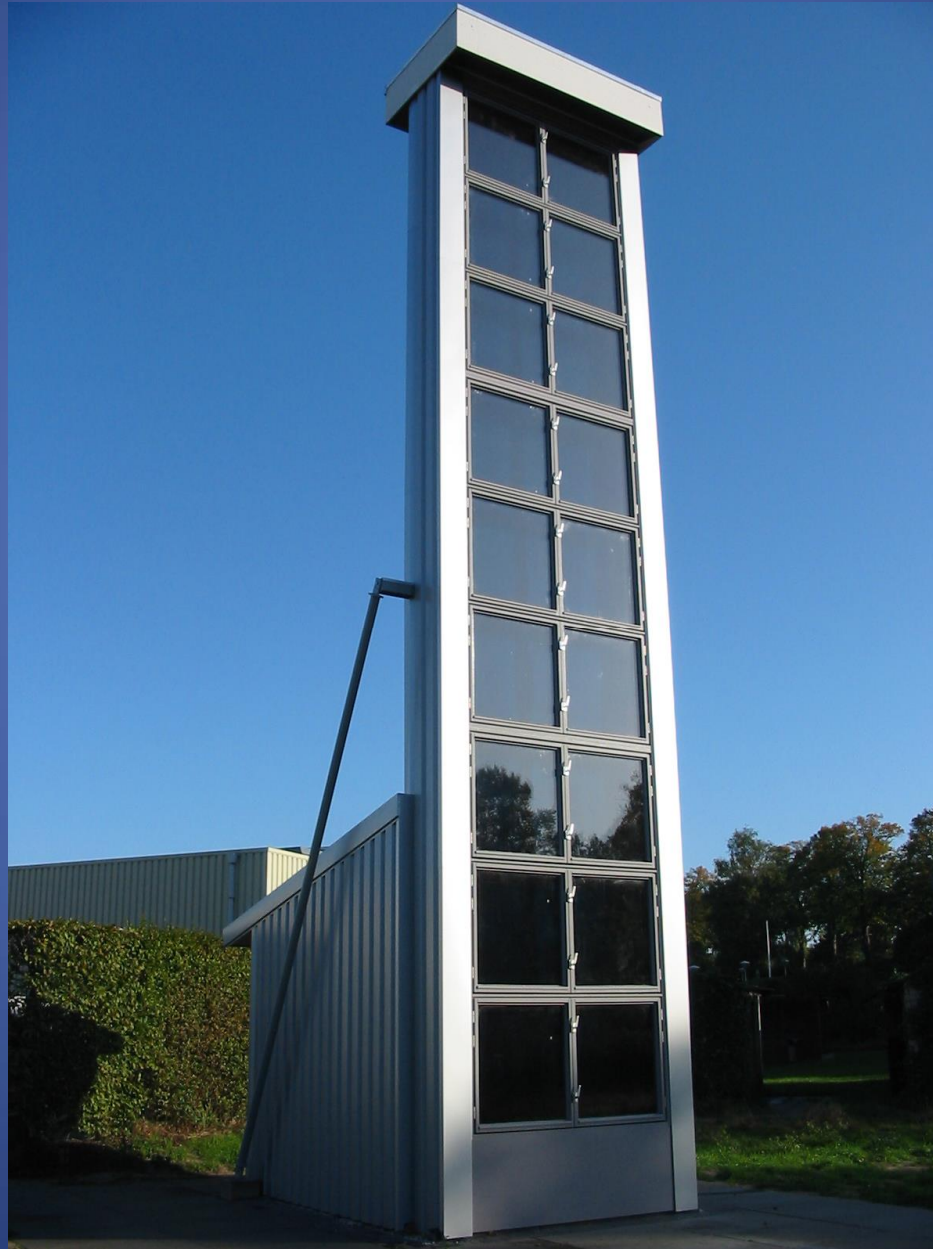


# Solar Chimney





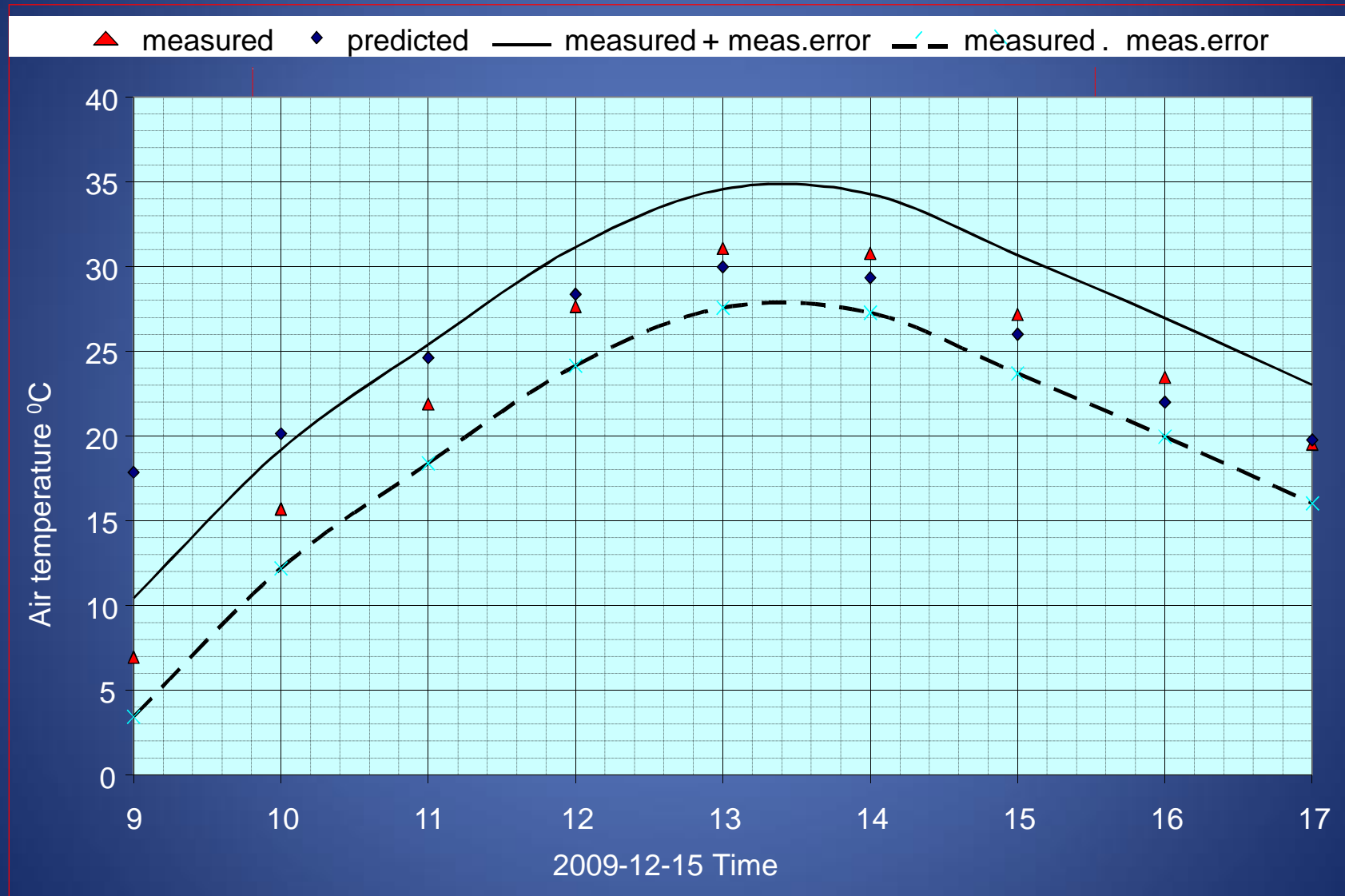
# Test mock-up Solar Chimney



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# ESP-r dynamic simulation



# Earth, Wind & Fire

## A social innovation (1)

- . Architect co-designer Climate System and also responsible for Energy and Indoor environment
- . Lower failure costs and Improved building quality

## A social innovation (2)

- . Improvement indoor environmental quality
- . Improved productivity office staff

## A technological innovation

- . Airconditioning powered by Nature
- . Intramural windpower
- . Zero energy buildings feasible

Will people like natural  
air-conditioning?

Most probably yes, because

No Noise

No Draught

Outdoor Air quality

No Dry air

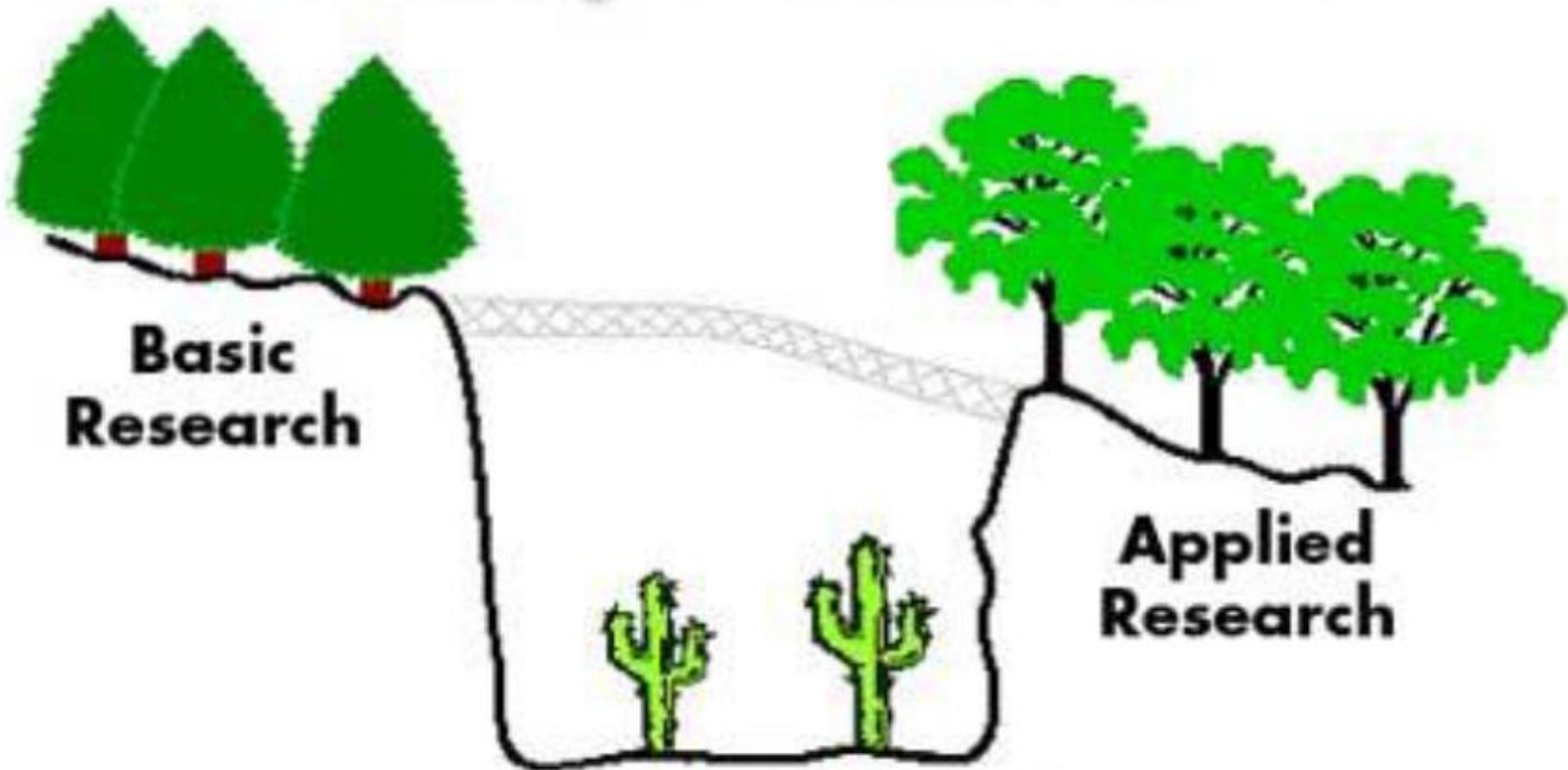
Zero Energy Consumption



# Filmpje Earth, wind and fire



# The Valley of Death ...



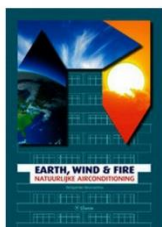
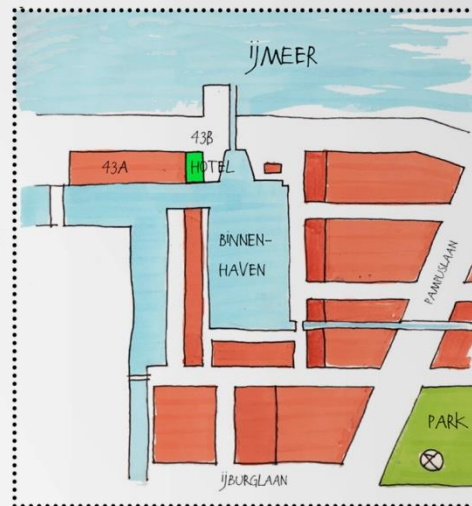
***"Valley of Death"***

# Sprong over de Doodsvallei

- “ “Aan de man brengen” van het concept bij de bouwwereld
- “ EWF Hotel BREEZE Amsterdam IJburg
- “ TU Eindhoven > Gastcolleges
- “ TU Delft > MSc seminars BT  $\approx$  120 deelnemers
- “ Momenteel één afstudeerder TU Delft
- “ Platform EWF i.o.
- “ Stadhuistoren Eindhoven??

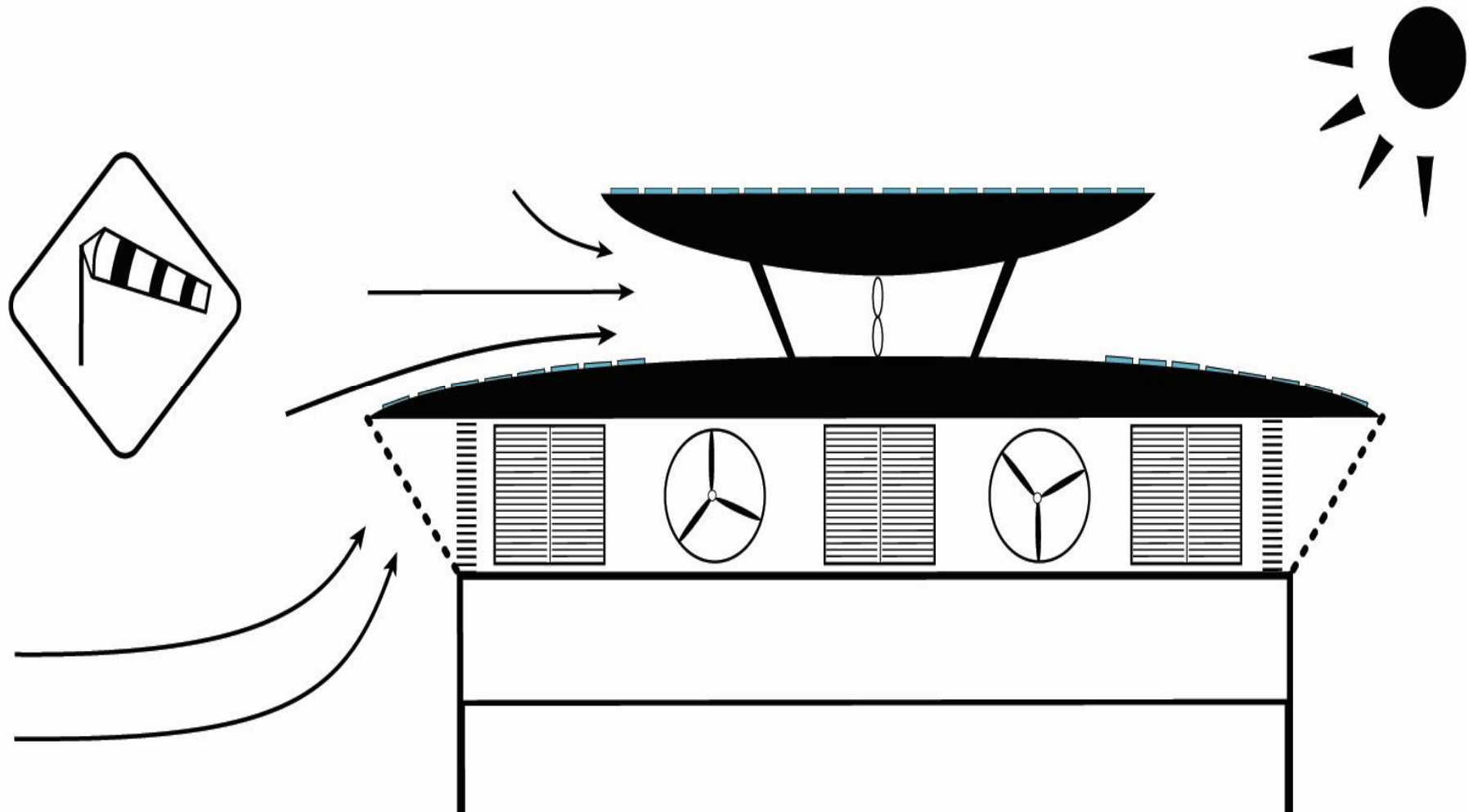
# breezeze

## DEVELOPING THE FIRST ENERGY-NEUTRAL HOTEL IN THE WORLD

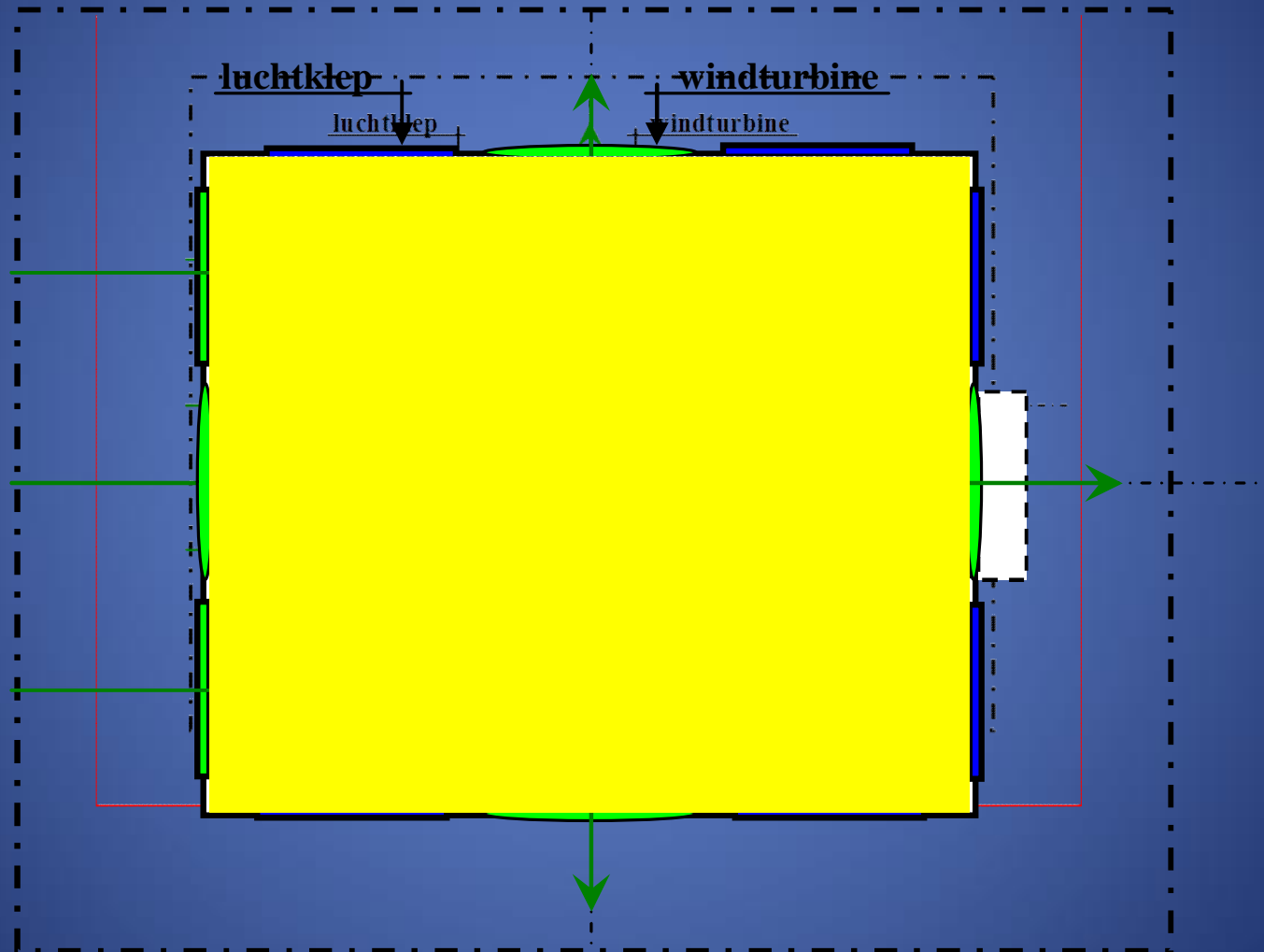




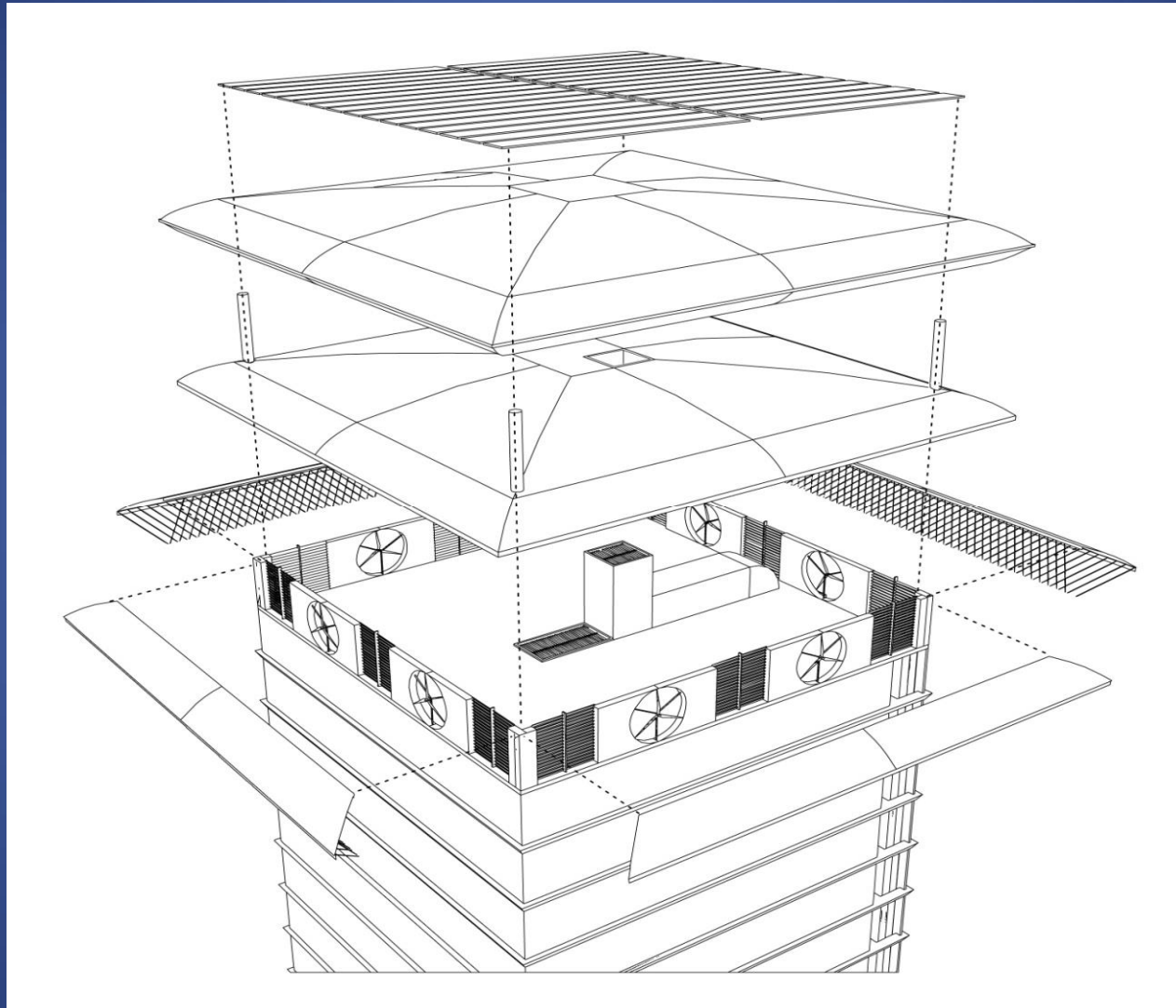
# Solar and Windpower in a Power Roof



# Pressure chamber with wind turbines

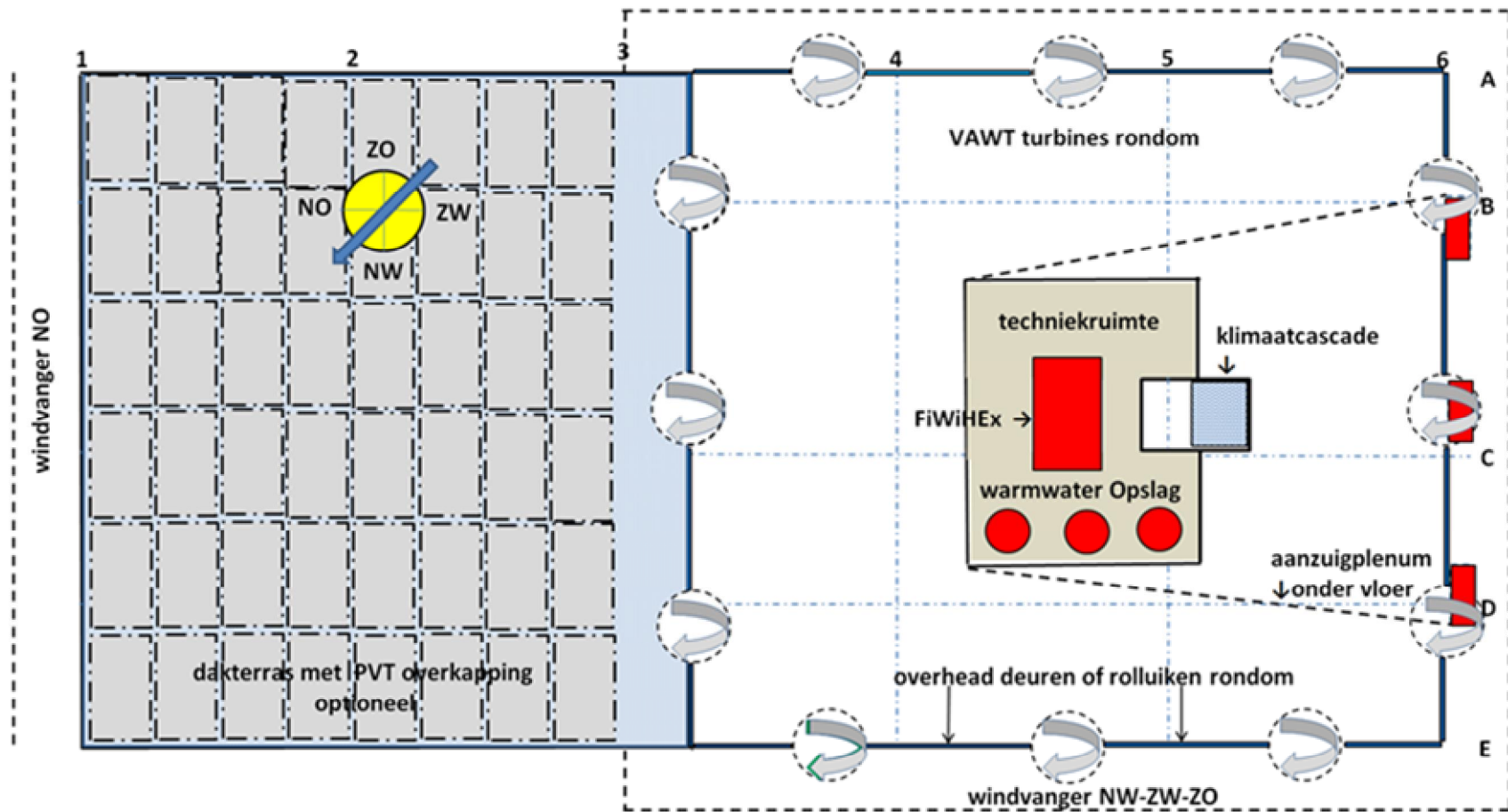


# Power Roof 1.0 – Intramural windenergy



# Power roof 1.0 – BREEZE Hotel

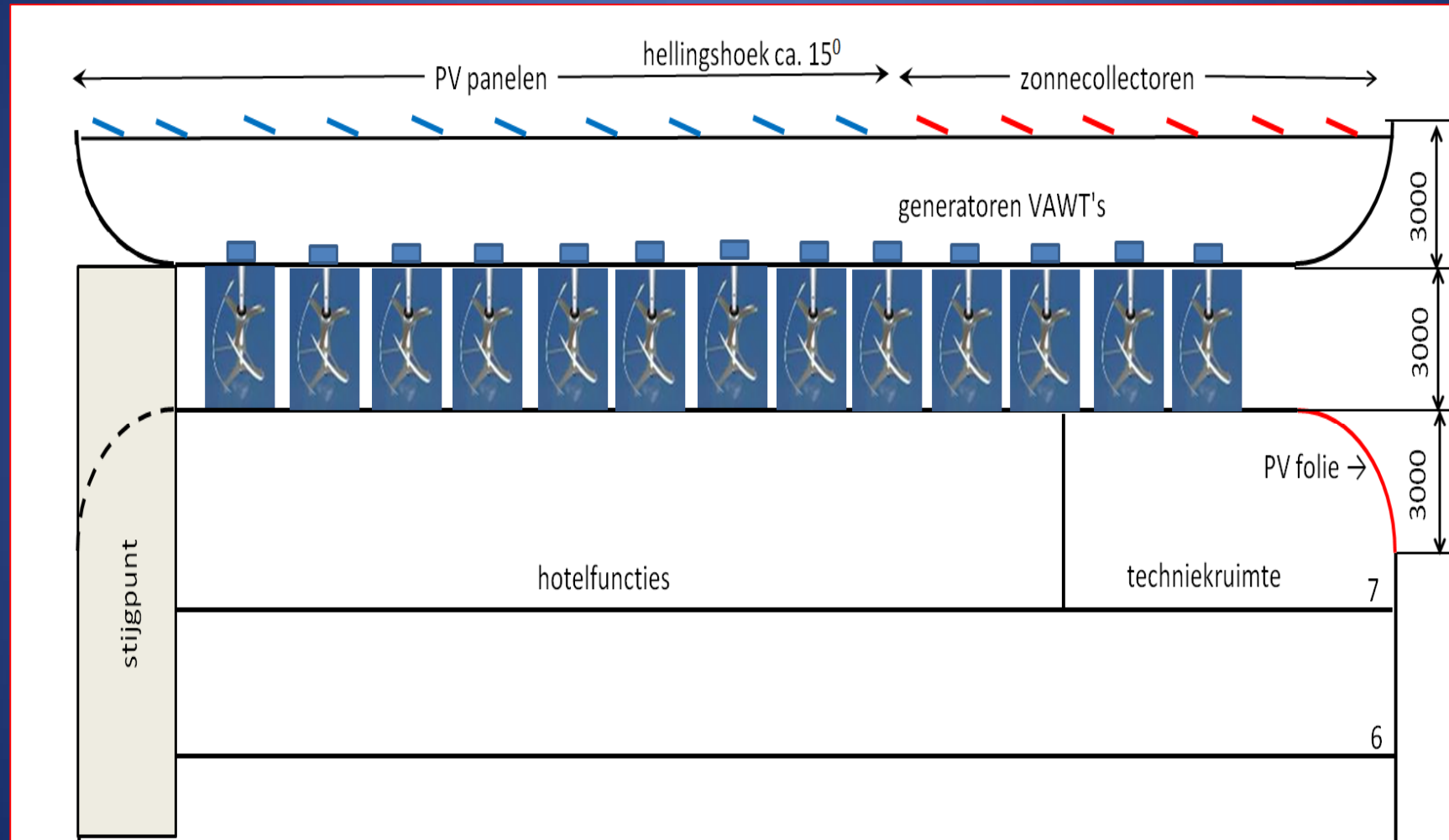
## Geen rendabele exploitatie mogelijk



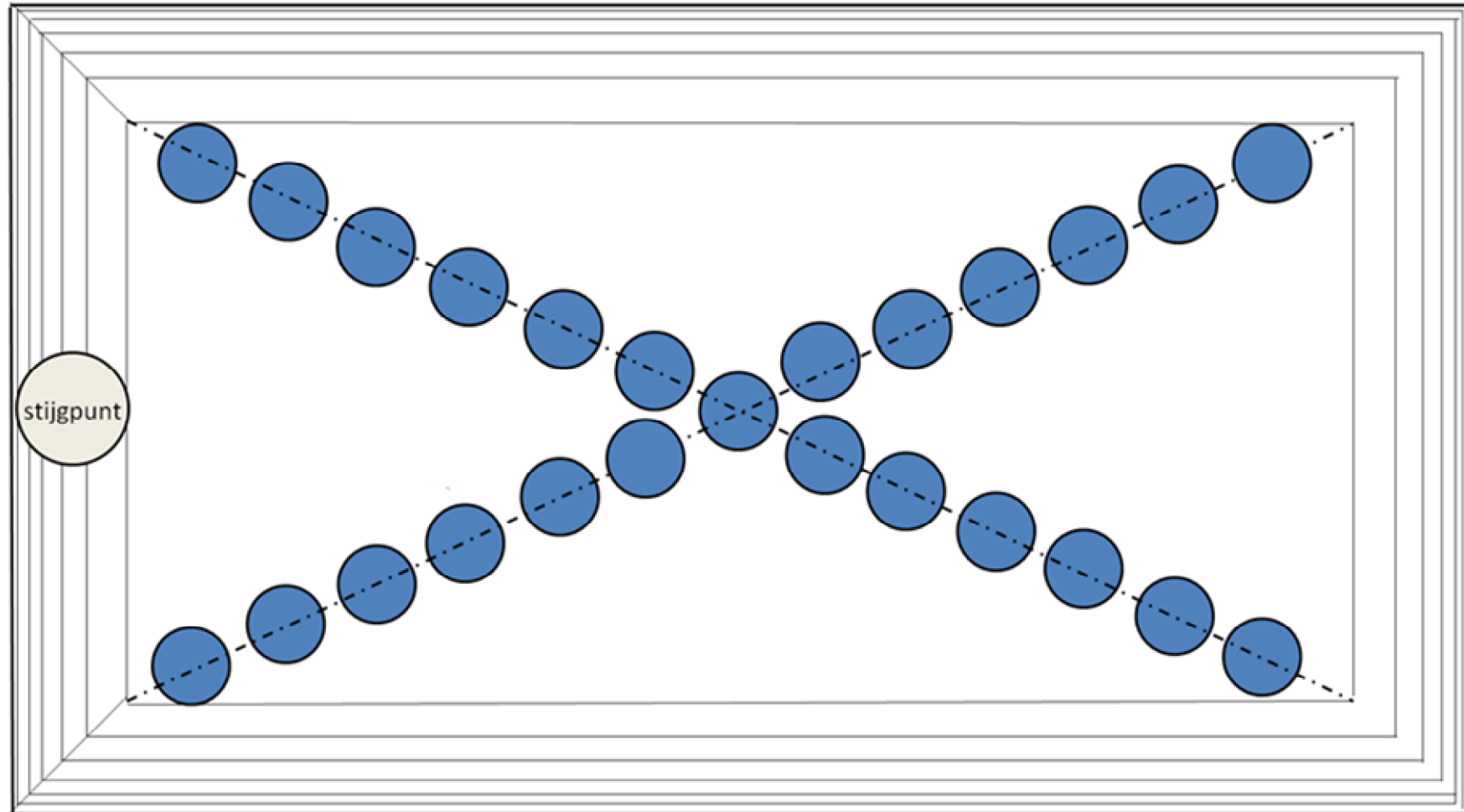


# Power roof 2.0 - BREEZE Hotel

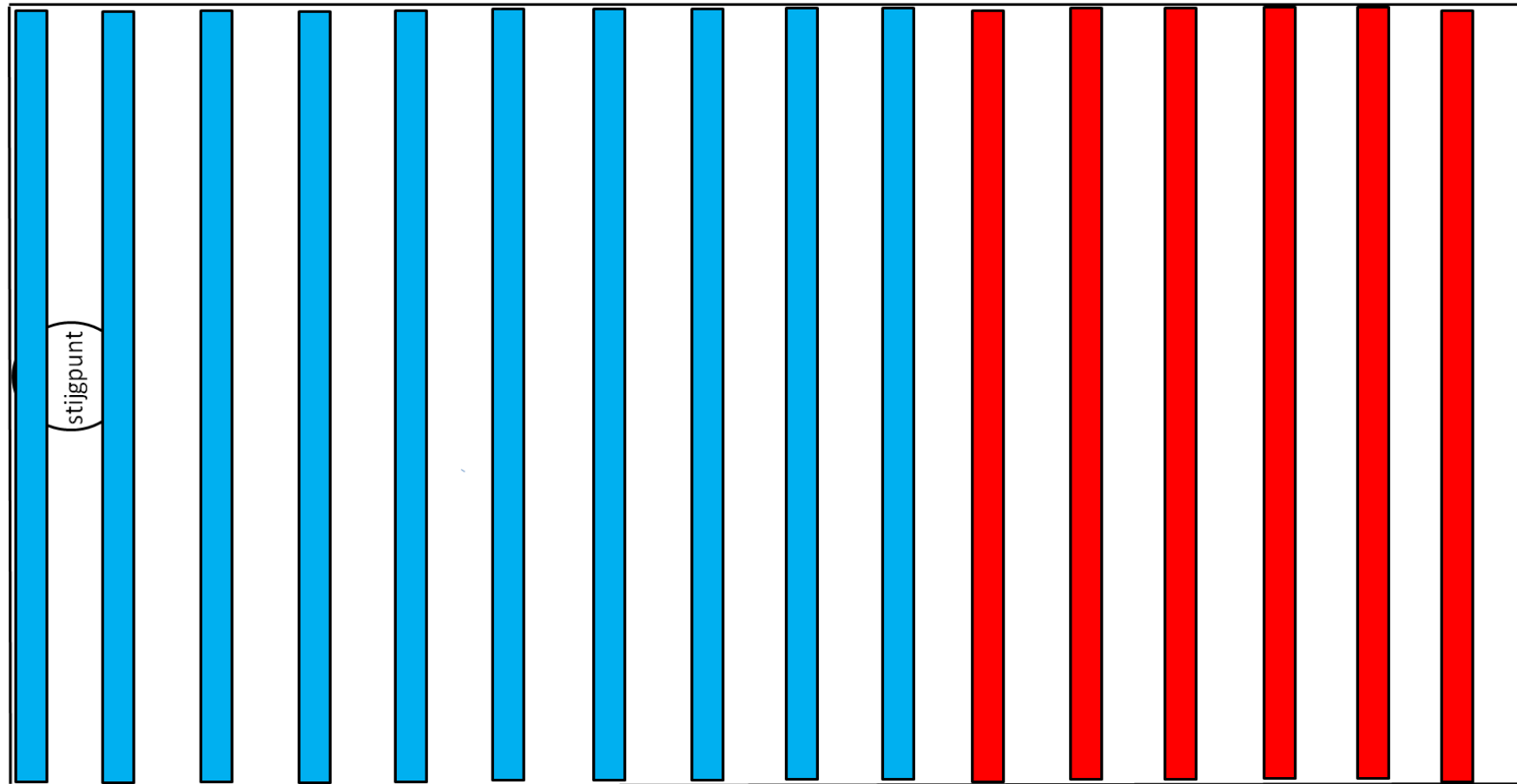
## Tegenvallende energieproductie



# Power roof 2.0 – BREEZE Hotel



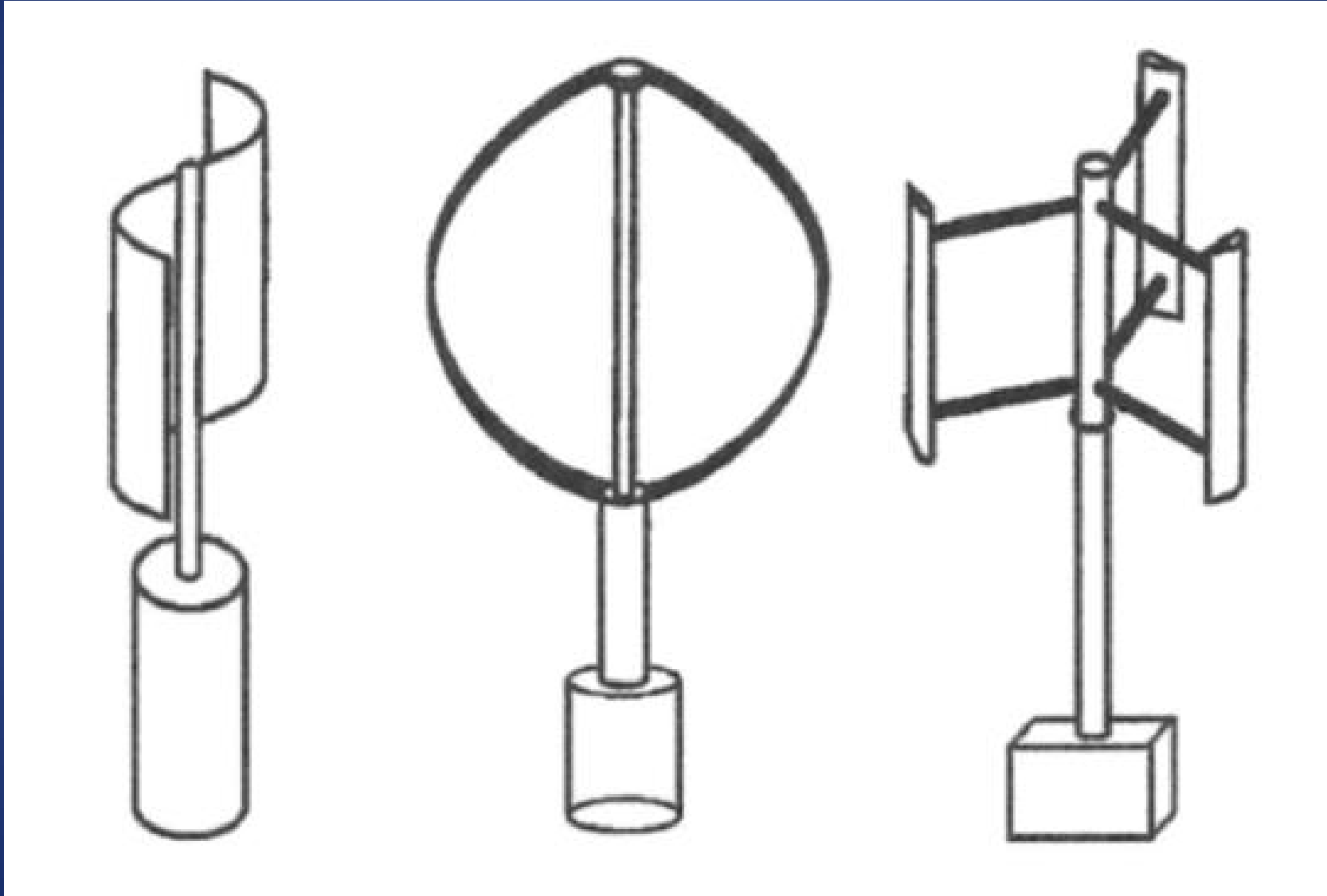
# Solar Roof collectors PV and Thermal



Savonius rotor

Darrieux rotor

H rotor

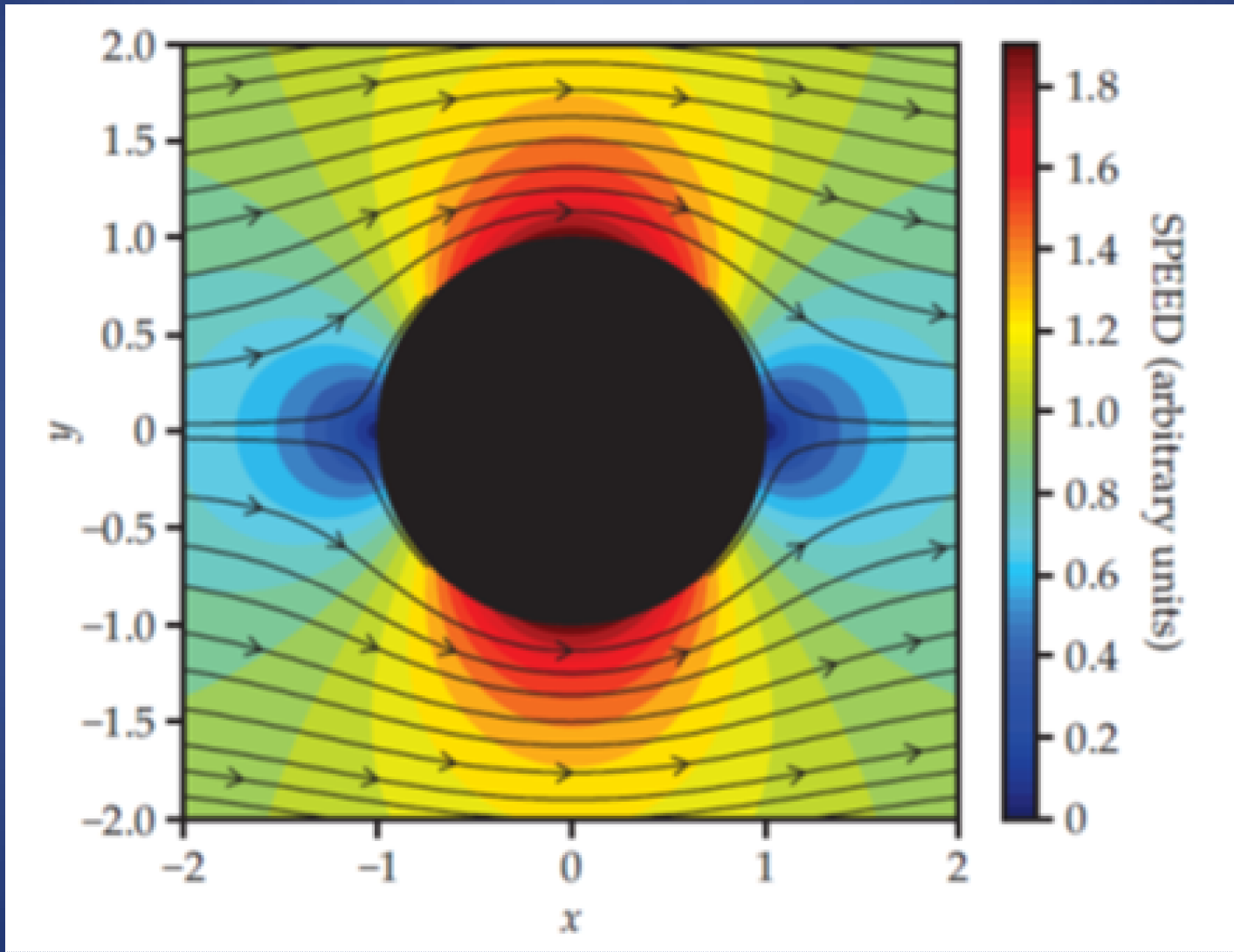




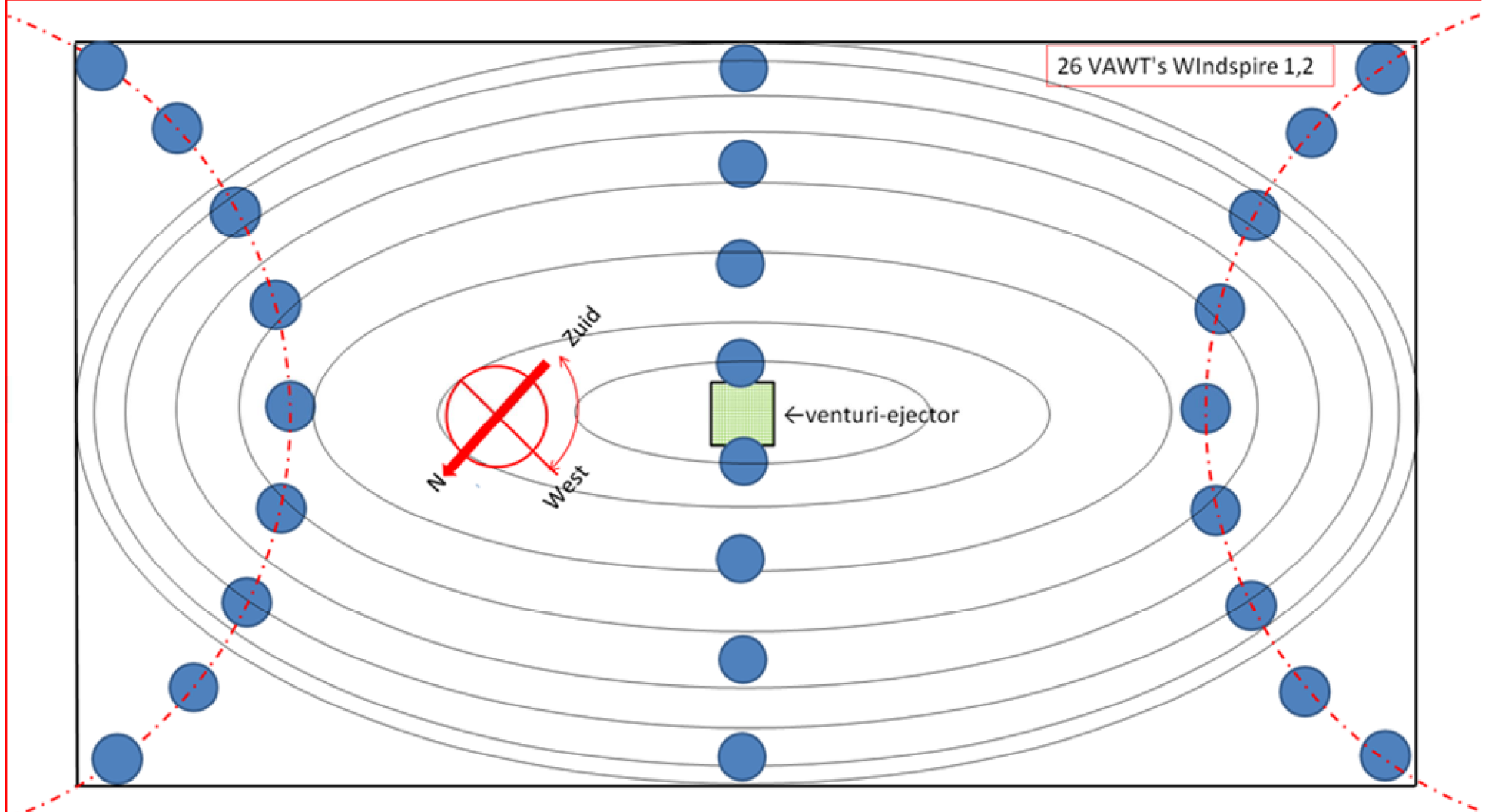
# Windspire VAWT



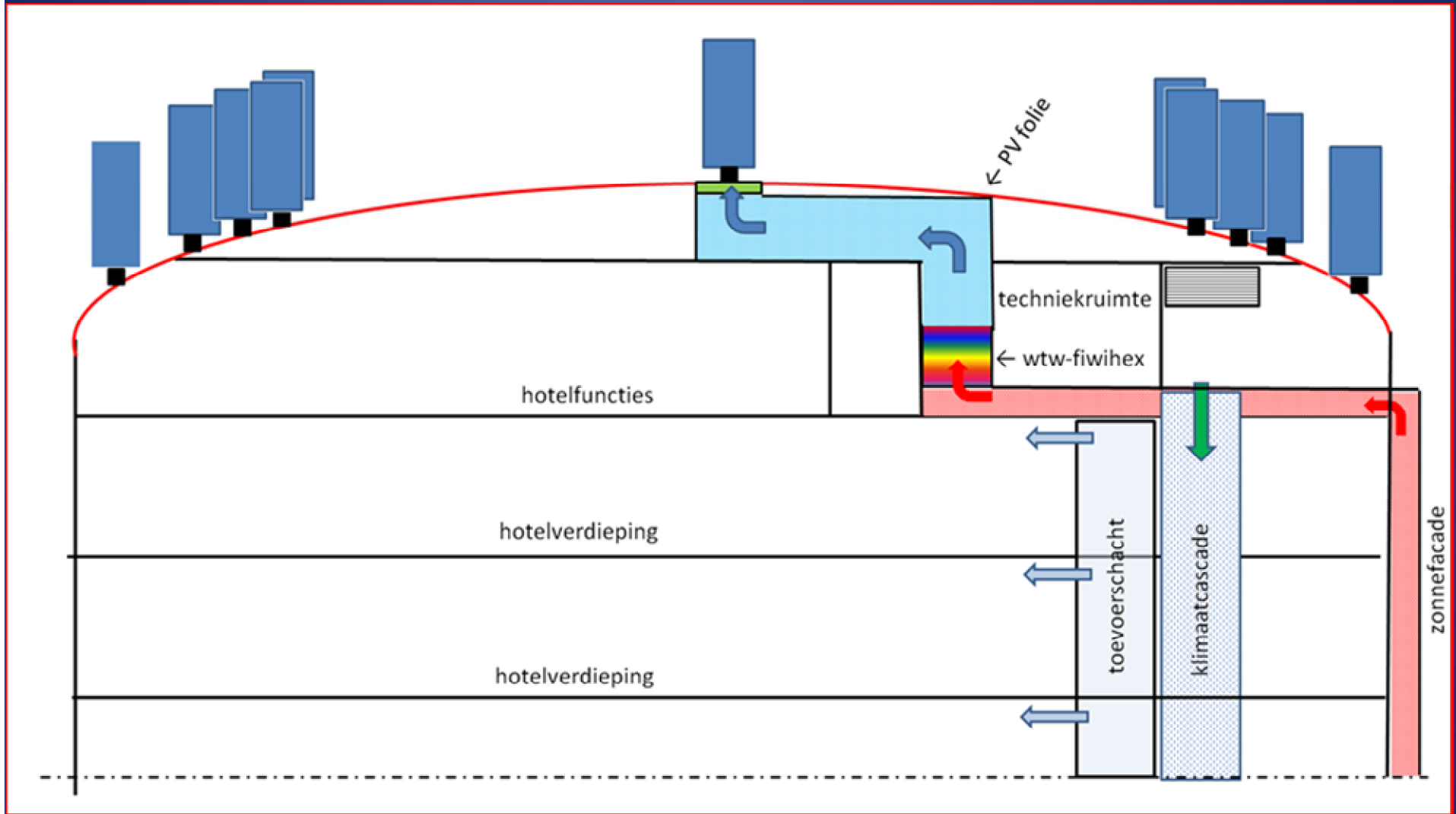
# Verhoging windsnelheid door een gekromd lichaam



# Power roof 3.0 – Windfarm met VAWT's

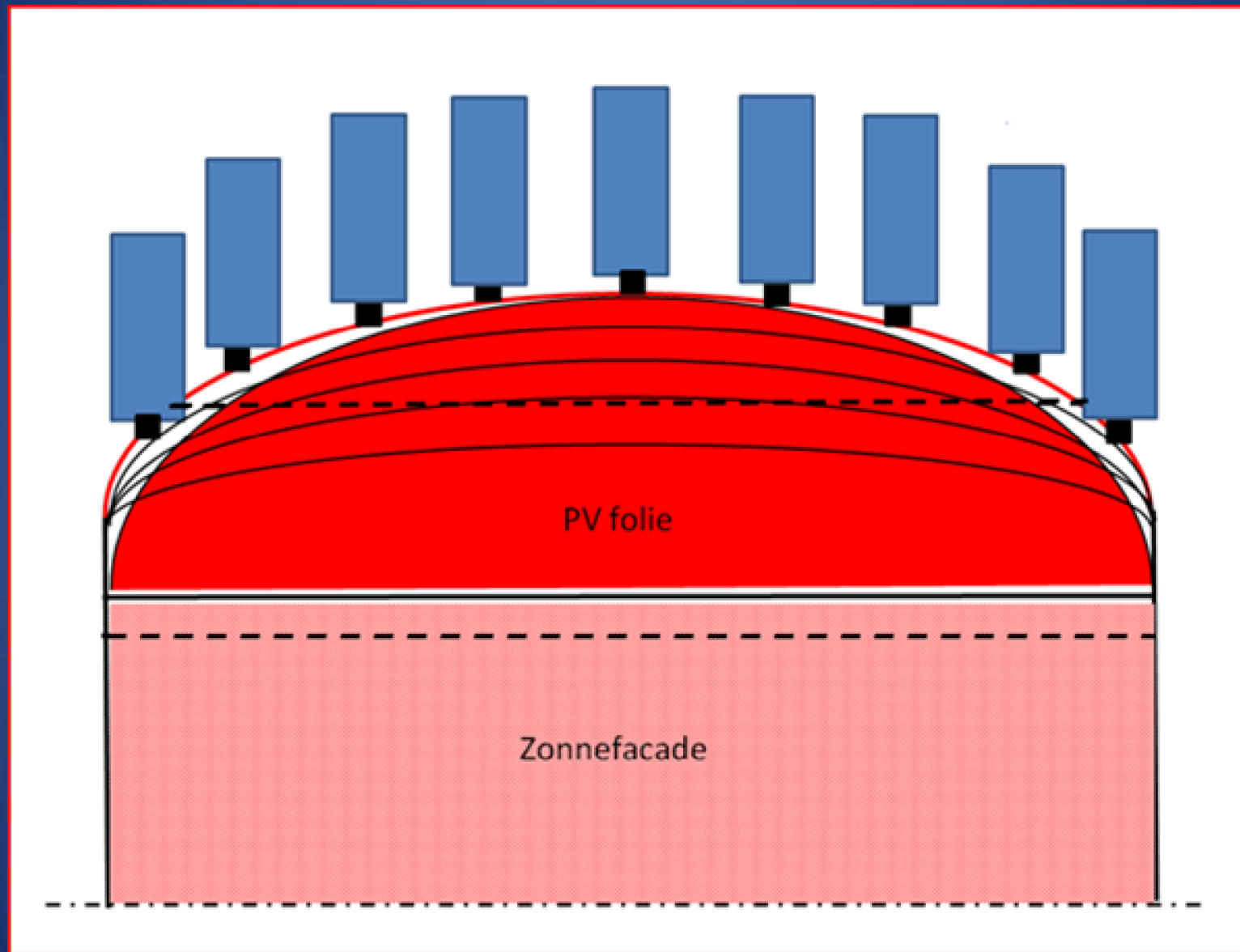


# Power roof 3.0 – Langsdoorsnede

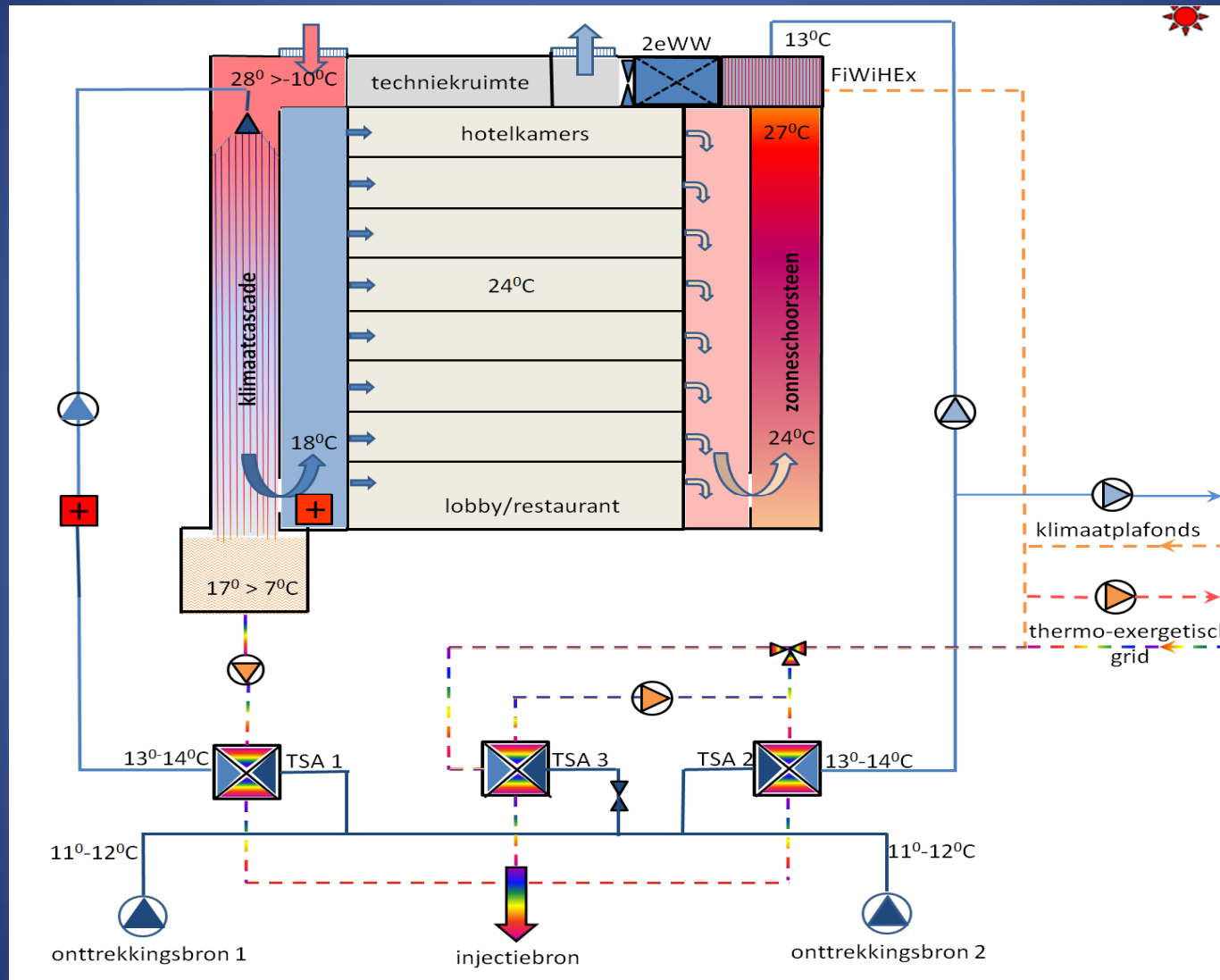




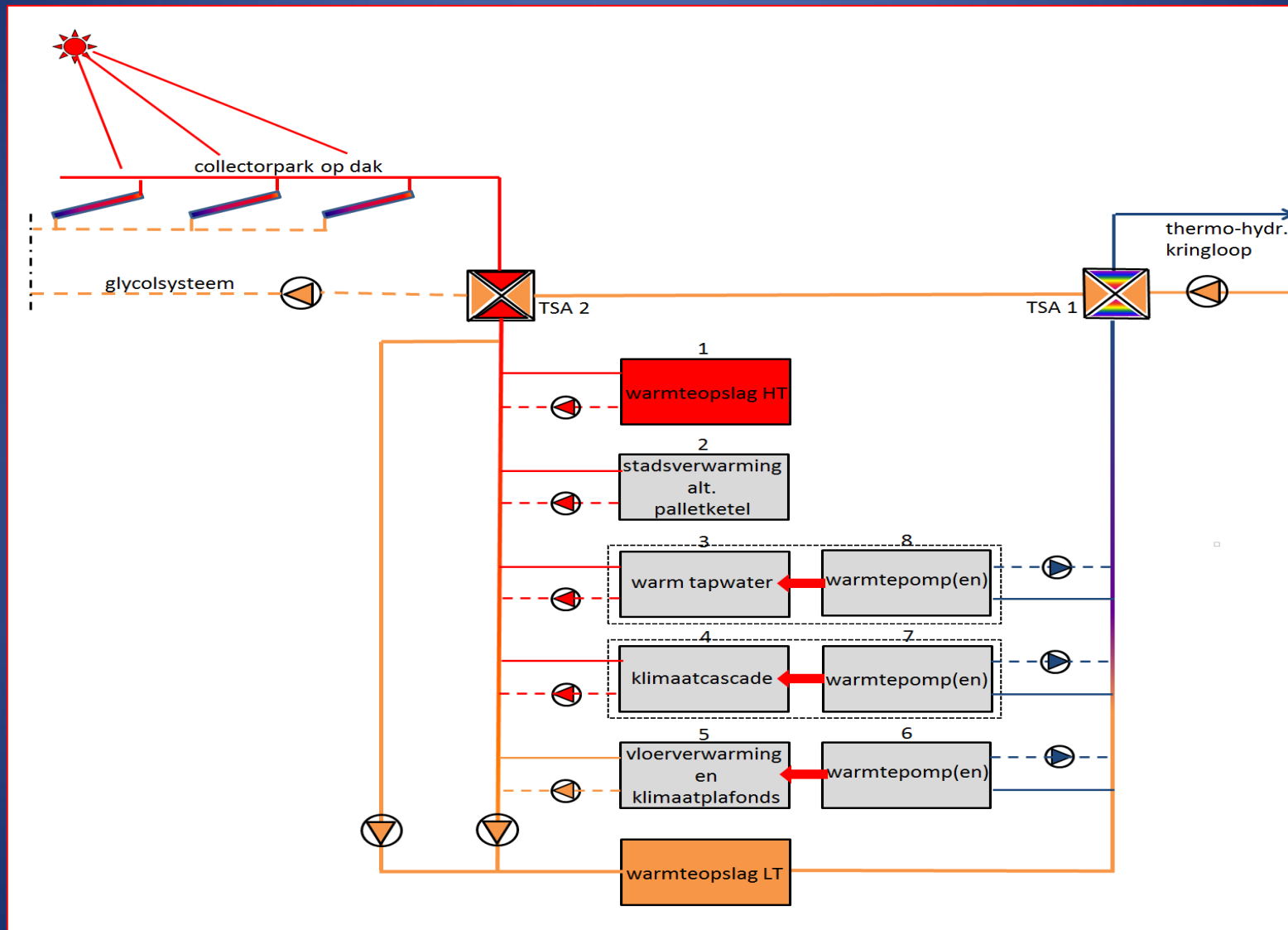
# Power roof 3.0 - Dwarsdoorsnede



# Thermo-hydraulic cycle



# Thermo-exergetic Smart Grid

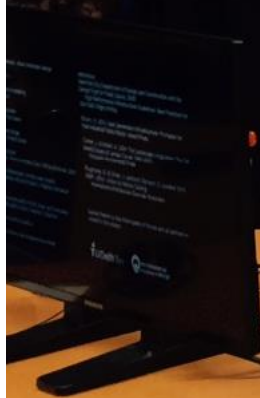
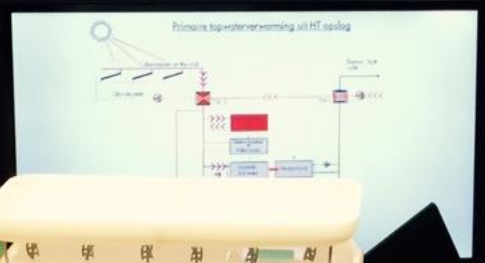


# TU Delft Research Exhibition Event

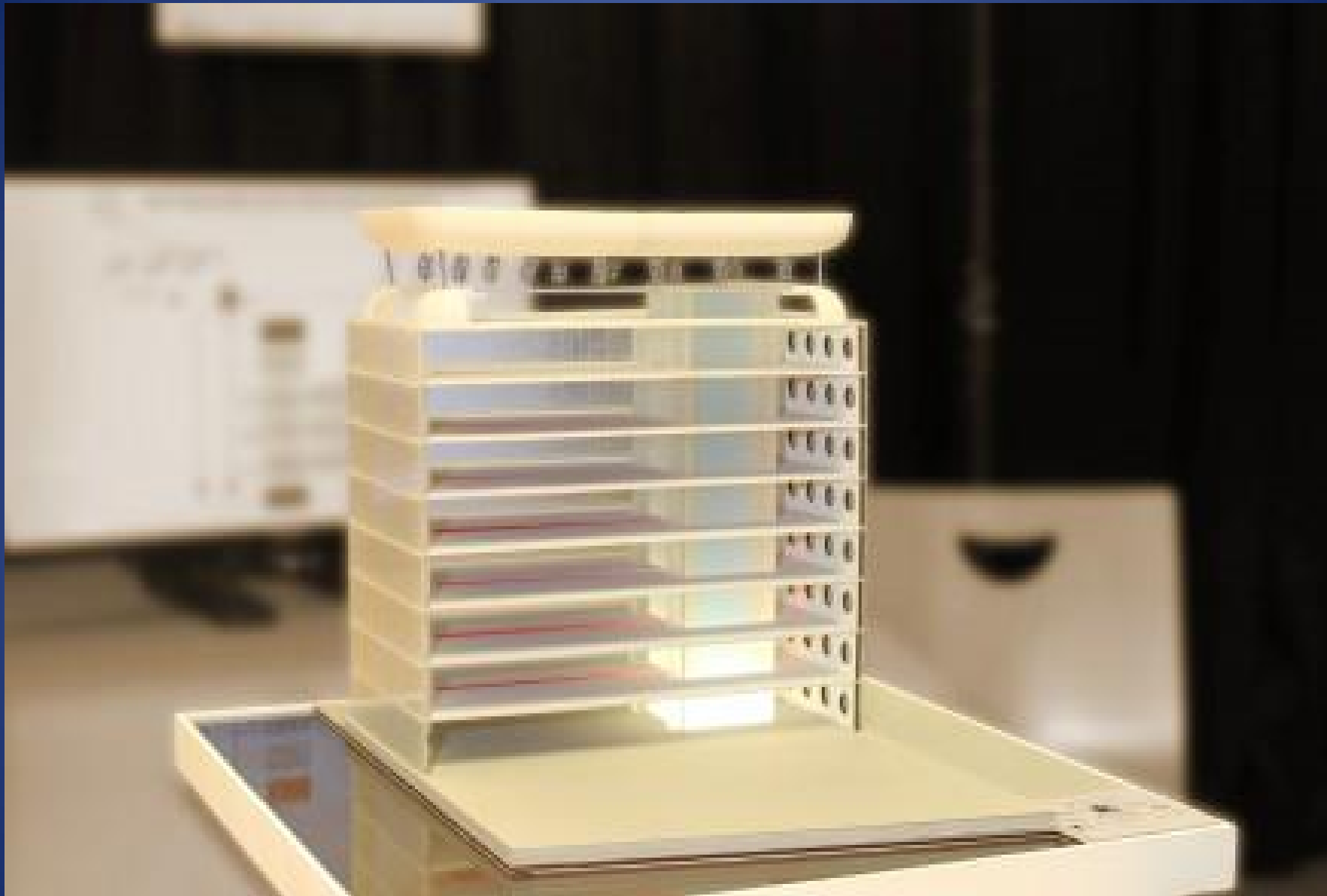
## 11 November 2014



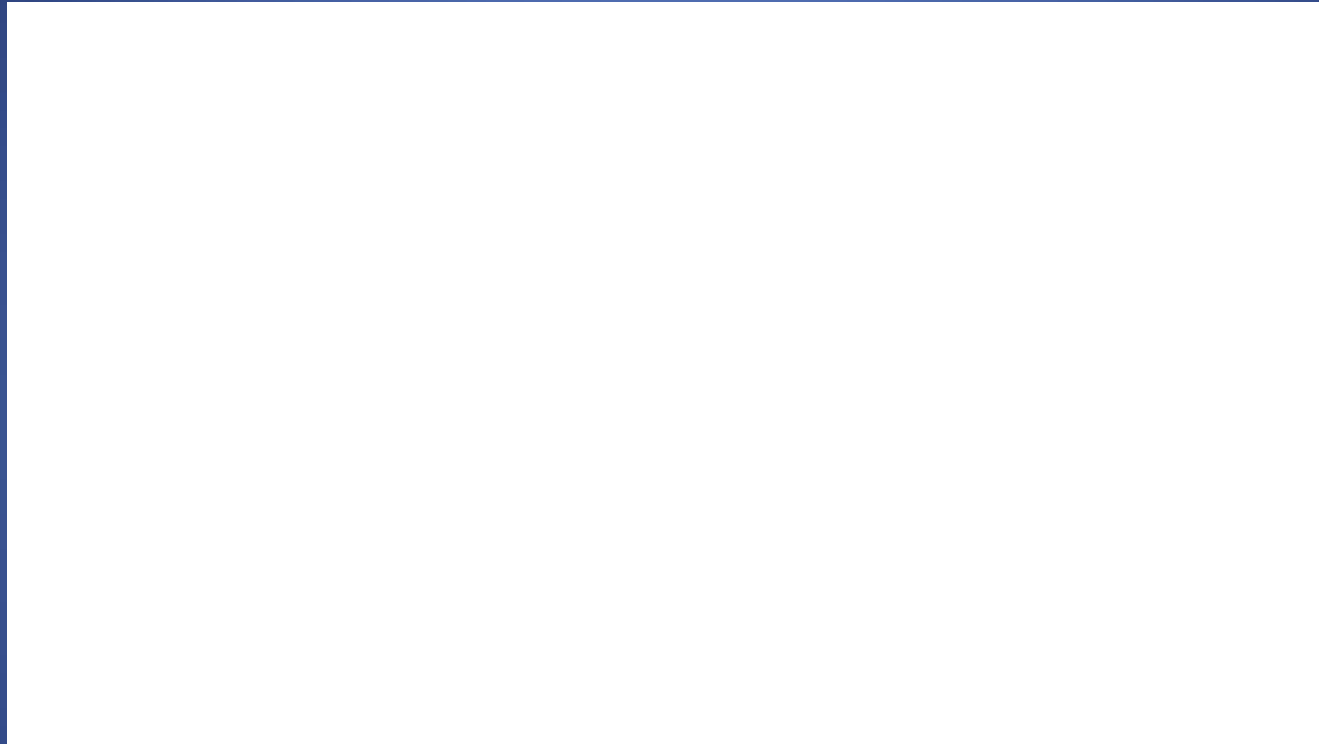
Serious Gaming – Teleportation – Green Blue  
Cities – Big Data – Interactive intelligence –  
Robotics – Genetic Analysis – Antibiotics –  
Artificial Photosynthesis – Self-healing materials  
– Simulation modelling – Water management  
and  
Earth, Wind & Fire







# Animatie BREEZE



A discovery is an  
accident meeting a  
prepared mind

# My favourite statements

*“The trouble with getting old is  
that one doesn’t”*

*(Oscar Wilde)*

*“The most wonderful youth is a  
youthful mind when you are no  
longer young”*

*(Paul Leotard)*



Morning,  
sir!

Time to install  
the earth, wind  
& fire-concept  
today?

ST14

